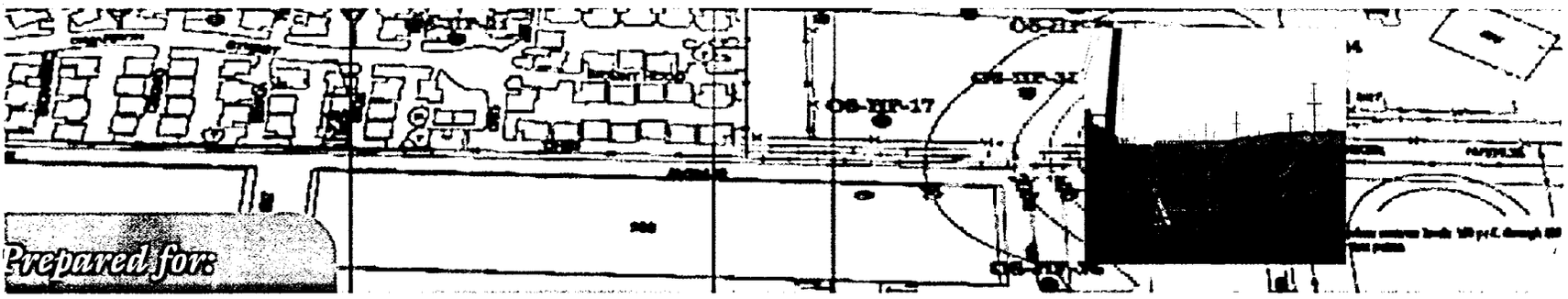
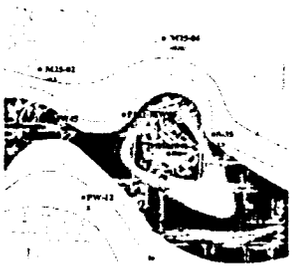
AR_N00236_003147
ALAMEDA POINT
SSIC NO. 5090.3.A

Groundwater Remedial Investigation/ Feasibility Study

Alameda Point Site 25 / Alameda Annex IR-02
Final

October 2004





U.S. Department of the Navy
Naval Facilities Engineering Command
Southwest Division
1230 Columbia Street, Suite 1100
San Diego, CA 92101

ERRG Engineering/Remediation Resources Group, Inc.

Groundwater Remedial Investigation/Feasibility Study

Alameda Point Site 25 and Alameda Annex IR-02

Alameda, California

Final

October 2004

Prepared for:

U.S. Department of the Navy
Naval Facilities Engineering Command – Southwest Division
1230 Columbia Street, Suite 1100
San Diego, California 92101

Prepared by:

ERRG

Engineering/Remediation Resources Group, Inc.
185 Mason Circle, Suite A
Concord, California 94520
(925) 969-0750

Groundwater Remedial Investigation/Feasibility Study
Alameda Point Site 25 and Alameda Annex IR-02

Final

October 2004

Signature Page

Submitted by:
Engineering/Remediation Resources Group, Inc.

Cheryl LeCompte, P.E., Project Engineer	October 18, 2004 Date
Doug Bielskis, P.E., Project Manager	October 18, 2004 Date

RESPONSE TO EPA COMMENTS – Draft Groundwater Remedial Investigation/Feasibility Study
Alameda Point IR Site 25, and Alameda Annex IR Site 02
Alameda, California
Document Date: October 2003

Comment No.	Section/Page Number	Comment	Response
Comments from Anna-Marie Cook, Remedial Project Manager, U.S. Environmental Protection Agency (EPA), dated December 2003			
1.	General	The document is well written and makes good use of figures and tables to summarize monitoring well and hydropunch data. The description of the site and the past fill events are nicely presented and it is the first time this reviewer has seen the Navy's 2000 Beneficial Uses of Groundwater document correctly summarized. Agreements between stakeholders are thoroughly recounted in the text which aids in overall understanding of the document.	Comment noted.
2.	General	However, the conceptual model of the groundwater contamination has not been as well thought through as it needs to be. The most major of the problems are the assumptions that the plumes are decreasing in concentration at a first order rate of decay and that the plumes are not migrating. A few things have led to these erroneous conclusions, namely a straight comparison between monitoring well data and hydropunch data and a dependence on computer generated graphs and plumes without performing a reality check on the output. (See specific comments # 14 and 17 for details).	In Sections 4 and 5 of the draft final report, the Navy has: (1) revised the conceptual model, (2) adjusted the computer-generated plume maps manually to provide a more realistic estimate of the plume lateral extent, (3) included the most recent groundwater analytical data, (4) performed Mann-Kendall tests on data from all monitoring wells with detectable concentrations of benzene (excluding recently installed wells with limited available data), and (5) revised plume maps to eliminate a direct comparison between monitoring well and hydropunch data. Conclusions regarding decay rates and plume migration were revised based on the updated data and associated analyses.
3.	General	The discussion of fate and transport is generally reasonable, and appears to recognize that additional monitoring wells and data to substantiate natural attenuation processes would be important. However, the claim for the stability or decreasing contaminant of concern (COC) plumes and the role of biotransformation is largely based on a qualitative interpretation of limited data. If Monitored Natural Attenuation (MNA) is considered as part of a remedial alternative, please recognize that the additional monitoring points and complete MNA data are important components for developing the supporting lines of evidence that the enhancements to MNA are effective. Lateral and vertical profiles and contours of MNA parameters (oxidation-reduction potential [ORP], dissolved oxygen [DO], Total Organic Carbon [TOC], and other electron acceptors) are important for supporting the claimed stability or decrease in benzene and naphthalene plumes. Given the shallow groundwater data, the existing plume of benzene in groundwater, and the potential for methane generation in the anaerobic environments, a monitoring plan for soil gases should also be developed so that sufficient data are obtained and so that these data are of a quality to allow for an assessment of current and future indoor air risks.	Since the draft version of the report was generated, additional groundwater and soil gas sampling has been conducted as part of the base wide groundwater monitoring program. Analytes for this sampling included MNA parameters. Sections 4 and 5 of the draft final report were revised to take all the latest data into account, to further strengthen the MNA supporting lines of evidence. Soil-gas/vapor monitoring and contingencies were added to the biosparging remedial alternatives presented in Section 9.

Comment No.	Section/Page Number	Comment	Response
4.	General	Asserting that indoor air does not yield a risk without including the data used to come to this conclusion is unacceptable. All data used for an FS evaluation must be available for the agencies and the public to view. If the Coast Guard data is deemed inadequate to be included in the report, the Navy must perform its own air monitoring and present the data to the regulatory agencies and the public.	A summary of the indoor air sampling evaluation by the Coast Guard was included in Section 3.2 of the draft final report, and an overview of the results were included in a vapor intrusion evaluation presented in Section 4.2.2 and Appendix D.
5.	General	EPA would like to see another alternative evaluated in this study. Alternative 4 should include biosparging with nutrient enhancement, followed by MNA with ICs. The reason EPA is promoting the nutrient enhancement in addition to biosparging is that it is not an expensive or complicated technology and the site conditions appear highly favorable for nutrient enhancement to greatly accelerate the effects of the addition of oxygen on degradation of the plume.	Section 9 of the draft final report evaluated Alternative 4 as requested.
1.	Page 1-1, second paragraph	The description of the parcels which overlie the plume should be better worded. The residential housing parcels occupy Parcel 181, the Coast Guard North Village Housing, and Parcel 179, Coast Guard Marina Village Housing. Parcel 179 and 180 have a school and day care center respectively.	The description of the parcels that overlie the plume was revised for clarity and accuracy, as requested.
2.	Page 1-5, Section 1.1.1, first paragraph	It is important to be clear that this report is not limited to the same parcels that comprise Operable Unit 5, which is a soils OU, and that this report does not only focus on Site 25, Parcel 181. The groundwater plume is present under Parcels 178, 179 and 180 in addition to Parcel 181. Parcel 178 is now designated as IR Site 31 and Parcels 179 and 180 as IR Site 30 due to the presence of groundwater contamination. IR Sites 30 and 31 have not yet been assigned an Operable Unit.	The description of the parcels that overlie the plume was revised for clarity and accuracy in Section 1.1.1.
3.	Page 1-11, third paragraph	Again, this report does not focus solely on Parcel 181 as contamination also underlies Parcels 178, 179 and 180.	This paragraph was deleted and a brief discussion of site history at adjacent parcels was added to Section 1.2.1.
4.	Page 1-11, fourth paragraph	What remediation activities occurred at Mayport/Kollman Circle during the Parcel Evaluation Plan? This information is vital in establishing whether the source for the highest concentration plume in this report has been effectively removed.	Past cleanup activities at Mayport/Kollman Circle have not been verified. Any reference to these cleanup actions was removed from the report. Section 4.5.5 was added to the draft final report to discuss data gaps, including investigating potential soil sources in the Mayport/Kollman Circle area.
5.	Section 2.0, Physical Characteristics of the Study Area, Page 2-1	The first bullet item refers to the location of a previous Navy removal action to address polynuclear aromatic hydrocarbons in shallow soils; however, this removal action is not described or shown on a figure. For clarity and completeness, and to demonstrate potential source area removal, please revise the RI/FS to describe this removal action and show the location on a figure.	The removal action was more completely described in Section 3.3, and the location of removed soils was clarified in the text. A reference was included to Figure 2-8 of the OU-5 RI, which depicts the extent of the removal action.

Comment No.	Section/Page Number	Comment	Response
6.	Section 2.1, Geology and Section 2.2, Hydrogeology, pages 2-1 through 2-3	It is unclear why there are no cross-sections. Cross-sections help the reader visualize the units discussed in the text. Please include at least one cross-section in the Draft Final RI/FS.	Two cross sections were added as Figures 2-1 and 2-2.
7.	Section 2.2, Hydrogeology, Page 2-3 and Figure 4-18	The text states "at the site, groundwater in the FWBZ flows in a north by northwest direction, towards Oakland Inner Harbor," but Figure 4-18 indicates that groundwater flows to the southwest and west. Please resolve this discrepancy and if the groundwater flow direction is variable, provide additional groundwater elevation maps.	The text was revised and two new groundwater contour maps were included in the document as Figures 2-3 and 2-4.
8.	Section 2.4, Utilities, Page 2-7	It is not clear how storm drain lines in Site 25 were evaluated for leaks or whether storm drain lines in Alameda Annex IR-02 and Site 25 were evaluated for potential infiltration of groundwater. Since contaminated groundwater infiltrating storm drain lines is a potential source of contamination to Oakland Inner Harbor, please revise the RI/FS to clarify whether this possibility was evaluated.	The discussion on storm drain lines acting as potential preferential pathways was expanded in Section 2.4.
9.	Page 3-4, Section 3.1.3, second paragraph	Firstly, the Marsh Crust did warrant remedial action in the form of Institutional Controls (See Final Remedial Action Plan/Record of Decision for the Marsh Crust at the Fleet and Industrial Supply Center Oakland, Alameda Facility/Alameda Annex and for the Marsh Crust and Former Subtidal Area at Alameda Point, January 2001) to minimize exposure to the PAHs in the Marsh Crust. Secondly, the Marsh Crust was ruled out as a source of groundwater contamination because the types and concentrations of PAHs in the groundwater, most notably naphthalene, do not reflect the types and concentrations of PAHs found in the Marsh Crust.	Section 3.1.3 was revised to clarify the remedial action selected for the Marsh Crust. Section 4.4.2 was revised to clarify why the Marsh Crust is not considered a primary source of groundwater contamination in this investigation.
10.	Page 3-5, Section 3.1.4, first paragraph and third paragraph	Explain why different wells were used in each sampling event and why wells were destroyed during the removal actions.	Further explanation was added to Section 3.1.4 to clarify that many different wells were sampled in the various field events since some were destroyed, or lost, and due to decisions made in the basewide groundwater monitoring program.
11.	Figure 3-1	This figure is confusing as Parcels 178, 179 and 180 are depicted as "Residential Parcels" which implies then that Parcel 181 is not. It would be more accurate and less confusing to either label them with Parcel numbers as they have been done in the OU 5 Soil FS or to label them as IR Sites 25, 30 and 31.	The labels of the parcel numbers in Figure 3-1 were revised to refer Alameda Points Sites 25, 30, and 31. In addition, Figures 1-2 and 1-3 were revised to depict the location of the investigation sites (Figure 1-2) and the parcels (Figure 1-3).

Comment No.	Section/Page Number	Comment	Response
12.	Section 3.2, Previous Soil Gas Investigations, Page 3-12	The text states that the highest detected concentration of benzene in soil gas was considered an anomaly because the sample was collected in an area where benzene was not detected in groundwater, but this statement does not consider that there may be other explanations. For example, vapors can migrate in soil, there could be preferred pathways for vapor migration, or there could have been a point source release to surface soil in the vicinity of the sampling point. Please revise the text to discuss possible explanations for this detection rather than dismissing it as an anomaly.	The text was expanded to further discuss the detected benzene concentrations in soil gas at Alameda Annex IR-02, specifically in the vicinity of plume center well EW-2. The revised text further clarifies that, although the maximum benzene concentration in shallow soil gas (17,000 $\mu g/m^3$ about 300 feet east of EW-2) is still considered anomalous, recent soil gas data collected in the area (as part of the basewide monitoring program) have detected elevated benzene (up to 262 $\mu g/m^3$ in shallow soil gas and 5,588 $\mu g/m^3$ in deep soil gas) that is likely attributed to volatilization from groundwater near EW-2. Continued monitoring will be performed in this area to verify benzene concentration trends in both soil gas and groundwater.
13.	Page 3-12, last paragraph	Explain the factors that went into the model to yield an indoor air risk that is greater for a concrete slab foundation than a concrete perimeter foundation.	This paragraph was revised slightly to note that the model for a concrete perimeter foundation included a vented crawlspace, which provides a more effective venting mechanism than slab on grade construction.
14.	Figures 4-1 through 4-5	All computer-generated maps should be checked by a geologist for accuracy, but there is no indication that this was done. For example, Figure 4-1 has solid lines where there is little information and the contours should extend further north and west; this may indicate that there is too much contour smoothing. Similarly, on Figure 4-2, contours should extend south toward S-16. On Figures 4-3, 4-4, and 4-5, the contours do not honor all of the data, particularly data below 50 micrograms/liter (µg/l). On Figure 4-3, there is only one data point in the western portion (P181-MW45), which is insufficient to contour this area. In addition, it is unclear why the shaded (contoured) area extends southwest of S-16 when there is no data in this area. On Figure 4-4, the computer-generated contours for all three plumes should extend farther to the northeast to honor all of the data. For the western plume on Figure 4-4, it appears that contours should also be extended farther to the south to incorporate data at OS-HP-09 and OS-HP-05. None of the contour maps have dashed lines where there is little data. None of the figures include a contour at the maximum contaminant level (MCL) or a zero contour. Please address these issues and consider replacing the computer-generated maps with hand-contoured maps. If hand-drawn maps are not used, please do not use white for the lowest range of concentrations, discuss the assumptions underlying the contouring algorithm and those input into the contour program, evaluate	All plume contour maps were reviewed and modified by a registered geologist. All the available data was incorporated in the applicable figures. Plume contours corresponding to the benzene MCL of 1 µg/L were added to all Section 4 figures. Dashed lines were added to all contour map to depict areas with estimated plume boundaries.

Comment No.	Section/Page Number	Comment	Response
		whether the degree of smoothing used is appropriate, and ensure that a geologist checks the contours for accuracy and inclusiveness. In addition, it is difficult to read the posted numbers. Please use a contrasting color for all posted numbers so that they can be read.	
15.	Page 4-1, Section 4.0, last bullet	Is there any connection between locations of storm/sewer pipes laid in high permeability trenching material and locations of soil gas concentration hits?	Section 4.2.3 of the draft final report notes that, based on previous and ongoing soil gas monitoring data, sewer and storm drains do not appear to be acting as a preferential conduit for contaminant migration in soil gas.
16.	Page 4-2, bulleted items	There is also a plume that originates in the Mayport/Kollman Circle. Also, where is the MTBE plume located relative to the benzene and naphthalene plumes?	Previous MTBE detections are anomalous and not indicative of a contaminant plume based on data collected during the RI and the Basewide Groundwater Monitoring Program. Section 4.1.1 of the draft final RI/FS was revised to reflect this conclusion and outline the following information: • The only MTBE concentrations above the tap water PRGs were detected at well P181MW46. This well has been sampled and analyzed for MTBE 11 times from February 1999 to March 2004. MTBE concentrations were detected at 12 micrograms per liter (µg/L) and 19 µg/L in December 1999 and May 2001, respectively. All subsequent MTBE analyses at well P181MW46 have been below the California-modified tap water preliminary remediation goal (PRG) of 6.2 µg/L, and the six most recent analyses have not detected MTBE above the laboratory reporting limits. • MTBE has been analyzed for at 17 monitoring wells throughout the NAS Alameda IR Site 25 and Alameda Annex IR Site 02 groundwater study area. With the exception of the anomalous MTBE detections at well P181MW46, MTBE concentrations at all wells were below the California-modified tap water PRG. There have been no historic detections (above laboratory reporting limits) of MTBE at 14 of the wells, and maximum concentrations detected at the other 2 wells (P181MW45 and S-35) were 5 µg/L. • MTBE was analyzed in 122 Hydropunch™ samples collected at 51 Hydropunch™ borings during the 2001

Comment No.	Section/Page Number	Comment	Response
			RI, and no concentrations were detected above the laboratory reporting limits. A new figure (Figure 4-1) was also prepared to depict MTBE analytical results.
17.	Page 4-4, Section 4.2.2	Unfortunately, use of the Surfer program does the report a disservice. It masks the real trends by artificially trying to fit the data to a pattern that doesn't exist. In addition, the contour maps show a fictitious delineation of the plume boundaries in the west and northwest portions, when in reality these areas are not yet bounded.	The computer-generated contour maps were reviewed and modified by a Registered Geologist and revised in areas where the mathematical modeling may not have been optimal. Additionally, recent data was added to figures and tables in the report.
18.	Page 4-16, bulleted items	I do not agree with the Mann-Kendall trend results presented in these bullets. Overall, concentrations of benzene from monitoring wells in the plume centers (i.e. EW-2, P181-MW45, P181-MW 47) are the same in 2001 as in 1994, despite a decrease in concentration in MW 45 and MW 47 in 1999. In fact, out of the nine wells that were sampled in 1994, 1999, and 2001, only one showed a continued decrease in concentration from 1994 to 1999 to 2001.	New Mann-Kendall trend analyses were performed for all wells containing detectable concentrations of benzene using all available data (with the exception of recently installed monitoring wells, due to limited available data). Table 4-1 has been added to summarize overall conclusions regarding plume delineation and stability based on the Mann-Kendall results and trend graphs. Concentrations in the majority of wells were considered "stable." In addition, Mann-Kendall trend evaluation was presented in Appendix C of the draft final RI/FS.
19.	Page 4-16, Section 4.2.5	EPA does not agree that there is convincing evidence from trend evaluation that contaminant mass is being reduced. Rather, it appears that a contamination source is still present and/or contamination has moved vertically downward in the groundwater, attenuation has stalled and there is slow migration of the contamination in a general northwest direction.	Section 4.1.5 and Table 4-1 were added to the draft final report to summarize overall conclusions regarding plume delineation (including vertical bounding) and stability based on the Mann-Kendall results and trend graphs. In addition, the discussion of monitored natural attenuation in Sections 4.1.6 and 5.2 was expanded to support the conclusion that anaerobic biodegradation is occurring, although at slower rates compared to aerobic biodegradation.
20.	Section 4.2.5, Monitored Natural Attenuation Parameters, Page 4-16	The results of analyses of monitored natural attenuation (MNA) parameters are listed in Table 4-1, but, with the exception of dissolved oxygen (DO) and oxidation-reduction potential (ORP) the results are not discussed. However, the RI/FS concludes that the MNA parameters indicate that biological degradation of benzene is occurring. Since the selection of the recommended alternative is based on the conclusion that biological degradation is occurring, the RI/FS should discuss, in detail, how the MNA parameters indicate that biological degradation is occurring and will remediate the site with the addition of nothing further than oxygen.	Section 4.1.6 was expanded to include graphs showing concentrations of MNA parameters along two transects across the site. In addition, the discussion in Section 5.2 has been expanded to discuss all of the MNA parameters.

Comment No.	Section/Page Number	Comment	Response
21.	Figure 4-18, Groundwater Elevation Map	This map should include monitoring well symbols and groundwater elevation values on the map so that the contours do not appear arbitrary and unsupported by data. Please add this information to the map.	Two new groundwater elevation maps have been included as Figures 2-3 and 2-4. The new figures include the locations of monitoring wells and measured depth to groundwater at these wells.
22.	Section 4.2.6, Groundwater Conceptual Model, Page 4-24	The first bullet on this page states that the absence of benzene in soil-gas indicates that volatilization in the vadose zone has already occurred, or that vadose zone biodegradation has already removed shallow benzene; however, this statement is contradicted by the text of Section 4.3, which lists several other factors that may account for the absence of benzene in soil gas unrelated to biodegradation. Therefore, the absence of benzene alone does not provide evidence that biodegradation in the vadose zone is occurring. Since the recommended remedial option, biosparging, is based on the premise that contaminants volatilized in groundwater will be biodegraded in the vadose zone rather than be emitted to the atmosphere, the RI/FS should provide evidence to indicate that this will occur. Please revise the RI/FS to include a discussion of the evidence that suggests that volatilized contaminants will biodegrade in the vadose zone. If this data is unavailable, it should be obtained during the design phase.	Comment noted. The report was reviewed to ensure consistency, and all alternatives including biosparging or air sparging were revised to include vapor monitoring and controls.
23.	Page 4-25, Section 4.4.2, second paragraph	EPA is concerned that the point source discharge located at Kollman/Mayport Circle has not been adequately remediated. In the absence of evidence documenting the remediation, EPA assumes that the remediation did not take place or at least not in a CERCLA approved manner. In addition, the high concentration of the plume in this location may be due to a continuing source.	Past cleanup activities at Mayport/Kollman Circle have not been verified. Any reference to these cleanup actions were removed from the document. Section 4.5.5 was added to the draft final report to discuss data gaps, including investigating potential soil sources in the Mayport/Kollman Circle area.
24.	Page 4-25, Section 4.4.2, third paragraph	Was MTBE found in the plumes underlying the Alameda Point site?	See the response to comment 16. Additional information regarding the location of MTBE detections was included in Section 4.1.1.
25.	Page 4-28, Section 4.6	EPA does not agree with the conclusion that the plume center concentrations are decreasing. Rather, it appears that the plumes are migrating downward and also to the northwest. It is possible that soil at Kollman Circle is an ongoing source of groundwater contamination.	Conclusions regarding plume degradation and movement were revised throughout Section 4. In particular, Section 4.1.5 and Table 4-1 were added to the draft final report to summarize overall conclusions regarding plume delineation (including vertical bounding) and stability based on the Mann-Kendall results and trend graphs. In addition, the discussion of potential sources of groundwater contamination in Section 4.4 was revised, and Section 4.5.5 was added to discuss data gaps, including investigating potential soil sources in the Mayport/Kollman Circle area..

Comment No.	Section/Page Number	Comment	Response
26.	Table 5-1	Advection seems to be evident in the lower stratigraphy, i.e. the 20-foot depth of contamination where the plume contour fits the northwest hydraulic gradient. Sorption description states that BTEX compounds are hydrophobic. However, benzene has a high water solubility, so perhaps BTEX should be changed to PAHs. Under the infiltration block, it should be noted that approximately 50-60% of the Alameda Point site is uncovered surface, so actually the majority of the site allows for infiltration. (See OU 5 FS).	The text was revised for clarity and accuracy.
27.	Page 5-6, Section 5.5, third paragraph	The plots do not show a first order decay of contaminants in groundwater. Even though the graphs claim that data up to mid-2001 is used, they only show data to 1999 which drastically skews the curves and the equations. For example, monitoring well P181-MW47 on Table 5-2 would show a 2001 data point of 1620 ppb benzene that exceeded the original 1994 data point of 1400 ppb if all data were used in the plot. This table is a prime example of using a computer program to produce an output which is not then double checked against reality. Tables 5-3, 5-5, and 5-6 exhibit the same problem. Tables 5-4 and 5-7 do not have data from 2001 and, for this reason, are poor choices to use to show trends.	The figures (5-1 through 5-11) were revised to include all of the data generated to date. The text has been revised to clarify that due to fluctuations in the data, the correlation coefficients of many of the decay curves are low, and this analysis is intended as a qualitative tool.
28.	Page 5-14, Section 5.6, first paragraph	The fact that PAHs adsorb to soil particles makes them harder to remediate through MNA. How will the problem of PAHs being a long term contaminant slowly desorbing off the soil into the groundwater be addressed?	A discussion was added to Section 4.3 regarding the potential for polycyclic aromatic hydrocarbons (PAHs), specifically naphthalene, in soil to act as a continuing source of groundwater contamination. The available data indicates that the majority of naphthalene contamination is present in the dissolved phase, indicating a low potential for residual naphthalene soil concentrations to act as a continuing source of groundwater contamination.
29.	Page 5-14, Section 5.6, fourth paragraph	EPA does not agree with the conclusion of decreasing concentrations. Only one well out of the nine that have been sampled in 1994, 1999 and 2001 showed an overall downward trend. The others have shown contaminant concentrations in 2001 returning to about the same level as the 1994 concentrations, in other words, the plumes exhibit stability, but no decrease in size.	See response to comment 25. New plume stability analyses were performed using all available data, for all plume monitoring wells. The text was revised and Table 4-1 was added to summarize the revised conclusions.
30.	Page 5-15, second and third paragraph	The 1994 and 2001 plume extents are fairly similar and show that not much degradation has occurred. How were data fluctuation from the different seasons taken into account, and what was the rationale for doing this given the assertion that infiltration at the site was negligible? Please note, EPA disagrees with the assertion that infiltration at the site is negligible since 50% to 60% of the site is uncovered.	Figure 4-28 was added to demonstrate the sensitivity of contaminant concentrations to seasonal influences. The report was revised in Table 5-1 to more accurately reflect the percentage of the Site that is uncovered.

Comment No.	Section/Page Number	Comment	Response
31.	Page 5-15, last paragraph	Actually, it appears that the plume at the deeper level has increased, while the plumes at the shallower depths have decreased. These trends should be acknowledged rather than glossed over. Comparison of shallow hydropunch data with monitoring well data serves only to aid in making the case that the plumes are shrinking, which is actually not the case for the deeper zone contamination. The monitoring wells are not all completed in the shallower zone, indeed six of the nine wells used in the 1994, 1999 and 2001sampling events were screened to at least 18 feet, and as much as 19.5 feet.	See response to general comment 2 and specific comment 25. Sections 4 and 5 of the draft final report was revised to address discrepancies in comparing Hydropunch™ data with monitoring well data, and conclusions regarding plume degradation.
32.	Page 5-22, Section 5.8.1	Approximately 60% of the site at Alameda Point is uncovered and infiltration would not be considered minimal.	The Navy acknowledges that infiltration may be occurring at unpaved locations at the site. The text was revised for clarity.
33.	Page 5-23, first paragraph	It is unacceptable to reference data that is not included or readily available to the regulators as proof that indoor air is not a problem for this site. EPA requires that the Navy perform indoor air sampling to verify the assertion that this exposure pathway does not present a threat to residents of the area.	The Navy included a discussion of the 2002 indoor air sampling data collected at Sites 25 and 31 by the Coast Guard in Sections 3.3 and 4.2.2. In addition, the report was included as Appendix B.
34.	Page 5-23, Section 5.8.4	What about gas vapors migrating along the high permeability trenching material in which sewer and storm drain pipes are laid?	Section 4.2.2 of the draft final report notes that, based on previous and ongoing soil gas monitoring data, sewer and storm drains do not appear to be acting as a preferential conduit for contaminant migration in soil gas.
35	Page 6-1, Section 6.1, second paragraph	Again, EPA cannot agree with the assertion that indoor air does not pose an unacceptable risk until the data from the Coast Guard indoor air study is included in this report or until the Navy performs some sampling of its own.	See the response to comment 33.
36.	Page 6-3, second paragraph	Residential homes, a school and a day care center already are present at the site, so there is really no need to consider it a possible future development. Please reword.	The text was revised for accuracy.
37.	Section 6.5, Ecological Risk Assessment, Page 6-5	The RI states that Ecological Risk Assessments (ERAs) have been conducted for Alameda Point and the Alameda Annex. Please cite the documents containing these ERAs, and indicate whether these documents have been approved as final by EPA.	Complete citations for these reports were provided within the text. The ERA for Alameda Point OU-5 was published in the OU-2 Remedial Investigation report (TtEMI, 1999), which at the time included the parcels currently identified as OU-5. The OU-2 RI report was submitted in draft form in 1999 and has not been finalized. The ERA for Alameda Annex was published in the final RI report for Alameda Annex PRC and Versar, 1996). The text was revised to clarify that exposure of terrestrial ecological receptors to contaminated groundwater is not likely based on site conditions. In addition, Section 5.8.2 presents an evaluation of potential exposure to aquatic receptors in the Oakland Inner Harbor.

Comment No.	Section/Page Number	Comment	Response
38.	Section 6.5.1, Alameda Point ERA Summary, Page 6-5	Direct exposure to surface water was considered a complete exposure pathway in the ERA. The text mentions the storm sewer system and concludes that exposure would be minimal; however, the text does not describe whether discharge of shallow groundwater to the Bay was evaluated as a potentially complete exposure pathway. Please indicate how this exposure pathway was evaluated in the ERA.	Findings of previous storm drain studies were referenced in Section 5.8.2 to address the potentially completed pathway. In addition, groundwater concentrations were compared (in Section 5.8.2 and Table 5-3) to water criteria applicable to the bay for a most conservative scenario (groundwater migrating directly to the bay through storm drains, with no attenuation).
39.	Section 6.5.2, Alameda Annex ERA Summary, Page 6-6	The summary states that storm drain discharge from Alameda Annex poses no ecological risk to sediment-dwelling organisms in the Bay. However, it is unclear whether concentrations in surface water were measured or compared to state-promulgated water quality criteria. Please indicate whether this comparison has been conducted.	Groundwater concentrations were compared (in Section 5.8.2 and Table 5-3) to water criteria applicable to the bay for a most conservative scenario (groundwater migrating directly to the bay through storm drains, with no attenuation).
40.	Section 6.5.2, Alameda Annex ERA Summary, Page 6-6	The RI cites a 1998 groundwater study that identified benzene as a chemical of concern, while polynuclear aromatic hydrocarbons (PAHs) and semi-volatile organic compounds (SVOCs) were "much less soluble and fairly immobile." The text should be revised to discuss whether potential impacts to the Bay were quantified via a comparison of groundwater concentrations to surface water quality criteria. Additionally, the text in Section 6.0, Risk Assessment, page 6-1 states that additional shallow groundwater data was collected in 2002. It is unclear whether these results would modify the conclusions of the 1998 groundwater study with respect to chemicals of concern that have the potential to migrate and discharge to the Bay. Please revise the RI to further discuss the potential for constituents in groundwater to impact surface water quality via discharge to the Bay.	See response to comment 39. The groundwater data included in Table 5-3 reflects the maximum detected concentrations during all previous monitoring events through December 2003.
41.	Table 7-1, Clean Water Act	Why is this requirement considered relevant and appropriate if it has been shown that site contamination is not migrating to the Bay or surface waters? Is there a typo?	The requirement was originally included in case groundwater to surface water pathway was completed; however, this was overly conservative. Existing data indicates that contamination has not migrated to Oakland Inner Harbor, the plume is stable to decreasing, and none of the proposed remedial alternatives would impact surface water. Therefore none of the requirements pertaining to surface water or the costal zone are ARARs.
42.	Table 7-4	If biosparging were converted to air sparging, wouldn't RCRA characterization and disposal regulations apply to the extracted waste stream as well?	RCRA air emission standards were considered, but are not applicable relevant or appropriate because the waste stream will not contact hazardous waste with organic concentrations of at least 10 percent by weight. Vapor extraction would require an air permit, and this requirement was included in Section 7.

Comment No.	Section/Page Number	Comment	Response
43.	Page 8-4, Section 8.3.3	Site monitoring is not a remedy. While site monitoring is part of the remedial investigation phase of a site and is also often a component of an active remedy, EPA does not accept site monitoring as a stand-alone remedy. In no way would this approach reduce or prevent risk and, of course, it would not provide any active treatment. This section and this alternative needs to be removed.	The statement suggesting that site monitoring could be a stand-alone remedy was deleted. Section 8.3.2 of the draft final report was revised to clarify that site monitoring is considered an institutional action that was retained for further analysis in Section 9. The MNA components of Alternatives 2 through 6 evaluated in Section 9 include site monitoring of contaminant concentrations as a component of the more comprehensive MNA program.
44.	Section 8.3.4, Containment - Phytoremediation, Page 8-5	It is not clear why phytoremediation was the only containment technology considered. There are many more commonly used containment technologies and it appears that it would be appropriate to evaluate some of these technologies. Also, the RI/FS states that groundwater extraction is considered as a containment option, but this option is not discussed. Please revise this section to clarify why phytoremediation was considered the most promising containment option and why other technologies, including groundwater extraction, were eliminated or include other technologies and carry them through the screening process.	Section 8 was restructured to include Pump and Treat as a Groundwater Containment technology (evaluated in new Section 8.3.3.1). This technology was retained and included as part of Alternative 6, evaluated in Section 9.
45.	Page 8-6, Section 8.3.5, third paragraph	Until evidence is provided that Kollman Circle has been remediated, we cannot agree that no hot spots remain to be excavated.	Past cleanup activities at Mayport/Kollman Circle have not been verified. Any reference to these cleanup actions was removed from the document. Section 4.5.5 was added to the draft final report to discuss data gaps, including investigating potential soil sources in the Mayport/Kollman Circle area.
46.	Page 8-7, Section 8.3.8, last paragraph, last sentence	Please elaborate on the last sentence to explain what an increase in use of biological treatment means for the site. For example, is the technology cheaper than it used to be, is it more readily available, easier to use, more applicable to a wider variety of sites?	This section was revised to clarify.
47.	Page 8-9, Section 8.3.8.2, bullets	An extra bullet should be added regarding plume size as a factor to consider in air sparging.	The text was revised accordingly.
48.	Page 8-10, Section 8.3.8.3, bullets	An extra bullet should be added regarding plume size and concentration as a factor to consider in biosparging.	The text was revised accordingly.

Comment No.	Section/Page Number	Comment	Response
49.	8.3.8.3, Biosparging, page 8-10	This section states that biosparging is most often used at sites with mid-weight petroleum products which do not readily volatilize but biodegrade more efficiently in aerobic environments. However, benzene volatilizes readily. It is not clear how biosparging, which is designed to eliminate fugitive emissions by pushing volatilized contaminants into the vadose zone, will operate on benzene contamination. It is not clear how emissions can be controlled. Also, if vapor extraction wells are installed as a contingency, the advantage of operating the system as a biosparging system rather than as an air sparging system is not clear. Please revise the RI/FS to clarify the likelihood of benzene being volatilized rather than biodegraded and compare the relative advantages and disadvantages of biosparging and air sparging in the detailed analysis of alternatives.	A fact sheet detailing biosparging and air sparging has been distributed to the Restoration Advisory Board (RAB), and additional text was added to the revised report to clarify and explain. Benzene vapors may enter the vadose zone during biosparging; however, the natural degradation potential of the vadose zone will likely degrade them prior to any surface discharge. Nevertheless, vapor monitoring and controls were added to the biosparging alternative to address the concerns. Both air sparging and biosparging were retained for evaluation in Section 9 in order the compare the relative effectiveness of each technology against the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) criteria.
50.	Page 8-12, Section 8.3.8.5	EPA requests that nutrient/microorganism enhancement in conjunction with biosparging be evaluated as a remedial alternative. We believe that the combination of the two approaches may be much more effective than either one alone, and the slight additional cost would be more than offset by the time saved to achieve RAOs.	Biosparging with nutrient/microorganism enhancement, MNA, and institutional controls was evaluated as Alternative 4 in Section 9.
51.	Page 8-16, first paragraph and fourth paragraphs	It should be noted that Site 5 is not a former UST site, and even though USTs probably contributed to the groundwater problem the primary contamination was a result of aircraft overhaul and plating activities. The steam enhanced extraction pilot study at Site 5 targeted DNAPLs in the groundwater and coincidentally managed to extract LNAPLs with the DNAPLs in a very effective removal action. The study evaluated the condition of the microbes in the subsurface and found that the microbe population returned to pre-steam injection levels within a few weeks indicating only a very short term adverse effect on the microbe population. The primary reasons not to consider steam injection as an alternative are that 1) the process is the most effective for treating DNAPL or extremely concentrated VOC plumes (which OU 5 does not have) and 2) the technology is fairly difficult and dangerous to implement in a residential area.	Comment noted. The discussion of steam-enhanced extraction at Site 5 was revised accordingly.
52.	Page 8-16, Section 8.4 and Table 8-1	Remove "site monitoring" as a remedial alternative.	See the response to specific comment 43.

Comment No.	Section/Page Number	Comment	Response
53.	Page 9-1	Please include an Alternative 4: Biosparging with nutrient/microorganism enhancement followed by MNA and ICs.	Biosparging with nutrient/microorganism enhancement, MNA, and institutional controls was evaluated as Alternative 4 in Section 9.
54.	Page 9-6, Section 9.2.4	Why does this alternative merit a ranking of 2 out of 5 for reduction of mobility, toxicity or volume through treatment? Where is the treatment on a no action alternative?	The comparison of alternatives in Section 9 has been revised, and a qualitative analysis is now presented in Figure 9-5. In the revised analysis, Alternative 1 did not meet the first threshold criteria; therefore, no comparative analysis was performed for this criterion.
55.	Page 9-8, Section 9.3	EPA has recently come out with a comprehensive MNA guidance document, which will assist the Navy further in determining how to meet the required lines of evidence necessary to establish MNA as a viable remedial alternative.	Available MNA guidance published by EPA was researched online (http://www.cluin.org/). In addition to the 1999 EPA directive regarding MNA (9200.4-17P), which was used in preparing the draft RI/FS, a May 2001 MNA document (EPA-SAB-EEC-01-004) was consulted and relevant excerpts included within the draft final document.
56.	Page 9-10, Section on Nature and Extent of Contamination	It appears that the lower portion of the plume centered below the Kollman Circle may be migrating in the direction of groundwater flow to the northwest. This fact should be taken into consideration when locating biosparging and possible nutrient enhancement wells.	Section 4 of the draft final report refines previous conclusions regarding plume delineation and stability. The plume is believed to be generally stable; however, Section 4 outlines additional steps, including both ongoing monitoring as part of the Groundwater Monitoring Program and additional investigation during the remedial design phase, to be taken to further refine the characterization of the site.
57.	Page 9-11, fourth paragraph	Please note that the 10^{-4} to 10^{-6} is not an acceptable risk range, but rather within the risk management range which allows the risk managers flexibility in determining how best to manage the risk.	The text was revised to appropriately discuss this risk range.
58.	Page 9-12, fourth paragraph	We disagree with the conclusions reached from reviewing data from P181-MW47. In 1994 data from this monitoring well yielded a concentration of 1400 ppb of benzene, in 1999 the concentration dropped to 251 ppb and in 2001 it shot back up to 1620 ppb. If this cyclic trend continues it is doubtful that the plume will decrease to any low concentration in our lifetimes and it is unbelievable that a time frame of 2016 (thirteen years from now) is projected for the concentration to degrade to 1 ppb. Again, a reality check would show that this assertion is completely unsupported by actual site behavior.	The latest available data was included in the draft final report. The data supports the conclusion that MNA processes are proceeding slowly within plume centers and at depths near the Marsh Crust. The report was revised to reflect this conclusion, and that MNA, as a stand-alone alternative, is now considered less likely to achieve cleanup within a reasonable timeframe, given analysis of all the data.

Comment No.	Section/Page Number	Comment	Response
59.	Page 9-14, Section on Institutional Controls	How will the ICs be enforced? What is the associated cost?	Per Department of Defense (DoD) policy, the record of decision (and by extension the feasibility study) will document the remedy selection and, "...will describe the IC objectives; explain why and for what purpose the Institutional Controls (ICs) are necessary, where they are necessary...." Ultimate responsibility for assuring that the objectives are met remains with Department of the Navy (DON) as the party responsible under CERCLA for the remedy." (DoD, 2004). The Navy evaluated potential institutional controls in the draft final FS in a manner that ensured that public health and the environment are adequately protected. The FS included: • a preliminary IC evaluation and objective, • the identification of any proprietary controls (e.g., an Environmental Restriction Covenant and Agreement with DTSC and deed restrictions), • the mechanism to ensure that the permission of the Navy is obtained prior to disturbance of the shallow aquifer by the property owner/occupant. Additionally, ICs will detail: • the owner/occupant would be required to submit a groundwater management plan to the Navy addressing sampling and analysis and appropriate disposal of contaminated groundwater along with its request for approval, • the owner/occupant would then be required to abide by the approved groundwater management plan and any other conditions of approval. The costs for performing these administrative functions was included in the FS. In addition, the duration of the ICs was estimated along with a fixed annual cost. The costs were estimated with sufficient accuracy for a feasibility study analysis (+50 percent / - 30 percent).

Comment No.	Section/Page Number	Comment	Response
60.	Page 9-16, Section 9.3.3	As far as the MNA component of the remedy is concerned, it is no different from the no action alternative with regards to long term effectiveness and permanence and so should receive a ranking of 1 out of 5. However, the IC component of the remedy gives this alternative a slightly better ranking in terms of long term effectiveness and permanence than no action and for this reason a ranking of 2 out of 5 can be used.	Comment noted. The comparison of alternatives has been revised and a qualitative analysis is now presented in Figure 9-5. In the revised analysis, Alternative 2 ranked "low" with regards to long term effectiveness and permanence.
61.	Page 9-16, Section 9.3.4	Like the no action alternative, MNA does not use any treatment to reduce mobility, toxicity or volume and so deserves a ranking of 1 out of 5.	Comment noted. The comparison of alternatives was revised and a qualitative analysis is now presented in Figure 9-5. In the revised analysis, Alternative 2 ranked "low" with regards to reduction of contamination through treatment.
62.	Page 9-16, Section 9.3.5	The same logic thread should be used for evaluating short term effectiveness as was used in Section 9.2.5. In Section 9.2.5 the lack of ICs gave this criteria a low ranking, even though no wells were going to be placed. In Section 9.3.5, putting in a few wells is considered low risk, yet the placement of ICs is not mentioned. Please use consistency in evaluating the criteria between alternatives.	The comparison of alternatives was revised and a qualitative analysis is now presented in Figure 9-5. In the revised analysis, Alternative 2 ranked "moderate" with regards to short term effectiveness.
63.	Page 9-28, Section 9.4.5	How can this alternative receive a higher ranking than MNA and no action when there is more short term risk from construction activities on site? Please use consistent logic here.	The comparison of alternatives was revised and a qualitative analysis is now presented in Figure 9-5. In the revised analysis. Short term effectiveness takes into account the increased risk due to the remedy as well as the effectiveness of the remedy in the short term. Therefore, Alternatives 3, 4, and 6 performed more favorably than MNA (Alternative 2) on this criteria because the estimated treatment timeframes are substantially shorter for these
64.	Page 9-32, Section 9.5.7	The assumption that the basewide groundwater monitoring program could absorb some of the costs of monitoring is not allowable. The basewide groundwater monitoring program will in all likelihood terminate with the completion of the last ROD signed for the base. Any groundwater monitoring requirements are considered part of the permanent remedy for as long as the remedy is in operation and as such must be factored into the cost for the duration of the remedy. Please redo the cost estimates with this fact in mind.	The cost estimate was revised to include the costs of all required groundwater monitoring.
65.	Page 9-32, Section 9.5.8	Typically, when something is listed in order of preference, the most preferred alternative is listed first. Therefore, this paragraph should list Alternative 3 first, then Alternative 2 and lastly Alternative 1. Cost is usually not considered a significant factor in community acceptance of the best remedy unless the remedy is prohibitively expensive (none of these remedies are very costly).	Comment noted. This section was revised to take into account that community and State acceptance will be assessed in the ROD following comment on the RI/FS and the proposed plan.

Comment No.	Section/Page Number	Comment	Response
Minor-1	Page 1-5, Section 1.1.2, first paragraph	What is a screening lot?	The term "screening lot" refers to the past operation of staging used equipment for screening, prior to either off-site disposal, salvage, recycle, etc. The text was revised for clarity.
Minor-2	Page 3-4, Section 3.1.3, last paragraph, first sentence	Insert the word "that" between the words "reports" and "are".	The text was revised accordingly.
Minor-3	Page 4-4, Section 4.2.2, last paragraph, first sentence	Reword to correct grammar.	This section was revised for clarity.
Minor-4	Section 8.0 Identification and Screening of Technologies, Page 8-1	"Sepia" is referenced throughout this section. It appears that this was a spell-checker substitute for U.S. EPA. Please use the correct acronym.	This was corrected throughout the document.
Comments from EPA Office of Regional Counsel, dated December 2003			
1.	General comment regarding Alternative 3--biosparging	The FS is somewhat confusing as to whether Alternative 3 includes the possibility of air sparging and using vapor extraction wells. The discussion in chapter 8 indicates that air sparging is not retained as an alternative (page 8-10), and the ARARs charts (Table 4-1 in Appendix C and Table 7-4) state that the recommended alternative does not include vapor extraction and treatment. However, page 9-23 raises the possibility that air sparging "could be used" in Zone 2, and that "engineering controls for vapor capture and treatment may be considered." This should be clarified.	The report was revised to clarify that the retained biosparging alternative is to be implemented with low injection pressures so that vapor capture will not be required, but vapor wells will be installed as a contingency to avoid possible risks to sensitive receptors such as local residents. In addition, Section 8 of the draft final report retained air sparging for further analysis in Section 9.
2.	Sec. 7 and Appendix C -- ARARs	Many of these comments refer to the ARARs discussions and tables in both Section 7 and Appendix C. EPA notes that both drafting and review of this document could be facilitated by having only one ARARs discussion and set of ARARs tables. Review of the ARARs is also made more difficult by putting the ARARs tables in Appendix C in the middle of the each portion of the ARARs text. Finally, we are curious why the Navy divided the location-specific ARARs tables into separate federal and state tables. Other than the general and editorial comments, our comments are arranged by potential ARAR rather than by page number, since the discussion of each potential ARAR is found in a multitude of places (Sec. 7 text, Sec. 7 tables, Appendix C summary text, Appendix C detailed text, and Appendix C tables).	The complete ARARs section was included in Section 7 of the draft final report text.

Comment No.	Section/Page Number	Comment	Response
3.	Page 7-1.	The document (fourth paragraph p. 7-1) refers to "TBC ARARs," which is not technically correct, since TBC criteria are not ARARs; therefore, EPA recommends that the wording be changed to "To-be-considered criteria." If the Navy chooses to adopt a TBC criterion as a requirement, then in the ROD it should be made clear that the requirement is no longer just a TBC, but rather a performance standard with which the chosen remedy must comply.	The reference to "TBC ARARs" was removed.
4.	Page C-1-3 fourth paragraph, third line	Should "Alameda Point Site 5" be "Site 25"?	The text was revised accordingly.
5.	Page C-1-3, fourth paragraph, end of next-to-last line	The comma at the end of the line should be change to "or."	The text was revised accordingly.
6.	Page C-3-2, sec. 3.1.1, par. 2	Should "OU-5" be changed to "Site 25"?	The text was revised accordingly.
7.	Chemical-specific ARARs	Health advisory for naphthalene. EPA considers the health advisory level for naphthalene to be a TBC rather than an ARAR. EPA 822-R-02038 (Drinking Water Standards and Health Advisories) states that a health advisory is not a legally enforceable federal standard, but serves as technical guidance.	Comment noted.
8.	Chemical-specific ARARs	MCLs. The tables list both State and federal MCLs. The Navy should include only the more stringent. The text on page 7-1, text in Appendix C, and Appendix C Table 2-2 all indicate that the State MCL for benzene is the more stringent and is the controlling ARAR. EPA recommends that the federal MCL be removed from the tables to avoid confusion.	Comment noted. Both federal and state requirements were listed in Table 7-2 to document that the federal MCLs were considered and that the more stringent level was used as the controlling ARAR.
9.	Chemical-specific ARARs	SMCLs. The tables include SMCLs as a TBC but state that they do not directly relate to any contaminants of concern. Thus, it is unclear why the SMCLs are considered a TBC, or what SMCLs are being considered. The text at C-2-4 indicates that SMCLs for asthetic qualitities such as odor are considered to be TBCs. Unless the Navy expects to select this SMCL as a performance standard in the ROD, it is not necessary to discuss this in either the FS or the ROD.	The discussion of SMCLs was removed.

Comment No.	Section/Page Number	Comment	Response
10.	Chemical-specific ARARs	Water quality standards. It is not clear why these are included when the contaminants are not migrating or discharging to surface water.	The requirement was originally included in case groundwater to surface water pathway was completed; however, this was overly conservative. Existing data indicates that contamination has not migrated to Oakland Inner Harbor, the plume is stable to decreasing, and none of the proposed remedial alternatives would impact surface water. Therefore none of the requirements pertaining to surface water or the costal zone are ARARs.
11.	Location-specific ARARs	General comment: Several of the proposed location-specific ARARs deal with laws generally requiring that actions do not harm the Bay or wildlife. It is not clear how the particular remedial alternatives being discussed in this FS could cause such harm, although there is some mention in the FS (p. C-3-3) of sediment being generated by construction activities, of wells being a route for entry of sediments and illegal surface dumping of toxic chemicals, and the potential risk of toxic pollutants dumping into marine waters. If the Navy in fact considers these laws to be ARARs, it should more clearly state which specific remedial action could implicate which specific portion of each law. Additionally, if there are concerns such as those noted on page C-3-3, the Navy should also discuss whether there are any action-specific ARARs which address those concerns. For example, if the concern is disposal of contaminated remediation waste, the Navy should explain how the waste is to be disposed of, and discuss the action-specific remedies related to that disposal. If the concern is members of the general public taking remediation waste and illegally dumping it, or birds being exposed to remediation waste, then the Navy needs to discuss whether there are any action-specific ARARs for storage or management of remediation waste. If the concern is runoff from the site, the Navy should consider whether substantive portions of the State's general permit for stormwater discharges from construction sites greater than one acre should be considered an ARAR.	This section was revised to be consistent with the conceptual site model.
12.	Location-specific ARARs	Fish and Wildlife Coordination Act. EPA questions whether this remedial action will involve a waterbody being "impounded, diverted, the channel deepened, or otherwise controlled or modified" such that this Act should be considered an ARAR.	See Comment 10. Inclusion of this act was overly conservative. The draft final report identifies this act as "not an ARAR."

Comment No.	Section/Page Number	Comment	Response
13.	Location-specific ARARs	Water quality standards. The inclusion of water quality standards as ARARs is confusing for several reasons. First, they are included, but not consistently, as both chemical-specific and location-specific. Under chemical-specific ARARs, the comment in the FS table is that the contamination is not migrating to surface waters. Under location-specific, there is mention of the remedial actions possibly affecting the San Francisco Bay. It needs to be clarified whether the actions could in fact affect the Bay, and, if so, how. It would also be helpful to explain what specific WQS are considered to be relevant and appropriate. For example, there is a citation to the California Toxics Rule, but no discussion of whether there are any specific toxic pollutants covered by the California Toxics Rule that the Navy expects could be discharged to the Bay during the remedial action. (Additionally, the text on page C-3-2 refers to 40 CFR 137.38, whereas the ARARs table refers to 131.38.)	See Comment 10. Theses standards were originally included in case the groundwater to surface water pathway was completed; however, this was overly conservative. Existing data indicates that contamination has not migrated to Oakland Inner Harbor, the plume is stable to decreasing, and none of the proposed remedial alternatives would impact surface water. Therefore none of the requirements pertaining to surface water or the costal zone are ARARs
14.	Location-specific ARARs	CZMA. Here, too, it needs to be clarified whether the actions could in fact affect the Bay, and, if so, how. Page C-3-6 indicates that a remedial action could result in sediment deposit in coastal waters. It is unclear which of the alternatives could have that result, and how. If the Navy in fact concludes that CZMA is an ARAR, the specific sections of the CZMA with which the remedial action must comply should be specified.	See Comment 10.
15.	Location-specific ARARs	McAteer-Petris Act. Same comment as regarding CZMA.	See Comment 10.
16.	Location-specific ARARs	California Water Pollution Prohibition Act. It is unclear how any of the remedial alternatives could implicate this law. If the concern is with regard to materials passing into waters of the State, the Navy should more clearly discuss how remediation wastes will be disposed of and whether the proposed means of disposal triggers any ARARs.	See Comment 10.
17.	Action-specific ARARs	BAAQMD requirements. The tables indicate that certain BAAQMD requirements in Rules 2 and 47 are relevant and appropriate, but that they would be applicable "if the biosparging were converted to air sparging, and vapor extraction and treatment were added." The implication is that if the biosparging were <u>not</u> converted to air sparging, then the Navy considers these requirements to be appropriate and relevant for the biosparging. This should be clarified. Also, the text on page 8-11 suggests that even with the biosparging, there may be vapor extraction, although the ARARs table suggests that vapor extraction would only be used with air sparging. This should be clarified.	This section was clarified to detail that these requirements are applicable for Alternatives 3, 4, and 5, which incorporate a SVE system to capture any fugitive vapor emissions. BAAQMD requirements are relevant and appropriate when the SVE system is operational.

Comment No.	Section/Page Number	Comment	Response
18.	Action-specific ARARs	SIP. It is unclear what specific portions of the SIP are considered to be ARARs, and whether they add any requirements beyond the BAAQMD requirements. Additionally, the reference to the Clean Air Act in Table 4-1 of the Appendix should be to 42 USC, not 40 USC. Also, the text on page C-4-3 indicates that NAAQS are relevant and appropriate requirements because they are not enforceable. EPA's position is that because NAAQS are not enforceable, they are not considered to be ARARs. However, State requirements based on the NAAQS could be ARARs.	The BAAQMD requirements listed are considered federal ARARs because they are included in the SIP. References to the Clean Air Act were corrected. NAAQS are identified as "not an ARAR" in the draft final report.
19.	Action-specific ARARs	RCRA characterization requirements. The text in chapter 7 indicates that RCRA requirements regarding characterization of hazardous waste would be included, and Appendix C discusses at length the requirements regarding characterization of waste under RCRA and State law; however, none of these requirements are included in the ARARs tables. EPA generally considers requirements to characterize waste such as those found in 22 CCR 66262.11 to be action-specific ARARs. The Navy should indicate whether there are any ARARs of this type given that the FS (p. C-1-9) indicates that some investigation derived wastes may be generated during the remedial actions.	RCRA characterization requirements were listed as potentially applicable ARARs in both the media specific and action specific ARARs tables.
20.	Action-specific ARARs	RCRA management requirements. The text in Appendix page C-4-2 mentions RCRA requirements for management of solid and hazardous waste, but none are included in the tables. The text also indicates that groundwater from some wells at the center of the plume has the potential to be classified as a RCRA hazardous waste, and that "the appropriate requirements for storing, manifesting, and transporting this material for final disposal will be followed if soil cuttings and well purge water are classified as RCRA characteristic hazardous waste," but does not indicate what those requirements are. EPA recommends that the Navy consider whether the RCRA management requirements identified by the Navy in the recently-submitted FS for Site 26 groundwater are also ARARs for this action. Additionally, the implication from the discussion in the Appendix is that any remediation wastes would be disposed of off-site; however, this is not clear, and should be clarified.	RCRA characterization requirements were listed as potentially applicable ARARs in both the media specific and action specific ARARs tables. Specific requirements for storage and transport are shown in the action specific ARARs tables.
21.	Action-specific ARARs	Disposal of wastes. As noted above, the Appendix indicates that some wastes will be generated during remedial action. EPA recommends that the Navy clarify how such wastes will be disposed of and whether there are any requirements which are applicable or relevant and appropriate to such disposal.	Section 7.1.4.1 summarizes the wastes that will be generated as part of this investigation and the criteria to determine if the wastes would be considered RCRA characteristic. More specific requirements are listed in Table 7-5.

Comment No.	Section/Page Number	Comment	Response
22.	Action-specific ARARs	Monitoring. The FS recently submitted by the Navy for Site 26 groundwater includes several RCRA ARARs regarding monitoring. The Navy should consider whether those ARARs should be included in this FS.	RCRA ARARs regarding monitoring are relevant and appropriate to discrete waste management units. This is not the case at this Site; therefore, the RCRA monitoring requirements are not ARARs.
23.	Action-specific ARARs	NPDES. The FS includes substantive portions of a NPDES permit as relevant and appropriate. This is somewhat confusing. First, the text at C-4-2 says, "The proposed response alternatives do not involve discharge of wastes to surface water. However, in the event of a discharge to the surface waters the DON will comply with substantive effluent limitations of an NPDES permit..." This should be clarified; specifically, the Navy should clearly indicate whether it intends to discharge any wastes to surface water. Additionally, the ARARs table is overbroad and lists CWA 302-307 as the citation for the NPDES requirements. Instead, the Navy should consider what NPDES requirements in 40 CFR parts 122 and 125 would be ARARs.	See the response to comment 10.
24.	P. 8-1.	What is the reference to "Sepia" in the first paragraph? Is this a typo for "USEPA"? Note that references to "Sepia" occur throughout the document.	This typo was corrected throughout the document.
25.	Sec. 8.1, p. 8-1, second paragraph, second sentence	It appears that the word "where" should be "which".	The text was revised accordingly.
26.	Sec. 8.3.2.1, p. 8-3, Deed Notification.	The discussion confuses deed notification with deed restriction. EPA does not consider deed notification to be an effective LUC and prefers deed restrictions and land-use covenants. EPA also recommends that at some point in the FS, there should be a discussion of the layered approach and the need for both a deed restriction in the Navy's transfer document and a LUC with the State. Additionally, there needs to be a citation to the RWQCB requirements (third bullet on page 8-3).	The discussion of deed restrictions and LUCs was revised accordingly.
27.	Page 8-4, "Institutional Controls" General Screening.	Because of the permanent nature of most ICs and the need for periodic monitoring and enforcement of ICs, EPA does not concur that the cost of ICs in general is necessarily low compared to more aggressive remedial technologies.	Comment noted. See the response to comment 59 from the EPA Remedial Project Manager (RPM).
28.	Sec. 9.1, page 9-3 and following - Evaluation criteria	In this and the following section, the Navy assigns numbers for all the evaluation criteria, including the threshold criteria of protectiveness and compliance with ARARs. For the two threshold criteria, the Navy should simply state whether the criteria are met rather than assigning numbers between 1 and 5. It is neither necessary nor appropriate to develop complicated rating schemes for these two criteria. An alternative has to meet them in order to be considered further -- it can't partially meet them.	The comparative evaluation in Section 9 was revised. The evaluation was revised to reflect the requirement that each alternative must be able to meet the specified ARARs.

Comment No.	Section/Page Number	Comment	Response
29.	Sec. 9.1--ARARs	It is not appropriate to rank "applicable" ARARs higher than "relevant and appropriate" ARARs. As noted on page C-1-2 of the FS, when the analysis determines that a requirement is both relevant and appropriate, such a requirement must be complied with to the same degree as if it were applicable. Thus, the selected alternative needs to comply with all ARARs, regardless of whether they are applicable, or relevant and appropriate.	The comparative evaluation in Section 9 was revised. The evaluation was revised to reflect the requirement that each alternative must be able to meet the specified ARARs.
30.	p. 9-14, Institutional Controls to Accompany MNA	There needs to be monitoring of the ICs at least annually. The Navy needs to commit to being a party to, and enforcing, the LUC (see Navy's 2000 agreement with the State of California regarding LUCs), and the Navy should commit to having a deed restriction in the Navy's deed transferring the property. (It appears from the line items in Appendix F that a deed restriction is in fact contemplated.)	Comment noted. See the response to comment 59 from the EPA RPM. The frequency of monitoring will be determined based on site-specific conditions in the remedial design phase (DoD 2004).
31.	9.3.1. page 9-14. MNA--protectiveness	It is not clear whether the Navy considers this criterion to meet the threshold criterion of overall protection of human health and the environment.	The text was revised to clarify.
32.	9.3.2. MNA--compliance with ARARs.	It is not clear whether the Navy considers this criterion to meet the threshold criterion of compliance with ARARs.	The text was revised to clarify.
33.	9.3.7. MNA--cost	It is not clear whether the cost estimate includes the costs of implementing, monitoring, and enforcing the ICs. (It appears from Appendix F that some IC costs are contemplated.)	See the response to comment 59 from the EPA RPM regarding the level of detail for ICs that was included in the FS.
34.	Line item 5 (p. 3)--5-year review	Limiting review to every five years is insufficient. There needs to be at least annual monitoring of ICs, under either the MNA or the biosparging remedy.	Comment noted. The frequency of monitoring will be determined based on site-specific conditions in the remedial design phase (DoD 2004).
Comments from Dr. Sophia Serda, EPA Toxicologist, dated December 2003			
1.	General	Most of the risk assessment text is taken verbatim from the January 2000 Baseline Human Health Risk Assessment, FISCO Alameda Facility/Annex Site. In fact, the major changes are the benzene & naphthalene concentrations terms used to calculate tier 2 risk.	Comment noted. The original consultant who prepared the risk assessment for the baseline report also prepared the risk assessment for this investigation so that project institutional knowledge could be conserved. Contaminant concentrations, including benzene and naphthalene concentrations, were updated to reflect current site conditions. In addition, concentrations of metals in groundwater were included in the risk assessment.
2.	General	Contamination remains in groundwater I recommend soil vapor sampling be conducted biannually to ensure the vapor concentrations are not increasing. Also, I recommend that future construction on the property require both periodic soil vapor sampling and buildings be built with vapor barriers and ventilation systems.	Comment noted.

RESPONSE TO DTSC COMMENTS – Draft Groundwater Remedial Investigation/Feasibility Study
Alameda Point IR Site 25, and Alameda Annex IR Site 02
Alameda, California
Document Date: October 2003

Comment No.	Section/Page Number	Comment	Response
Comments from Marcia Liao, Department of Toxic Substances Control (DTSC) Remedial Project Manager (RPM) for Alameda Point, dated February 24, 2004			
1.	Overall Comment	The document is concisely written, nicely organized and makes effective use of tables, figures and appendices to explain a rather complex set of data collected over a period of more than ten years by various contractors. However, many of the statements and/or conclusions are not necessarily supported by the data. Others are drawn from earlier studies or work by non-Navy entity where the status of DTSC concurrence is unclear. Substantial efforts to clarify and/or substantiate these conclusions or statements will be necessary.	The draft final remedial investigation (RI) / Feasibility Study (FS) report was revised in response to agency and community comments on the draft report.
2.	Section 1 – Site Identification and Boundary	The affected area, as Page 1-1, Figures 1-2 and 1-3 of the document indicate, also underlies residential parcels 178, 179, 180 and 184 at Alameda Point. These parcels are currently used for a school (George Miller Elementary), a daycare center (Woodstock Child Development Center) and residential housing (Marina Village) and designated as Installation Restoration (IR) sites 30 and 31. They are not part of IR Site 25. The title of this RI/FS document is incorrect. Please revise it (please also see FISCA Comment #4).	References to Parcels 178, 179, 180 and 184 were added, along with the clarification that although those parcels are outside of the Operable Unit (OU) 5 boundaries, the remedy selected will affect all the parcels under which the benzene and naphthalene plumes exist. The document title will remain unchanged since the plume centers, and by extension the presumed contaminant sources, are present on Alameda Point Installation Restoration (IR) Site 25 and Alameda Annex IR Site 02. Alameda Point IR Site 30 and 31 are being investigated separately.
3.	Section 1 – Site History	It is worth noting that these residential parcels at Alameda Point (i.e. Parcels 178, 179, 180 and 184) were historically part of FISCA or Alameda Annex and are believed to have been impacted by industrial activities (see FISCA Comment #5). Given their close proximity, it is likely that IR Site 25, particularly the southeastern portion of Parcel 181, was also subject to industrial use at one time. Please: • Provide detailed site history for Parcels 178, 179, 180 and 184 in the report; • Make efforts (e.g. review of aerial photos and interview with former Alameda Naval Air Station employees) to identify the "large structures of unknown use on the eastern half of" IR Site 25 (see page 1-11, 3rd paragraph); Discuss the possibility that the historical soil staining observed near present-day intersection of Mayport and Kollmann Circles at Parcel 181 of IR Site 25 is linked to past industrial activities extended from the FISCA site.	Site history for Parcels 178, 179, 180 and 184 was added to the draft final report, as appropriate to discuss potential groundwater contamination sources. Detailed site history for Parcels 178, 179, 180 and 184 will be provided in the investigation reports for Alameda Point IR Sites 30 and 31. The analysis of the aerial photos was expanded in Section 1.2.1 to clarify the chronology of construction activities on the site, especially in the eastern half of Site 25. The site history information pertaining to the soil staining at Mayport and Kollman Circles was expanded. The aerial photograph showing the staining was included as Figure 1-6. Available information about potential contamination sources was included in Section 4.4.

Comment No.	Section/Page Number	Comment	Response
4.	Section 2 – IR Site 25 Removal Action	Page 2-1 indicates that a park is located on the northern side of IR Site 25 and the park was the location of a previous Navy removal action to address polynuclear aromatic hydrocarbons (PAHs) in shallow soils. Similar references have been made at a number of places throughout this report (e.g. Section 4.4.1). Please note that the subject removal action, conducted between November 2001 and September 2002, encompassed a total area of approximately 25.6 acres, which is much more than just the park or the northern section of IR 25 as indicated in the report. Also note that the removal involved only top two feet of soil and did not address the PAH contamination in deeper soil. Please revise the report accordingly.	The discussion of the past removal action was clarified, and expanded. The text was revised on page 2-1 for accuracy and Section 3.3 was expanded to discuss the October 2000 removal action in Clover Park and the subsequent removal action covering a larger portion of Parcel 181.
5.	Section 2 – Fill Material	Please clarify if dredge spoils from the seaplane lagoon had been used as fill materials at the subject site (page 2-2). If indeed so, please provide further details such as periods of dredging and approximate locations of filling.	The report was revised to refer consistently to the dredged fill materials being generated from San Francisco Bay and the Oakland Inner Harbor. There is no documentation that dredge materials originated from Seaplane Lagoon were used as fill material in the area. Additionally, a review of historic aerial photographs shows the area around IR Site 25 as complete prior to the construction of what is now the Seaplane Lagoon.
6.	Section 2 – Fill Material	It appears that industrial wastes, in addition to dredge spoils from surrounding water bodies, may have been used as fill materials at the subject site (page 4-25). For clarity and completeness, please include this information in the discussion of fill origins in Section 2.1.	The report (specifically in Sections 2.1 and 4.4.1) was revised to detail that industrial waste could have been a potential source of fill material.
7.	Section 3 - Previous Investigations	Please provide a list of agency concurrence status on all previous investigation reports referenced in this RI.	A list of the documents providing Site specific information used in this report were listed in the new Table 3-1. Information about the review status of each document (that is, draft, draft final, or final) was provided in Table 3-1.
8.	Section 3 – Previous Soil Investigation	This section does not include any discussion on previous soil investigations. Since spills/releases from past industrial activities and contaminated fill material are believed to be the sources of groundwater contamination, a discussion on previous soil investigation at the subject site -- such as those pertaining to chemicals of concern (COCs) -- is considered essential to the understanding of contaminant sources and should, therefore, be included in the RI (please refer to Comment #20 and DTSC's Geological Services Unit comments regarding COC selection). DTSC recommends that soil sampling maps for each COC be presented in this report. The maps should allow easy retrieval of pertinent information such as sampling depth and locations where the contaminant concentration exceeds the screening level.	A discussion of previous soil investigations was added in Section 3.3. A discussion of contaminants of concern (COC) identified in previous reports, as well as soil data for benzene and naphthalene was included in Section 4.3. The revised RI/FS report will provide specific references to other reports that contain chemical concentrations maps for various chemicals detected in the soil.

Comment No.	Section/Page Number	Comment	Response
9.	Section 3 – Well Decommissioning	According to Sections 3.1.4 and 4.2.2, up to 49 monitoring wells have been destroyed at the subject site by remedial actions and construction activities. Please clarify if these wells have been decommissioned in accordance with California Water Well Standards, Bulletin 74-81 and supplemental bulletins including Bulletin 74-95.	Section 4.1.3 was revised to include a summary of the results of the 2001 well inventory conducted to support the Basewide Groundwater Monitoring Program. However, limited data exists about the procedures used to decommission the monitoring wells.
10.	Section 3.2 – Previous Soil Gas Investigation	Section 3.2 indicates that up to 355 soil gas samples have been collected in six different studies over a period of more than ten years at the subject site. However, Figure 3-5, the only pictorial presentation of previous soil gas investigation, depicts only the four soil gas probes installed in 2002. Please provide a map showing the locations and depths of all soil gas samples collected to date and highlight those where the vapor concentrations exceed the target levels listed in U.S. EPA's Subsurface Vapor Intrusion Guidance (see FISCA Comment #15).	The discussion of soil-gas data was expanded. New Figure 3-6 was added to show the location and maximum benzene concentrations (relative to generic screening levels from EPA vapor intrusion guidance) from all previous soil gas samples collected at the site. Figure 4-34 was also added to demonstrate the relation of the groundwater plume to locations were benzene vapor concentrations exceeded the 2nd tier screening level (50 times the generic screening level) specified in EPA vapor intrusion guidance. Please see the response to comment 15 from the DTSC RPM for Fleet Industrial Supply Center Oakland Alameda Facility/Alameda Annex (FISCA) for discussion on appropriate soil-gas target levels.
11.	Section 3.2 – Previous Soil Gas Investigation	The six studies reported in this section do not include the 1999 work by TtEMI entitled "Updated Alameda Point/Alameda Annex Benzene Soil-Gas Investigation." This particular TtEMI study is referenced in Section 4.3, in supportive of Navy's assertion that human health risks associated with benzene volatilization from groundwater is negligible (see Comment #14). Please clarify any agency concurrence status on this TtEMI study and determine if this document should be listed as one of the previous soil gas investigations in Section 3.2.	This report was added to the list of previous soil-gas investigations in Section 3.2. This document is listed as an "Updated" document. Final agency concurrence on this document has not been documented; however, the draft final report does not rely solely on the findings of this study to support its conclusion. The draft final report provides results from the 2002 U.S. Coast Guard risk evaluation of the vapor intrusion pathway (Appendix B), and provides a revised evaluation of the vapor intrusion pathway using the most current soil gas and groundwater data from the site.
12.	Section 4 – Soil Contamination/ Sources of Contamination	Section 4.1 asserts that soil contaminants do not appear to correlate with groundwater contamination. Section 4.4 states that the source(s) of groundwater contamination has not been located despite several characterization efforts (page 4-24) and that these potential source area(s) (i.e. the past spills or contaminated fill materials) do not appear to be acting as ongoing source material continuing to leach contaminants to groundwater. It is, however, unclear if any soil samples (shallow as well at depth) had been collected at or near the plume center(s) and if they have conclusively demonstrated that the contaminant level at these potential source areas is	While the available soil data does not prove conclusively that there is not an ongoing source present at the site, there is some naphthalene soil data available, collected from locations across the area including some within or near the current plume centers. The limited data does not indicate the potential for high-grade source materials, but does reflect elevated concentrations in soils near plume centers. Sections 4.3 and 4.4 were revised to include a discussion of the data collected to date and its implications regarding

Comment No.	Section/Page Number	Comment	Response
		negligible. Generally, DTSC believes that if soil contaminant level at the source area is non-detect or negligibly low, it may be concluded that contaminants at the source (e.g. past spills or contaminated fill material) have all been leached out from the soil matrix and dissipated into the groundwater (aqueous phase) and the source is "gone" or no longer releasing contaminants into groundwater. This reasoning, understandably, relies exclusively on the assumption that the soil was sampled and analyzed properly and the quality of the data is good enough to withstand scrutiny. In order to conclude with confidence that no known source of groundwater contamination can be located at the subject site and that soil is no longer acting as ongoing source material and is unrelated to groundwater contamination, it is necessary that this RI re-examines the existing data and presents a case satisfactory to the premises described above. It is recommended that this RI: • Provide maps illustrating previous soil sampling locations, depths and relevant chemical data (see Comment #8). • Discuss soil sampling and analysis methodology and the data quality (e.g. Was Encore used in soil VOC sampling? Was the soil sample taken at the surface or at depth? What analytical method was used? How was the detection limit?)	possible source materials. In addition, the document was revised to clarify that previous soil sampling for VOCs was limited to near-surface soil and previous characterization of VOCs in the vadose zone was based primarily on soil gas results. The expanded discussion supports the conclusion that the available data, although insufficient to conclusively determine whether there is a continuing source, is sufficient select a remedial alternative with a reasonable degree of confidence. Limitations of the soil data were discussed in Section 4.3. Section 4.5.5 was added to the draft final report to discuss data gaps, including investigating potential soil sources in the Mayport/Kollman Circle area. A general discussion of data quality from previous investigations was provided in Section 4.5; however, the reader is referred to individual investigation documents for a specific discussion of sampling methods and data quality analyses from previous investigations.
13.	Section 4 – Soil Gas Contamination	According to Section 4.3, approximately 10% of the 355 soil gas samples were detected for benzene. Many of these detections were located outside of the known groundwater plume. The highest reading was 17,000 ug/m^3, which the Navy considers as an anomaly (see page 3-12). Based on the low detection frequency and the observation that soil gas do not co-locate with the groundwater plume, the Navy concludes that there is little correlation between groundwater and soil gas contamination (see page 4-24), contaminants in groundwater do not volatilize into the vadose zone (page 4-28) and soil gas is not a complete exposure pathway (page 5-23 and Executive Summary Paragraph 4) and therefore poses no threat to human health. These conclusions appear to be derived without first considering a few critical issues. For example, although the detection frequency has been low, benzene and other VOCs have, after all, been detected in the soil gas in numerous occasions throughout the past ten plus years. If they are not from the groundwater, where do they come from? Besides, this RI does not discuss field conditions that could have complicated soil gas sampling. It is unclear, for	Section 3.2 was revised to further clarify that, although the maximum benzene concentration in shallow soil gas (17,000 μg/m^3 about 300 feet east of EW-2) is still considered anomalous, recent soil gas data collected in the area (as part of the basewide monitoring program) have detected elevated benzene (up to 262 μg/m^3 in shallow soil gas and 5,588 μg/m^3 in deep soil gas) that is likely attributed to volatilization from groundwater near EW-2. Continued monitoring will be performed in this area to verify benzene concentration trends in both soil gas and groundwater. Volatilization of benzene from the groundwater into the vadose zone is a potential exposure pathway. Section 4.2 of the draft final RI/FS was revised to clarify that this potential has been addressed, and to expand the discussion

Comment No.	Section/Page Number	Comment	Response
		instance, if tight soil or high soil moisture has played a role in the low detection of soil vapor. Furthermore, this RI provides little specific discussion on underground utilities acting as preferential pathways for soil gas migration. Given that extensive underground utility systems are present within the site (see Section 2.4), it is important that utility lines be specifically evaluated for their potential roles in the detection of soil vapor, particularly at locations outside of known groundwater plume. Because of the current and future expanded residential use of the subject site, soil gas contamination is a genuine concern and needs to be rigorously examined before concluding it is unrelated to the known groundwater contamination and does not pose threat to the on-site residents. DTSC requests that this RI: • Provide all soil gas data collected to date. • Depict soil gas sampling locations on a map (see Comment #10) and highlight those locations where VOCs were detected above the screening level. • Discuss field conditions that might have impacted soil gas sampling (e.g. sampling depth, soil profile, depth to groundwater, soil moisture level, etc.). • Locate the utility layout for the project site and determine if utilities act as preferential pathways assisting soil gas migration within the site. • Provide indoor air sampling data as referenced on page 5-23 (Please also discuss sampling methods and the data quality). • Present soil gas incremental risk and hazard in a more accessible and easily understood format (see Comment #18).	of the site conceptual model and existing soil gas and indoor air data. The draft final report provides results from the 2002 U.S. Coast Guard risk evaluation of the vapor intrusion pathway, and provides a revised evaluation of the vapor intrusion pathway using the most current soil gas and groundwater data from the site. The data adequately demonstrate that benzene and other VOCs present in the vadose zone do not pose an unacceptable risk to human health via the inhalation pathway. Section 4.2.3 of the draft final report notes that, based on previous and ongoing soil gas monitoring data, sewer and storm drains do not appear to be acting as a preferential conduit for contaminant migration in soil gas. The RI/FS was revised to address the specific concerns as follows: • Section 3.2 was expanded to provide specific references to previous reports containing soil-gas data. • The requested figure were provided as Figure 3-6; see the response to comment 10 for further details. • Limitations of the soil gas data set were discussed in Section 4.5.4. • A subsurface utility layout map was provided as Figure 2-5 and discussed in Section 2.4. • Indoor air data recently obtained from the Coast Guard was provided in Appendix B and discussed in Section 3.2. • The discussion of human health risk via the inhalation pathway was expanded in Section 4.2. See the response to comment 18 about the integration of incremental risks from soil, indoor air, and groundwater.

RESPONSE TO DTSC COMMENTS – Draft Groundwater Remedial Investigation/Feasibility Study
Alameda Point IR Site 25, and Alameda Annex IR Site 02
Alameda, California
Document Date: October 2003

Comment No.	Section/Page Number	Comment	Response
14.	Section 4.3 – Soil Gas Contamination	This section states, "In addition, human-health risks associated with benzene volatilization have been found to be less than 10^{-6} (TtEMI, 1999a)." Please clarify if this is consistent with the health risk presented in this RI (Table 6-1 of this RI reports a cancer risk of 2×10^{-5} for residents and 3×10^{-6} for school children). Also, this statement is irrelevant to the understanding of nature and extent of contamination and may be deleted from Section 4.	This section has been revised to include a comparison of all of the available soil gas data according to the USEPA vapor intrusion guidance. The reference to the previous risk calculation was removed from this section.
15.	Section 5.8 – Preferential Pathways for Groundwater Migration	Section 5.8 correctly states that contaminated groundwater could migrate into or along storm drain or other utility lines and eventually discharge into the Oakland Inner Harbor or trenches during site construction work. Little specific evidence was, however, presented in this RI to demonstrate that such migration does not or will not occur at the subject site. To help close the gap, DTSC requests this RI: • Provide sufficient details from the storm drain studies (Please include evaluations on bedding materials as well as leaks). • Clarify any agency concurrence status on the storm drain studies. • Clarify if subsurface utilities other than storm drains had been evaluated for their potential roles as preferential pathways.	Available information about the potential for subsurface utilities to act as preferential pathways was included in Section 2.4 of the draft final report, including details from previous storm drain studies and the status of agency concurrence on these studies. However, the available studies are not sufficient to prove that storm drains could not be a preferential pathway for contaminant migration. Therefore, Section 5.8.2 of the report has been revised to highlight that while this potential pathway exists, ongoing groundwater monitoring indicates that contamination is not migrating northward into Oakland Inner Harbor at detectable concentrations.
16.	Section 6 and Appendix B – Potential Receptors	Parcels 178, 179, 180, and 184 are presently used for homes, school and daycare (see Comment #2). Residents and school children are current receptors, not hypothetical or future potential receptors. Please correct it.	The text was revised accordingly.

Comment No.	Section/Page Number	Comment	Response
17.	Section 6 and Appendix B – Presentation of Risk Assessment Results	This RI presents human health risk in a very brief synopsis in Section 6 and leaves all details to Appendix B, which is a compact disk, assessable only electronically. To make it easier for the stakeholder to decipher the information and provide input in the RI/FS process, DTSC requires the following: • Include sufficient details in the main text (i.e. Section 6) to allow an average reader understand the risk and its derivation, without wading into the details in Appendix B. The reader should be able to know succinctly (a) the selection criteria of the chemical of potential concern (COPC), (b) the equations (illustrated by sample calculations) used to establish exposure point concentrations, (c) the definition and reason for using the 500 and 725-foot radius Kriging, (d) the description and justification for using Tier 1 and Tier 2 risk assessments, (e) the consistency and deviation between the Navy's risk assessment approach and U.S. EPA's 1989 Risk Assessment Guidance. • Explicitly state that the risk presented herein is for groundwater only. It does not include the incremental risk posed by the soil and therefore represents only a portion of the total risk and hazard the residents and workers are exposed to.	The discussion of the risk assessment was expanded to provide the requested level of detail, as follows: • Section 6.4 was revised to include a table of the calculated Exposure Point Concentrations for the primary risk drivers and to explain that all analytes with a frequency of detection greater than 5 percent were retained as COCs in the risk assessment. • Section 6.5 was added to discuss the selection of the Block Kriging radii. • The description and justification of using Tier 1 and Tier 2 risk assessments was included in Section 6.4. • Page 6-1 was revised to clarify that the risk assessment was conducted in accordance with the USEPA's 1989 Risk Assessment Guidance, and that this risk assessment was conducted to evaluate the potential risks to human health posed by hazardous substances detected in groundwater at the site. Total risks will be presented in future documents for each IR Site.
18.	Section 6, Integration of Soil and Groundwater Incremental Risks	DTSC understands and supports the Navy's approach to address the groundwater plumes jointly for all affected areas. But DTSC strongly believes that the baseline risk assessment should consider all environmental media (i.e. soil and groundwater) the receptors are exposed to. Given that some parcels in the affected areas have not been subjected to risk assessment and therefore do not have soil incremental risk results for ready integration, DTSC recommends that this RI explicitly state, for each of the affected areas or parcels, when and how (e.g. in the soil FS) the total incremental risks and/or hazards due to exposure to both soil and groundwater are going to be presented.	The report was revised to clarify that the risk presented in the RI/FS report is for groundwater only, and that the total risk for OU-5 (Parcels 181, 182, and 183) will be presented in the OU-5 Proposed Plan. The report also clarified that the incremental risk for groundwater exposure at other Parcels 178, 179, 180, and 184 will be included in documents associated with the applicable IR sites.
19.	Section 6 and Appendix B, Risk Assessment Methodology	Please clarify the basis and agency concurrence on risk assessment methodology used in this study including COPC selection, two-tiered approach (i.e. Tier 1 and Tier 2), and block Kriging.	See the response to comment 17 about the basis of the risk assessment methodology. See the responses to comments from DTSC's Human and Ecological Risk Division (HERD) regarding specific concerns about the groundwater RI/FS.

Comment No.	Section/Page Number	Comment	Response
20.	Section 6 and Appendix B: Detection Limit	Table 2 of Appendix B indicates that chemicals not detected or detected less than 5% of the time are eliminated from COPC consideration. However, the upper range of detection limits reported appears to be high – 2,000 µg/L or even 20,000 µg/L in some instances. Please review the data and determine how wide-spread the high detection limit problem is. It is our opinion that non-detects are generally not meaningful if the detection limits are higher than the screening levels established for the study (e.g. PRG, MCL).	The data were reviewed and additional discussion was added in Section 6.4 and 4.5.4 regarding the significance of elevated detection limits.
21.	Section 6 – Ecological Risk	The possibility exists that storm drain or other subsurface utility lines act as preferential pathways for groundwater migration and result in the discharge of contaminants into the Oakland Inner Harbor, impacting the ecological resources in the area. Please discuss if this possibility has been considered in the ecological risk assessments conducted for the subject site (also see Comment # 15).	While preferential pathways for contaminant migration may exist, ongoing groundwater monitoring does not indicate that this is occurring. See the response to comment 15.
Comments from Henry Wong, DTSC RPM for Fleet and Industrial Supply Center Oakland, Alameda Facility/Alameda Annex (FISCA), dated February 24, 2004			
1.	Facility Name	The RI/FS identifies Alameda Annex as the "Fleet and Industrial Supply Center Oakland" and abbreviated as FISCO. Please note that the correct name of the former Navy base is the "Fleet and Industrial Supply Center Oakland, Alameda Facility/Alameda Annex" and abbreviated as either FISCA or Alameda Annex. The Fleet and Industrial Supply Center Oakland property, currently owned by the Port of Oakland, was a former Navy base located in the City of Oakland.	The acronym for FISCO was changed to FISCA in Section 1 where it is first introduced along with the term "Alameda Annex." Alameda Annex is used throughout the report to refer to the FISCA property.
2.	Site Identification	Are there any differences between Operable Unit 5 (OU5), Installation Restoration Site 25, and Parcel 181? If there are no differences, please provide a statement indicating these nomenclatures identify the same area.	The report was revised to clarify that the areas covered by OU-5 and Alameda Point IR Site 25 are the same, and contain Parcels 181, 182, and 183.
3.	Pavement	Throughout the RI/FS, it reports that IR-02 is paved. The FISCA Basewide Environmental Baseline Survey (EBS), dated December 30, 1996, describes IR-02, or the screen lot and scrap yard, as an unpaved area. In 2001, the Navy completed surface soil remediation at IR-02, backfilled the excavation, and compacted the fill to original grade. The Navy has not paved IR-02 upon site restoration. IR-02 is currently unpaved. This discrepancy impacts the discussion of fate and transport, human health risk assessment, etc. in the RI/FS. The RI/FS should be revised based on the open bare soil condition at IR-02.	Section 2 of the draft final report was revised for clarity and accuracy with respect to the current site condition at FISCA IR Site 02. The human health risk assessment for future residential receptors will reflect the planned site conditions (that is, residential, primarily paved) as opposed to current site conditions.

Comment No.	Section/Page Number	Comment	Response
4.	Site Boundary, Figure 1-5	Figure 1-5 shows the benzene plume with a 50 µg/L isoconcentration boundary. The plume would be larger if an 1 µg/L contour line were to be used. DTSC requests the RI/FS be revised to show the benzene plume with an 1 µg/L isoconcentration boundary. The outlined plume consists approximately 25% of Site 25, 15% of IR-02, 25% of Marina Village, 20% of FISCA IR-01, and remaining 15% distributes among FISCA's BRAC Parcels 22, 23, 27, 28, and 30, and the College of Alameda. Less than half of the plume is found at Site 25 and IR-02. The RI/FS should be renamed to avoid the impression that groundwater contamination is only found at Site 25 and IR-02.	The plume maps were revised to include a 1µg/L contour line, and the report was clarified to discuss how potential risk associated with the portions of this plume that extend into adjacent parcels beyond Alameda Point IR-25 and FISCA IR-02 will be managed. However, the RI/FS report retains the same title, as discussed in the response to comment 2 from the DTSC RPM for Alameda Point.
5.	Marina Village	The RI/FS identifies Marina Village as the "Alameda Point Residential Parcels" and indicates that the area includes mostly residential housing and a school. The RI/FS should also indicate the presence of a child care center (Building 258). The FISCA Resource Conservation and Recovery Act (RCRA) Part B Permit Application dated September 21, 1992 showed a property boundary compassing the current FISCA property the Marina Village area. On June 28, 1993, DTSC issued the Hazardous Waste Facility Permit to the Navy with an effective date from July 31, 1993 through July 31, 2003. The Hazardous Waste Facility Permit has two important components: (a) allowed the Navy to operate a hazardous waste storage facility at Building 5, and (b) imposed RCRA corrective action requirements for all areas within the FISCA property boundary as defined in the permit application. The Navy closed the hazardous waste storage facility at Building 5 in 1999 and obtained DTSC's clean closure concurrence for the storage facility on June 9, 1999. The Navy ceased the ability to operate as a hazardous waste treatment and a storage facility in 1999. However, the Navy and all subsequent landowners are required to comply with any remaining RCRA corrective action requirements imposed by the 1993 Hazardous Waste Facility Permit even the permit expired on July 31, 2003. RCRA corrective action requirements do not expire like the permit. All past, current, and future landowners for areas covered by the 1993 Hazardous Waste Facility Permit are responsible to cleanup any contamination caused by past activities at FISCA. Sometime after receiving the1993 Hazardous Waste Facility Permit, the Navy transferred the operational control of the Marina Village from FISCA to Alameda Naval Air Station. Marina Village currently lies within the facility	The site history and land use descriptions for Marina Village was revised to include the child care center. The comment about the RCRA Part B permit is noted. The IR Program activities at Alameda Point and FISCA are intended to investigate and clean up contamination caused by past Navy activities. This includes ongoing investigations at the Marina Village Area as Alameda Point IR Sites 30 and 31. The requested information about the construction of Marina Village was summarized in the Parcel 178 Evaluation Data Summary document (IT, 2001) prepared as part of the Environmental Baseline Report for Alameda Point. Parcel 178, and the adjacent areas in Parcels 179 and 180, will be further investigated as Alameda Point IR Sites 30 and 31. The soil sources associated with the benzene plume are believed to be located within Alameda Point IR Site 25 and FISCA IR Site 02, and therefore a discussion of potential soil contamination outside of these locations is not included in this RI/FS report.

Comment No.	Section/Page Number	Comment	Response
		boundary of Alameda Naval Air Station, which later renamed as the Alameda Point. Several big warehouses and storage areas hand occupied the Marina Village area before the Navy built houses and created the Marina Village. Past Navy operations may have caused soil and groundwater contamination in the Marina Village area. The Navy had to install a liner and import clean soil before constructing homes at the Marina Village. The ground surface at Marina Village is currently above other adjacent areas due to this added buffer. DTSC questions the rationale for such voluntary remedial activity and requests a full chronology of events leading to Marina Village construction. DTSC also requests submittal of all previous environmental investigations which prompted the Navy to perform the voluntary remedial action. Since the Marina Village coincides with the benzene plume as covered by the RI/FS, DTSC requests the Navy to address this issue as soon as possible.	
6.	Current Land Use at Marina Village	The environmental problems at the Marina Village, including homes, school, and child care center, have not been fully investigated; however, the village continues to be used by sensitive population. Please provide any documentation and regulatory agency's concurrence that the current land use of the Marina Village is appropriate. The Navy's response would directly impact the RI/FS schedule.	The requested information about Marina Village will be provided as part of the RI/FS process for Alameda Point IR Sites 30 and 31.
7.	Section 1.1.2	The RI/FS states that the Alameda Annex comprises of 168 acres; however, the 1996 EBS reports the Alameda Annex amounts to 142.84 acres. Please correct the RI/FS accordingly.	The report was revised to report the accurate acreage of FISCA.
8.	Section 1.2.1	Please provide a figure showing Parcels 181, 182, and 183. Aerial photographs from 1947 and 1958 show housing units and some large structures of unknown use on the eastern half of Parcel 181. Please discuss whether these large structures were located in the Kollmann Circle area. Please describe the land use between 1958 and 1968 for Parcel 181. The Navy remediated the stained area near the intersection of Mayport and Kollmann Circles. Please discuss the kind of remediation being performed at the stained area, including types of the contaminations, concentrations, confirmation samples and results, overseeing regulatory agencies, etc. Please also discuss the relationship of this stained area with the benzene contaminated plume.	Boundaries of Parcels 181, 182, and 183 were shown on Figure 1-3. Additional site history for Parcel 181 was added to the report in Section 1.2.1. Past cleanup activities at Mayport/Kollman Circle have not been verified and references to this removal effort were deleted from the report. Section 4.5.5 was added to the draft final report to discuss data gaps, including investigating potential soil sources in the Mayport/Kollman Circle area.

RESPONSE TO DTSC COMMENTS – Draft Groundwater Remedial Investigation/Feasibility Study
Alameda Point IR Site 25, and Alameda Annex IR Site 02
Alameda, California
Document Date: October 2003

Comment No.	Section/Page Number	Comment	Response
9.	Section 2	The RI/FS identifies IR-02 as a 12.5-acre site; however, other Navy documents reference IR-02 to contain 10.65 acres. Please resolve the acreage discrepancy. Please also revise the RI/FS to accurately state that the Alameda Point Residential Parcels are comprised of residential housing, a school, and a child care center.	The report was revised to report the accurate acreage, and the description of Parcels 178, 179, 180, and 184 was revised to note the presence of residential housing, a school, and a day care center.
10.	Section 3.1.3	The RI/FS expresses that the marsh crust was ruled out as a possible groundwater contamination source in the RI/FS because the Marsh Crust Feasibility Study concluded that the marsh crust did not merit remedial action. Please note the remedial action for the marsh crust is an institutional control prohibiting excavation below the threshold depth in accordance with the City of Alameda Ordinance No. 2824. Institutional control was selected for the marsh crush because other physical removal/treatment alternatives were impractical and economically infeasible. The marsh crust remains a possible groundwater contamination source and the RI/FS should be revised accordingly.	The discussion of the Marsh Crust FS in Section 3.1.3 was revised to clarify the nature of the remediation decision, and the discussion of the conceptual site model in Section 4.4.2 was revised to clarify that while the Marsh Crust may be contributing in Part to the contamination observed in groundwater, it is not a primary source of the contamination in groundwater at the Site.
11.	Figure 3-2	The location for P181-MW46 seems to be incorrectly identified in Figure 3-2. Please revise the figure accordingly.	The figure was revised accordingly.
12.	Figure 3-4	Wells OU5-HP-37 and OS-HP-35 seem to be incorrectly depicted. Please revise the figure accordingly.	The figure was revised accordingly.
13.	Sections 3.1.3, 3.1.4, and 3.2	The RI/FS has not included groundwater and soil gas data collected by other parties. For example, data from wells RA-1 through RA-5 sampled in February 2000, and wells ERM-HP-01 through ERM-HP-09 sampled in March 2001 are not reported. Benzene concentration for groundwater at ERM-HP-7 at 15 to 19 feet below ground surface (bgs) is 710 µg/L. This well reveals benzene contamination extending beyond IR-02 and into FISCA IR-01, and maybe the College of Alameda. DTSC requests the RI/FS to include all existing data for evaluation.	The additional data was provided in Appendix A, including the requested data and additional sampling data from the basewide groundwater monitoring program.
14.	Section 3.2	The RI/FS discusses previous soil gas investigations from 1989 to 2002. The detected benzene soil gas concentrations range from around 10 to 17,000 $\mu g/m^3$. The Navy is also collecting soil gas periodically via soil gas monitoring probes. DTSC requests the RI/FS to include all soil gas data presented in tables and all sampling locations depicted in figures. These data must include soil gas sampling events by all parties.	See the response to comment 13 from the DTSC RPM for Alameda Point.

RESPONSE TO DTSC COMMENTS – Draft Groundwater Remedial Investigation/Feasibility Study
Alameda Point IR Site 25, and Alameda Annex IR Site 02
Alameda, California
Document Date: October 2003

Comment No.	Section/Page Number	Comment	Response
15.	Sections 3.2 and Section 6, and Appendix B	The U.S. Environmental Protection Agency (U.S. EPA) has published the *"Draft Guidance for Evaluation the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soil"* (Subsurface Vapor Intrusion Guidance) in November 2002. Table 2c of this guidance shows that a target shallow (i.e., less than five feet bgs) benzene soil gas concentration of 3.1 $\mu g/m^3$ corresponds to a target indoor air risk of 1E-06, based on an attenuation factor of 0.1. A comparison with this target level would invalidate previous conclusions that the soil gas at the Site does not pose an indoor air risk since benzene soil gas concentrations range from around 10 to 17,000 $\mu g/m^3$. DTSC requires the Navy to perform a rigorous indoor air risk assessment using all existing soil gas data in accordance with the Subsurface Vapor Intrusion Guidance.	Previous risk assessment work addressing the vapor intrusion pathway (most recently the 2002 evaluation prepared by the Coast Guard) was reviewed for consistency with current regulatory guidance, including the EPA's vapor intrusion guidance. The risk assessment was revised as appropriate after this review. To clarify, the soil-gas screening level of 3.1 $\mu g/m^3$ listed in Table 2c is the generic Tier screening level outlined in EPA guidance. EPA guidance recommends that further analysis be performed for chemical concentrations that exceed 50 times the corresponding generic Tier 2 screening criteria.
16.	Section 4.1	Please discuss the soil contamination (i.e., benzene and other volatile contaminants) related to groundwater at Alameda Point Site 25. The 2002 OU5 Remedial Investigation Report does not seem to report any soil data for benzene or volatile organic compounds at Site 25.	See the response to comment 12 from the DTSC RPM for Alameda Point.
17.	Section 4.2.3 and Tables A-1 and A-3:	The RI/FS states that the latest available, validated data was used during the writing of the report. However, Tables A-1 and A-3 do not include data from December 2002 and May 2003. Please update the tables and include the latest data in the RI/FS discussion.	Applicable data through December 2003 was incorporated into the report. Plume stability studies and trend analyses will be based on the available data set.
18.	Figure 4-12	The figure shows benzene concentration close to 0 $\mu g/L$ in March 1999 for monitoring well S-12; however, Table A-1 does not have any information for this data point. Please revise the RI/FS accordingly.	The report was revised to correct this discrepancy.
19.	Tables A-1 and A-3	Please provide benzene and naphthalene concentrations for wells M25-1 through M25-5 for Tables A-1 and A-3, respectively.	The additional data was incorporated.
20.	Sections 4.2.6, 4.3, 5.8.2, and 6	DTSC does not agree with the conceptual site model that benzene is not found in soil gas at the Site. DTSC requires a human health risk assessment using all existing soil gas data in accordance with the Subsurface Vapor Intrusion Guidance.	See response to comment 15.
21.	Section 4.4	Please clarify the meaning of the marsh crust being "ruled out" during the Marsh Crust Feasibility Study. The Marsh Crust Feasibility Study concluded that physical remediation of the marsh crust was not feasible; hence it was being ruled out for further evaluation.	See response to comment 10.

Comment No.	Section/Page Number	Comment	Response
22.	Section 4.6	The RI/FS summarizes that contamination does not appear to be migrating laterally or vertically, and is not volatilizing into vadose zone. DTSC disagrees with this conclusion. For example, benzene was detected at 710 µg/L at ERM-HP-7 and may laterally migrate to the College of Alameda, benzene was detected with highest concentration at around 20 feet bgs but deeper samples are not sufficient to support the absence of vertical migration, benzene soil gas in the vadose zone were found at around 400 $\mu g/m^3$, or to a maximum of 17,000 $\mu g/m^3$, suggesting an imminent indoor air risk based on the Subsurface Vapor Intrusion Guidance. DTSC believes the remedial investigation for groundwater and soil gas in the Alameda Point 25, FISCA IR-02, FISCA IR-01, Marina Village, the College of Alameda, and other adjacent areas are incomplete. Preparation of the feasibility study for the Site at this time is premature.	Preparation of an FS for OU-5 groundwater is not premature. The groundwater RI/FS report builds on numerous previous investigations at OU-5 that provide sufficient data to select a remedial technology for OU-5 groundwater that is protective of human health and the environment. The draft final report was revised to explain the previous investigations in more detail and to discuss uncertainties associated with the current groundwater characterization at OU-5. Section 4.5.5 was added to discuss additional data needs and the plan to collect the required data. See the response to comment 13 from the DTSC RPM for Alameda Point about the adequacy of the previous conclusion that benzene and other VOCs present in the vadose zone do not pose an unacceptable risk to human health via the inhalation pathway. The soil sources associated with the benzene plume are believed to be located within Alameda Point IR Site 25 and FISCA IR Site 02. Therefore, a discussion of potential soil contamination outside of these locations, such as FISCA IR Site 01 and the Marina Village Area, was not included in this RI/FS report.
23.	Section 5.8.4	Please discuss the depths of storm drain lines in various locations at the Site and their corresponding groundwater depths.	See the response to comment 15 from the DTSC RPM for Alameda Point.
24.	Section 6.1	The RI/FS used the acronym "Sepia" for "USEPA" in various sections. Please correct this typo in the document.	This typo was corrected throughout the document.
25.	Section 6.1	The RI/FS presents that non-carcinogenic hazard indices ranged from 3.1 to 152 under potable water use; however these numbers are inconsistent with Table 6-1.	This section was revised for consistency and accuracy.
26.	Tables 6-1 and ES.2 of Appendix B	The non-carcinogenic hazard indexes reported in Tables 6-1 and ES.2 of Appendix B are inconsistent. This comment may be moot since DTSC is requiring a revised human health risk assessment; nonetheless, please ensure consistent information is reported in future versions.	The report was reviewed to ensure that all non-carcinogenic cancer indices are reported consistently.

Comment No.	Section/Page Number	Comment	Response
27.	Section 6.4	Please provide a summary table within Section 6.4 listing all exposure point concentrations for benzene, naphthalene, and MTBE used in the human health risk assessment.	A summary table showing the exposure point concentrations was provided as Table 6-3.
28.	Section 8	DTSC requests the RI/FS to include the following technologies for screening in Section 8 and further analysis in Section 9: (a) vapor collection and venting for any newly constructed residential, commercial, and industrial buildings, and (b) six-phase heating (SPH). The City of Alameda has proposed a sub-slab depressurization system for the 39-unit housing site as a voluntary action to support the removal of the interim land use restriction in advance of the remedy selection for the Site. DTSC believes a vapor collection and venting system should be evaluated in the feasibility study as well. SPH is reported to be a fast (on the order of months) and effective method of in-situ remediation of volatile and semi-volatile contaminants in soil and groundwater. Application of SPH could remediate the groundwater at IR-02 to cleanup goals within months, and may alleviate the need for a long term groundwater monitoring program.	Engineering controls, such as vapor collection and venting of current or proposed buildings, were evaluated in Section 8 but not retained for further analysis in Section 9 because current conditions do not pose an unacceptable risk to human health via the vapor intrusion pathway. Any active remedial technology that could increase volatilization of groundwater contamination in excess of acceptable levels would require a contingency action that will be evaluated in conjunction with the remedial technology prompting the action. Specifically, soil vapor extraction (SVE) was added as part of the biosparging and air sparging technologies in Section 8, as well as the biosparging and air sparging alternatives in Section 9, to mitigate any increased risks posed by these technologies. Electrical resistance heating was included as section 8.3.5.9, and was not retained for further analysis due to high costs and low implementability in a residential area.
29.	Section 8.1	The RI/FS proposes groundwater remedial action objectives (RAOs) for benzene as the California maximum contaminant level of 1 µg/L and for naphthalene as the U.S. EPA Health Advisory of 100 µg/L. Please provide rationales for choosing these levels and not the California Regional Water Quality Control Board's environmental screening levels, the U.S. EPA, Region 9's tap water preliminary remediation goals, or the federal maximum contaminant levels. DTSC will review these rationales and determine the appropriate RAOs for benzene and naphthalene.	The federal MCLs were considered; however, the state MCL is more conservative for benzene. There is no federal MCL for naphthalene, only a health advisory level. As presented in Section 7.2.1, MCLs are promulgated criteria enforceable for drinking water while health advisories are guidance values; both are considered relevant and appropriate criteria for selecting chemical-specific ARARs for benzene and naphthalene. EPA tap water PRGs and RWQCB ESLs are "to be considered" criteria that are not considered relevant and appropriate for the site.

Comment No.	Section/Page Number	Comment	Response
30.	Section 8.3.2.1	Any liquid and groundwater from excavation at the Site presumably contain hazardous substances. Please discuss the construction dewatering procedures to ensure groundwater and any standing liquid from excavation are managed, analyzed, and disposed properly in accordance with all applicable regulations. The institutional control alternative must contain procedures/requirements for managing groundwater and any standing liquid during construction dewatering.	Potential institutional controls (ICs) were evaluated in Section 9.3 of the draft final RI/FS, and included a description of the ICs and a summary of the IC objectives. The ICs detailed: • the owner/occupant would be required to submit a groundwater management plan to the Navy addressing sampling and analysis and appropriate disposal of contaminated groundwater along with its request for approval, • the owner/occupant would then be required to abide by the approved groundwater management plan and any other conditions of approval. Per Department of Defense (DoD) policy, the specific procedures by which the ICs will be implemented are to be specified during the remedial design phase (DoD 2004), and are therefore not specified in the RI/FS.
31.	Section 8.3.8.2	The RI/FS presents that if air sparing were to be used at the Site, vapor extraction and treatment would be required to protect nearby residents from fugitive benzene emissions. This seems to suggest that if the air sparing area is away from residents, vapor extraction and treatment would not be necessary. DTSC disagrees and requires a vapor recovery system to capture and treat fugitive emissions generated by air sparing at all locations.	The text of Section 8.3.5.2 was clarified to indicate that air sparging systems include a vapor recovery system.
32.	Section 8.3.8.3	The RI/FS states that biosparging is designed to push volatilized contaminants into vadose zone where they undergo treatment via biodegradation. At the Site, the bottom of vadose zone ranges from around five to ten feet bgs. Please discuss the effectiveness of biosparging at depths where the vadose zone is around five feet bgs. The RI/FS informs that previous investigations at the Site have found the soils to be moderately permeable. Please specify the types of soil encountered at the Site. Would subsurface heterogeneity due to filling techniques and previous tidal channels inhibit the uniform distribution of air around the biosparging wells? The RI/FS reports that benzene has had a low frequency of detection in the vadose zone indicating not only weathered contaminants, but also that vadose zone biodegradation has assisted in breaking down contaminants. Please	Section 8.3.5.4 was revised to provide information indicating that migration of contaminants through the vadose zone is limited. In addition, the biosparging alternative was revised to include a contingency vapor recovery system. As described in Section 2, soils at the site consist of heterogeneous fill materials predominantly dredge spoils. In-situ remedial technologies are challenged by subsurface heterogeneity; however, biosparging is believed to be more effective than other in-situ technologies, such as chemical oxidation, that require direct contact between an injected material and the contaminant. Sparging raises the overall oxygen content of the subsurface zone, converting an anaerobic zone into an aerobic zone, which then allows

Comment No.	Section/Page Number	Comment	Response
		substantiate this statement by providing a detection frequency for FISCA IR-02 and Alameda Point Site 25. The OU5 RI Report does not seem to contain any benzene data for soils in the Site 25 areas. Please discuss the rationale for not collecting groundwater samples deeper than the 20-foot bgs depth. Normally, air flow in a biosparging system is maintained at low pressure to minimize fugitive emissions; however, the RI/FS suggests that biosparging is designed to volatilize and push benzene into vadose zone where benzene vapor is undergoing biodegradation. Please discuss the balance between the required pressure, radius of influence, vadose zone thickness, fugitive emissions, etc., in order to achieve an optimal and effective treatment over time. Please provide a scaled diagram showing air flow paths from the sparge well, treatment zone in saturated and vadose zones, radius of influence, fugitive emission controls, etc., for the P181-MW47 location. Figure 9-1 does not contain this information.	microbes ubiquitous in the subsurface to degrade contamination more rapidly. See the response to comments 12 and 13 from the DTSC RPM for Alameda Point about previous soil and soil-gas sampling results. Groundwater samples have been collected from three deep wells installed at the site. Data from monitoring well D-02, sampled quarterly as part of the basewide monitoring plan, does not show consistent benzene or naphthalene in the second water-bearing zone (SWBZ). In addition, Sections 4.1.3 and 4.1.4 present a discussion of previous Hydropunch™ sampling from 20 to 24 feet bgs. Section 9 was revised to further detail the assumed radius of influence, and other engineering parameters of the biosparging and air sparging alternatives. Additional detail will be developed during the remedial design phase.
33.	Section 8.3.8.5	The RI/FS explains that previous studies have found that the microorganisms and nutrients typically need for in situ biological treatment are usually present in subsurface soils. Please provide a summary table showing the amount of nutrients and microorganisms in a decreasing dissolve oxygen conditions. Please also provide the reference to previous studies supporting this observation. DTSC will evaluate the information and may require the RI/FS to further analyze the nutrient/microorganism enhancement remedial technology in Section 9.	See the response to EPA general comment 5.
34.	Section 8.3.8.6	Aerobic degradation with oxygen release compound (ORC) is not being retained for further analysis because of low to moderate effectiveness for large areas such as the Site, and other reasons. The RI/FS further details that the ORC injection well spacing is rather large (100 feet or more). How does ORC injection well spacing compare with the biosparging well spacing of around 80 feet (see page 9-24)? DTSC believes the well spacing for these two remedial technologies are similar and the RI/FS should not favor one but not the others. DTSC requires ORC injection to be further analyzed in Section 9.	The discussion of the two technologies will be revised to avoid the appearance that any one technology was favored. However, ORC was not retained for further analysis due to the high costs of implementation at the Site (due to the size of the affected area), and because the high salinity of Site groundwater would require frequent replenishment.

Comment No.	Section/Page Number	Comment	Response
35.	Section 8.3.8.7	The RI/FS claims that the presence of clays and other subsurface heterogeneities at the Site would hamper uniform application of the chemical oxidants. The presence of clays and other subsurface heterogeneities could reduce the biosparging's 40 feet radius of influence and render the biosparging technology ineffective. Please discuss whether biosparging would have the same limitation as in chemical oxidation considering the same subsurface geology at the Site.	See the response to comment 32.
36.	Section 8.3.8.8	The RI/FS suggests that the steam-enhanced extraction technology would require a large field of steam injection wells. Please estimate the number of steam injection wells needed for the biosparge zones as depicted in Figure 9-2. How does this number compare with the 50 biosparging wells proposed for the same areas?	The discussion of biosparging and steam-enhanced extraction (SEE) were expanded in the revised document. However, SEE was not retained for further analysis due to its higher cost relative to biosparging, and increased level of physical hazards in a residential area.
37.	Section 8.3.8.8	The RI/FS has not retained steam-enhanced extraction because of low effectiveness for large areas, moderate to high cost, and low implementability for large areas and areas with heterogeneous subsurface. These constrains are not unique to steam-enhanced extraction. Biosparging and other active treatment technologies share the same constrains. The reasons for rejecting the steam-enhanced extraction option are unjust. The RI/FS discusses that the removal efficiency for mid- to heavy-weight petroleum hydrocarbons is less efficient than for volatile contaminants. The contaminants of concern in this RI/FS are benzene and naphthalene, which are not mid- to heavy-weight petroleum hydrocarbons. The removal efficiency for benzene and naphthalene is favorable when using steam-enhanced extraction.	See the response to comment 36 above.
38.	Page 9-10	DTSC believes that the vertical extent of contamination (e.g., 20 to 30 feet bgs) at the Site has not been characterized. The lateral extent of contamination is unknown, at least in the southeastern direction toward the College of Alameda.	Sections 4.1.3 and 4.1.4 present a discussion of previous Hydropunch™ sampling from 20 to 24 feet bags and support the conclusion that the vertical extent of contamination has been defined.
39.	Page 9-10	Please discuss the difference between ethane and ethane by R.S. Kerr Standard Operating Procedure 175.	This was a typo and was corrected to read "methane, ethane and *ethene* by R.S. Kerr Standard Operating Procedure 175."
40.	Page 9-11 and Section 6	Please consider the validity of an exposure pathway via human consumption of home grown produces with deep roots (e.g., tomatoes). If this is not a valid exposure pathway, please document the reasons for exclusion in the human health risk assessment.	While root depths of tomatoes may exceed 1 yard. The majority of roots are located between 1 to 2 feet bgs and are not likely to have direct contact with groundwater. The possible risks of consumption of home grown produce are not applicable to the HHRA performed under the groundwater RI/FS. This potential exposure pathway will be addressed, as appropriate, in the OU-5 soil FS.

Comment No.	Section/Page Number	Comment	Response
41.	Page 9-11, fifth paragraph, first sentence	Should "anaerobic" be replaced with "aerobic?"	This sentence correctly references the finding that there are anaerobic zones present at the site.
42.	Page 9-14, first bullet and Table 9-2	Please reconcile the discrepancy of the number of additional monitoring wells needed to create a 20-well monitoring network.	The report was revised to reflect the current number of existing wells and the revised number of additional wells needed for a 20-well network.
43.	Page 9-14, second bullet	Please specify whether one year of sampling means four quarterly sampling events.	The report was revised to clarify that four quarterly sampling events are planned.
44.	Page 9-14, third bullet	Please discuss the number of soil gas monitoring event within one year, and whether this monitoring frequency is consistent throughout the first five years.	The text of Section 9.3 was revised to clarify that sampling will be quarterly for the first five years..
45.	Page 9-14 and Table 9-2	Please note that DTSC requires the Navy and all subsequent landowners to submit written requests with supportive data for any modification and/or termination of the monitored natural attenuation program. DTSC's concurrence on the RI/FS or approval of the remedial action plan does not constitute an acceptance of the monitoring schedule and the frequency outlined in Table 9-2.	Comment noted.
46.	Table 9-2	Please provide the soil gas monitoring schedule and frequency in Table 9-2.	See the response to comment 44. Table 9-2 is no longer included in the document, but the change was made in the text of Section 9.3.
47.	Section 9.4 and Figure 9-2	Figure 9-2 is showing blue and light blue areas that are outside of Biosparge Zones 1, 2, and 3. The benzene concentrations in these outside areas range from 50 to 1,000 µg/L. Please evaluate the biodegradation timeframe for these areas and discuss whether monitored natural attenuation would reduce benzene contamination from 1,000 to 1 µg/L in nine years.	The biosparge zones were designed to primarily address the plume centers. These areas have relatively lower concentrations and are expected to be treated adequately by MNA. The text was revised to clarify this technical approach.
48.	Page 9-23, first bullet	Please correct the typo "P181-MW457."	This typo was corrected.

Comment No.	Section/Page Number	Comment	Response
49.	Page 9-23, second bullet	The RI/FS states that Biosparge Zone 2 is located in an open, unused paved area, and residential development is planned for Biosparge Zone 2 in the near future. Please note that IR-02 is unpaved and no asphalt cap is installed. The western one-third of IR-02 is planned for the 39-unit housing site. The Interim Covenant to Restrict Use of Property between DTSC and the Navy recorded with the Alameda County on July 20, 2000 specifies the residential use area within IR-02 to be 2.5 acres. This 39-unit housing site is a rectangular shaped area measuring 341.05 feet by 319.31 feet. DTSC requests the Navy to superimpose the 39-unit housing site onto Figure 9-2. The 39-unit housing site boundary and Biosparge Zones 1 and 2 must be shown accurately.	The text was revised to discuss the planned land use (including the ongoing residential development) and current site conditions. The specific location of the 39-unit housing area was not available for inclusion on Figure 9-2.
50.	Page 9-23	The RI/FS is not definitive about the vapor capture and treatment system for Biosparge Zones 1 and 3. If a radius of influence of 40 feet were to be maintained, pressurized air would have to be introduced to subsurface and fugitive benzene emission is inevitable. DTSC herein requires the biosparging system to include vapor collection and treatment system for Biosparge Zones 1, 2, and 3.	The report was revised to clarify that the vapor monitoring system included in Alternatives 3, 4, and 5 will be used to monitor potential fugitive emissions. In addition, given the sensitive receptors in the area, a contingency vapor collection and treatment system will be installed.
51.	Page 9-24	The RI/FS argues that continued declining contaminant concentrations in monitoring wells would meet cleanup goals within nine years. Please estimate the benzene and naphthalene concentrations at the Biosparge Zones after two years of operation. The maximum detected benzene concentration was at 6,000 µg/L at well OS-HP-10. What would be the estimated benzene concentrations at this location two years and nine years after the commencement of the remedy?	Revised estimates on contaminant reduction were provided in Section 5.5 of the draft final report based on the revised plume stability analyses incorporating recent data. Estimates of contaminant reduction with active remediation were estimated using this site-specific information and performance data from other remediation systems. These estimates will be refined in the remedial design.
52.	Page 9-24 and Table 9-3	The RI/FS proposes 50 sparge wells and 13 soil gas monitoring probes for the three biosparge zones. Please submit a figure showing all sparge well and soil gas monitoring locations. DTSC understands the exact location would be determined in the field, but DTSC needs to evaluate the effectiveness of the biosparging technology for areas, especially around exiting residential buildings and the 39-unit housing unit site.	A preliminary design schematic was provided as Figure 9.2; however, complete design details will be developed at the remedial design phase of the project.
53.	Table 9-3	Please provide a monitoring frequency for the soil gas probes.	The text of Section 9.4 and Appendix H were revised to specify that the soil gas probes would be sampled on a biweekly basis.
54.	Table 9-3	The RI/FS proposes groundwater monitoring frequency and staggered well abandonment schedule. DTSC understands such schedule is for cost estimation only. The Navy and all subsequent landowners must submit data for DTSC's review and approval before any modifications to the groundwater and soil gas monitoring programs.	Comment noted.

Comment No.	Section/Page Number	Comment	Response
55.	Page 9-26	The RI/FS suggests that a large radius of influence (e.g., 40 feet or more) would be used for areas with surface obstructions (e.g., residential buildings), and a small radius of influence (e.g., 15 to 20 feet) would be used for areas with no surface obstructions (e.g., IR-02). Please discuss the feasibility of using a 40-foot radius of influence at areas with surface obstructions such as residential buildings. DTSC believes a larger radius of influence requires a higher air injection pressure which would increase benzene volatilization.	Further discussion of the effect of surface structures such as residential buildings were included, on page 9-18.
56.	Sections 9.4.2 and 7	Since DTSC requires a vapor extraction and treatment system for the biosparging technology, the Clean Air Act and the Bay Area Air Quality Management District Regulation Title 8 are applicable requirements.	The ARARs section was revised to reflect that these air quality regulations are relevant for all alternatives that include an SVE system.
57.	Section 9.5.3	Please provide information to support that biosparging would reduce concentrations in the most contaminated areas within 1.5 years and that monitored natural attenuation would reduce residual concentrations to below cleanup goals. Please estimate the contaminants' concentrations after 1.5 years of biosparging operations at various locations with elevated contaminant concentrations.	See the response to comment 51.
58.	Appendix F, Cost Table for Sparge Well System Controls	If a soil vapor extraction system is required, the RI/FS reveals that an extraction blower, some tubing, and one water knockout vessel would be added. This does not seem to be a complete vapor extraction system for capturing and treating fugitive emissions. Please revise the RI/FS accordingly.	The text and cost estimates for Alternatives 3, 4, and 5 were revised to provide a more complete description of the vapor extraction system. The cost estimates are located in Appendix H of the draft final report.

RESPONSE TO DTSC COMMENTS – Draft Groundwater Remedial Investigation/Feasibility Study
Alameda Point IR Site 25, and Alameda Annex IR Site 02
Alameda, California
Document Date: October 2003

Comment No.	Section/Page Number	Comment	Response
Comments from Marie McCrink, R.G., DTSC Geologic Services Unit (GSU), dated January 20, 2004			
1.	General	The purpose of a remedial investigation (RI) is to define the extent of contamination in order to conduct an accurate assessment of human health and ecological risk. The GSU believes there are a few major deficiencies with this RI, which should be corrected before proceeding with an FS. First, we do not concur that the lateral and vertical extent of the benzene and naphthalene plumes has been adequately characterized. Therefore, we believe the RI report should be separated from the FS in order to address the issues we have outlined in the specific comments that follow. Second, the GSU is concerned that the process of identifying COPCs and selecting final COCs is not described in enough detail for a reviewer to evaluate if all COCs have been adequately identified. Finally, because an RI is a document in which decisions are made to include or exclude contaminants from further consideration of risk, a clear demonstration must be provided of the impact of individual chemicals on groundwater.	The groundwater RI/FS report builds on previous investigations at Site 25 and Alameda Annex that provide sufficient data to select a remedial technology for Site 25 and Alameda Annex groundwater that is protective of human health and the environment. The report was revised to explain the previous investigations in more detail, and to discuss uncertainties associated with the current groundwater characterization at the Site. All available groundwater results were discussed or referenced in Section 3. The process of selecting the final COCs was discussed in more detail in Section 4. Benzene has been identified as a chemical that has impacted groundwater and sufficient data exists to proceed with the selection of a remedial action alternative for the Site.
2.	Executive Summary	There is no statement in the Executive Summary (ES) about the chemicals that were identified as contaminants of potential concern (COPCs), and the final compounds that have been retained as chemicals of concern (COCs). The GSU recommends a complete list of COPCs and COCs be provided in the ES, not just primary risk drivers. In addition, the documents in which COPCs and COCs were developed and approved should be identified, and the process should be summarized.	The process of selecting the final COCs was summarized in Section 4 of this RI/FS. References to the previous investigations were clarified. The lists of COCs identified in past investigations have not been consistent over time as investigations have been conducted for under different programs and for different media. Therefore, the discussion of previously identified COCs is too complex to be appropriate for the Executive Summary, and is only included in the body of the text.
3.	Figures 1-2 and 1-3 – Investigation Areas	It is stated in Section 2.0 that there is a school located within the Alameda Point Residential Parcels. The location of the school must be shown on both Figures 1-2 and 1-3. In addition, it is GSU's understanding that there is a daycare center next to the school, which also must be shown on these figures.	The locations of the daycare and school will be included on Figures 1-2 and 1-3. In addition to this RI/FS effort, both the school and daycare center are being investigated as IR Site 30 under a separate task order. .

Comment No.	Section/Page Number	Comment	Response
4.	Sections 2.1 and 2.2 – Geology and Hydrogeology	Only a written description of the geologic and hydrogeologic units beneath the sites is provided. Graphic displays, such as a stratigraphic column and a site conceptual model (SCM), should be included that show the approximate thicknesses and depths in the vicinity of these sites. In particular, a clear understanding must be presented about the variation in thickness of the Bay Mud layer immediately underlying these sites. It is stated in the 3rd paragraph on page 2-2 that Bay Mud ranges in thickness from 10 to 95 feet, and is thin or absent in the southeastern region of the Site. It is difficult to visualize a SCM with a potential change in thickness up to 85 feet beneath the limited aerial extent of these sites. Also, only a written description of groundwater flow is provided. An acceptable groundwater gradient and flow direction map must be included with the discussion of hydrogeology. Plus, it is stated in the 2nd paragraph on page 2-3 that groundwater in the FWBZ flows in a north by northwest direction. This flow direction directly conflicts with the interpretation of flow direction shown on Figure 4-18. As currently presented in Section 4, Figure 4-18, is not acceptable to the GSU, and therefore can not be referenced for discussion in this section. The groundwater gradient and flow direction map must show the well names and locations used to construct the map, screen intervals, and each unique water level measurement used. Finally, a discussion should be included about previous studies that have evaluated tidal influence in the FWBZ, and map should show the extent of tidally influenced groundwater. If a tidal influence study has not been conducted for the FWBZ in this area, the GSU recommends this be proposed and submitted for regulatory review as soon as possible. No evaluation of contaminant migration and impact to receptors can be conducted until the direction of groundwater flow is understood throughout the seasons of the year.	Two representative geologic cross-sections were included as Figures 2-1 and 2-2. The variation in thickness of the Bay Mud was more clearly described in Section 2.1. A site conceptual model graphic was added to the report as Figure 4-33. The report was reviewed to ensure that a consistent groundwater flow direction was presented in the figures and text. Two complete groundwater contour maps were provided as Figures 2-3 and 2-4. The well names and water level readings were included on these figures. Screened intervals for these wells were provided in Figures 3-1 to 3-5. A summary of previously reported information about tidal influence was also provided in Section 2.1.

Comment No.	Section/Page Number	Comment	Response
5.	Section 3.13 – Previous Groundwater Investigations for Alameda Point & Annex	The 2nd paragraph discusses one of the conclusions from the Marsh Crust FS, which impacts this RI. In the Marsh Crust FS, it was concluded that since the Marsh Crust did not merit remedial action, it was ruled out as a possible groundwater contamination source in this RI. The GSU recommends a detailed summary be provided about the Marsh Crust. This summary should include, but not be limited to, a written and graphical description of the lateral and vertical physical extent of the Crust, a list of the COCs identified in the Crust, a map of the extent of COCs reported in the Marsh Crust, an explanation of why the Crust did not merit a remedial action, and a complete set of references to all primary documents approved and finalized about the Marsh Crust. This RI must provide the data necessary to independently evaluate and conclude whether or not the Marsh Crust is a continuing source of groundwater contamination at these sites.	The summary of the Marsh Crust FS in Section 3.1.3 was revised to clarify the conclusions of the Marsh Crust FS and to expand the discussion of potential sources of groundwater contamination in Section 4.4.
6.	Section 3.2 – Previous Soil Gas Investigation	On page 3-13 in the review of data from the *Alameda Point OU-5 RI* (IT, 2002), it is stated that soil gas samples co-located with groundwater samples could be correlated, but in general, there appeared to be little correlation. The GSU recommends the two statements be clarified or reworded, as they appear to directly conflict with each other. The inclusion of data tables or subsets of data tables and corresponding maps to show the recent soil gas data relative to the current configuration of groundwater monitoring wells and plume concentrations must be provided in this report to demonstrate the presence or absence of a correlation between the data.	Section 3.2 has been expanded and Section 4.2 has been added to summarize previous soil gas investigations at the site. Figure 3-6 presents the location and maximum benzene concentrations (relative to generic screening levels from EPA vapor intrusion guidance) from all previous soil gas samples collected at the site. Figure 4-34 was also added to demonstrate the relation of the groundwater plume to locations were benzene vapor concentrations exceeded the 2nd tier screening level (50 times the generic screening level) specified in EPA vapor intrusion guidance. Section 4.2.3 was revised to further discuss the potential correlation soil gas and groundwater data.

Comment No.	Section/Page Number	Comment	Response
7.	Section 4.1 – Soil Contamination Related to Groundwater	It is stated in the 2nd paragraph that low level metal contamination does not appear to have significantly impacted groundwater. The GSU recommends a summary table and figure of metals detected in soil and groundwater be presented from previous investigations and discussed in this section to support this statement. A reference to a previous report or the compact disc (CD) containing all the analytical data is not appropriate. Use of the phrase, *'not significant'*, must be defined. The discussion should include the methodology used to compare soil and groundwater data for evaluating the extent of impact, the regulatory standards and/or existing station-wide background values used to compare and evaluate the significance of the detected metal concentrations, and any available leachate testing results for metals in soil. If leachate testing was not conducted to evaluate potential impact of metals on groundwater, an explanation should be provided. A clear demonstrate of the lack of impact of metals from soil on groundwater must be provided in the text.	Discussions were added to Section 4 for each media to explain the previous investigations in more detail and to describe the process for selecting the final COCs.
8.	Section 4.1 – Soil Contamination Related to Groundwater	It is stated in the 2nd paragraph that low level PAH contamination in shallow soils (less than approximately 20 feet bgs) does not appear to have affected groundwater. The GSU recommends this statement either be clarified and justified or removed. The FWBZ is acknowledged to be 20 feet thick with a saturated thickness of about 10 feet. It is difficult to visualize a SCM that proposes all PAH soil contamination impacting groundwater occurs entirely between 19 and 20 feet bgs. We recommend this section provide a summary data table and figure of all PAHs previously detected in soil and groundwater. The summaries should illustrate the nature and extent of PAHs reported in soil and groundwater beneath these sites, and present a clear demonstrate of the impact of PAHs on soil and groundwater.	This section was revised to clarify and support the Conceptual Site Model (CSM). References were provided to the OU-5 RI report for detailed PAH results in soil and groundwater.

Comment No.	Section/Page Number	Comment	Response
9.	Section 4.2 – Groundwater Contamination	It is stated in the first paragraph that results from previous groundwater characterization efforts have been presented in other reports and are summarized in this section. The GSU believes the summary of other characterization efforts is too brief for an RI. As previously stated, decision documents in which contaminants will be excluded from any further evaluation must include summary information in the specific sections to address specific COCs and issues. Furthermore, the GSU does not find the definition of the lateral extent of contamination has been completed, for benzene and naphthalene. Plus, it is impossible to assess if the lateral extent of other COCs has been adequately defined because it is unclear if a complete list of COCs has been identified, and the supporting data has not been presented. The GSU recommends an RI work plan addendum be developed using existing hydropunch data to determine locations for the installation of permanent monitoring wells to complete the definition of lateral extent of contamination of benzene and naphthalene.	The summary of previous characterization efforts was expanded. Plume maps were revised to incorporate additional data. Section 4.5.5 was added to discuss uncertainties associated with the current groundwater and soil gas characterization at Site 25. Sufficient data exists to proceed with the selection of the remedial alternative. Additional data needs were identified in Section 4.5.5.
10.	Section 4.2 – Groundwater Contamination	In the 2nd paragraph, page 4-2, it is stated that no contamination was found in the second water bearing zone (SWBZ). The GSU finds no documentation to support this statement and to evaluate the vertical migration of contaminants below the FWBZ. We recommend this statement be removed and a new subsection of Section 4.0, *Evaluation of Vertical Extent*, be added in the next version of the document. This subsection should present complete documentation of the Navy's understanding of the extent of contamination in the Bay Sediments Unit (BSU) and the SWBZ. Defining extent of contamination is a critical component of an RI. The GSU can not certify that characterization is adequate for a DTSC toxicologist to review the risk assessment until extent of contamination has been adequately defined. On the contrary, the GSU finds unambiguous evidence to document that the extent of vertical contamination is *not* defined. It is stated in the 2nd bullet on page 4-2 that the highest detections of benzene are at approximately 20 feet bgs. Figure 4-5 – *2001 Benzene Contour Map, 16'-20' bgs Hydropunch Data* shows that all green and blues areas represent benzene concentrations greater than 100 µg/L, two orders of magnitude greater than the maximum contaminant level (MCL) for benzene. There is no benzene data presented, referenced, or discussed that demonstrates benzene is 1 µg/L or less immediately below this zone. Furthermore, Figure 4-5 compared to Figure 4-4 - *Benzene Contour Map, 12'-16' bgs Hydropunch Data* shows benzene concentrations are increasing with depth. In numerous cases the concentrations posted on these	Sections 4.1.3 and 4.1.4 were expanded to detail groundwater sampling results in the bottom of the FWBZ as well as available data in the SWBZ underlying Site 25. These sections also discuss the site lithology, specifically the Bay Mud layer present across the Site at thicknesses ranging from 25 to 100 feet, which serves to limit downward migration of contaminants. The vertical distribution of benzene in the FWBZ is explained in the CSM. Specifically, that benzene is undergoing natural attenuation in the shallow, aerobic portions of the FWBZ. With increasing depth, conditions become increasingly anaerobic and less favorable for natural biodegradation and may result in greater benzene concentrations at depth. The discussion of potential sources of groundwater contamination in Section 4.4 will be revised. Sufficient data exist to select a remedial technology for Site 25 groundwater that is protective of human health and the environment.

Comment No.	Section/Page Number	Comment	Response
		two figures show more than an order of magnitude increase in concentration. The data suggests that benzene could be migrating vertically downward, which is not characteristic of a stable or naturally attenuating plume. Furthermore, the occurrence and aerial extent of the Marsh Crust must be correlated with the occurrence of the benzene and naphthalene starting at 10 feet bgs. The possibility must be evaluated that the Crust is providing a continuing source to groundwater that causes the increase in benzene concentrations reported with depth. Finally, according to Figure 3-1, Historical Groundwater Monitoring Wells, and Section 13, Site 25, of the *Draft Final Work Plan for Base-wide Groundwater Monitoring Program (GMWP), Alameda Point, Alameda CA, Dated June 30, 2003* (Shaw Environmental, Inc., 2003), there are only three wells the GSU can find that are screened below the FWBZ, wells D-01, D-02, and D-03. Well D-02, screened from 95'-105' bgs, was evaluated in the GMWP. Although the GMWP does not list specific concentrations detected in well D-02, it is stated that volatile organic contaminants (VOCs) were detected at 95'-105' bgs. Therefore, VOCs are present in the SWBZ, and contamination beneath the FWBZ has not been evaluated. Contamination below the FWBZ must be addressed in the next version of the document. In summary, the vertical extent has not been defined in groundwater beneath Site 25 and Annex IR-02. The GSU can not certify the characterization is adequate to complete defensible risk assessments or evaluate remedial alternatives. We recommend reassessing the data quality objectives (DQOs), amending them if necessary, and continuing the remedial investigation to define the vertical extent of benzene and all potential COCs.	

Comment No.	Section/Page Number	Comment	Response
11.	Section 4.2 – Groundwater Contamination	In the 4th bullet, page 4-2, it is stated that dissolved phase methyl tertiary butyl ether (MTBE) and 1,2-dichloroethane (1,2-DCA) were detected in the FWBZ, but at lower frequencies and concentrations. The GSU recommends a summary table and figure be provided of all MTBE and VOCs previously detected in soil and groundwater. The table and figure should illustrate the nature and extent of MTBE and chlorinated VOCs reported beneath these sites. In addition, these contaminants have not been listed as COCs. Documentation must be provided to show MTBE and VOCs were formally evaluated as COPCs, and officially eliminated form the list of COCs.	MTBE and 1,2-DCA were evaluated in previous investigation reports. Section 4.1.1 will be revised to further discuss MTBE and 1,2-DCA data collected during previous investigations to support the conclusion that neither MTBE or 1,2-DCA warrant remedial action as part of this RI/FS. In addition, Figure 4-1 was added to show the locations of MTBE detections and present data for wells with detectable MTBE concentrations. References to specific maps in the OU-5 RI report that depict 1,2-DCA concentrations were provided. See the response to EPA RPM comment 16 for specific information regarding MTBE and 1,2-DCA detections.
12.	Section 4.2 – Groundwater Contamination	In the 3rd paragraph, page 4-2, it is stated that benzene and naphthalene are used as the primary COCs for this investigation because they are co-located and because benzene is also the primary health risk driver. The GSU recommends a complete list of all specific COCs that have been identified, not just the general term, PAH or VOC, be included in this section. According to the GMWP, all PAHs, BTEX, MTBE, chromium, lead, and nickel have been identified as primary COCs. This potential discrepancy in the identification of COCs between different documents about the same sites should be resolved.	Section 4 was revised to explain the COCs identified in previous investigations in more detail and to describe the process for selecting the COCs used in the HHRA and to select benzene and naphthalene as the primary risk drivers for the site.
13.	Section 4.2 – Groundwater Contamination	In the 4th paragraph, page 4-2, it is stated that MTBE and 1,2-DCA were detected in samples taken from areas that overlap with benzene, indicating the presence of less weathered products or possible older discharges. The GSU recommends that separate maps be prepared for the extent of MTBE and 1,2-DCA. The fate, transport, and degradation behavior of both compounds can be very different from benzene and naphthalene, especially for MTBE. In addition, if these chemicals represent different discharges, the definition of their extent may be different than that of benzene.	See response to comment 11. The draft final report was revised to explain the previous investigations in more detail and explain why the detections of MTBE and 1,2-DCA are not correlated with the benzene and naphthalene plumes and do not warrant remedial action. The source(s) of the limited MTBE and 1,2 DCA detections is unknown; however, given the limited detection frequency and low estimated mass, the detected concentrations do not pose a risk to human health or the environment. For that reason neither MTBE nor 1,2, DCA are considered COCs for remedial action in this RI/FS.

Comment No.	Section/Page Number	Comment	Response
14.	Section 4.2.2 – Computer Generated Contour Maps Produced for this Report	Listed in this section are the Surfer generated concentration contour maps, Figures 4-1 through 4-5. These maps are used to describe the extent of benzene and naphthalene contamination reported in the FWBZ. The GSU recommends several changes be made to these maps to enable better visual review and evaluation: a. Two different color schemes are used to represent concentrations. We recommend all maps use the same color schemes to represent concentrations in order to visually compare the change in benzene concentrations over time and at different depths; b. Reds and hot colors should begin at the 1000 µg/L contour. This concentration represents 1 mg/L of benzene in groundwater, and the figures should clearly show the widespread occurrence of benzene that is present three orders of magnitude above the MCL; c. Color shading is not used for concentrations less than 50 µg/L, and should be used to visually show the area of benzene contamination greater than the MCL. We recommend the beige color used for the 50 to 100 µg/L interval on Figure 4-4 and 4-5 be used on all maps to represent the 1 to 50 µg/L interval. The extent of benzene in groundwater above the MCL should be clearly presented in an RI; d. Contour intervals (CI) must be clearly labeled. Only Figure 4-1 has visible CI labels; and e. No differentiation of well symbols is provided for the figures. The figures should clearly show which data points are permanent monitoring wells and which are temporary well points.	The plume maps were revised with a new consistent color scheme, with labeled contours extending to 1 µg/L, and using different symbols to differentiate between monitoring well and Hydropunch™ sampling locations.
15.	Section 4.2.2 – Computer Generated Contour Maps Produced for this Report	Figures 4-1 through 4-5 are presented to describe the stratification, lateral, and vertical distribution of benzene contamination reported in the FWBZ. The GSU finds the lateral extent of contamination has not been adequately defined. We understand a great deal of data has been collected, and a serious effort has been made to display the data in a meaningful manner. However, we do not believe the maps present realistic pictures of the extent of contamination beneath these sites. Plus, the extent of only one contaminant has been portrayed. Because this is an RI, a complete picture of all identified COCs must be provided, not just the primary risk driver. The GSU proposes the BRAC Cleanup Team (BCT) consider using the following alternate approach to graphically show all identified COCs. The saturated zone containing the bulk of the contamination reported is about 10 feet thick, ranging in depth from approximately 10'-20' bgs. Ten feet is the	The draft final RI/FS report was revised to: (1) include plume maps including more recent data for benzene and provide representative plume maps for naphthalene, nature and extent of other contaminants detected were discussed in the text. The plume maps were reviewed by a registered geologist and revised accordingly. Areas where plume contours were approximated were more clearly indicated with dashed lines and question marks (2) explain the previous investigations in more detail, and (3) add a new section (Section 4.5.5) discussing data gaps.

Comment No.	Section/Page Number	Comment	Response
		optimal length of most screen intervals at many other CERCLA sites nation-wide. The GSU proposes one map for each COC be made at the same scale that contains all recent (1998 or later) monitoring well and hydropunch data. These separate maps would allow a more complete evaluation of the presence of each COC in the saturated zone, and a better determination if the additional characterization of lateral extent is necessary for each COC. Because this is a formal RI, the extent of characterization of all COCs must be evaluated. This requirement is not achieved by the graphical presentation provided in this draft document. Showing the stratified nature of the benzene occurrence is an important part of the CSM. Therefore, the GSU recommends for COCs other than benzene, all data within the 10 foot saturated zone could be shown on one map. However, for benzene we recommend the following issues be addressed for the maps showing the stratified nature of benzene: a. Figures 4-1 and 4-2 are maps based on older data, 1994 and 1999, respectively. The lateral extent/shape of the northern lobe of the plume on figure 4-1 is not adequately defined. Only two data points, P181-MW46 and S-44, have been used to make this part of the map. The western box on figure 4-1 is not a realistic picture of the extent of contamination, which does not usually occur in right angle patterns. Also, data in the western box is too sparse to define the extent. On Figure 4-2, the western lobe of the main plume does not appear to be well supported by nearby data. Because these figures represent older data sets, the GSU recommends both the 1994 and 1999 benzene values simply be posted on clean maps without any Surfer interpretation and coloring. Then, the data can be more simply viewed and compared to concentrations detected in more recent sampling events. b. On Figure 4-3, the lateral extent of contamination is not defined in the western, northern, and southern lobes of the benzene plume shown. In addition, the shapes of the lobes appear to be based on virtually no data. If the 11 data points shown are truly the only monitoring well data points for this interval, the GSU recommends posting the screen interval, and benzene and naphthalene concentrations in a text box next to each well. The figure label box should also define the range of depths representing 'shallow' on this map. Finally, we believe a map like this compromises the credibility of previous work by suggesting the need for a many additional wells to define the lateral extent. Therefore, the GSU recommends a work plan be developed for an amendment to the RI to complete the definition of extent in this zone.	

Comment No.	Section/Page Number	Comment	Response
		c. Figures 4-4 and 4-5 present the 12'-16' bgs hydropunch data and 16'-20' bgs hydropunch data, respectively. The lateral extents of the southeastern and western edges of the plumes shown are not defined. Additional drilling should be conducted to complete plume definition to the MCL for benzene. In addition, the 16'-20' bgs map clearly shows that the vertical extent has not been defined as well. Additional characterization efforts must be conducted to evaluate the extent of benzene in the BSU immediately below the FWBZ. If there are significant levels of benzene present below 20 feet bgs, as suggested by Figure 4-5, this could represent a large continuing source of benzene to groundwater, which must be fully evaluate before an FS can be valid.	
16.	Section 4.2.4 – Time-Series Evaluation of Benzene in Groundwater	This section describes the Mann-Kendall trend evaluations that were conducted on the three wells at the centers of the three plume lobes. It is stated that concentrations in all other wells were found to be decreasing, so Mann-Kendall tests were not performed. The GSU does not agree with this statement because visual inspection or numerical analysis is not an appropriate way to evaluate trends. Based on our visual analysis, we believe data from the last few years shows considerable variability. Therefore, we recommend this statement be validated by conducting trend analysis on the wells located around the proposed plume edges, using data that include the most recent sampling events.	Mann-Kendal trend analysis were performed using the most recent data from all of the monitoring wells with detectable concentrations of benzene, with the exception of the recently installed wells. Mann-Kendall results were included in Appendix C.
17.	Section 4.2.4 – Time-Series Evaluation of Benzene in Groundwater	In the last paragraph, it is stated that the decreasing benzene concentrations at the outer edges of the plume indicate benzene contamination is not migrating beyond the monitoring well network and is being reduced in mass. Again, the GSU recommends this statement be verified by conducting trend analysis on the wells located around the proposed plume edges, using data that include the most recent sampling events.	Please refer to the response to DTSC GSU comment 16.

Comment No.	Section/Page Number	Comment	Response
18.	Section 4.2.4 – Time-Series Evaluation of Benzene in Groundwater	In the last sentence of this section, Figure 4-18, site groundwater contour map is presented to aid in interpreting contaminant distribution. Figure 4-18 and the discussion of water levels must be revised. The revisions should include, but not be limited to: posting the well identification of all wells in which water levels were measured to make the map; posting the water level measurement; including a table of water level data, screen depths, and total well depths; showing with additional figures and explaining how water levels have changed over time beneath these sites; and discussing if this area is tidally influenced, and if so, the methodology used to correct the data. A reference to the groundwater monitoring program report for this information is not adequate for an RI. The data must be readily available in this report for any reviewer to access while reading. Finally, the statement that this map will aid in the interpretation of contaminant distribution must be explained. The GSU believes this is a very important concept for an RI to discuss. However, as currently presented, the map is difficult to interpret, and there are no points to show on what data the map is based. Therefore, the text should provide discussion to explain how the map aids in the interpretation of contaminant distribution.	Please refer to the response to DTSC GSU comment 4.
19.	Section 4.2.5 – Monitored Natural Attenuation (MNA) Parameters	In the first sentence of this section, it is stated that benzene groundwater analytical data indicates fate and transport mechanisms are reducing contaminant mass. The GSU finds absolutely no data or discussion about mass balance of chemical compounds that would be used to document reduction in the mass of one compound with a corresponding increase in the mass of another. This statement must be removed and replaced with a complete discussion of mass balance. Proposing MNA for any site must include data collected over several years that clearly demonstrates multiple lines of evidence of natural attenuation. The GSU recommends this section be expanded to include discussions of the following kinds of MNA information: Documentation of *Sequential Degradation and Loss of Contaminants* as shown by statistically determined concentration trends, presence and concentrations of intermediate and end products in a degradation pathway, plume geometry changes, mass balance calculations, and documentation of a smaller plume length or area vs a longer or larger than expected plume size had MNA not been occurring;	The MNA discussion was expanded in Section 4.5.2 and Section 5.2 to present the multiple lines of evidence based on the most recent data, primarily contaminant trend analyses and geochemistry results. A detailed mass balance for benzene and naphthalene was not performed since available information indicates that there are no specific EPA-approved analytical methods for their intermediate breakdown products (most notably Catecol, $C_6H_6O_2$), and their ultimate breakdown products (carbon dioxide and water) are ubiquitous in the environment. MNA parameters were measured in the 2001 OU-5 RI and continue to be measured as part of ongoing groundwater monitoring. MNA data is summarized in Section 4.1.6, and, based on the conclusions from this section and in Section 5, microbial analyses are not needed to demonstrate the effectiveness of MNA.

Comment No.	Section/Page Number	Comment	Response
		Documentation of the *Presence of Geochemical and Inorganic Indicators of Contaminant Degradation* as shown by temperature, pH, conductivity, dissolved oxygen, oxidation-reduction potential, sulfate/sulfide, nitrate/nitrite, ferrous iron, ethene, ethane, methane, carbon dioxide, and/or chloride; and, Documentation of *Microbial Evidence* such as anaerobic and aerobic heterotrophs and degraders (if present), and/or inorganic reducers.	
20.	Section 4.2.5 – Monitored Natural Attenuation (MNA) Parameters	In the last paragraph of this section, the recommendation is made to conduct additional MNA parameter monitoring to gain a better understanding of site conditions. The GSU concurs with this recommendation. We recommend a comprehensive work plan be developed to collect detailed MNA data specific to these sites, not just as part of the base-wide groundwater monitoring program. The end product of this data set should be to provide a detailed demonstration of the occurrence of MNA by documenting the multiple lines of evidence outlined in Comment No. 19. Finally, the GSU believes it is premature to conduct an FS for these sites until a detailed demonstration of MNA is complete. We can not approve a remedial alternative analysis that proposes and/or recommends MNA based on the existing data set.	The Navy will continue to collect MNA data as part of the basewide groundwater monitoring program; however, sufficient MNA data has been collected to proceed with an FS evaluation of remedial action alternatives.
21.	Section 4.2.6 – Groundwater Conceptual Site Model (CSM)	The GSU recommends a graphic illustration of the CSM be provided to help visualize the written description. In addition, the CSM must illustrate how the highest concentrations of contaminants are located at the base of the FWBZ and show the potential impact to the BSU in contact with the base of FWBZ.	A schematic of the CSM was added as Figure 4-33. Please refer to the response to DTSC GSU comment 10 about the contaminant distribution in the FWBZ.
22.	Section 4.3 – Soil Gas Contamination	In the first paragraph of this section, Figures 4-70 to 4-84 from the Alameda Point OU-5 RI Report (IT, 2002) are referenced to make a critical argument about the lack of correlation between soil gas and groundwater contamination. These figures should be included in this report in order to make this argument. In addition, a summary table and map of soil gas data collected to date should be contained in this RI. The table should include the boring identification and depth (or depths) from which soil gas was collected, and the concentrations of contaminants detected. In addition, although the frequency of detections for benzene is low, it is still present. Because the unsaturated portion of the vadose zone is less than or equal to five feet, regardless of concentrations, the GSU recommends indoor air risk be evaluated for the school, the daycare center, and all housing units present in this area.	Further evaluation of soil gas data was added to the report in Section 4.2. Tables 5-54 through 5-61 of the OU-5 RI report present inhalation risk results for the maximum detected soil gas concentrations within OU-5 and off-site properties, including the school and day care center. The estimated excess cancer risk for these areas was at or below 1×10^{-6} and the estimated noncancer hazard quotient was well below 1. The draft final groundwater RI/FS report also updated the indoor air risk calculations based on current soil gas and groundwater concentrations within the benzene plume. Because recent data for some analytes included values higher than the originally used soil gas and groundwater analytical data set, the risk assessment was rerun.

Comment No.	Section/Page Number	Comment	Response
23.	Section 4.4 – Evaluation of Possible Contaminant Sources	It is stated in the 2nd paragraph that the Marsh Crust was considered as a possible source of groundwater contamination but was ruled out during the Marsh Crust FS, as discussed in Section 3.0. As recommended in comment No. 5, this RI must provide the data necessary to independently evaluate and conclude whether or not the Marsh Crust is a continuing source of contamination to groundwater at these sites.	Please refer to the response to DTSC GSU comment 5.
24.	Section 4.4.2 – Point Source Discharges	In the fourth paragraph of this section, it is stated that if PAH contamination from contaminated fill were causing groundwater contamination, naphthalene would not be the only PAH with a high frequency of detection. The GSU recommends the text discuss the kind of CSM that would create this scenario with only naphthalene having a high frequency of detection for PAHs. The discussion should include potential kinds of past disposal practices and industrial or cultural activities that could result in this scenario. Finally, as stated earlier, we recommend a summary data table of PAH detections be included in this report so it can be referenced for this discussion. The GSU has not seen the necessary documentation to justify that naphthalene is the only PAH for which the DTSC would have human health or ecological concerns.	This paragraph and the CSM were revised accordingly. Please refer to the response to DTSC GSU comment 8 for further information.
25.	Section 4.5.1 – Hydropunch Sampling Depth Incon-sistencies	It is stated in this section that hydropunch field data yielded sufficient data to characterize groundwater contamination as function of depth, but additional sampling depth intervals would have provided useful data. The GSU does not concur that sufficient data have been collected to characterize the vertical extent of groundwater contamination. As recommended in comment No. 10, additional characterization of vertical extent must be conducted before the GSU can approve this report and consider remedial alternatives.	Please refer to the responses to DTSC GSU comments 1 and 10.
26.	Section 4.5.2 – MNA Parameter Monitoring	It is stated in this section that additional data are needed to better understand the MNA processes occurring at these sites, and a more rigorous statistical analysis needs to be conducted on MNA data being generated through the base-wide groundwater monitoring program. The GSU concurs that additional MNA data are needed. In comment No. 20, we have recommended a comprehensive MNA work plan be developed to collect detailed MNA data specific to these sites. However, as previously recommended, the GSU believes an MNA work plan should be independent of the base-wide groundwater monitoring program in order to evaluate MNA as a potential remedial alternative.	Please refer to the responses to DTSC GSU comments 19 and 20.

Comment No.	Section/Page Number	Comment	Response
27.	Section 4.6 – Summary of Nature and Extent of Contamination	It is stated in the summary that based on risk assessment results, the COCs are dissolved-phase benzene and naphthalene. The GSU recommends the process be summarized again in this section of how COPCs were identified and final COCs were selected. The summary of the risk assessment section in this document does not appear to contain those kinds of basic details. The issues of COPCs and COCs may be clearer if the Human Health Risk Assessment is more readily available by incorporating it into the text, rather than attached as an appendix on a CD. It is also stated in the summary that contamination does not appear to be migrating laterally or vertically. The GSU strongly disagrees that contamination is not migrating laterally or vertically, as the definition of lateral or vertical extent of contamination has not been completed. We do not concur with a non-statistical, visual assessment that data around the plume edges shows decreasing trends, which didn't include the use of the most recently collected data. This statement must be removed until conclusively documented as outlined in the recommendations above. Finally, it is stated in this summary that contaminants do not appear to be volatilizing into the vadose zone. This statement has not been documented with real data presented in this report, only summaries of other reports. In addition, VOCs have been reported in the vadose zone between 0 and 5 feet bgs. Therefore, until proven otherwise, volatilization from groundwater into the capillary fringe and vadose zone must be considered a potential source for the VOCs detected in the vadose zone. In addition, because the unsaturated portion of the vadose zone is so small, regardless of concentrations, the GSU recommends indoor air risk be evaluated for the school, the daycare center, and all housing units present in this area.	Please refer to the responses to the following DTSC GSU comments: • Comments 1 and 2 about the process for finalizing COCs • Comments 9 and 10 about plume delineation • Comments 6 and 22 about soil-gas results and conclusions
28.	Section 5.4 – Previous Fate and Transport Study	It is stated at the end of this section that modeling performed by TtEMI (1998) predicted the benzene plume would recede by 2020, but residual contamination above 1.0 µg/L of benzene would still be present. The GSU recommends this section discuss the aerial extent and volume of residual contamination greater than 1.0 µg/L predicted by the model to still be present by 2020.	Additional information about the TtEMI model was provided.

Comment No.	Section/Page Number	Comment	Response
29.	Section 5.5 – Evaluation of Fate and Transport Mechanisms – Current and Future	This section discusses Figures 5-1 through 5-7. The GSU has the following concerns about these figures that should be addressed. Figure 5-1 and 5-2 appear to exclude the last three sampling points as shown on Figures 4-8 and 4-9, respectively. Figure 5-3 appears to exclude the last five sampling points as shown on Figure 4-10. Figures 5-4, 5-5, 5-6, and 5-7 do not show sampling data collected in the last five years. The GSU recommends the figures be redone with the inclusion of recent monitoring data, if they exist. If not, other wells with complete recent data sets should be used to document the occurrence of first order exponential decay patterns. If enough recent data from permanent monitoring wells does not currently exist, the presence of this decay pattern should be reevaluated after enough data have been collected. We are concerned that the conclusions drawn about biodegradation with an incomplete data set do adequately portray the dynamic nature of a shallow, thin water bearing zone and contaminant plumes within it.	Figures 5-1 to 5-11 were revised to include all available data and all wells with detectable concentrations of benzene. The conclusions in the text were updated accordingly.
30.	Section 5.6 – Plume Stability Evaluation	It is stated in the 4th paragraph that numerical comparisons of benzene concentrations revealed an overall downward decreasing trend, and that the first order decay curves were also used to evaluate trends. The GSU is concerned that this same incomplete information keeps being repeated and used over and over. We do not believe numerical comparisons to determine a decreasing trend is the same as a statistically valid trend analysis like the Mann-Kendall analysis that was conducted on only three wells (Section 4.2.4). In addition, as commented on in comment No. 29, the first order decay curve plots have not included recent groundwater monitoring data. Therefore, again we recommend that Mann-Kendall trend analysis be conducted on the wells located around the proposed plume edges, using data that include the most recent sampling events.	This paragraph was revised to reflect the additional Mann-Kendal analyses that were performed and reflect inclusion of all recent data.

Comment No.	Section/Page Number	Comment	Response
31.	Section 5.6 – Plume Stability Evaluation	On page 5-15 discussion is provided about various graphical comparisons that were made about the lateral extent of benzene concentrations based on the 1998 TtEMI fate and transport study, monitoring well data from 1994, 1999, and 2001, and hydropunch data collected in 1994, 1999, and 2001. The conclusion stated in the 3rd paragraph is that the benzene plume has remained relatively stable from 1994 to 2001. The GSU is confused by the potential incompatibility of conclusions presented in Sections 4 and 5. It is stated in Section 4 that data shows concentrations are decreasing. However, it is concluded in Section 5 that the benzene plume has remained relatively stable. Therefore, we recommend the text be clarified to better explain this situation. In general, a relatively stable plume does not exclusively indicative of a plume undergoing bioremediation. Due to the possibility that of a variety of non-point sources exist in the fill of the FWBZ, a stable plume could also indicate a continuing source to groundwater balanced by a continuous rate of dilution and/or dispersion.	Section 5.6 and similar discussions in Sections 4 and 5 were revised for clarity and consistency.
32.	Section 5.8.1 – Lateral Migration of Groundwater	It is concluded in this section that because contaminant plumes have been shown to be relatively stable, lateral migration of contaminated groundwater to potential receptors (Oakland Harbor, approximately 900 feet north to northwest) is unlikely. The GSU would like to concur with this conclusion. However, based on the total dissolved solids concentrations, groundwater could be tidally influenced. The impact to potential receptors can not be evaluated until the presence or absence of tidal influence is conclusively determined. If tidal influence is present, an accurate gradient and flow direction of groundwater must be determined before the direction of contaminant transport and impact to receptors can be evaluated.	Please refer to the response to DTSC GSU comment 4.
33.	Section 5.8.2 – Soil Gas Migration	It is stated in this section that an indoor air survey was conducted by the United States Coast Guard and TtEMI, in which concentrations of benzene were reported near or below detection limits. The GSU recommends data from these indoor air studies data be summarized in tabular form, included in this section, and discussion be provided on the detection limits achieved and the methodology used to conduct the surveys. We also recommend, regardless of the results from the past surveys, additional indoor air samples be collected from the school and daycare facility and other residential areas before final conclusions about volatilization from groundwater and soil gas migration are drawn.	Please refer to the response to DTSC GSU comment 22 about previous indoor air risk calculations. A summary of the indoor air sampling conducted by the United States Coast Guard (USCG) was included in Section 3.2 of the draft final report, and the entire Coast Guard report has been included as Appendix B.

Comment No.	Section/Page Number	Comment	Response
34.	Section 8 – Identification and Screening of Technologies	The GSU believes the report has adequately screened treatment technologies to recommend appropriate remedies and conduct detailed analyses. However, the concurrence of Engineering Services Unit (ESU) should be obtained for evaluating the adequacy of the technology screening process. More important, the GSU finds the assessment of lateral and vertical extent is not yet adequate to proceed to the FS phase. As commented earlier, we recommend the RI be separated from the FS due to the need for additional characterization. In addition, the current level of understanding of natural attenuation processes occurring is not adequate for MNA to be an central part of two technologies being developed for selected remedial alternatives.	Please refer to the responses to the following DTSC GSU comments: • Comment 1 about the sufficiency of site characterization data • Comments 19 and 20 about MNA supporting evidence
35.	Section 8.1 – Remedial Action Objectives (RAOs)	The only proposed RAO is for groundwater. The GSU recommends an RAO should also be considered for indoor air through volatilization from groundwater due to the presence of an elementary school, a daycare center, and several residential units. We do not find adequate evaluation has been conducted for the indoor air pathway. Although the highest concentrations of benzene are detected in the deeper part of the saturated zone, the entire vadose and saturated zone together is a maximum of 20 feet in thickness. Therefore, the limited evaluation that has been conducted for a health risk associated with this pathway is not adequate to close this issue. Finally, RAOs should be developed for all COCs. As previously stated, the RI does not conclusively document the process of identifying COPCs and COCs. Therefore, the GSU is not convinced that RAOs for only benzene and naphthalene are adequate.	Please refer to the response to DTSC GSU comment 22 about previous soil-gas sampling and indoor air risk evaluations. The draft final RI/FS included the vapor intrusion pathway as a remedial action objective.
36.	Section 9 – Development and Screening of Remedial Alternatives	From the geologic and hydrogeologic perspective, the GSU concurs with the remedial alternatives selected for the detailed comparison and evaluation. However, the concurrence of Engineering Services Unit (ESU) should be obtained for evaluation of the development and screening of the selected remedial alternatives.	Please refer to the responses to DTSC ESU comments.

Comment No.	Section/Page Number	Comment	Response
37.	Section 9.3 – Alternative 2 – MNA with Institutional Controls	On page 9-8 in the discussion of Applicability of MNA, the ASTM guidance from *Section 5.7.2*, states that for sites with sufficient historical monitoring data, the primary lines of evidence will often be adequate to demonstrate remediation by natural attenuation. First, the GSU does not believe that sufficient historical monitoring data exists for these sites because the lateral extent of contamination has not been defined in several areas, and the vertical extent has not been defined at all. Second, the GSU does not support the use of only primary lines of evidence for demonstrating natural attenuation. As stated in comment No. 19, proposing MNA as part of a remedial alternative for any site must include data collected over several years that clearly demonstrates multiple lines of evidence of natural attenuation. Therefore, data to demonstrate multiple lines of evidence of natural attenuation must be collected for these sites before incorporating MNA into remedial alternatives.	Please refer to the responses to the following DTSC GSU comments: • Comment 1 about the sufficiency of site characterization data • Comments 19 and 20 about MNA supporting evidence
38.	Section 9 – Table 9-2 & 9-3, MNA System Components & Biosparging System Components	It is proposed in both tables to install nine additional monitoring wells to create a 20-well monitoring network. In addition, it is proposed in Table 9-3 to install 13 additional soil gas monitoring probes. Also, for both tables specific proposals are provided for exact numbers of monitoring wells to sampled at specific time intervals in the future and to be abandoned. The GSU recommends that the specific numbers of wells and soil gas probes to be installed, and the exact numbers of wells to be monitored during specific future time increments be considered guidelines and estimates. We understand for costing estimates, specific numbers must be used. However, the table should contain a footnote that site specific field conditions and data may require the need for installation of different numbers of wells or soil gas probes (more or less) than specified here.	The tables were redundant with the bulleted list included in the description of each remedial alternative, and they were removed. The text was clarified to indicate that the numbers of wells and soil-gas probes are approximate numbers used for costing purposes only, and that actual well and soil gas sampling design will be adjusted based on site-specific field conditions.
39.	Section 9 – Table 9-2 & 9-3, MNA System Components & Biosparging System Components	It is proposed in the last item on both tables that system review will be conducted every five years as per the National Contingency Plan (NCP). The GSU recommends that during the first five years a minimum of semi-annual monitoring be conducted along with a comprehensive annual review. The annual review must be initially conducted to evaluate and fine tune the frequency of monitoring, if the appropriate wells are being monitored, and if the monitoring program is adequately achieving the data quality objectives.	The text was clarified to indicate that groundwater monitoring will be reviewed on an annual basis, and that the 5-year review will consist of a comprehensive review of the remedial action, per the NCP.
40.	Section 9.3 – Alternative 2 – MNA with Institutional Controls	On page 9-9 in the discussion of Nature and Extent of Contamination, the text continues to reiterate that the nature and extent of groundwater contamination has been defined by numerous characterization efforts. As stated in numerous preceding comments, the GSU disagrees with this statement, and we recommend the characterization be completed before proceeding with an FS.	Please refer to the responses to the following DTSC GSU comments: • Comment 1 about the sufficiency of site characterization data • Comments 9 and 10 about plume delineation

Comment No.	Section/Page Number	Comment	Response
41.	Section 10 – Conclusions and Recommendations	The recommended alternative is Alternative 3, biosparging with MNA and institutional controls. From the geologic and hydrogeologic perspective, the GSU concurs with the selected alternative, contingent on adequately responding to the preceeding comments and recommendations. As stated in our comments, the GSU recommends additional characterization be conducted to better define the lateral and vertical extent of contamination, and the understanding of natural attenuation processes occurring in groundwater at these sites.	The RI/FS has been revised to avoid recommending or selecting any remedial alternative, which will be done in the proposed plan and ROD. Please refer to the responses to the following DTSC GSU comments: • Comment 1 about the sufficiency of site characterization data • Comments 19 and 20 about MNA supporting evidence
Comments from James Polisini, PhD, DTSC Human & Ecological Risk Division (HERD), dated January 23, 2004			
General	General	HERD defers to the comments made by the Geological Services Unit (GSU) in their January 20, 2004 memorandum regarding the adequacy of the sampling and the kriged water concentrations. HERD has concerns similar to those outlined by the GSU regarding the identification of the contributors to risk and/or hazard as outlined in specific comments below.	Comment noted. See responses to specific comments below.
1.	Section 1.3, page 1-14	The existing school is considering expansion within the Alameda Annex site. Any expansion of the existing school should be referred to the Department of Toxic Substances (DTSC) Schools Unit for evaluation. The toxicologists working within the Schools Unit indicate that parcels or areas which pass a residential use scenario would most probably not be a problem, however, review by the Schools Unit should be requested prior to any expansion.	Comment noted.
2.	Section 2.4, page 2-6	The potential for preferential migration of COCs into Oakland Inner Harbor via the bedding in the 'extensive system of sanitary sewer and storm drain lines with the Site' should be evaluated. The absence of leaks in the storm drain system does not indicate that the bedding material doesn't serve as a preferential migration pathway.	A discussion was added to this section to address the possibility that the bedding material can become a preferential pathway for contaminants in groundwater. However, based on available groundwater data, contamination does not appear to be migrating to the Oakland Inner Harbor.
3.	Section 6.1, page 6-1	Please define the term 'Sepia's acceptable risk management range.'	"USEPA" was accidentally replaced by "Sepia" while spellchecking the document. This error has been corrected throughout the document. Also see the response to EPA comment 57 regarding a clarification of this terminology.

Comment No.	Section/Page Number	Comment	Response
4.	Section 6.3, page 6-3	Use of the chemical transfer model for water to air using the DTSC 'shower scenario' guidelines would appear protective as shower water would be at a higher temperature than car wash water and the shower space would be much more confined than the space at an open air car wash. The car wash scenario would therefore appear protective for inhalation exposure of workers in a car wash. In addition, most car wash water is recycled within the same facility so that the water concentration of Volatile Organic Compounds (VOCs) would drop perceptibly after the first use. This comment is meant for the DTSC Project Manager and no response is required from the Navy or Navy contractors.	Comment noted.
5.	Section 6.3, page 6-3	The basis for the estimate of irrigation rate for the irrigation/landscape worker scenario (Section 6.3, page 6-3) appears well supported (Center for Irrigation Technology, California State University-Fresno and the U.S. Bureaus of Reclamation).	Comment noted.
6.	Section 6.3, page 6-4	The text description of the site-specific exposure characteristics (i.e., depth to groundwater and type of construction) and the version of the Johnson and Ettinger indoor air exposure model (i.e., including CalEPA toxicity values) appear appropriate for evaluation of human health risk.	Comment noted.
7.	Section 6.5.1, page 6-5	HERD agrees with the most likely list of primary exposure pathways as direct contact, incidental ingestion and food-web exposures. However, the exclusion of the inhalation of volatile compounds in air must be documented by some demonstration, perhaps based on a generic demonstration with a Jury model, given the minimal depth to groundwater in OU5. A calculation of the incidental cancer risk and /or non-cancer hazard in the area of the highest groundwater concentration and/or minimal depth would be sufficient in the event the incremental cancer risk and/or non-cancer hazard are *de minimis.*	Please refer to the response to DTSC GSU comment 22 regarding previous indoor air risk calculations and those included in the revised risk assessment for the draft final report.
8.	Table 9-4, page 9-30	Biosparging with Institutional Controls (ICs) are the selected remedial alternative. HERD has no objection to this Remedial Alternative, but defers to the Geological Services Unit in DTSC for final evaluation.	Comment noted.
9.	Appendix E, page 1	Please clearly define the proposed monitoring schedule to determine that 'volatile constituents are not released into the atmosphere but are biodegraded in the groundwater or vadose zone'. This monitoring, once approved, should be a condition of the Remedial Action Plan (RAP) or Record of Decision (ROD), especially in the area of the school and proposed school expansion.	The draft final RI/FS discussed appropriate vapor monitoring requirements associated with the biosparging alternative. Soil gas probes will be monitored biweekly at a minimum to ensure that the system is not posing any increased risks to the residents, students, and workers at the Site.

Comment No.	Section/Page Number	Comment	Response
10.	Appendix B, Table ES.2	HERD cannot locate any estimate of the potential drawdown of groundwater in support of the 500 foot or 750 foot radius for the kriged exposure point concentration (EPC) used in the Human Health Risk Assessment (HHRA). Please provide the basis for the assumed radii, or reference the location in the text. HERD defers to the Geological Services Unit (GSU) regarding the estimation of groundwater concentration and delineation of groundwater isopleths.	Section 6.5 was provided to detail the rationale for each radius selected for the EPC calculation.
11.	Appendix E	The HHRA scenarios used (i.e., residential, car wash worker, and landscape worker) appear to encompass protective estimations of human exposure to groundwater. However, some estimation of the total incremental risk and/or hazard due to exposure to soil contaminants in addition to groundwater exposure must be provided for the residential scenario for consideration by the risk managers.	The risk assessment for soil contaminants is provided in the soil feasibility study for OU-5. Total risk for soil and groundwater will be presented in the proposed plan.
12.	Appendix E, Table 2	Benzene and naphthalene are identified as 'risk drivers' in the main body of the text (Section 1, page 1 and Section 3.1.5, page 3-5), yet multiple polycyclic aromatic hydrocarbons (PAHs) have Frequency of Detection (FODs) near or above 50 percent. Other benzene-substituted compounds (e.g., 1,2,4-trimethylbenzene and m,p-xylene) are present in a significant number of groundwater samples. Please amend the text to indicate that while benzene contributes the majority of incremental cancer risk and naphthalene accounts for the majority of non-cancer hazard, there are other elements and compounds which contribute to the estimate of cancer risk and/or non-cancer hazard.	Section 6.1 of the report was revised to clarify that other chemicals were detected that contribute to the estimated cancer risk and non-cancer hazard.
13.	Appendix E, Table 3.5	The central tendency groundwater concentrations were compared to the Reasonable Maximum Exposure (RME) groundwater concentrations (Appendix E, Table 3.6) and appear to be reasonably represent the appropriate range of concentrations for a HHRA.	Comment noted.
14.	Appendix E, Table 3.7	The arithmetic average, as indicated in the column heading or some estimate of central tendency (e.g., median or mode) should be provided for the consideration of the risk managers. The column identified in this comment is completely blank.	The maximum detected concentration of each analyte was used to provide a conservative estimate of risks posed by the Site. Estimates of central tendency were not calculated.
15.	Appendix E, Tables 4.1 through 4.20	Exposure parameters for the HHRA intake calculations were checked at random, for each exposure scenario, and found to be acceptable with suitable justification and citations. This comment is meant for the DTSC Project Manager and no response is required from the Navy or Navy contractors.	Comment noted.

Comment No.	Section/Page Number	Comment	Response
16.	Appendix E, Table 5.1, page 1 of 2	The oral cancer slope factors (SfO) were checked for benzene, which is identified as the 'risk driver' for cancer risk. The oral value listed, $3.0x10^{-03}$ mg/kg-day, attributed to NCEA does not agree with the value used by the U.S. EPA Region 9 of $5.5x10^{-03}$ mg/kg-day (EPA Region 9 PRG table 2002), nor the California Office of Environmental Health Hazard Assessment (OEHHA) oral slope factor for benzene of $1.0x10^{-01}$ mg/kg-day. However, the inhalation cancer slope factor listed (Appendix E, Table 6.2, page 1 of 2) of $1.0x10^{-01}$ mg/kg/day does agree with the California OEHHA value. Please explain this discrepancy. Also, please check the cancer slope factors and Reference Doses (RfDs) to ensure that the most protective value is used, whether it is U.S. EPA, U.S. EPA NCEA, U.S. EPA Region 9, or California OEHHA.	Tables 5-1 and 5-2 in the HHRA appendix (now Appendix E) were checked for accuracy and revised as appropriate.
17.	Appendix E, table 7.1 through table 7.20	Estimates of risk and/or hazard were checked at random and found to be arithmetically correct, given the values supplied. There, however, remains the issue of correct cancer slope factors or RfDs to be resolved.	Comment noted. See the response to comment 16 above.
18.	HHRA	When HERD requests, or is submitted, an electronic copy of the HHRA calculations please submit those files in the native spreadsheet format rather than an Adobe PDF file conversions of the file. An Adobe PDF formatted file merely means that HERD must print the files and re-enter the calculations into a spreadsheet to verify the calculations.	Comment noted. A native format electronic copy will be provided upon request.
Conclusions	General	The HHRA for OU5 for soil indicates incremental cancer risk and non-cancer hazard in excess of the usual *de minimis* level. Incremental risk for the residential scenario exceeds one in a million ($1x10^{-6}$) and a hazard index of 1 in multiple locations within OU5. A total incremental cancer risk and hazard quotient for both soil and groundwater must be submitted to the project managers.	See the response to comment 11 above.
Conclusions	General	Monitoring of the groundwater concentrations during and after the proposed biosparging should be a requirement of the Feasibility Study (FS) work plan.	Groundwater monitoring is currently being performed under the basewide groundwater monitoring program. Future groundwater monitoring is an element of all remedial alternatives (except no action) and costs for monitoring were included in the estimate.
Conclusions	General	The potential for preferential migration of groundwater contaminants to the Oakland Inner Harbor through the bedding material of the extensive utility corridors should be evaluated for ecological hazard concerns.	See the response to comment 2 above.

Comment No.	Section/Page Number	Comment	Response
Conclusions	General	HERD has previously strongly recommended that a signed Alameda City Council Ruling be obtained, and transmitted to DTSC, to define the limitations on the future use of property within OU5 boundary in perpetuity with regard to soil exposure, prior to DTSC acceptance of the reviewed Draft HHRA for soils in OU5. This same condition should apply to the area defined as the groundwater treatment area for Site 25/IR02 which lies within OU5 .	Comment noted.
Comments from Mark Berscheid, DTSC Engineering Services Unit (ESU), dated January 22, 2004			
General	General	The preliminary screening process for applicable technologies summarized in Table 8-1 of the RI/FS, eliminates the in situ chemical oxidation (ISCO) alternative. The RI/FS indicates ISCO has been successful in reducing the level of contamination at multiple pilot locations on site. These COCs were more recalcitrant to the in situ oxidation process than the hydrocarbons noted in the RI portion of the document. Therefore, the ESU recommends the ISCO technology be considered in the detailed analysis of alternatives. The ESU considers this treatment technology to be worthy, based on the pilot test assessments provided to DTSC by DOD, of treatability tests to adequately compare the biosparging/MNA and ISCO treatment technologies.	The discussion of ISCO in Section 8 was expanded to more clearly explain the rationale for not retaining it for further analysis.
General	General	The list of treatment technologies applicable for the initial screening process in the RI/FS does not include six-phase in situ heating. The ESU would consider this treatment technology as successfully demonstrated and a treatment technology that would appear to meet the ARARs specified. The ESU recommends this treatment technology be included in the RI/FS screening of treatment technologies and may warrant consideration in the detailed analysis of alternatives.	Six-phase heating was added as section 8.3.5.9, and was was not retained due to high costs and low implementability. .

RESPONSE TO DTSC COMMENTS – Draft Groundwater Remedial Investigation/Feasibility Study
Alameda Point IR Site 25, and Alameda Annex IR Site 02
Alameda, California
Document Date: October 2003

Comment No.	Section/Page Number	Comment	Response
1.	Chapter 8	The RI/FS indicates a significant difference between air sparging and biosparging. However, the radius of influence (ROI) used for the biosparge design well placement is based on distances that appear to be rather optimistic and reflect aggressive injection of air. These ROIs in combination with the required injection pressure for a optimum injection depth of greater than 25 feet bgs, reflect injection pressures that would appear to relate to a significant volume of air (SCFM). The volume of air related to the design criteria appears to be sufficient to not only increase the level of dissolved oxygen to more advantageous levels but physically separate benzene from saturated zone soils at levels sufficient to require vadose zone control. This possibility, in combination with the minimal vadose zone width (i.e., 8 to 10 feet bgs), indicates a need to plan for the SVE infrastructure in the cost estimates for the alternative. Specifically, the ESU recommends that as a minimum in areas in which the concentration of benzene is relatively high (i.e., Figure 4-5) the biosparging alternative contain the infrastructure necessary to collect vadose zone COCs to prevent migration to the surface. This addition of SVE infrastructure should be reflected in the cost estimate for this alternative.	A discussion of vapor-control remedies was added into section 8.3.5.2 and 8.3.5.3. SVE was included as part of each alternative that included biosparging or air sparging.
2.	Table 4-1	The RI/FS provides data regarding the evaluation of MNA parameters in Table 4-1. This table also provides data indicating the presence of elevated levels of methane dissolved in ground water at this site. The RI/FS does not address this compound in the evaluation of risk at the site. The ESU recommends the RI/FS address the presence of methane at this site related to: a. Indoor breathing spaces; b. Lower Explosive Limit. The biosparging alternative, without the capacity to collect gases created by sparging activities in the vadose zone, may create elevated levels of methane in the vadose zone. The presence of these gases may lead to subsequent migration into buildings at levels capable of posing problems in these areas.	Because no toxicity data is available for methane it was not included in the human health risk assessment. A discussion was added in Section 4.2.1 comparing the observed concentrations of methane to the Lower Explosive Limit and the Title 27 standard to control potentially explosive landfill gases. The same vapor-control remedies used to mitigate any chemical hazards posed by volatilization of benzene will also mitigate potential chemical and explosive hazards posed by a release of methane.
3.		The RI/FS indicates that the most important element of MNA, a stable plume, is present at this site. This assumption is based on the accumulation of RI data taken from multiple investigations and summarized in a single data base used for this analysis. The ESU recommends the review of this analysis by a DTSC hydro-geologist to confirm the stability of the plume at this site. The ESU also recommends the addition of two mandatory elements of the MNA alternative: a. Point of compliance monitoring wells; and b. A contingency plan (i.e., containment wells).	Section 4.1.3 has been restructured to more clearly present the evidence that the plume is stable. Section 4.5.5 has been added to discuss additional data needs. Point of compliance and containment wells will be specified in the remedial action monitoring plan (part of the remedial design).

Comment No.	Section/Page Number	Comment	Response
4.	Appendix E, Biosparging Description	Appendix E, Biosparging Description, contains a table with biosparging evaluative parameters. This table indicates, as a rule of thumb, the dissolved iron concentrations should be below 10 mg/L. The table indicates some of the data points at this site are below 10 mg/L. The need to further evaluate this issue would appear to further support the implementation of treatability tests as part of a final RI/FS. (No comment number 5.)	Additional data will be collected, as needed, during the remedial design phase. The high dissolved ferrous iron concentration may result in a decrease of permeability near the injection wells as the ferrous iron is oxidized. The contingency built into the cost estimate may be used to install replacement wells if necessary.
6.		Although the reuse designation indicates a residential scenario, the present status of some areas within the Alameda Annex property reflect open fields and are future candidates for residential construction. The ESU would consider these areas as optimal areas for the pilot test evaluations or full scale implementation of treatment technologies, such as six phase heating, that may be more aggressive than biosparging, resulting in shorter remedy time lines but may be of greater risk to residences. The ESU recommends the final RI/FS make a distinction between these areas in the evaluation criteria used in the screening process of the RI/FS.	Please refer to the responses to DTSC ESU general comments above.

RESPONSE TO RWQCB COMMENTS – Draft Groundwater Remedial Investigation/Feasibility Study
Alameda Point IR Site 25, and Alameda Annex IR Site 02
Alameda, California
Document Date: October 2003

Comment No.	Section/Page Number	Comment	Response
Comments from Judy C. Huang, PE, Remedial Project Manager, California Regional Water Quality Control Board (RWQCB), dated January 6, 2004			
General	General	All the figures containing benzene plumes only delineate the plume to 50 ppb. The drinking water Maximum Contaminant Level for benzene is 1 ppb. Please provide revised figures delineate the plumes down to 1 ppb.	The figures were revised to extend plume contours to 1 microgram per liter (µg/L).
1.	Page 3-12, Section 3.2	This section stated that "Benzene was detected in 13 samples at concentrations ranging from 50 to 17,000 µg/m3. The highest reading, however, was considered an anomaly, given that prior testing throughout the housing and IR-02 areas ranged between 10 and 400 µg/m3, and that the sample was located in an area where benzene was not detected in the groundwater." Staff is concerned that the highest reading might not be an anomaly, especially if the high readings are located with near or under residential housing units. Please provide the location of the highest readings and any additional soil gas sampling results if U.S. Navy has collected additional soil gas samples near these locations.	Further discussion of the soil gas data, including the location of the highest result, was provided in Sections 3.2 and 4.2.
2.	Page 3-13, Section 3.2	This section stated that "In general, there appeared to be little correlation between benzene groundwater contamination and benzene soil-gas detection, indicating volatilization of dissolved-phase benzene was not occurring." If volatilization of dissolved-phase benzene was not occurring, what is the source of the soil-gas benzene? Please clarify.	Section 3.2 was revised to delete this general statement, and both Sections 3.2 and 4.2 were expanded to detail the soil gas characterization data and the potential links to groundwater contamination.
3.	Page 4-2, Section 4.2	This section stated "MTBE and 1,2-dichloroethane were detected in samples taken from areas that overlap with benzene contamination, indicating the presence of less-weathered petroleum products, as well as possible older discharges." Based on review of records provided by U.S. Navy, there are no known releases of petroleum at Alameda Point Site 25 or Alameda Annex IR-02. In addition, 1,2-dichloroethane is not a component of gasoline. Staff understands that this RI/FS only addresses benzene. Please provide information as to the sources of the MTBE and 1,2-dichloroethane or programs where these constituents will be addressed.	MTBE and 1,2-DCA were evaluated in previous investigation reports. The draft final report was revised to further discuss MTBE and 1,2-DCA data collected during previous investigations to support the conclusion that neither MTBE or 1,2-DCA are chemicals of concern (COCs) for the FS evaluation. In addition, Figure 4-1 was included to depict MTBE concentrations. See the response to EPA RPM comment 16 for specific information regarding MTBE detections, and see the response to DTSC GSU comment 11 for specific information regarding 1,2-DCA detections The source(s) of the limited MTBE and 1,2 DCA detections is unknown; however, given the limited detection frequency and low estimated mass, the detected concentrations do not pose a risk to human health or the environment. For that reason neither MTBE nor 1,2, DCA are considered COCs for remedial action in this RI/FS.

RESPONSE TO RWQCB COMMENTS – Draft Groundwater Remedial Investigation/Feasibility Study
Alameda Point IR Site 25, and Alameda Annex IR Site 02
Alameda, California
Document Date: October 2003

Comment No.	Section/Page Number	Comment	Response
4.	Page 6-5, Section 6.5.1 Alameda Point ERA Summary, Second Paragraph	This paragraph stated "Direct exposure to surface water was identified as a completed exposure pathway in general, but surface water in Alameda Point OU-5 is contained and managed within the storm sewer system where opportunities for exposure to ecological receptors would be minimal." The storm sewer system in this area generally drains to the Oakland Inner Harbor, where the potential exposure to ecological receptors might be considerable. Please supply documents and or reports that support the conclusion there would be minimal ecological impact.	Groundwater concentrations were compared to water criteria applicable to the bay in Table 5-3, in order to address the potentially completed pathway. The results of this comparison were discussed in Section 5.8.2.
5.	Page 8-14, Section 8.3.8.7 Aerobic Degradation Using Chemical Oxidation, Fourth Paragraph	This paragraph stated that the presence of clays and other subsurface heterogeneities would hamper the uniform application of the solution. Staff is curious why the heterogeneities of the subsurface geology would not also impact the application of air sparging. Please clarify.	In-situ remedial technologies are challenged by subsurface heterogeneity. The primary difference between sparging and chemical oxidation injection is that the latter requires direct contact between the chemical injected and the contaminant. Sparging raises the overall oxygen content of the subsurface, and converts an anaerobic zone into an aerobic zone, allowing microbes ubiquitous in the subsurface to degrade contamination.
6.	Page 9-11, Section 9.3 Alternative 2 – MNA with Institutional Controls, Potential Receptors and Exposure Pathways, First Paragraph	This paragraph stated "soil–gas and indoor samples indicate that volatilization of contaminants has not occurred." The indoor air and soil-gas sample results are not provided in the RI/FS. Without the data, it is very difficult for staff to evaluate the validity of this conclusion. Please include the indoor air and/or soil gas monitoring data in the RI/FS.	The discussion of indoor air and soil gas was expanded to provide analytical data and further analyze the data in the text. Specifically, historic soil gas data was provided in Appendix A, the U.S. Coast Guard indoor air data was included as Appendix B, and a vapor intrusion evaluation using indoor air and soil gas data was presented in Appendix D.
7.	Figure 9-2, Section 9.4 Alternative 3 – Biosparging with MNA and Institutional Controls, Alternative 3 Biosparge Zones	There is an inconsistency between the various benzene groundwater monitoring maps provided in Section 5 and this map. The plumes centered near monitoring wells MW-5 and MW-4 are not included in the biosparging zones. These plumes have concentrations above 50 µg/L. Please include these areas in the biosparging zones.	This figure corresponds to Figure 4-3, which has been revised. The elevated benzene concentrations near MW-5 and MW-4 were not included within the biosparging zone because it is presumed that monitored natural attenuation will effectively treat these plumes while biosparging is treating the centers of the higher concentration plumes.

RESPONSE TO RWQCB COMMENTS – Draft Groundwater Remedial Investigation/Feasibility Study
Alameda Point IR Site 25, and Alameda Annex IR Site 02
Alameda, California
Document Date: October 2003

Comment No.	Section/Page Number	Comment	Response
8.	Table 9-3, Section 9.4 Alternative 3 – Biosparging with MNA and Institutional Controls, Biosparging System Components	This table made no mention of indoor air monitoring during treatment. Since Biosparge Zone 1 and 3 are located in residential area, indoor air monitoring should be conducted. Please include a discussion in indoor air monitoring. In addition, in Years 3-7, the groundwater should be monitored quarterly or until the data proves that rebound is not occurring. Please revise the monitoring frequency.	The biosparging alternative was revised to include subsurface vapor monitoring and controls. No indoor air monitoring is planned, based on the results of 2002 indoor air monitoring performed by the Coast Guard (Tetra Tech 2002), which is provided as Appendix B to the draft final report. The groundwater monitoring frequency in Table 9-3 was revised accordingly; Table 9-3 was eliminated and the specification was made within the text of Section 9.3.

RESPONSE TO CITY OF ALAMEDA COMMENTS – Draft Groundwater Remedial Investigation/Feasibility Study
Alameda Point IR Site 25, and Alameda Annex IR Site 02
Alameda, California
Document Date: October 2003

Comment No.	Section/Page Number	Comment	Response
Comments from Debbie Potter, Base Reuse and Redevelopment Manager, City of Alameda Reuse and Redevelopment Authority, dated December 23, 2003			
1.	Section 3.1.3, Paragraph 2, last sentence	Since it (Marsh Crust FS) concluded that the Marsh Crust did not merit remedial action, it was ruled out as a possible groundwater contamination source in this report. (emphasis added) This sentence goes too far in implying that, even if the Marsh Crust FS had not concluded remedial action is merited, the Marsh Crust being a source of groundwater contamination is not possible. First, the FS cannot rightly have concluded that such a source is impossible, only improbable – one cannot prove the negative in this case. Second, the marsh Crust Ordinance is a remedial action, and not an engineering remedy.	This section was revised to clarify that the Marsh Crust FS concluded that the Marsh Crust warranted remedial action in the form of institutional controls. In addition, Section 4.4.2 was expanded to explain that while the Marsh Crust may be contributing, in part, to the contamination observed in groundwater, it is not considered a primary source of the contamination.
2.	Section 4.2.4, Paragraph 2, Sentence 2	*...benzene concentrations are decreasing in the majority of plume locations...* Figures 4-6 though 4-16 omit important data, primarily from 2002 to 2003. The cited text should be reconsidered in light of the missing data. It appears to be incorrect. The reliance on the faulty data is propagated into the final three paragraphs of this section. The Mann-Kendall tests should be repeated, using all of the data, for all wells that are not clearly decreasing in benzene concentration. The next to the last paragraph of this section claims that the decrease in benzene concentrations is a *fact*. The conclusion that benzene concentrations have decreased is based on statistics and judgment, and is at most a probability, not a fact. The statement in the final paragraph of this section: *Figure 4-17 illustrates that benzene concentrations are decreasing at the outer edges of the plume...*, appears to be incorrect, especially at Monitoring Wells P181-MW46 and S-13.	Mann-Kendall tests were run using all available data, and for all monitoring wells within the plume boundary, with the exception of the recently installed wells. The revised results were included as Appendix C.
3.	Figure 4-17	Some of the plots on this figure (e.g., Monitoring Well P181-MW46) appear to disagree with the data in Table A-1. Additionally, because there are no benzene-free wells shown on this figure, it is unclear why the plume boundary contour is drawn through wells, rather than outside them. In the case of Monitoring Well S-13, there is some question as to whether the data support drawing any plume boundary, without querying the boundary line to indicate uncertainty.	The plume maps were reviewed and redrawn by a registered geologist to ensure they more accurately depict site conditions.
4.	Figures 4-19 and 4-20	At which location(s) were the data on these figures collected? These plots appear not to agree with the data in Table 4-1.	All figures and tables in the report were reviewed for consistency and accuracy.
5.	Section 4.2.6, 4th bullet	Contrary to the text of this bullet, the naphthalene concentrations in Monitoring Wells, P181-MW45 and P181-MW46 appear not to be generally decreasing. These exceptions should be stated in the text.	Section 4.1.5 has been revised to include Mann-Kendall results for the naphthalene data in addition to the benzene data. Specifically, the text was revised to indicate that neither well P181-MW45 nor well P181-MW46 exhibited statistically significant trends.

RESPONSE TO CITY OF ALAMEDA COMMENTS – Draft Groundwater Remedial Investigation/Feasibility Study
Alameda Point IR Site 25, and Alameda Annex IR Site 02
Alameda, California
Document Date: October 2003

Comment No.	Section/Page Number	Comment	Response
6.	Section 4.6, Paragraph 2, last sentence	Neither of the sources (point-source discharges and contaminated fill materials) appears to be acting as an ongoing source responsible for plume expansion or contaminant concentration increases. This sentence goes too far in that it doesn't acknowledge a potential scenario where one or more sources still exist, but compensating processes (e.g., biodegradation) lessen the source's effect. This is important because the continued presence of the source renders natural attenuation and other remedies less effective than they would be without the sources.	Section 4.4 has been revised to clarify the possible sources of contamination, and more clearly explains that there does not appear to be a continuing source or contamination. Further, Sections 4 and 5 have revised to better support the conclusion that the groundwater contaminant plume is stable and that benzene and naphthalene concentrations are generally stable and in some cases decreasing.
7.	Section 5.2, Paragraph 2	Dissolved oxygen concentrations are incorrectly stated in µg/L, rather than in mg/L.	The units were corrected.
8.	Section 5.5 and Figures 5-1 though 5-7	Most of these figures disagree with Figure 4-17 and Table A-1. Important data are omitted from the plots, and presumably from the curve-fitting regressions as well. Had the missing data been included, many of the curves would look appreciably different and the r^2 values would be larger. Section 5.5 and other sections of the FS referring to or relying on these figures should be revised and changed as needed once these figures are corrected.	The figures and tables were revised to include all available data.
9.	Section 5.6, Paragraphs 4 and 5	These paragraphs rely heavily on Section 4.2.4 and Figures 5-1 though 5-7, all of which are incorrect as described above in Comments 2 and 8	The paragraphs were revised based on the redrawn figures.
10.	Section 5.6, Paragraph 8, Sentence 3	*However, comparing them (*plume maps in this draft RI/FS with maps in an earlier report) *indicates that the lateral extent of benzene plume has remained relatively consistent since 1996. Relatively consistent* compared to what? There are *relatively* substantial differences between the maps. Please include the earlier maps so readers can judge for themselves how consistent the lateral extent has been.	Figures 4-2 through 4-8 provide series of plume maps that can be used to judge lateral plume stability.
11.	Section 5.6, Paragraph 9	Most of the statements made in this paragraph are speculative, primarily because the extent of the plume was unknown northwest of Monitoring Well P181-MW45 in 1994 and 1999, and east of Monitoring Well S-03 in 2001 and, was known to a lesser extent, in 1999. The presence of this uncertainty should be stated as a way of qualifying the paragraph's comparisons	The plume maps were reviewed and redrawn by a registered geologist to ensure they more accurately depict site conditions. The limitation of the conclusions will be noted in the text and represented graphically by dashed contours in revised plume maps.

RESPONSE TO CITY OF ALAMEDA COMMENTS – Draft Groundwater Remedial Investigation/Feasibility Study
Alameda Point IR Site 25, and Alameda Annex IR Site 02
Alameda, California
Document Date: October 2003

Comment No.	Section/Page Number	Comment	Response
12.	Section 5.6, Paragraph 12	The logic of this paragraph ignores the fact that the screened intervals of many of the wells extend below the fill and penetrate the Marsh Crust (EW-2, S-02, S-12, S-13, S-35, P181-MW-45 (S-45), P181-MW46 (S-46), and P181-S-47 (S-47)). Thus, these screened intervals intercept the zone which based on sampling to date, is expected to have the highest benzene concentrations. Generally, the top of the Marsh Crust occurs within the 16'-20' below ground surface (bgs) depth interval, which is the interval sampled by the deeper Hydropunch pushes. However, this paragraph asserts that the shallower 12'-16' bgs Hydropunch pushes are more comparable to the monitoring well data, even though usually these shallow Hydropunch data are not representative of groundwater concentrations immediately above the fill/Marsh Crust interface, where benzene concentrations are greatest. Comparison of monitoring well data to shallow Hydropunch data is appropriate only for the eastern border of the plume. Otherwise, the deeper Hydropunch data should be used in the comparison. This hybrid comparison should be used to tailor the maps shown on figures 5-8, 5-9, and 5-11. Interpretation of such comparisons should recognize that the greater screen intervals of the monitoring wells, which cause the wells to also sample the less benzene-contaminated groundwater farther above the fill/Marsh Crust interface, result in dilution that lowers the sample concentration.	See response to Specific Comment 1 from the TAPP Grant Review, Kenneth Conner of SCA Environmental Inc.
13.	Section 5.7	The summary must be revisited once the issues about the numerical and graphical comparisons have been resolved.	The summary was revised based on modified figures.
14.	Section 5.8.1, Paragraph 1	This section is founded on questionable conclusions in Section 4 and 5. It may need to be revised after the issues about benzene plume concentration trends in the earlier sections are resolved. This same comment applies to Section 9.2.3 and Subsections Nature and Extent of Contamination and Summary of Applicability of MNA of Section 9.3.	This section was revised based on revisions to sections 4 and 5.
15.	Section 6, Paragraph 2, last sentence	*The Hydropunch™ samples detected higher concentrations than have historically been detected in site monitoring wells, because the wells were screened across shallower depths.* This sentence would be more accurately revised to: *The Hydropunch™ samples detected higher concentration than have historically been detected in site monitoring wells, because the wells' screened intervals often included shallower depths.* See Comment 12 above.	The sentence was revised accordingly.

RESPONSE TO CITY OF ALAMEDA COMMENTS – Draft Groundwater Remedial Investigation/Feasibility Study
Alameda Point IR Site 25, and Alameda Annex IR Site 02
Alameda, California
Document Date: October 2003

Comment No.	Section/Page Number	Comment	Response
16.	Section 9, Paragraph 3, Alternative 3	*Biosparging has been included to evaluate an active remedial technology, which could reduce risk levels to allow use of the shallow groundwater as a potable water supply.* This sentence sets illusory expectations for biosparging. Natural attenuation, too, will eventually reduce risk levels compatible with use of the shallow groundwater as a potable water supply. Biosparging unquestionably accelerates that process, but decades will pass before risk levels consistent with such use are achieved by either alternative. The only support for this assertion is apparently the timeframes suggested by the decay rate analysis of Sections 5.5, which are suspect because those analyses use censored data sets, which omit higher recent concentrations.	The decay rates presented in the draft version of the document were revised, and conclusions regarding cleanup time for the biosparging alternative were adjusted accordingly.
17.	Section 9.3, Subsections Alternative 2 Performance Criteria and Alternative 3 Performance Criteria	These subsections fail to indicate whether meeting cleanup goals later than the predicted cleanup timeframe is acceptable or non-acceptable performance. In addition, the predicted cleanup timeframe will probably become much longer once the censored data are considered in Section 5.5.	This section was revised to indicate that a longer cleanup timeframe may make the alternative not feasible (if cleanup to drinking water standards is required). The document was revised to include a more detailed discussion of estimated time required for MNA cleanup, based on MNA and chemical data collected to date.
18.	Section9.3, Subsection Summary of Applicability of MNA, Paragraph 1	The third sentence of this paragraph includes *...the benzene plume has been shown to be stable and decreasing across the Site...* This draft RI/FS does not convincingly show this. Subsection Nature and Extent of Contamination, earlier in Section 9.3, states the thought more accurately: *...the benzene plume in the first water bearing zone (FWBZ) has been found to be relatively stable and appears not to be migrating or expanding.* This revision is necessary because of uncertainties about the plume boundaries and concentration changes with time.	The text was revised accordingly.
19.	Section 9.3, Subsection MNA Components, first bullet and Table 9-2, first bullet	These two bullets disagree as to whether Alternative 2 proposes four or nine additional monitoring wells.	The text was revised to present a consistent number of additional monitoring wells. Installation of monitoring wells as part of the ongoing basewide groundwater monitoring program will also be taken into consideration.
20.	Table 9-2, bullet 3	It would be very helpful to expand this bullet to describe which hypotheses are to be tested.	This table has been eliminated from the document to limit redundancy; however, Section 9.3 has been revised accordingly.
21.	Section 9.3.5	Although the statements in this section are true, the topic of the section is not addressed. This section should be expanded to discuss the short-term effectiveness of Alternative 2.	"Short Term Effectiveness" includes additional short term risks due to implementation of the remedy. The statements in this section do address the topic of the section.

Comment No.	Section/Page Number	Comment	Response
22.	Section 9.4, Paragraph 6	This paragraph is currently written to recognize that air sparging would be acceptable in Zone 2, but does not state whether air sparging is part of Alternative 3. If air sparging is planned for Zone 2, then the alternative should explicitly include it in the alternative's initial formulation at the beginning of Section 9.	The report was revised to present biosparging and air sparging as separate alternatives.

RESPONSE TO COMMUNITY COMMENTS – Draft Groundwater Remedial Investigation/Feasibility Study
Alameda Point IR Site 25, and Alameda Annex IR Site 02
Alameda, California
Document Date: October 2003

Comment No.	Section/Page Number	Comment	Response
Comments from the TAPP Grant Review, Kenneth Conner, P.E., CHMM, SCA Environmental, Inc., dated February 2, 2004			
1.	General	The report is presented in a manner that is generally consistent with other reports prepared for such projects for review by DTSC and USEPA. It appears to meet the general standards for the industry.	Comment noted.
2.	General	The remedies reviewed in detail for the report do not include groundwater extraction and treatment or "pump and treat". Pump and treat was looked at on a cursory basis, but was not retained for more detailed analysis. As any sparging or introduction of oxygen to the subsurface could cause benzene and other volatiles to be liberated, it would seem that other technologies (not as likely to cause volatiles to be released) also would be reviewed in detail.	The discussion of pump and treat was expanded in Section 8.3.3.1 and included for detailed analysis as Alternative 6 in the revised report.
3.	General	The reviewer recognizes that the preferred treatment alternative is better than the present situation (no treatment), but the potential effects of air or biosparging in such a shallow vadose area need to be considered as well.	To address the concerns of fugitive emissions, vapor monitoring and installation of a contingency SVE system were added to the biosparging and air sparging alternatives.
4.	General	This document should reference the Soil Feasibility Study for OU5 and should reconcile any conclusions/observations between the two. At present, this is not the case.	Additional discussion of the OU-5 soil FS was included in Section 3.3, and details were included in Section 4.3 to discuss contaminants found in soil and potential relationships to contamination found in groundwater.
5.	General	The document does not show horizontal or vertical delineation of the plume. It also does not identify the source of the plume nor does it explain the presence of MtBE in the groundwater. These "missing pieces" are important to selecting, estimating, and sizing a treatment process. The reviewer believes strongly that further work on these missing pieces be performed before a treatment process is selected.	Section 4.1.3 was revised to more clearly delineate the plume horizontally and vertically. The discussion of the conceptual site model was revised and summarized in Section 4.1.7 and new Figure 4-33 was added to show the various possible sources of contamination. MTBE was evaluated in previous investigation reports. Section 4.1.1 was revised to further discuss MTBE data collected during previous investigations to support the conclusion that MTBE is not a chemical of concern (COC) for remedial action in this RI/FS. In addition, Figure 4-1 was added to summarize the MTBE data for the three wells with detectable concentrations of MTBE and references to specific maps in the OU-5 RI report that depict MTBE concentrations were provided. See the response to EPA RPM comment 16 for specific information regarding MTBE detections.

Comment No.	Section/Page Number	Comment	Response
6.	General	Given that the plume is thought to have been in the groundwater for an extended period of time and also has MtBE associated with it, the natural attenuation (NA) discussion and the basis for believing that NA will work at the site needs to be made much stronger. If the plume is not from a continuing source (this reviewer believes that it is from a continuing source), it would be logical to believe that the gasoline/diesel components of the plume would have attenuated thus far. The fact that they do not seem to have attenuated would leave one to believe that the subsurface conditions are not conducive to NA or that the plume is continually being fed from the source (as yet unidentified). Some guidelines for determining whether NA is appropriate or effective need to be set in this document as part of the NA proposal. Also, more specifics such as the wells that would be used for the NA study, the major and minor axes of the plume for the NA study and the parameters which would be monitored for the NA study need to be addressed in this document.	Additional monitored natural attenuation (MNA) data has been collected by the basewide groundwater monitoring program, and was included in an expanded review of MNA data in Section 5-2. See the response to general comment 5 regarding previous MTBE detections.
7.	General	As this area is likely a tidally influenced area and the groundwater elevation may change even on a daily basis, the reviewer would suggest that a groundwater monitoring plan be set in place and followed to gather more useful data. This may rectify the problems with the missing pieces mentioned above and may give more insight on the movement of the plume, the source of the MtBE, the age of the plume and the proper treatment technology. Also, the chosen treatment technology may not be as effective in a tidally influenced area.	The site is approximately 1,000 feet from the nearest shoreline. Therefore tidal influence is minimal, and is only reflected in slight groundwater level variations, as opposed to mass transport due to seawater intrusion. Previous investigations of the tidal influences at the site were summarized in Section 2.2. A basewide groundwater monitoring program is currently in place for the site. Recent chemical and MNA data from groundwater samples were used to revise the document.
1.	Previous Investigations 3-4 to 3-5	Some discussion should be in order at this point in the document for the use of data from monitoring wells vs. "hydropunch". Beyond the difference of sampling and resampling (monitoring wells can be resampled, but hydropunch is more difficult), the key difference is that the volume of water sampled during monitoring well sampling vs. hydropunch sampling is different and can bias results. Dilution can occur in monitoring well samples because of screen length and the total volume water from which the sample is taken. Likewise, hydropunch sampling can bias results because the screen interval may be too small and the "lens" of water from which the sample is taken may not have the same concentration as the lenses of water above or below the screened interval.	Section 4.5.3 was revised to clarify how monitoring well and hydropunch data are used in the report. Specifically, monitoring well data is used to delineate the extent of a plume within the FWBZ and SWBZ at the site and to track potential plume migration over time. The hydropunch data is used to determine the presence or absence of a substance vertically or horizontally within the FWBZ at a specific point in time. Concerns regarding dilution of groundwater samples collected from monitoring wells should be balanced with the limitations of hydropunch characterization efforts. Specifically, the heterogeneity of the fill material that comprises the FWBZ at Alameda does not support a

Comment No.	Section/Page Number	Comment	Response
			conceptual model of numerous, laterally-contiguous lenses of permeable soil warranting long-term, depth-discrete groundwater monitoring. Instead, the site heterogeneity supports the approach for monitoring wells screened across a longer interval (typically 10 feet) to track all contaminants that may be present within the FWBZ. Monitoring wells are the means of delineating contaminant plumes. Past investigations at Naval Air Station (NAS) Alameda and FISCA have emphasized groundwater characterization efforts using monitoring wells, and the ongoing groundwater monitoring being performed throughout NAS Alameda will continue to use groundwater monitoring wells. Samples collected as part of the basewide monitoring program are collected using low-flow groundwater sampling methods. In this method, groundwater is pumped from the well slowly to draw water at approximately the rate that the natural groundwater flow would pass through the well. This minimizes mixing of water from the entire screened interval.
2.	Previous Investigations 3-12	Diagrams showing the locations of the past soil gas points would be helpful as would actual samples from enclosed areas in the subject site. All of the model calculations are useful, but direct sampling would be better.	Figure 3-6 and 4-34 were added to show detected concentrations of benzene in soil gas to give the reader a better understanding of the spatial relationship between the groundwater plume and the soil-gas detections.
3.	Nature and Extent of Contamination 4-1 and 4-2	Based on the data shown, it appears that point source for the contamination is not known, but some speculation has been presented regarding the fill material placed at the site in the early- to mid-20th Century. Given that MtBE use was relatively recent (late 1970s to the present) and certainly did not occur at the same time as the Town Gas plants or the other industrial processes of the late 19th and early 20th Centuries, how does one reconcile the MtBE concentrations in the groundwater? This evidence would seem to point to a possible continuing and more recently released source and also may include leachate from the soil.	The conceptual site model was clarified to address the possibility of a more recent spill containing MTBE; however, the sporadic nature of MTBE detections (both temporally and spatially) do not correlate well with benzene and naphthalene detections, and do not support any link between MTBE and to the elevated benzene and naphthalene concentrations within the plume centers. See the response to general comment 5 regarding previous MTBE detections.

Comment No.	Section/Page Number	Comment	Response
4.	Nature and Extent of Contamination 4-3 and 4-4	As a minor point, SURFER© is a trademarked name and should noted as such in the text. The use of this program is great in the environmental industry and this reviewer highly recommends it, but it does have limitations and human intervention (and some subjectivity) is often necessary. Judging from the contours drawn for the project, it seems that the program force-fitted some of the data points without regard to normal plume behavior. As a reference to other reviewers, it may be helpful to name the kriging technique that was chosen in the program to generate the contours (natural neighbor, kriging, log, etc.) and any anisotropy employed in the contouring. This reviewer believes that a more natural or accurate set of contours could be generated from the data by using the proper settings on the program and some intuitive (and subjective) judgment on the registered geologist's or engineer's part. This may also be helpful in identifying the source areas.	Surfer® was referenced appropriately in the text. The computer-generated contour maps were reviewed and adjusted by a registered geologist. The new plume maps indicated areas where the contours were approximated. A discussion of the kriging technique used to generate the plots was also included in Section 4.1.3.
5.	Nature and Extent of Contamination 4-4	The Mann-Kendall statistic is also very useful, but can be misleading depending on the data set, time frame of the data and the number of data points. This reviewer prefers to use the Mann-Kendall statistic is conjunction with other techniques to determine if the Mann-Kendall statistic is applicable to the data set. One can also calculate the confidence level of the statistic given the number of data points being reviewed. In this case, the Mann-Kendall statistic may be somewhat skewed because of the relatively small number of data points used for the valuation. A more useful technique may be to graph the constituent concentrations and the groundwater levels vs. time to determine overall trends and to compare to variations in seasonal groundwater fluctuations. Some of the wells are obviously stable or decreasing, but others are clearly increasing and should be noted as such for a more complete report.	Comment noted. The Mann-Kendall statistics for all wells with detectable concentrations of benzene were calculated and reported with the confidence level for the statistic. Tables used to calculate the Mann-Kendall statistics were provided in Appendix C. Figures 2-2 and 2-3 were included to demonstrate groundwater flow direction and seasonal fluctuations at the site.
6.	Nature and Extent of Contamination 4-20	The reviewer concurs that some of the NA data can be useful when plotted versus depth; however, in this case plots of acceptors and donors concentrations along the length and width of the plume (across the major and minor axes) may be helpful in determining whether other treatment technologies (or the locations for preferred treatment technologies may be improved) may be better suited for the cleanup.	Comment noted. Figures 4-31 and 4-32 were added to present the latest available MNA data generated by the ongoing basewide groundwater sampling program across two lateral plume transects.
7.	Nature and Extent of Contamination 4-23	As MtBE is a constituent in the plume and a curious contaminant for an older plume, it would be helpful to explain its presence in the Conceptual Site Model. With no discussion in the CSM for it, it is a question that may continue to surface.	The conceptual site model was revised to address possible source(s) of MTBE. See the response to general comment 5 regarding previous MTBE detections.

RESPONSE TO COMMUNITY COMMENTS – Draft Groundwater Remedial Investigation/Feasibility Study
Alameda Point IR Site 25, and Alameda Annex IR Site 02
Alameda, California
Document Date: October 2003

Comment No.	Section/Page Number	Comment	Response
8.	Nature and Extent of Contamination 4-23 through 4-26	The reviewer is cognizant of the fact that the current and past soil-gas data do not lend themselves to explaining the current groundwater contamination. However, with no source of contamination identified and the presence of MtBE within the groundwater plume, it seems that this portion of the report is not complete and to recommend a treatment option without knowing whether more contaminant mass may be added to the plume seems premature.	The conceptual site model was revised to more clearly explain the possible sources. See the response to general comment 5 regarding the sporadic nature of previous MTBE detections. MTBE was included in the risk assessment and contributed less than 1 percent to the calculated risk. The alternatives presented in the RI/FS were designed to address the primary risk drivers, benzene and naphthalene.
9.	Contaminant Fate and Transport	The reviewer still questions the use of hydropunch data and monitoring well data together as equals for determining trends for the site.	See the response to specific comment 1.
10.	Identification and Screening of Technologies 8-7	Although the reviewer is not a general supporter of groundwater pump and treat systems for all groundwater contamination, in this case, the detailed analysis of pump and treat would make sense and may actually be a better technology given the nearby residential and educational uses of the site than the preferred treatment technology. The reviewer recommends that pump and treat be analyzed at the same level of completeness as air sparging (or biosparging).	See the response to general comment 2.

RESPONSE TO COMMUNITY COMMENTS – Draft Groundwater Remedial Investigation/Feasibility Study
Alameda Point IR Site 25, and Alameda Annex IR Site 02
Alameda, California
Document Date: October 2003

Comment No.	Section/Page Number	Comment	Response
Comments from Lea Loizos, Restoration Advisory Board OU-5 Focus Group			
	General	First and foremost, we are concerned that a remedy is being discussed without having properly defined the plume and its source. Efforts to remediate the groundwater plume may be futile if there is still a source area. It is our sincere hope that a better analysis of the available data and possible source areas will be conducted before any final decisions are made about the remedy. We are also greatly concerned about the increased volatilization that will occur with biosparging. If the gases do not biodegrade as expected in the vadose zone and emissions are not controlled, there is a substantial risk of inhalation of toxic gases for those living on Site 25.	Please refer to the response to Mr. Conner's general comment 5 and specific comment 8 regarding the plume delineation and source identification. To address concerns over fugitive emissions of benzene from the subsurface during biosparging, vapor monitoring and controls were added to all alternatives involving biosparging or air sparging.
1a.	Source of the plume	As of yet, the source of the benzene plume has not been identified. Despite claims that the levels of contamination are decreasing, it is our opinion that the plume is stable and that the plume is migrating to the northwest. In reviewing the data it is clear that concentrations are neither increasing nor decreasing substantially. This is rather concerning as it is unusual for a plume of this type to remain in the groundwater for as long as this plume has. Although it may be due in part to anaerobic conditions, we are not yet convinced of this and are concerned that there may still be a source of the benzene. There are reports from former employees that the area was used for the burning of aircraft parts. We urge the Navy to conduct a better investigation of the historical uses of the area and provide better justification for the assumption that there is no longer a source of contamination to the groundwater.	Additional aerial photo research was performed to refine the understanding of past site operations and was reported within the revised text. The conceptual site model was expanded and clarified, as discussed in the response to Mr. Conner's specific comment 8, so that the source theories were more thoroughly examined.
1b.	Source of the plume	A better investigation into the stained area is required. It seems like more than coincidence that the hotspot of the plume is directly below the stained area. There is no justification provided to prove otherwise. A reference is given on page 1-11 to an ERM-West document that discusses remediation that took place in the stained area, however the document is not listed in the references section. Indeed, later in the document it states, "The stained area was allegedly remediated, indicating there is no continuing source area. However, no information was available to confirm that remediation had occurred." (Section 4.4.2) Please clarify whether or not remediation occurred in this area.	Past cleanup activities at Mayport/Kollman Circle have not been verified. Any reference to these cleanup actions was removed. Section 4.5.5 was added to the draft final report to discuss data gaps, including investigating potential soil sources in the Mayport/Kollman Circle area.
1c.	Source of the plume	The utility lines may also be a source. Have the utility lines in this area been investigated to ensure that there are no leaking pipelines? Please include a utility diagram in the report.	Utility lines have been investigated for leaks as discussed in Section 2.4. A map of the utilities was provided in the revised report, as Figure 2-5.

Comment No.	Section/Page Number	Comment	Response
2.	Poor boundary definition	The boundaries of the plume are incorrectly represented in several of the figures. The figures give the impression that the plume is bound on all sides, when in fact the west and northwest boundaries are not yet defined. Furthermore, the program used to draw the boundaries has created odd-shaped plumes that do not naturally occur (e.g., Figure 4-2). If the Navy believes this to be a true representation of the plume shape, an explanation for the unusual shape is required (e.g., is there a geologic reason?) We urge you to redraw the plume maps to adequately represent all of the data and to only show the plume boundaries that have been defined thus far.	The computer-generated plume maps were reviewed and adjusted, as necessary by a registered geologist, so that they more accurately reflected site conditions and overcame the limitations of the computer program. A discussion of the kriging technique used to generate the initial contours was also included in Section 4.1.3.
3.	Lack of discussion about MTBE contamination	The document only focuses on the benzene contamination in the groundwater without any in-depth discussion about other detected contaminants, such as MTBE and 1,2-dichloroethane. The MTBE is of particular concern, as it indicates a more recent spill (within the last 15 years). The 1,2-dichloroethane is also of concern as it is not a component of gasoline, the suspected original source of the benzene plume. A more thorough examination of these contaminants is necessary, including possible sources, associated risks, and possible remedial alternatives, if necessary. Please include a map showing the location of the MTBE plume relative to the benzene plume.	The conceptual site model was revised to address possible sources of these contaminants. Section 4.1.1 was revised to summarize the previous detections of MTBE and 1,2-DCA. The available data supports the conclusion that neither MTBE or 1,2-DCA warrant remedial action under this RI/FS. In addition, references to specific maps in the OU-5 RI report that depict MTBE and 1,2-DCA concentrations were provided. Figure 4-1 was also provided to summarize MTBE data in all wells with detectable concentrations of MTBE. See the response to EPA RPM comment 16 for specific information regarding MTBE detections, and see the response to DTSC GSU comment 11 for specific information regarding 1,2-DCA detections. The source(s) of the limited MTBE and 1,2 DCA detections is unknown; however, given the limited detection frequency and low estimated mass, the detected concentrations do not pose a risk to human health or the environment. For that reason neither MTBE nor 1,2, DCA warrant remedial action under this RI/FS.
4a.	Lack of soil gas and indoor air data	Since the beginning of the Remedial Investigation and Feasibility Study process for OU-5, we have been requesting indoor air sampling. Results of samples taken by the Coast Guard were to be included in this report but are not presented. Please include this data or provide data from indoor air samples taken by the Navy.	The report presenting the results of the indoor air sampling conducted by the Coast Guard was included as Appendix B,

RESPONSE TO COMMUNITY COMMENTS – Draft Groundwater Remedial Investigation/Feasibility Study
Alameda Point IR Site 25, and Alameda Annex IR Site 02
Alameda, California
Document Date: October 2003

Comment No.	Section/Page Number	Comment	Response
4b.	Lack of soil gas and indoor air data	The conclusions drawn from the soil gas sampling are not well supported. A better explanation of how it was determined that the benzene detected in the soil gas is not related to the groundwater benzene plume is required. (Section 3.2) The results of the soil gas sampling would be more useful if a figure was provided showing where the soil gas samples were taken.	A more thorough explanation of soil-gas sampling results, including recent data generated by the ongoing basewide groundwater monitoring program, was included in Sections 3.2 and 4.2 of the revised report. Figures 3-6 and 4-34 were added to show the soil gas detections relative to vapor intrusion screening criteria.
5.	Increasing volatilization through the introduction of air	We are concerned about the possibility of increased volatilization that could occur as a result of the biosparging. As most of Site 25 is currently residential property, the risk of toxic gases entering the homes is already a great concern. By creating a more aerobic environment and increasing the degradation rate of the groundwater plume, the amount of volatiles entering into indoor air may increase. For this reason, we believe that other remedies that do not increase the possibility for volatilization should be analyzed. Specifically, we would like to see the groundwater and extraction (or "pump and treat") remedy analyzed as thoroughly as the other remedies. Although this remedy may require more time to reach the cleanup levels and is typically not preferred, it may be a more appropriate remedy for a residential site. At the same time, a better analysis of the effects of bio or airsparging should be conducted, especially considering the shallow depth of the vadose zone. How can we be certain that volatile organics will not be entering the homes above the plume? What type of monitoring will be done to ensure the protection of those living on the site? If harmful levels of benzene or other volatiles are detected, what can/will be done to mitigate the risk?	A more complete discussion of the potential impacts of biosparging in a residential area with a shallow vadose zone was provided. Additional discussion of the proposed monitoring and contingency soil vapor extraction system was provided. Pump and treat remedial technology wase more thoroughly reviewed within Section 8 and was retained as Alternative 6 in Section 9.
6a.	Missing groundwater data	There is also no fence data, which makes it difficult to know at what depths the wells are located. Please include this information in the draft final version.	Screened intervals for the current monitoring wells were provided within the figures in Section 3.
6b.	Missing groundwater data	The document makes improper comparisons of hydropunch and monitoring well data, as if the two are the same. The volume of water collected from a monitoring well is greater than that collected from a hydropunch, allowing for more dilution. Comparing the data from the two misrepresents the trends occurring on the site. Please adjust your analyses as necessary to correct this discrepancy.	See response to Mr. Conner's specific comment 1.

RESPONSE TO COMMUNITY COMMENTS – Draft Groundwater Remedial Investigation/Feasibility Study
Alameda Point IR Site 25, and Alameda Annex IR Site 02
Alameda, California
Document Date: October 2003

Comment No.	Section/Page Number	Comment	Response
7.	Use of the Mann-Kendall statistic	The Mann-Kendall statistic was used to determine the stability of the plume. We are concerned that the results are skewed because of the relatively small data set that was used. Furthermore, it seems that the use of this statistic is not appropriate in areas that are tidally influenced. Please include the results of other techniques commonly used for this purpose so that we may compare them with the results of the Mann-Kendall statistic. For example, a graph of the constituent concentrations and groundwater levels vs. time would be useful.	The Mann-Kendall tests were run for all wells at the site (with the exception of recently installed wells), using the latest available data, results were presented in Appendix D. A graph of benzene concentrations versus depth to groundwater was presented as Figure 4-28.

References:

Department of Defense. 2004. Memorandum from Alex A. Beehler, Assistant Under Secretary of Defense (Environment, Safety, and Occupational Health) regarding "*Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Record of Decision (ROD) and Post-ROD Policy.*" January 16.

International Technology Corporation (IT). 2001. *Parcel Evaluation Data Summary, Phase 2A Sampling, Zone 16: Housing Zone, Parcel 178: Family Housing, Alameda Point, Alameda, California.* January.

IT, Neptune and Company, Inc., and Environ (IT et al.). 2002. *Draft Final Operable Unit 5 (OU-5) Remedial Investigation Report, Alameda Point, Alameda, California.* July 12.

PRC Environmental Management, Inc. and Versar, Inc. (PRC and Versar), 1996. *Final Remedial Investigation, Fleet Industrial Supply Center, Alameda Annex.* January.

Tetra Tech, Inc. 2002. *Residential Risk Evaluation for U.S. Coast Guard Housing, Alameda, California.* August.

Tetra Tech EM, Inc., 1999. *Draft OU-2 Remedial Investigation Report, Alameda Point.*

TABLE OF CONTENTS

EXECUTIVE SUMMARY ES-1

1. INTRODUCTION **1-1**

1.1. SITE DESCRIPTION 1-3

1.1.1. Alameda Point Sites 25, 30, and 31 Description 1-3

1.1.2. Alameda Annex Description 1-3

1.2. SITE HISTORY 1-4

1.2.1. Alameda Point History 1-4

1.2.2. Alameda Annex Site History 1-6

1.3. CURRENTLY PLANNED SITE REUSE 1-6

2. PHYSICAL CHARACTERISTICS OF THE STUDY AREA **2-1**

2.1. GEOLOGY 2-1

2.2. HYDROGEOLOGY 2-2

2.3. GROUNDWATER BENEFICIAL USE 2-4

2.3.1. Potential Beneficial Uses of Groundwater – Alameda Point 2-4

2.3.2. Potential Beneficial Uses of Groundwater – Alameda Annex 2-5

2.3.3. Groundwater Beneficial Use Discussions – 2002 2-6

2.3.4. Summary of Groundwater Beneficial Use Investigations 2-6

2.4. UTILITIES 2-7

3. PREVIOUS INVESTIGATIONS **3-1**

3.1. PREVIOUS GROUNDWATER INVESTIGATIONS 3-1

3.1.1. Previous Alameda Point Groundwater Investigations 3-1

3.1.2. Previous Alameda Annex Groundwater Investigations 3-6

3.1.3. Previous Groundwater Investigations for Alameda Point and Annex 3-7

3.1.4. Monitoring Well Network and Hydropunch™ Sampling Locations 3-8

3.1.5. Groundwater Analytical Data Set 3-9

3.2. PREVIOUS SOIL GAS AND INDOOR AIR INVESTIGATIONS 3-9

3.3. PREVIOUS SOIL INVESTIGATIONS AND REMOVAL ACTIONS 3-13

4. NATURE AND EXTENT OF CONTAMINATION **4-1**

4.1. GROUNDWATER CONTAMINATION 4-1

4.1.1. Contaminants of Potential Concern in Groundwater 4-1

4.1.2. Benzene Contour Maps Presented in Previous Reports 4-4

4.1.3. Benzene Contour Maps Prepared for this Report 4-5

4.1.4. Naphthalene Contour Maps 4-7

TABLE OF CONTENTS (continued)

4.1.5. Time-Series Evaluation of Benzene and Naphthalene in Groundwater 4-7
4.1.6. Monitored Natural Attenuation Parameters 4-12
4.1.7. Groundwater Conceptual Site Model 4-13
4.2. SOIL GAS CONTAMINATION 4-16
4.2.1. Contaminants of Potential Concern in Soil Gas 4-16
4.2.2. Vapor Intrusion Evaluation 4-17
4.2.3. Soil Gas Contamination Related to Groundwater 4-20
4.3. SOILS CONTAMINATION RELATED TO GROUNDWATER 4-21
4.4. EVALUATION OF POSSIBLE CONTAMINANT SOURCES 4-22
4.4.1. Contaminated Fill Materials and Buried Inclusions 4-23
4.4.2. Marsh Crust 4-23
4.4.3. Point-Source Discharges 4-24
4.4.4. Summary – Possible Contaminant Sources 4-24
4.5. ASSESSMENT OF ADEQUACY OF DATA 4-25
4.5.1. Hydropunch™ Sampling Depth Inconsistencies 4-25
4.5.2. MNA Parameter Monitoring 4-25
4.5.3. Correlation of Monitoring Well and Hydropunch™ Data 4-26
4.5.4. Detection Limits Above Risk Based Criteria 4-26
4.5.5. Data Gaps 4-28
4.6. SUMMARY – NATURE AND EXTENT OF CONTAMINATION 4-29

5. CONTAMINANT FATE AND TRANSPORT 5-1
5.1. FATE AND TRANSPORT MECHANISMS 5-1
5.2. BIODEGRADATION MECHANISMS FOR BENZENE AND NAPHTHALENE 5-1
5.3. EVALUATION OF FATE AND TRANSPORT MECHANISMS – INITIAL RELEASE TO THE PRESENT 5-7
5.4. PREVIOUS FATE AND TRANSPORT STUDY 5-8
5.5. EVALUATION OF FATE AND TRANSPORT MECHANISMS – CURRENT AND FUTURE 5-9
5.6. PLUME STABILITY EVALUATION 5-9
5.7. PLUME STABILITY SUMMARY 5-12
5.8. EXPOSURE PATHWAY EVALUATION 5-12
5.8.1. Human Health Exposure Pathways 5-12
5.8.1.1 Soil Gas Migration 5-12
5.8.1.2 Groundwater Migration via Shallow Well Pumping 5-13

TABLE OF CONTENTS (continued)

5.8.2. Ecological Exposure Pathways 5-13
5.8.2.1 Lateral Groundwater Migration 5-14
5.8.2.2 Storm Drain System Migration 5-17
5.9. FATE AND TRANSPORT SUMMARY 5-18

6. RISK ASSESSMENT 6-1
6.1. SUMMARY OF HHRA RESULTS 6-1
6.2. EXPOSURE PATHWAYS 6-2
6.3. FATE AND TRANSPORT ASSUMPTIONS 6-3
6.4. EXPOSURE POINT CONCENTRATION DATA 6-5
6.5. SELECTION OF BLOCK KRIGING RADII 6-7
6.6. ECOLOGICAL RISK ASSESSMENT 6-8
6.6.1. Alameda Point ERA Summary 6-8
6.6.2. Alameda Annex ERA Summary 6-8
6.6.3. ERA Summary 6-9

7. APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS 7-1
7.1. INTRODUCTION 7-1
7.1.1. Summary of CERCLA and National Contingency Plan Requirements 7-1
7.1.2. Methodology Description 7-4
7.1.2.1 General 7-4
7.1.2.2 Identifying and Evaluating Federal ARARs 7-5
7.1.2.3 Identifying and Evaluating State ARARs 7-5
7.1.3. Other General Issues 7-6
7.1.3.1 General Approach to Requirements of the Federal Resource Conservation and Recovery Act 7-6
7.1.4. Waste Characterization 7-7
7.1.4.1 RCRA Hazardous Waste Determination 7-7
7.1.4.2 California-Regulated, Non-RCRA Hazardous Waste 7-10
7.1.4.3 Other California Waste Classifications 7-10
7.2. CHEMICAL-SPECIFIC ARARS 7-11
7.2.1. Summary of ARARs Conclusions by Medium 7-11
7.2.1.1 Groundwater ARARs Conclusions 7-11
7.2.1.2 Air ARARs Conclusions 7-17
7.2.2. Detailed Discussion of ARARs by Medium 7-18
7.2.2.1 Groundwater ARARs 7-18
7.2.2.2 Air ARARs 7-23

TABLE OF CONTENTS (continued)

7.3. Location-Specific ARARs 7-24
7.3.1. Summary of Location-Specific ARARs 7-24
7.3.1.1 Hydrologic Resources Conclusions 7-25
7.3.1.2 Biological Resources Conclusions 7-25
7.3.1.3 Coastal Resources Conclusions 7-25
7.3.2. Detailed Discussion of ARARs 7-25
7.3.2.1 Hydrologic Resources ARARs 7-35
7.3.2.2 Biological Resources ARARs 7-35
7.3.2.3 Coastal Resources ARARs 7-36
7.4. ACTION-SPECIFIC ARARS 7-37
7.4.1. Alternative 1 – No Action 7-38
7.4.2. Alternative 2 – Monitored Natural Attenuation with Institutional Controls 7-38
7.4.2.1 Groundwater Monitoring ARARs 7-59
7.4.2.2 Institutional Controls ARARs 7-60
7.4.2.3 Conclusion 7-61
7.4.3. Alternative 3 – Biosparging, with Soil Vapor Extraction, Monitored Natural Attenuation, and Institutional Controls 7-62
7.4.3.1 Sparging and SVE ARARs 7-62
7.4.3.2 Conclusions 7-63
7.4.4. Alternative 4 – Biosparging with Nutrient/Microorganism Enhancement, SVE, MNA, and Institutional Controls 7-63
7.4.5. Alternative 5 – Air Sparging with SVE, MNA, and Institutional Controls 7-63
7.4.6. Alternative 6 – Pump and Treat with MNA and Institutional Controls 7-63
7.5. SUMMARY 7-64

8. IDENTIFICATION AND SCREENING OF TECHNOLOGIES 8-1
8.1. REMEDIAL ACTION OBJECTIVES 8-1
8.2. GENERAL RESPONSE ACTIONS 8-3
8.3. IDENTIFICATION AND SCREENING OF TECHNOLOGY TYPES AND PROCESSES 8-3
8.3.1. No-Action 8-3
8.3.2. Institutional Actions 8-4
8.3.2.1 Institutional Controls 8-4
8.3.2.2 Engineering Controls 8-5
8.3.2.3 Site Monitoring 8-5

TABLE OF CONTENTS (continued)

8.3.3. Groundwater Containment and/or Removal, Treatment, and Disposal 8-6
8.3.3.1 Groundwater Pump and Treat Systems 8-6
8.3.3.2 Phytoremediation 8-7
8.3.4. Saturated Soil Removal, Treatment, and Disposal 8-8
8.3.5. In Situ Treatment 8-9
8.3.5.1 Monitored Natural Attenuation 8-9
8.3.5.2 Air Sparging with Soil Vapor Extraction 8-10
8.3.5.3 Biosparging with Soil Vapor Extraction 8-11
8.3.5.4 Bioventing 8-13
8.3.5.5 Nutrient/Microorganism Enhancement 8-14
8.3.5.6 Aerobic Degradation with Oxygen Release Compound 8-15
8.3.5.7 Aerobic Degradation using Chemical Oxidation 8-16
8.3.5.8 Steam Enhanced Extraction 8-17
8.3.5.9 Electrical Resistance Heating 8-18
8.4. SUMMARY OF RETAINED TECHNOLOGIES AND PROCESS OPTIONS 8-19

9. DEVELOPMENT AND SCREENING OF REMEDIAL ALTERNATIVES 9-1
9.1. Evaluation Criteria 9-3
9.2. ALTERNATIVE 1 – NO ACTION 9-4
9.2.1. Overall Protection of Human Health and the Environment 9-4
9.2.2. Compliance with ARARs 9-5
9.2.3. Long-Term Effectiveness and Permanence 9-5
9.2.4. Reduction of Toxicity, Mobility, or Volume through Treatment 9-5
9.2.5. Short-Term Effectiveness 9-5
9.2.6. Implementability 9-5
9.2.7. Cost 9-6
9.2.8. State/Community Acceptance 9-6
9.3. ALTERNATIVE 2 – MONITORED NATURAL ATTENUATION WITH INSTITUTIONAL CONTROLS 9-6
9.3.1. Overall Protection of Human Health and the Environment 9-14
9.3.2. Compliance with ARARs 9-14
9.3.3. Long-Term Effectiveness and Permanence 9-15
9.3.4. Reduction of Toxicity, Mobility, or Volume through Treatment 9-15
9.3.5. Short-Term Effectiveness 9-15
9.3.6. Implementability 9-15
9.3.7. Cost 9-15

TABLE OF CONTENTS (continued)

9.3.8. State/Community Acceptance 9-16

9.4. ALTERNATIVE 3 – BIOSPARGING WITH SOIL VAPOR EXTRACTION, MONITORED NATURAL ATTENUATION, AND INSTITUTIONAL CONTROLS 9-16

9.4.1. Overall Protection of Human Health and the Environment 9-19

9.4.2. Compliance with ARARs 9-19

9.4.3. Long-Term Effectiveness and Permanence 9-20

9.4.4. Reduction of Toxicity, Mobility, or Volume through Treatment 9-20

9.4.5. Short-Term Effectiveness 9-21

9.4.6. Implementability 9-21

9.4.7. Cost 9-21

9.4.8. State/Community Acceptance 9-22

9.5. ALTERNATIVE 4 – BIOSPARGING WITH SOIL VAPOR EXTRACTION, NUTRIENT/MICROORGANISM ENHANCEMENT, MONITORED NATURAL ATTENUATION, AND INSTITUTIONAL CONTROLS 9-22

9.5.1. Performance Criteria 9-23

9.5.2. Biosparging System Design 9-23

9.5.3. Overall Protection of Human Health and the Environment 9-23

9.5.4. Compliance with ARARs 9-23

9.5.5. Long-Term Effectiveness and Permanence 9-24

9.5.6. Reduction of Toxicity, Mobility, or Volume through Treatment 9-24

9.5.7. Short-Term Effectiveness 9-24

9.5.8. Implementability 9-24

9.5.9. Cost 9-25

9.5.10. State/Community Acceptance 9-25

9.6. ALTERNATIVE 5 – AIR SPARGING WITH SOIL VAPOR EXTRACTION, MONITORED NATURAL ATTENUATION, AND INSTITUTIONAL CONTROLS 9-25

9.6.1. Performance Criteria 9-26

9.6.2. Air Sparging System Design 9-26

9.6.3. Overall Protection of Human Health and the Environment 9-26

9.6.4. Compliance with ARARs 9-26

9.6.5. Long-Term Effectiveness and Permanence 9-27

9.6.6. Reduction of Toxicity, Mobility, or Volume through Treatment 9-27

9.6.7. Short-Term Effectiveness 9-27

9.6.8. Implementability 9-27

TABLE OF CONTENTS (continued)

9.6.9. Cost 9-28
9.6.10. State/Community Acceptance 9-28
9.7. ALTERNATIVE 6 – PUMP AND TREAT WITH MONITORED NATURAL ATTENUATION AND INSTITUTIONAL CONTROLS 9-28
9.7.1. Performance Criteria 9-29
9.7.2. Pump and Treat System Design 9-29
9.7.3. Overall Protection of Human Health and the Environment 9-30
9.7.4. Compliance with ARARs 9-30
9.7.5. Long-Term Effectiveness and Permanence 9-31
9.7.6. Reduction of Toxicity, Mobility, or Volume through Treatment 9-31
9.7.7. Short-Term Effectiveness 9-31
9.7.8. Implementability 9-31
9.7.9. Cost 9-31
9.7.10. State/Community Acceptance 9-31
9.8. COMPARATIVE EVALUATION OF REMEDIAL ALTERNATIVES 9-32
9.8.1. Long-Term Effectiveness and Permanence 9-32
9.8.2. Reduction of Toxicity, Mobility, or Volume through Treatment 9-33
9.8.3. Short-Term Effectiveness 9-33
9.8.4. Implementability 9-34
9.8.5. Cost 9-35
9.8.6. State/Community Acceptance 9-35

10. CONCLUSIONS 10-1

11. REFERENCES 11-1

TABLE OF CONTENTS (continued)

List of Figures

Figure 1-1: Site Location Map
Figure 1-2: Investigation Site Boundaries
Figure 1-3: EBS Parcel Boundaries
Figure 1-4: Comparison of Historic Shoreline
Figure 1-5: Aerial Photograph, August 14, 1953
Figure 1-6: Aerial Photograph, April 10, 1968
Figure 2-1: Geologic Cross-Section A-A' (from IT Corp RI)
Figure 2-2: Geologic Cross-Section B-B' (from IT Corp RI)
Figure 2-3: Groundwater Elevation Map Winter 2002
Figure 2-4: Groundwater Elevation Map Summer 2003
Figure 2-5: Subsurface Utilities Map
Figure 3-1: Historical Groundwater Monitoring Wells
Figure 3-2: Monitoring Wells Included in 2001 Sampling Event
Figure 3-3: EBS Hydropunch™ Locations
Figure 3-4: 2001 Hydropunch™ Locations
Figure 3-5: Soil gas Probes and Monitoring Wells Installed in 2002
Figure 3-6: Benzene Concentrations in Soil gas
Figure 4-1: MTBE Concentrations in Shallow Monitoring Wells
Figure 4-2: 1994 Benzene Contour Map, Shallow Monitoring Well Data
Figure 4-3: 1999 Benzene Contour Map, Shallow Monitoring Well Data
Figure 4-4: 2001 Benzene Contour Map, Shallow Monitoring Well Data
Figure 4-5: 2001 Benzene Contour Map, 12-16' bgs Hydropunch™ Data
Figure 4-6: 2001 Benzene Contour Map, 16-20' bgs Hydropunch™ Data
Figure 4-7: 2001 Benzene Contour Map, 20-24' bgs Hydropunch™ Data
Figure 4-8: 2003 Benzene Contour Map, Shallow Monitoring Well Data
Figure 4-9: 2001 Naphthalene Contour Map, Hydropunch™ Data, 16-20' bgs
Figure 4-10: 2003 Naphthalene Contour Map, Shallow Monitoring Well Data
Figure 4-11: Benzene in Monitoring Well EW-2
Figure 4-12: Benzene in Monitoring Well P181-MW45
Figure 4-13: Benzene in Monitoring Well P181-MW46

TABLE OF CONTENTS (continued)

Figure 4-14: Benzene in Monitoring Well P181-MW47

Figure 4-15: Benzene in Monitoring Well PW12

Figure 4-16: Benzene in Monitoring Well S-02

Figure 4-17: Benzene in Monitoring Well S-12

Figure 4-18: Benzene in Monitoring Well S-13

Figure 4-19: Benzene in Monitoring Well S-16

Figure 4-20: Benzene in Monitoring Well S-35

Figure 4-21: Benzene in Monitoring Well PW-10A

Figure 4-22: Benzene in Monitoring Well MW25-01

Figure 4-23: Benzene in Monitoring Well MW25-02

Figure 4-24: Benzene in Monitoring Well MW25-03

Figure 4-25: Benzene in Monitoring Well MW25-04

Figure 4-26: Benzene in Monitoring Well MW25-05

Figure 4-27: Monitoring Wells Time-Series Data For Benzene

Figure 4-28: Correlation of Benzene Concentrations with Depth to Groundwater in Monitoring Well M25-05

Figure 4-29: DO as a Function of Depth

Figure 4-30: ORP as a Function of Depth

Figure 4-31: MNA Parameters Across a North/South Plume Transect

Figure 4-32: MNA Parameters Across an East/West Plume Transect

Figure 4-33: Conceptual Site Model

Figure 4-34: Benzene Concentrations Exceeding Screening Levels

Figure 5-1: First-Order Decay of Benzene in Monitoring Well EW-2

Figure 5-2: First-Order Decay of Benzene in Monitoring Well P181-MW45

Figure 5-3: First-Order Decay of Benzene in Monitoring Well P181-MW46

Figure 5-4: First-Order Decay of Benzene in Monitoring Well P181-MW47

Figure 5-5: First-Order Decay of Benzene in Monitoring Well PW12

Figure 5-6: First-Order Decay of Benzene in Monitoring Well S-02

Figure 5-7: First-Order Decay of Benzene in Monitoring Well S-12

Figure 5-8: First-Order Decay of Benzene in Monitoring Well S-13

Figure 5-9: First-Order Decay of Benzene in Monitoring Well S-16/S-16-2

TABLE OF CONTENTS (continued)

Figure 5-10: First-Order Decay of Benzene in Monitoring Well S-35

Figure 5-11: First-Order Decay of Benzene in Monitoring Well PW-10A

Figure 5-12: Benzene Groundwater Contour Map; 1994 Monitoring Well Data and 2003 Monitoring Well Data

Figure 5-13: Benzene Groundwater Contour Map; 2001 Shallow Hydropunch™ Data (12-16' bgs) versus 2001 Deeper Hydropunch™ Data (16-20' bgs)

Figure 9-1: Biosparging System Conceptual Drawing

Figure 9-2: Alternative 3 – Biosparging Zones

Figure 9-3: Typical Biosparging System Components

Figure 9-4: Typical Sparging Well Construction

Figure 9-5: Comparative Analysis of Remedial Alternatives

List of Tables

Table 3-1: Supporting Document Summary

Table 4-1: Benzene Plume Delineation Summary

Table 4-2: Evaluation of MNA Parameters in 2001 Hydropunch™ Samples

Table 4-3: Summary of Historic Soil Gas Data – Detected Compounds

Table 4-4: Naphthalene Concentrations in Co-Located Soil and Groundwater Samples

Table 5-1: Summary of Fate and Transport Mechanisms

Table 5-2: Physical/Chemical Properties Affecting Contaminant Fate and Transport

Table 5-3: Comparison of Concentrations of Maximum Detected Groundwater Concentrations to Ambient Water Quality Criteria

Table 6-1: Summary of Tier 2 HHRA Results

Table 6-2: Summary of Tier 2 HHRA Results Modeled from Soil Gas Data

Table 6-3: Summary of Tier 2 HHRA Exposure Point Concentrations

Table 7-1: Proposed Federal and State Chemical-Specific ARARs for Groundwater

Table 7-2: Criteria and Standards for Chemicals of Concern in Groundwater

Table 7-3: Proposed Federal Location-Specific ARARs

Table 7-4: Proposed State Location-Specific ARARs

Table 7-5: Proposed Federal Action-Specific ARARs

Table 7-6: Proposed State Action-Specific ARARs

Table 8-1: Remedial Technology Screening Table and Evaluative Criteria Results

TABLE OF CONTENTS (continued)

List of Appendices

Appendix A: Groundwater Analytical Data Set

Appendix B: Residential Risk Evaluation for U.S. Coast Guard Housing (August 2002 Report)

Appendix C: Mann-Kendall Trend Evaluations

Appendix D: Vapor Intrusion Evaluation

Appendix E: Human Health Risk Assessment

Appendix F: Monitored Natural Attenuation Description

Appendix G: Biosparging Description

Appendix H: Remedial Alternative Cost Estimates

ACRONYMS AND ABBREVIATIONS

AFWBZ	Alameda Formation Water Bearing Zone
Alameda Point	Former Naval Air Station Alameda
AM	Action Memorandum
ARAR	Applicable or Relevant and Appropriate Requirement
ARB	California Air Resources Board
ASTM	American Society for Testing and Materials
BAAQMD	Bay Area Air Quality Management District
BACT	best available control technology
BaP	benzo(a)pyrene
BCT	BRAC Cleanup Team
bgs	below ground surface
BRAC	Base Realignment and Closure Act
BTEX	benzene, toluene, ethylbenzene, and xylene
CAA	Clean Air Act
Cal. Code Regs.	California Code of Regulations
Cal/EPA	California Environmental Protection Agency
CAP	Corrective Action Plan
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
ChemOx	chemical oxidation
COPC	contaminant of potential concern
CZMA	Coastal Zone Management Act
DAP	diammonium phosphate
DCE	dichloroethylene
DNAPL	dense non-aqueous phase liquid
DO	dissolved oxygen
DTSC	Department of Toxic Substances Control
EBS	Environmental Baseline Survey
EP	extraction procedures
ERA	Ecological Risk Assessment
Fed. Reg.	Federal Register
FISCA	Fleet and Industrial Supply Center Oakland, Alameda Facility/Alameda Annex
FS	Feasibility Study
FWBZ	first water bearing zone
GAC	granular activated carbon
gpm	gallons per minute
GRA	General Response Action

HHRA	Human Health Risk Assessment
HI	hazard index
HSWA	Hazardous and Solid Waste Amendments of 1984
IR	Installation Restoration
IRP	Installation Restoration Program
IT	International Technology Corporation
LLNL	Lawrence Livermore National Laboratory
m^3/m^2-d	cubic meters per square meters per day
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
mg/L	milligrams per liter
MNA	monitored natural attenuation
MOU	Memorandum of Understanding
MSL	mean sea level
MTBE	methyl tertiary butyl ether
NAAQS	National Ambient Air Quality Standards
NAS	Naval Air Station
Navy	U.S. Department of the Navy
NAWQC	National Ambient Water Quality Criteria
NCP	National Contingency Plan
NPDES	National Pollutant Discharge Elimination System
NPV	net present value
NSC	Naval Supply Center
O&M	operation and maintenance
ORC®	Oxygen Releasing Compound
ORP	oxidation-reduction potential
OSWER	USEPA Office of Solid Waste and Emergency Response
OU	Operable Unit
PAH	polynuclear aromatic hydrocarbon
POC	point of compliance
ppm	parts per million
ppm_w	parts per million by weight
PRG	Preliminary Remediation Goal
RAO	Remedial Action Objective

RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
ROD	Record of Decision
RWQCB	Regional Water Quality Control Board
SDWA	Safe Drinking Water Act
Shaw	Shaw Environmental and Infrastructure
SIP	State Implementation Plan
Site	affected areas of Alameda Point and Alameda Annex
Site 25	Alameda Point Installation Restoration Site 25
SPH	six-phase heating
STLC	Soluble Threshold Limit Concentrations
SVE	soil vapor extraction
SVOC	semi-volatile organic compound
SWBZ	second water bearing zone
TBC	to be considered
TCE	trichloroethylene
TCLP	toxicity characteristic leaching procedure
TDS	total dissolved solids
TPH	total petroleum hydrocarbons
TtEMI	Tetra Tech EM Inc.
TTLC	Total Threshold Limit Concentrations
UCL	upper confidence limit
USACE	United States Army Corp of Engineers
USC	United States Code
USCG	United States Coast Guard
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
VOC	volatile organic compound
WET	waste extraction test
µg/L	micrograms per liter
$\mu g/m^3$	micrograms per cubic meter

EXECUTIVE SUMMARY

This report presents the Remedial Investigation/Feasibility Study performed for shallow groundwater beneath portions of Alameda Point Site 25 and Alameda Annex Installation Restoration Site 02 (IR-02).

Shallow groundwater beneath the Site is contaminated with dissolved-phase benzene and polynuclear aromatic hydrocarbons, primarily naphthalene. The sources of this contamination are believed to be primarily previous point-source discharges and contaminated fill used to create Alameda Point Site 25 and Alameda Annex IR-02. Contamination entrapped in the Marsh Crust may also be contributing in part to the concentrations of contaminants observed in groundwater.

The remedial investigation portion of this report draws largely from the results of previous remedial investigations of both Alameda Point Site 25 and the Alameda Annex to summarize the nature and extent of contamination, and to evaluate its fate and transport.

Based on previous investigations, groundwater contamination at the Site does not appear to be migrating laterally, and has been undergoing natural degradation processes that are continuing to reduce contaminant concentrations. Dissolved oxygen (DO) readings decrease with depth to 20 feet below ground surface and subsurface conditions across the site have become predominantly anaerobic. Anaerobic biodegradation is occurring under predominantly sulfate reducing or methanogenic conditions, which generally proceed at a much slower rate than aerobic degradation. Ongoing groundwater and soil gas monitoring is being performed under the Alameda Point Basewide Groundwater Monitoring Program to track groundwater contamination and natural attenuation parameters.

Current conditions at the Site do not pose any unacceptable risks to residents, students, or workers, and ongoing groundwater monitoring has demonstrated that ecological receptors are not being exposed to contaminated groundwater from the Site. However, to determine if a Comprehensive Environmental Response, Compensation, and Liability Act remediation was required, a human health risk assessment was performed that included evaluation of the groundwater ingestion exposure pathway. Of the pathways evaluated in the risk assessment, only the hypothetical groundwater ingestion scenario (use of shallow groundwater as a potable water supply) was found to have associated risks outside the United States Environmental Protection Agency's risk management range.

Based on the results of the risk assessment, the remedial alternatives evaluated in this report were designed to reduce contamination to below drinking water standards, so that if the drinking water pathway were completed in the future, there would be no unacceptable risk to human health.

To address the risk associated with contaminated groundwater at the site, the following six remedial alternatives were formulated and evaluated using National Contingency Plan criteria:

- **Alternative 1** – No Action
- **Alternative 2** – Monitored Natural Attenuation (MNA) with Institutional Controls
- **Alternative 3** – Biosparging with Contingency Soil Vapor Extraction (SVE), MNA, and Institutional Controls
- **Alternative 4** – Biosparging with Nutrient/Microorganism Enhancement, Contingency Soil Vapor Extraction, MNA, and Institutional Controls
- **Alternative 5** – Air Sparging with SVE, MNA, and Institutional Controls
- **Alternative 6** – Pump and Treat with MNA and Institutional Controls

Alternative 1 was not considered to be protective of human health and the environment, and was therefore eliminated from a comparative analysis of the remaining alternatives. The comparative analysis of Alternatives 2, 3, 4, 5, and 6 concluded that each alternative was technically and administratively implementable and, with the exception of Alternative 6, the estimated cost of each alternative was comparable. The primary distinguishing factor in the comparative analysis was the performance of each alternative relative to the long-term effectiveness criteria, which can be summarized as follows:

- **Alternative 2** – The estimated time required to reduce groundwater contamination to below drinking water standards is 50 years.
- **Alternative 3** – The estimated time required to reduce groundwater contamination to below drinking water standards is 9 years (2 years for biosparging at three plume centers, and 7 years of subsequent MNA).
- **Alternative 4** – The estimated time required to reduce groundwater contamination to below drinking water standards is 8 years (2 years for biosparging with nutrient enhancement at three plume centers, and 6 years of subsequent MNA).
- **Alternative 5** – The estimated time required to reduce groundwater contamination to below drinking water standards is 8 years (1 year for air sparging at three plume centers, and 7 years of subsequent MNA).
- **Alternative 6** – The estimated time required to reduce groundwater contamination to below drinking water standards is 15 years (8 years for groundwater extraction and treatment at three plume centers, and 7 years of subsequent MNA).

In addition, the short-term effectiveness of each alternative was judged to be generally comparable, with the exception of Alternative 5 (air sparging). The increased air injection pressure associated with Alternative 5 will increase the volatilization of groundwater contaminants into the vadose zone. The volatilization will be controlled with soil vapor extraction and treatment; however, given the sensitive receptors at the Site, the increased fugitive emissions from an air sparging system may be less preferable compared to other alternatives.

1. INTRODUCTION

This report presents a focused Remedial Investigation/Feasibility Study (RI/FS) of groundwater contamination underlying portions of two adjacent Department of the Navy (Navy) properties in Alameda, California: the former Naval Air Station (NAS) Alameda (hereafter referred to as "Alameda Point") and the former Fleet and Industrial Supply Center Oakland (FISCA), Alameda Facility/Alameda Annex (hereafter referred to as "Alameda Annex"). Groundwater beneath the properties historically has been characterized under separate investigations performed at Alameda Point Operable Unit (OU) 5 (OU-5), also referred to as Installation Restoration (IR) Site 25 (hereafter referred to as "Site 25"), and Alameda Annex IR Site 02 (IR-02). This report evaluates the groundwater contamination at both Site 25 and Alameda Annex IR-02, because they comprise part of a single contaminant plume.

The general location of Site 25 and Alameda Annex IR-02 is shown in Figure 1-1. Detailed maps of the two sites and adjacent Navy properties are presented in Figures 1-2 and 1-3. The majority of the affected area within Site 25 is located in Parcel 181. The majority of the affected area within Alameda Annex is located in Alameda Annex IR-02. United States Coast Guard (USCG) North Village residential housing (Parcel 181), a park area (Parcel 182), and a community center (Parcel 183) currently occupy Site 25. Alameda Annex IR-02 is currently being developed as residential housing, but was formerly occupied by warehouses that served as an equipment storage and supply facility. The affected area also underlies residential parcels at Alameda Point, which are occupied by USCG Marina Village residential housing (Parcels 178 and 184), George Miller Elementary School (Alameda Parcel 179), and the Woodstock Child Development Center (Parcel 180). For the purposes of this RI/FS report, the areas affected by groundwater contamination at Alameda Point and Alameda Annex will be collectively referred to as the "Site."

A separate RI is being performed, concurrent with this groundwater RI/FS, at Miller Elementary School and the Woodstock Child Development Center (Parcels 179 and 180, renamed IR Site 30) and the residential housing (Parcels 178 and 184, renamed IR Site 31). The purpose of the investigation at IR Sites 30 and 31 is to further characterize the soil conditions and to verify that previous groundwater investigations, performed for Site 25 and Alameda Annex IR-02, have collected sufficient data to assess the risks to sensitive receptors at IR Sites 30 and 31.

The primary contaminants of potential concern (COPCs) in groundwater at the Site, based on risk assessment results (see Section 6), are dissolved-phase benzene and naphthalene. These chemicals are present in the shallow, unconfined first water bearing zone (FWBZ), the bottom of which is located approximately 20 feet below ground surface (bgs). This RI/FS focuses on these COPCs because they will drive the risk-based remediation alternatives to be analyzed in the FS portion of this report. Other COPCs, whether previously investigated or subject to continued site monitoring, will be briefly discussed,

and references will be provided to other documents that contain more comprehensive information. The remediation alternative recommended in this report is anticipated to apply to all areas with contaminated groundwater within the Site, including those located on Parcels 178, 179, 180, and 184. The conclusions of the RI being performed at IR Sites 30 and 31 are not anticipated to affect the alternative recommended within this report.

The sections that follow summarize site characterization data generated during previous investigations; evaluate contaminant fate and transport; present the results of a recent human health risk assessment (HHRA); formulate remedial alternatives using the most applicable technologies and/or processes; and conclude with the most appropriate remedial alternative for the Site.

The organization of this report is based on the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) cleanup process and the United States Environmental Protection Agency (USEPA) guidelines for conducting an RI/FS, and is organized as follows:

- **Section 1**: Introduction
- **Section 2**: Physical Characteristics of the Study Area
- **Section 3**: Previous Investigations
- **Section 4**: Nature and Extent of Contamination
- **Section 5**: Contaminant Fate and Transport
- **Section 6**: Risk Assessment
- **Section 7**: Applicable or Relevant and Appropriate Requirements
- **Section 8**: Identification and Screening of Technologies
- **Section 9**: Development and Screening of Remedial Alternatives
- **Section 10**: Conclusion and Recommendations
- **Appendix A**: Groundwater Analytical Data Set
- **Appendix B**: Residential Risk Evaluation for U.S. Coast Guard Housing (August 2002 Report)
- **Appendix C**: Mann-Kendall Trend Evaluations
- **Appendix D**: Vapor Intrusion Evaluation
- **Appendix E**: Human Health Risk Assessment
- **Appendix F**: Monitored Natural Attenuation Description
- **Appendix G**: Biosparging Description
- **Appendix H**: Remedial Alternative Cost Estimates

Tables occur within the body of the text, and figures are located at the end of each section.

1.1. SITE DESCRIPTION

The sections that follow present general descriptions of Alameda Point Sites 25, 30, and 31, and Alameda Annex IR-02. An overview of Site history and planned reuse is presented following the general descriptions. Detailed site histories for the USCG Marina Village housing (Parcels 178 and 184), Miller Elementary School (Parcel 179), and Woodstock Child Development Center (Parcel 180) will be included in the RI for Sites 30 and 31.

1.1.1. Alameda Point Sites 25, 30, and 31 Description

Alameda Point is composed of 1,734 acres, located adjacent to the Alameda Annex on the western end of Alameda Island (Shaw Environment and Infrastructure [Shaw], 2004a). Thirty-two IR sites were identified at Alameda Point, and have been the subject of numerous investigations, some of which are ongoing. This report focuses on groundwater contamination present under Alameda Point Site 25 which also extends under Alameda Point Sites 30 and 31 (Figures 1-2 and 1-3).

Sites 25, 30, and 31 are composed of approximately 42, 6, and 24 acres, respectively, of relatively flat land created by filling tidelands, marshlands, and sloughs in the early 1900s. Elevations range from approximately 6 to 11 feet above mean sea level (MSL) (International Technology Corporation [IT] et al., 2002).

Site 25 was divided into three parcels (181, 182, and 183) in the Environmental Baseline Survey (EBS) (IT, 1998). Parcel 181 contains USCG North Village multi-unit housing structures (occupied), which are under lease from the Navy. Parcel 182 contains a park area, and Parcel 183 contains a community center (Building 545).

As previously discussed, Parcels 179 and 180 were recently designated as Alameda Point Site 30 and Parcels 178 and 184 were recently designated as Alameda Point Site 31. Parcels 178 and 184 contain USCG Marina Village residential housing. Parcel 179 contains the George Miller Elementary School and Parcel 180 contains the Woodstock Child Development Center. All of these facilities are currently occupied.

1.1.2. Alameda Annex Description

The Alameda Annex, comprising approximately 143 acres, is located along the southern shore of the Oakland Inner Harbor adjacent to Alameda Point Site 25 (see Figures 1-2 and 1-3). Eight IR sites were identified at the facility, and Alameda Annex IR-02 is the primary focus for this report. Alameda Annex IR-02 was historically used as a screening lot and scrap yard. The western portion of Alameda Annex IR-02 was used as a screening lot, where equipment was stored temporarily and sorted for resale or disposal. The eastern portion of Alameda Annex IR-02 was used as a scrapyard, where discarded autos, stockpiled scrap metal, and surplus equipment were temporarily stored. Similar to Alameda Point Site

25, Alameda Annex was constructed in the early to mid-1900s by filling in marshland, primarily with dredged material from the Oakland Inner Harbor and San Francisco Bay (PRC and Versar, 1996).

1.2. SITE HISTORY

In the late 1800s, the nearest land to the Site consisted of the "Alameda Mole," a railroad embankment that ran through marshland and intertidal areas. From the late 1800s until the 1920s, two manufactured gas plants and an oil refinery (Pacific Coast Oil Works), an asphalt pipe manufacturing plant, a soap company, a carriage factory, and other manufacturing businesses were located near the present-day Site (Willard, 1988). These facilities may have discharged petroleum products and other wastes, which were deposited along the sides of tidal channels and on the surface of marshlands near the present-day Site.

As the marshlands and intertidal areas were filled in, the discharged petroleum products became entrapped in the subsurface, creating what is now referred to as the Marsh Crust. The Marsh Crust layer consists of entrapped organic matter with medium- to heavy-weight petroleum hydrocarbons, situated at 15 to 20 feet bgs across Alameda Point and at an average depth of 15 feet bgs beneath Alameda Annex (Neptune and Company, Inc. [Neptune] et al., 2001; PRC Environmental Management, Inc. [PRC] and Versar, Inc. [Versar], 1996).

In addition to the entrapped petroleum contamination from neighboring facilities, the fill used to create the Site is believed to contain contaminants from the original dredge materials (IT et al., 2002).

1.2.1. Alameda Point History

Prior to construction of the Site, the western tip of Alameda Island was farmland, and later became an industrial and transit center. Railroad yards and rights-of-way for the Southern Pacific, Central Pacific, and small local railways were built over the property and sloughs to the north of the present-day Site. For a short period in 1869, the western terminus of the transcontinental railroad was located at the southeastern corner of Alameda Point. The U.S. Department of the Army acquired the western tip of Alameda from the City of Alameda in 1930 and began construction activities in 1931. In 1936, in response to the military buildup in Europe prior to World War II, the Navy acquired title to the land from the Army and began building the NAS Alameda. Construction involved filling in the tidelands, marshes, and sloughs between the Oakland Inner Harbor and the western tip of Alameda Island. Figure 1-4 compares the shoreline in 1915 with the shoreline in 1937. According to historical photographs and records, the NAS Alameda Site 25 area was filled in during two separate events (Tetra Tech EMI [TtEMI], 2000a). The first fill event (1887 to 1915) included most of NAS Alameda Site 25. A later fill event (1930 to 1939) added the fill material that is now the southeast portion of Alameda Point Site 25. As mentioned previously, the fill material used to create the Site consisted largely of dredge spoils from the surrounding San Francisco Bay and Oakland Inner Harbor. After the United States entered World War II in 1941, the Navy acquired more land to the west of the installation.

Following the end of the war in 1945, Alameda Point continued to provide facilities and support for fleet aviation activities. During the period that it was an active naval base, the installation provided berthing for Pacific Fleet ships and support for Naval aviation.

The majority of the Site has been used for residential housing and equipment storage, with the layout of residential housing and equipment storage areas re-aligned between 1958 and 1969. Aerial photographs from 1947, 1953, and 1958 show military housing and associated development present across Parcels 181, 182, and 183 extending to Alameda Annex Building 3, and approximately 300 feet south of Singleton Avenue (IT, 1998). Figure 1-5 shows the military housing as it appeared in an aerial photograph in 1953. An aerial photograph from 1958 shows that the housing area south of Singleton Avenue had been cleared, and that the area was being used for equipment storage. This photograph did not show the eastern half of Parcel 181. By 1963, the housing in the eastern half of Parcel 181 (from Fifth Street west approximately 500 feet) had been cleared.

As shown in Figure 1-6, in 1968, the area in the eastern half of Parcel 181 was being used for equipment storage and the remaining housing barracks west of this area had been cleared. An area of stained soil is visible in what is now the Mayport/Kollmann Circle area. This area of stained soil is one potential source of the groundwater contamination at the site. However, no documentation exists to explain the nature or cause of the soil staining. Planned activities to address this potential source of contamination are discussed in Section 4.5.5.

Fifty-one residential buildings constructed in 1969 presently occupy Parcel 181. No chemicals are known to have been used or stored at Parcel 181.

Beneath Alameda Point Site 25 and Alameda Annex is an extensive system of sanitary and stormwater sewers. The stormwater sewers interconnect and drain from south to north into the nearby Oakland Inner Harbor. The results of previous investigations of the sanitary and storm sewer systems are further discussed in Section 2.4.

Environmental investigation of Alameda Point began in the early 1980s under the Naval Assessment and Control of Installation Pollutants program. At that time, Alameda Point Site 25 was not identified as one of the IR sites because no historical spills had been documented in the area. In September 1993, Alameda Point was identified for closure under the Base Realignment and Closure Act (BRAC). In April 1997, the installation ceased all Naval operations and is now undergoing site cleanup to facilitate transfer to the City of Alameda.

Alameda Annex IR-02 is currently being redeveloped into residential housing as part of the land transfer process. Development activities will include the installation of new subsurface utility lines through areas with known groundwater contamination.

A more comprehensive history of Alameda Point and the surrounding area is provided in the *Comprehensive Guide to the Environmental Baseline Survey* (IT, 2001j).

1.2.2. Alameda Annex Site History

From 1900 to 1939, fill material obtained from unknown sources was used to create the Alameda Annex IR-02 (IT, 1998). Based on the history of Alameda Point Site 25, it is believed that the source of the fill material was dredge spoils from the surrounding San Francisco Bay and the Oakland Inner Harbor.

In the mid-1920s, a commercial airport known as the San Francisco Bay Airdrome was constructed in what is now the southern portion of Alameda Annex. The airdrome consisted of a 2,500-foot runway, a passenger terminal, and an aircraft maintenance hangar. Maintenance of aircraft would likely have involved the use and storage of hazardous materials and the generation of associated wastes in the form of solvents, paints, and petroleum-based products such as aircraft fuel and lubricating oil. By 1932, the airdrome reached its operational peak, serving approximately 11,000 customers per month.

Wartime activities at the nearby NAS Alameda caused air traffic conflicts and, in 1941, the airdrome was closed (PRC and Versar, 1996).

Between 1946 and 1966, the U.S. government purchased the property that is now the Alameda Annex, along with an area to the north. The northern property was occupied by the U.S. Army's Alameda Medical Depot beginning in 1945, before the federal government purchased the Site. The Sharpe Army Depot later used this property.

The property comprising the Alameda Annex was assigned to the NAS Alameda in 1951. In 1980, the Alameda Annex was transferred to the Naval Supply Center (NSC) Oakland. The Alameda Annex, in conjunction with the NSC Oakland, served as the main supply facility supporting the Department of Defense operation of military fleets and shore activities in the Pacific Basin. The facility was closed in September 1998 (TtEMI, 2000a).

The history of the area around Alameda Annex is discussed in more detail in the RI report for Alameda Annex (PRC and Versar, 1996).

1.3. CURRENTLY PLANNED SITE REUSE

The planned reuse for the Site is primarily residential, with possible mixed use such as live/work spaces, as well as the continued operation of a school. Residential housing construction is underway at the Alameda Annex facility.

REFERENCE: 2002 DeLORME, TOPO USA

0 2mi 4mi

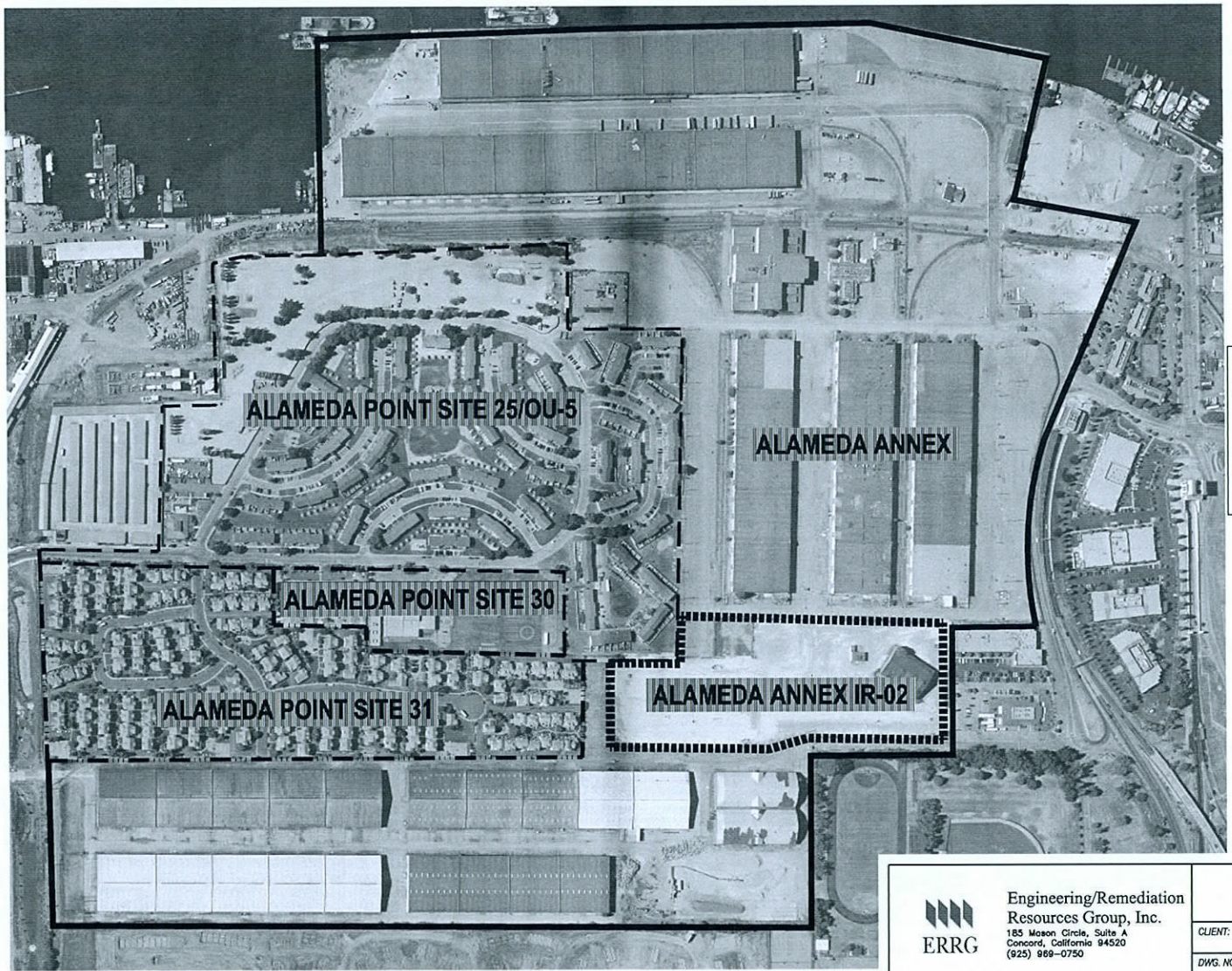
ERRG
Engineering/Remediation Resources Group, Inc.
185 Mason Circle, Suite A
Concord, California 94520
(925) 969-0750

SITE LOCATION MAP

CLIENT:	NAVY SWDIV	FIGURE:
DWG. NO.:	22-052-FIGURE 1	1-1

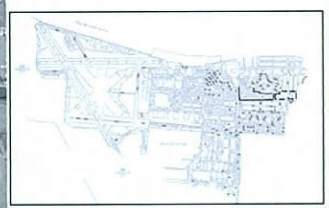
FILE: P:\2002 Projects\22-052 RI FS Alameda Point\Figures\Prelim Draft Version\Figure 1-1 Site Location Map\22-052-Fig_1-1.dwg USER: nwong Jul 08, 2004 10:56am

Figure 1-2
(Located in separate file on CD)



LEGEND

- ALAMEDA POINT SITE 25 BOUNDARY
- ALAMEDA ANNEX BOUNDARY
- ALAMEDA ANNEX IR-02 BOUNDARY
- ALAMEDA POINT SITE 31 BOUNDARY – MARINA VILLAGE HOUSING
- ALAMEDA POINT SITE 30 BOUNDARY – GEORGE MILLER ELEMENTARY SCHOOL AND WOODSTOCK CHILD DEVELOPMENT CENTER



LOCATION MAP

N

SCALE

0 350 700

ERRG

Engineering/Remediation Resources Group, Inc.
185 Mason Circle, Suite A
Concord, California 94520
(925) 969-0750

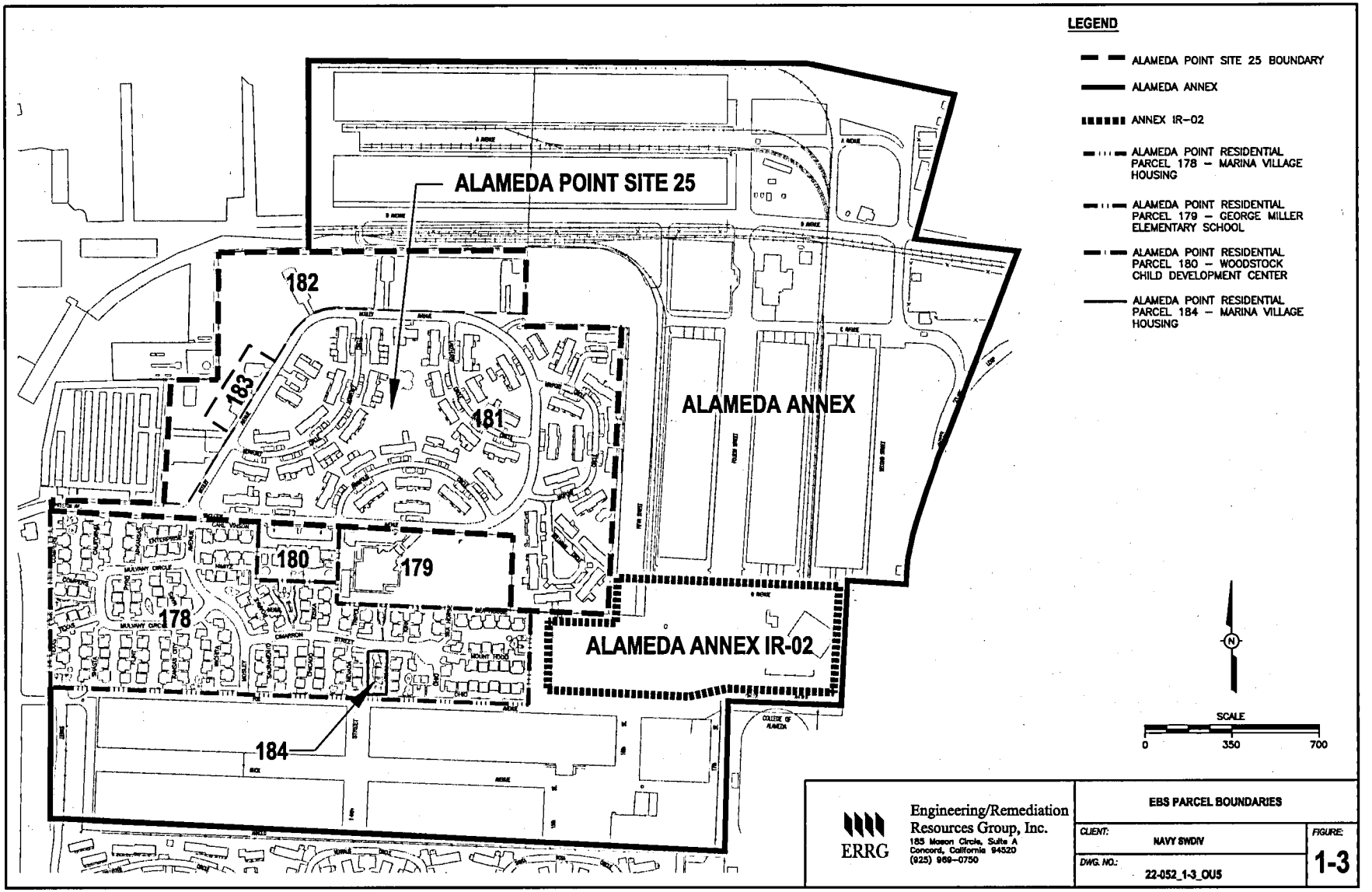
INVESTIGATION SITE BOUNDARIES

CLIENT: NAVY SWDIV

DWG. NO.: 22-052-FIGURE 1-2

FIGURE: **1-2**

XREF: Ala1base_orig
FILE: P:\2002 Projects\22-052 RI FS Alameda Point\Figures\Draft version\8 Oct 03\22-052 FIG 1-2.dwg USER: rwong Aug 11, 2004 1:52pm



ERRG

Engineering/Remediation Resources Group, Inc.
185 Mason Circle, Suite A
Concord, California 94520
(925) 969-0750

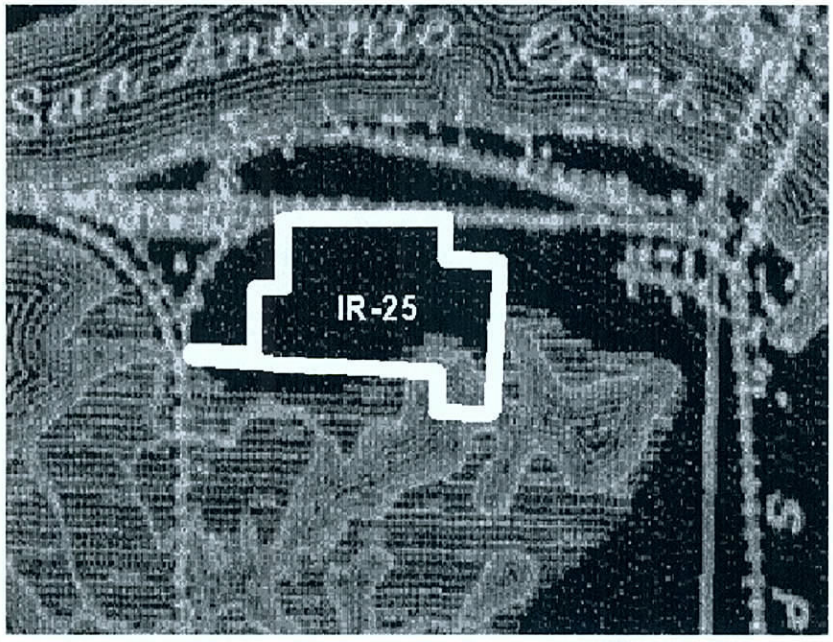
EBS PARCEL BOUNDARIES

CLIENT: NAVY SWDIV

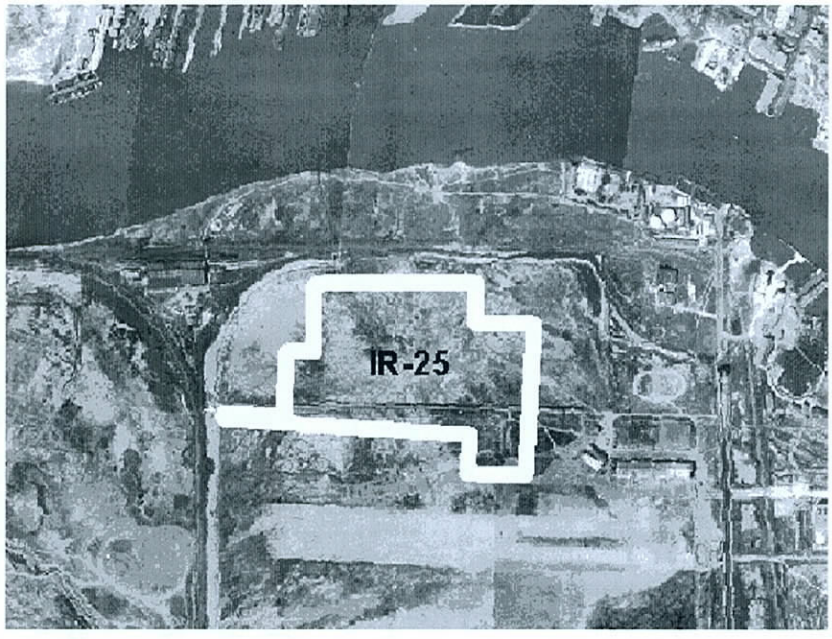
DWG. NO.: 22-052_1-3_OU5

FIGURE: 1-3

XREF: Alc1base_orig
FILE: P:\2002 Projects\22-052 RI FS Alameda Point\Figures\Draft version\8 Oct 03\22-052_1-3.dwg USER: nrong Aug 11, 2004 1:54pm



1915 USGS QUADRANGLE



1937 AERIAL PHOTOGRAPH

BAY

LAND

N

SCALE

500 0 500 Feet

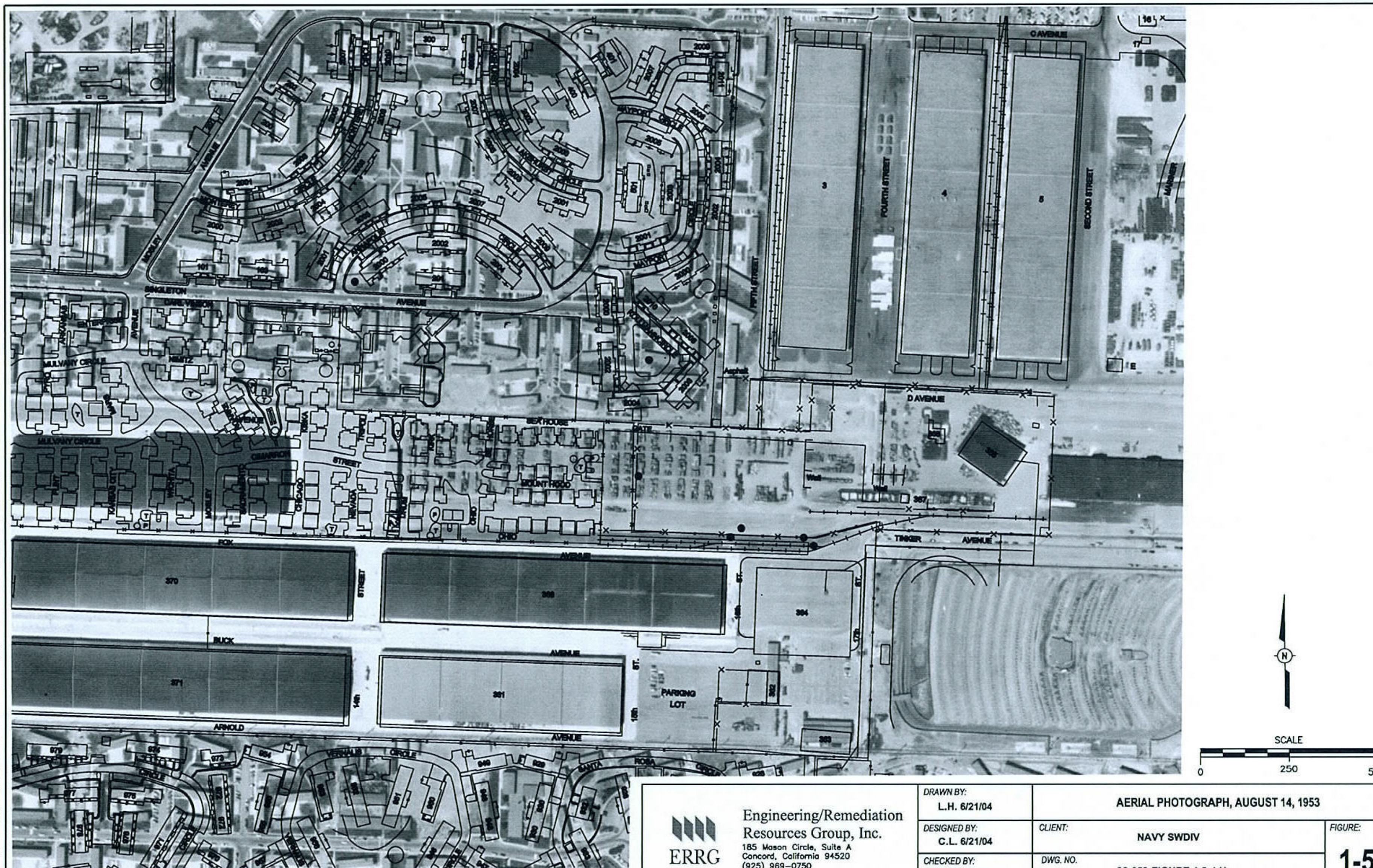
ERRG

Engineering/Remediation Resources Group, Inc.
185 Mason Circle, Suite A
Concord, California 94520
(925) 969-0750

COMPARISON OF HISTORIC SHORELINE

Client: NAVY SWDIV		FIGURE: 1-4
DWG. NO.: 22-052-FIGURE 1-4		

XREF:
FILE: P:\2002 Projects\22-052 RI FS Alameda Point\Figures\Draft version\8 Oct 03\22-052 fig 1-4 historic shoreline.dwg USER: rwong Jul 01, 2004 2:05pm



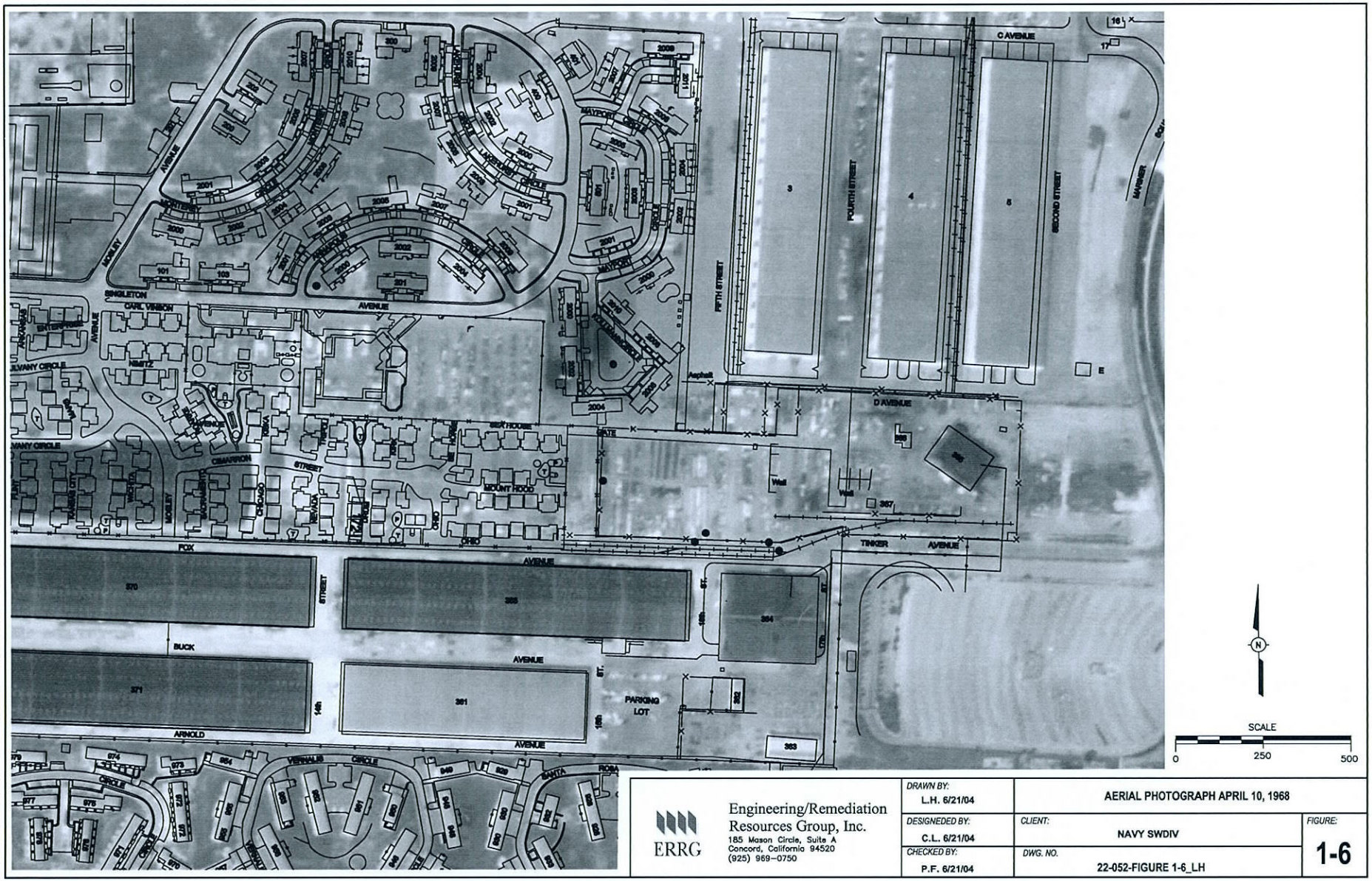
ERRG

Engineering/Remediation Resources Group, Inc.
185 Mason Circle, Suite A
Concord, California 94520
(925) 969–0750

DRAWN BY: L.H. 6/21/04	AERIAL PHOTOGRAPH, AUGUST 14, 1953
DESIGNED BY: C.L. 6/21/04	CLIENT: NAVY SWDIV
CHECKED BY: P.F. 6/22/04	DWG. NO. 22-052-FIGURE 1-5_LH

FIGURE: 1-5

FILE: P:\2002 Projects\22-052 RI FS Alameda Point\Figures\Draft version\4 Sep 03\22-052-figure 1-5_LH2000.dwg USER: rwong Jul 08, 2004 5:38pm



FILE: P:\2002 Projects\22-052 RI FS Alameda Point\Figures\Draft version\4 Sep 03\22-052-figure 1-6_LH2000.dwg USER: nwong Jul 08, 2004 5:23pm

ERRG Engineering/Remediation Resources Group, Inc. 185 Mason Circle, Suite A Concord, California 94520 (925) 969-0750	DRAWN BY: L.H. 6/21/04	AERIAL PHOTOGRAPH APRIL 10, 1968	
	DESIGNEDED BY: C.L. 6/21/04	CLIENT: NAVY SWDIV	FIGURE: 1-6
	CHECKED BY: P.F. 6/21/04	DWG. NO. 22-052-FIGURE 1-6_LH	

2. PHYSICAL CHARACTERISTICS OF THE STUDY AREA

The physical characteristics of the study area have been summarized during numerous previous investigations (IT et al., 2002; PRC and Versar, 1996; TtEMI, 2000b). The general physical characteristics of Site 25, the adjoining Alameda Point Sites 30 and 31, and Alameda Annex IR-02 can be summarized as follows:

- **Alameda Point Site 25:** A 42-acre site, consisting of USCG North Village residential housing (Parcel 181), a park area (Parcel 182), and a community center (Parcel 183). A previous removal action was performed at Site 25, encompassing a total area of approximately 26 acres to address polynuclear aromatic hydrocarbons (PAHs) in the top 2 feet of soil.
- **Alameda Point Site 30:** An approximately 6-acre site, consisting of George Miller Elementary School (Alameda Parcel 179) and the Woodstock Child Development Center (Parcel 180).
- **Alameda Point Site 31:** An approximately 24-acre site, consisting of USCG Marina Village residential housing (Parcels 178 and 184).
- **Alameda Annex IR-02:** A 12.5-acre site (PRC and Versar, 1996), which was used previously as a storage lot for equipment and is currently undergoing redevelopment.

All four of the areas within the Site are relatively flat and have no other surface features such as rivers, mountains, or gullies. Residential development is planned in the near future (general construction, including site grading has already begun) for Alameda Annex IR-02, which is currently an open, largely unpaved lot without residences. As discussed in Section 1.0, a separate RI is being performed at Alameda Point Sites 30 and 31 to further characterize the soil conditions and to verify that previous groundwater investigations, performed for Site 25 and Alameda Annex IR-02, have collected sufficient data to assess the risks to sensitive receptors at IR Sites 30 and 31.

The sections that follow provide additional summary detail on the physical characteristics of the Site.

2.1. GEOLOGY

The Site is located along the eastern San Francisco Bay (East Bay Margin), which occupies a depression between two uplifted areas: the Berkeley Hills, located approximately 10 miles east of the Site, and the Montara mountains (and others) located to the west. The depression and uplifted areas were formed by two sub-parallel, active faults: the San Andreas Fault west of San Francisco Bay, and the Hayward Fault east of San Francisco Bay.

The San Andreas Fault is located approximately 12 miles west of the Site, and the Hayward Fault is located approximately 5 miles east of the Site. Hickenbottom and Muir have described the geology of the eastern San Francisco Bay (Hickenbottom and Muir, 1988). TtEMI has outlined the specific lithology present at Alameda Point (TtEMI, 2000b).

The geology, as described in the groundwater beneficial use report (TtEMI, 2000b), described two geological units within the shallow water-bearing zone: (1) shallow fill found in the uppermost 10 to 20 feet; and (2) underlying native sediment material that includes the Bay Mud and Merritt Sand Formation.

Surface and near-surface soil at the Site consists of artificial fill placed during the historical filling of the tidal marshlands, which occurred from approximately 1900 to 1930. The fill is present in the northern portion of the Site from approximately 10 feet bgs and in the southern portion from 20 feet bgs. The fill is approximately 15 to 20 feet thick, and is deepest in the southern portion of the Site, formerly marshland and San Francisco Bay intertidal area (the northern portion of the Site previously contained an outcropping of land). Two cross sections of the site are shown in Figures 2-1 and 2-2.

Fill material at the Site is a heterogeneous, laterally discontinuous mixture of poorly graded, fine- to medium-grained sand, clay, and silt mixed with some construction debris and organic material. The artificial fill materials are believed to be dredging spoils from the tidal flats in the surrounding San Francisco Bay and the Oakland Inner Harbor. Industrial waste is also believed to be a potential source of the fill material. The thickness of the fill is probably most influenced by the presence of historical tidal channels that once transected the tidal flats.

The Bay Mud layer underlying the Site fill material ranges in thickness from 25 to 100 feet (PRC and Versar, 1996) and consists of recent sediment deposited in an estuarine environment. The Bay Mud is thickest at the west side of the site, and thins to approximately 25 feet at the northeastern and southeastern regions of the Site (PRC, 1993). The Bay Mud generally consists of gray to black, medium- to high-plasticity silty clay with laterally discontinuous, poorly-graded silty and clayey sand layers. Occasional thin lenses of fine sand have also been observed. However, no extensive sand layers were observed within the Bay Mud.

The Merritt Sand Formation underlies the Bay Mud across most of the Site. The Merritt Sand Formation is composed of brown, fine- to medium-grained, poorly-graded sand. The sand formation is generally laterally continuous throughout the Site, except where it is bisected by a major paleochannel that is filled with thicker deposits of the Bay Mud. The Merritt Sand Formation is found at depths as great as 135 feet bgs across Alameda Point. However, the thickness of the formation is unknown beneath the Site.

2.2. HYDROGEOLOGY

Contamination is located in the fill material above the Bay Mud, which constitutes the shallow, unconfined FWBZ beneath the Site. The Bay Mud under the FWBZ forms an aquitard between the shallow groundwater and the Merritt Sand, which composes much of the deeper, confined aquifer beneath the facility (PRC and Versar, 1996).

Two primary regional aquifers have been identified beneath the Site: the Merritt Sand aquifer, which is referred to as the Second Water Bearing Zone (SWBZ); and the deeper Alameda aquifer, which is

referred to as the Alameda Formation Water Bearing Zone (AFWBZ). The groundwater management sub-area containing the Merritt Sand and the Alameda aquifer is referred to as the Oakland Upland and Alluvial Plain Management Subarea.

The saturated thickness of the FWBZ averages approximately 10 feet beneath the site, and the depth to groundwater ranges from approximately 2 to 10 feet bgs (IT et al., 2002; Shaw 2004b and c). The elevation of the water table in the FWBZ ranges from 3 to 8 feet above mean sea level (Shaw, 2004b and c).

Ongoing groundwater monitoring programs continue to investigate the depth to groundwater, as well as other groundwater characteristics. Groundwater flow direction in the FWBZ is highly variable beneath the Site. Groundwater generally has been reported to flow in a north to northwest direction, toward the Oakland Inner Harbor (PRC and Versar, 1996; TtEMI, 1999c; IT et al., 2002). However, groundwater contour maps indicate a high level of local variability. Figures 2-3 and 2-4 show groundwater elevation contours from winter 2002 and summer 2003, generated as part of the Quarterly Monitoring Program (Shaw, 2004b and c). The local variation is likely due primarily to the variations in permeability of the shallow aquifer fill material.

Two tidal influence studies were conducted for the Alameda Annex site (PRC, 1993; PRC and Versar, 1996). The results of these studies indicate that maximum groundwater fluctuations in the measured wells ranged from 0.059 to 1.1 feet, while the maximum tidal fluctuations in Oakland Inner Harbor ranged from 6.1 to 6.9 feet. The greatest fluctuations were from wells that were screened in higher-permeability materials (PRC and Versar, 1996). Localized, higher-permeability areas appear to exist outside identified historic tidal channels (PRC and Versar, 1996). Shallow groundwater level fluctuations during the daily tidal cycle are expected because the FWBZ is hydraulically connected to the Oakland Inner Harbor. The groundwater level fluctuations reflect a temporary shift in the groundwater flow direction that changes direction during the daily tidal cycle, but does not affect the mean groundwater flow direction north to northwest toward the Oakland Inner Harbor. In addition, the tidal influence exhibited by shallow monitoring wells reflects the hydraulic response based on the changing tide, and does not represent active mixing of the groundwater underlying the Site with the Oakland Inner Harbor.

In addition, leaking water lines on the eastern edge of the Site were identified as potential sources of groundwater recharge and mounding; however, these were repaired in 1998 (TtEMI, 1999c).

The Bay Sediment Unit, a layer of silts and clays, acts as a confining or semi-confining layer separating the FWBZ from the SWBZ. Recharge of the SWBZ is mainly by lateral flow from upgradient areas on Alameda Island. The SWBZ is believed to discharge through lateral groundwater flow to the San Francisco Bay, Oakland Inner Harbor, and Seaplane Lagoon. Gradients tend to be steeper at low tide, and reverse at high tide in some areas (IT et al., 2002).

The top of the AFWBZ at the Site is approximately 100 feet bgs, ranging in thickness from 200 to 800 feet. The San Antonio aquitard, which includes the Yerba Buena Mud and a thin, upper clay-rich portion of the Alameda Formation, separates the AFWBZ from the SWBZ. Little is known about the hydraulic properties of the AFWBZ.

2.3. GROUNDWATER BENEFICIAL USE

Two primary reports have been issued with respect to possible beneficial uses of groundwater: one evaluated groundwater at Alameda Point (TtEMI, 2000b), and the other evaluated groundwater at Alameda Annex (TtEMI, 1999c). Both reports concluded that groundwater in the shallow water-bearing zone near the Site has no potential future use as a potable water supply.

The reports based their conclusions on both federal and State criteria. However, the Alameda Point investigation did not use site-specific factors such as well construction permits and seawater intrusion. Evaluation of potential beneficial use was therefore largely based on total dissolved solids (TDS) concentrations and well yields. Summaries of each of the reports are provided below.

2.3.1. Potential Beneficial Uses of Groundwater – Alameda Point

In July 2000, the *Final Determination of the Beneficial Uses of Groundwater, Alameda Point* was published, which revised the previously-released Draft version, and incorporated comments received from regulatory agencies. Specifically, comments from the USEPA were incorporated into the document, clarifying the use of site-specific factors in determining potential beneficial uses of groundwater. USEPA clarified that only federal and State criteria for TDS concentrations and well yield should be used to determine groundwater beneficial uses, and that site-specific factors should be used in making a risk management decision for a CERCLA action (TtEMI, 2000b).

At a meeting prior to the release of the final version of this document, a BRAC Cleanup Team (BCT) reviewed comments and agreed that the revised document would serve as the final determination for groundwater beneficial uses (TtEMI, 2000b).

The final report described Alameda Point OU-5 (the western portion of the Site) as located in the "central geologic region," which was created by infilling tidal marshlands in the early 1900s. Based on the USEPA criteria for TDS concentrations and well yield, the report classified the FWBZ as a Class II aquifer (a current or potential source of drinking water, or having other beneficial uses). Water in the SWBZ was classified as a Class III aquifer (not a potential source of drinking water, and of limited beneficial use) due to high TDS concentrations (TtEMI, 2000b).

After considering beneficial use criteria, the Alameda Point BCT concluded that groundwater beneath OU-5 is unlikely to be used as a drinking water source. However, contaminant mass reduction might be required to facilitate long-term contaminant attenuation and to allow for other beneficial uses of groundwater. The BCT also set groundwater cleanup levels above Maximum Contaminant Levels

(MCLs) so that contaminated groundwater could be remediated to levels that would eliminate exposures due to inhalation (groundwater vapors into buildings), dermal contact, and irrigation; and to ensure that groundwater contamination does not increase (TtEMI, 2000b).

The report also included TDS maps of the area, figures of site groundwater conceptual models, and a re-use map. The majority of measured TDS concentrations in the FWBZ in the vicinity of OU-5 were greater than 10,000 milligrams per liter (mg/L) (the federal ceiling for TDS in groundwater with a potential beneficial use); smaller areas of lower TDS concentrations occurred at the junction of Alameda Point and Alameda Annex. Water in the SWBZ contained TDS concentrations greater than 10,000 mg/L (TtEMI, 2000b).

2.3.2. Potential Beneficial Uses of Groundwater – Alameda Annex

In November 1999, a groundwater beneficial uses evaluation for Alameda Annex was released. As in the Alameda Point investigation, groundwater beneficial use was evaluated using both federal and State criteria, and also took into consideration site-specific factors (Navy, 1999).

The report concluded that shallow groundwater in the FWBZ should not be designated as a potential drinking water source for CERCLA purposes. Some of the findings leading to that conclusion are:

- TDS concentrations in the FWBZ exceed both federal and State criteria for the majority of Alameda Annex.
- TDS concentrations may further increase as leaking water pipes are removed or replaced.
- Prolonged pumping of shallow groundwater is likely to result in decreased well yields.
- The California Regional Water Quality Control Board (RWQCB) recommended de-designation of groundwater in shallow bay-front artificial fill materials overlying young bay mud (the case of Alameda Annex) for municipal beneficial uses.

Additionally, the RWQCB concurred in a written statement that, based on high TDS concentrations, the shallow groundwater beneath the Alameda Annex meets the State exemption criteria for drinking water, and therefore was not a potential source of drinking water. The RWQCB also stated that the Navy must evaluate all other potential beneficial uses of groundwater at Alameda Annex. Toward that end, the Navy also evaluated agricultural, industrial, and freshwater replenishment uses (RWQCB, 1999).

It was concluded that shallow groundwater beneath the Site may have agricultural and industrial beneficial uses, but the potential is considered low because:

- Existing and anticipated TDS concentrations exceed recommended levels for many agricultural and industrial uses.
- Expected well yields are not sufficient.
- Installation and operation of low-yield wells would not be cost-effective compared to the cost of water available from the existing municipal supply.

- Treating water for beneficial agricultural/industrial use would not be cost-effective.
- Land subsidence and saltwater intrusion might occur if shallow groundwater were pumped.
- Water supply wells screened in the FWBZ would not meet State or county minimum well construction requirements, and would be highly vulnerable to surface or near-surface contamination.

It was also concluded that the FWBZ is not a potential source of freshwater replenishment (RWQCB, 1999).

Other information provided in the report included physical characteristics of the Site, existing groundwater contamination and fate and transport modeling, the facility water supply system, and the stormwater and wastewater management systems.

2.3.3. Groundwater Beneficial Use Discussions – 2002

During summer 2002, in additional discussions that were held with regulatory agencies and stakeholders, concern was expressed about the possible use of shallow Site groundwater (in scenarios such as backyard well pumping, irrigation, and human ingestion). The concern stemmed largely from the potential for local residents to install shallow groundwater wells for drinking water.

To address stakeholder concerns that shallow groundwater at the Site could be used for drinking water purposes, the HHRA performed for this report evaluated the groundwater ingestion exposure pathway. The current HHRA used the most recent analytical data; previous HHRAs used older analytical data sets that did not include the higher detections of benzene found in recent Hydropunch™ samples.

2.3.4. Summary of Groundwater Beneficial Use Investigations

Two separate groundwater beneficial use studies have been performed for the Site, both concluding that groundwater in the FWBZ has no potential for beneficial use. The studies evaluated groundwater in the FWBZ and SWBZ, with an emphasis on the FWBZ due to shallow groundwater contamination, relevancy to human health risk calculations, and some TDS concentrations that meet the federal criteria for potential use as drinking water.

The beneficial use evaluations used two primary criteria: TDS concentrations and well yields. Water supply system leaks were identified at the Site, and, because the locations correlated fairly well with low-TDS areas shown on TDS isoconcentration maps, it can be inferred that the leaks were responsible for the low TDS concentrations, qualifying the areas as a federal Class II aquifer. The leaks have since been repaired, and the TDS levels in those areas likely have increased.

Subsequent to the previous beneficial use investigations, the Alameda Point BCT concurred that, despite the "probability" that water in the FWBZ would not be used as a future potable water supply, the HHRA for this report should evaluate the groundwater ingestion pathway. Therefore, the HHRA performed for

this report evaluates the human health risk associated with hypothetical use of contaminated site groundwater in the FWBZ as a potable water supply.

2.4. UTILITIES

The Site and adjacent areas contain an extensive system of sanitary sewer and storm drain lines that drain from south to north, into the Oakland Inner Harbor. Additionally, gas lines for residential properties run through the Site, as shown in Figure 2-5.

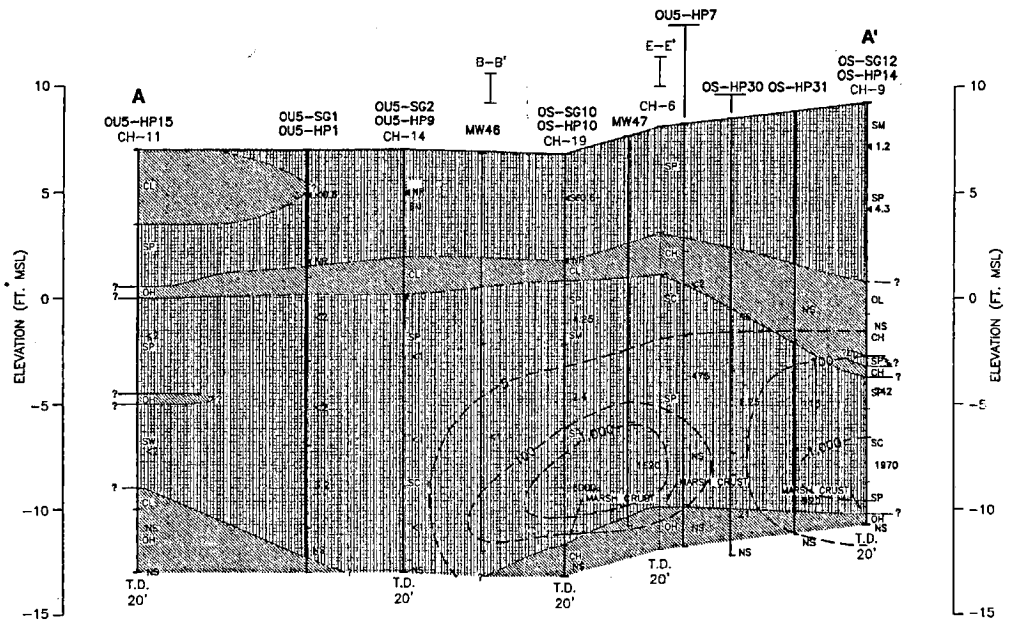
Two detailed storm drain investigations have been conducted to date; one was conducted as part of the Alameda Annex RI, and the other as part of the comprehensive Alameda Point study in 2001 (TtEMI, 2001a).

During the Alameda Annex RI, storm drain sediments, surface stormwater, and stormwater from drains were sampled and analyzed for a full suite of analytes. The results of the storm drain sediment sampling indicated that two areas of Alameda Annex might have released metals and volatile organic compounds (VOCs) into the stormwater drainage system, with metals as the primary contaminant. The two areas were identified as IR-02 and the west end of Buildings 1 and 2.

Benzene was not detected in storm drain sediments, but was detected at low concentrations in stormwater samples (the maximum detected concentration was 7 micrograms per liter [µg/L]) taken from within drains); the suspected source was contamination within Alameda Annex IR-02. The storm drain study for Alameda Annex was reported in 1996. In 1997, video investigation of the storm drain system indicated that no infiltration into the system was occurring, and that all storm drains on the Site were undamaged. A comprehensive Alameda Point storm drain study was performed subsequently. The study evaluated storm drains within Site 25, which are interconnected with, and downgradient from, those in Alameda Annex IR-02. No leaking storm drain lines were found in Site 25, and the study did not recommend any further investigation at Site 25. The study recommended sampling of OU-1 and OU-2 within Alameda Point, where high-permeability bedding materials might exist (TtEMI, 2001a).

To test whether the bedding material was acting as a preferential pathway for contaminant migration in OU-1 and OU-2, soil and groundwater samples were collected along sewer lines downgradient of plumes within Corrective Action Plan (CAP) Site 9A, and Installation Restoration Program (IRP) Sites 4, 5, 6, 9, 11, 13, 14, 16, 21, and 23. Vacuum extraction borings were advanced immediately adjacent to storm sewers for collection of undisturbed samples of bedding materials. Soil samples were also collected 10 feet from the storm drain line adjacent to each vacuum extraction location. The results, summarized in a 2002 draft data summary report, indicated that neither the bedding materials nor the sanitary sewer lines were acting as a preferential conduit for transportation of contaminants (TtEMI, 2002). Because this study was performed on areas of Alameda Point outside Site 25, definitive conclusions regarding the potential for storm drain bedding material to act as a preferential pathway for contaminant migration at Site 25 cannot be drawn solely from this information. However, the ongoing groundwater monitoring

program at Site 25 is tracking potential contaminant migration towards the Oakland Inner Harbor and has not detected any contaminant migration to date. In addition, ongoing soil gas monitoring around the groundwater contamination has shown no elevated concentrations that would indicate that subsurface utilities are acting as a preferential pathway for soil gas migration.



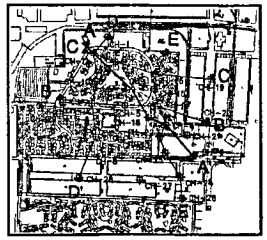
LEGEND

- ◄ SOIL GAS SAMPLING POINT CONCENTRATIONS PER BILLION-VAPOR
- GROUNDWATER SAMPLE INTERVAL, CONCENTRATION IN PARTS PER BILLION
- NR INSUFFICIENT VOLUME FOR SAMPLE
- NS INTERVAL NOT SAMPLED
- NA SAMPLE NOT ANALYZED

- SW - WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
- SP - POORLY-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
- SM - SILTY SANDS, SAND-SILT MIXTURES
- SC - CLAYEY SANDS, SAND-CLAY MIXTURES
- CL - INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
- OL - ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
- CH - INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
- OH - ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS

NOTE

MARSH CRUST NOTED WHEN INDICATED ON BORING LOGS



HORIZONTAL SCALE

0 300 600 FEET

VERTICAL SCALE

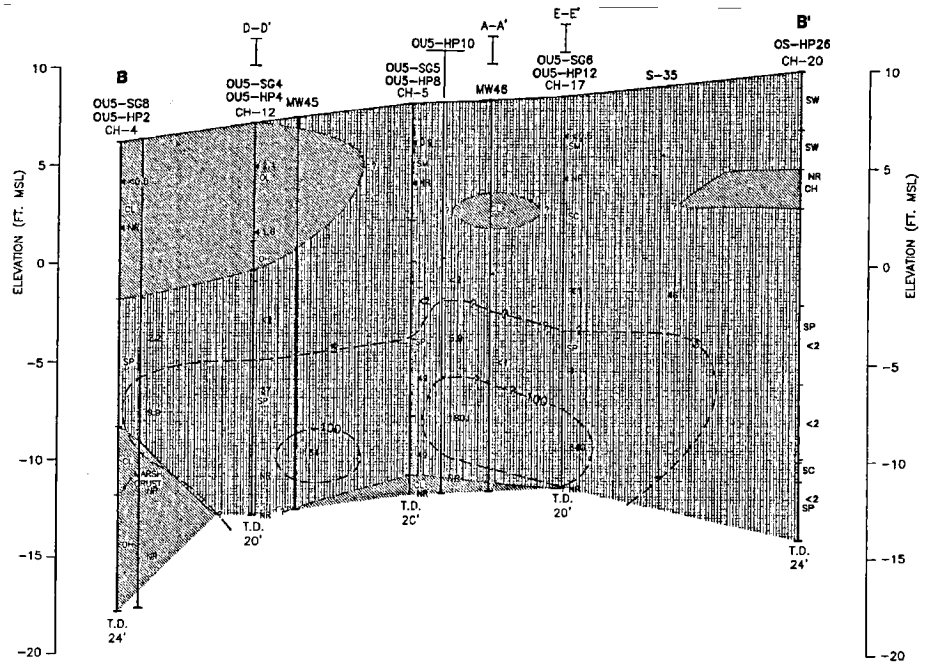
0 5 10 FEET

(VERTICAL EXAGGERATION = 60x)

REFERENCE:
IT CORPORATION, ET AL
OPERABLE UNIT 5 REMEDIAL INVESTIGATION REPORT
JULY 12, 2002

ERRG Engineering/Remediation Resources Group, Inc. 185 Mason Circle, Suite A Concord, California 94520 (925) 969-0750	DRAWN BY: L.H. 6/22/04	GEOLOGIC CROSS SECTION A-A'	
	DESIGNEDED BY: C.L. 6/22/04	CLIENT: NAVY SWDIV	FIGURE: 2-1
	CHECKED BY: P.F. 6/22/04	DWG. NO. 22-052-FIGURE 2-1	

FILE: P:\2002 Projects\22-052 RI FS Alameda Point\Figures\Draft version\4 Sep 03\22-052-Figure 2-1 2000.dwg USER: mwong Aug 23, 2004 12:55pm



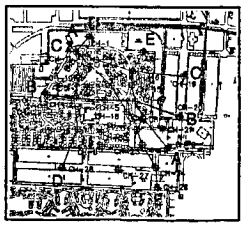
LEGEND

- SOIL GAS SAMPLING POINT CONCENTRATIONS PER BILLION-VAPOR
- GROUNDWATER SAMPLE INTERVAL, CONCENTRATION IN PARTS PER BILLION
- NR INSUFFICIENT VOLUME FOR SAMPLE
- NS INTERVAL NOT SAMPLED
- NA SAMPLE NOT ANALYZED

- SW – WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
- SP – POORLY-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
- SM – SILTY SANDS, SAND-SILT MIXTURES
- SC – CLAYEY SANDS, SAND-CLAY MIXTURES
- CL – INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
- OL – ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
- CH – INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
- OH – ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS

NOTE

MARSH CRUST NOTED WHEN INDICATED ON BORING LOG.



INSET

HORIZONTAL SCALE

0 300 600 FEET

VERTICAL SCALE

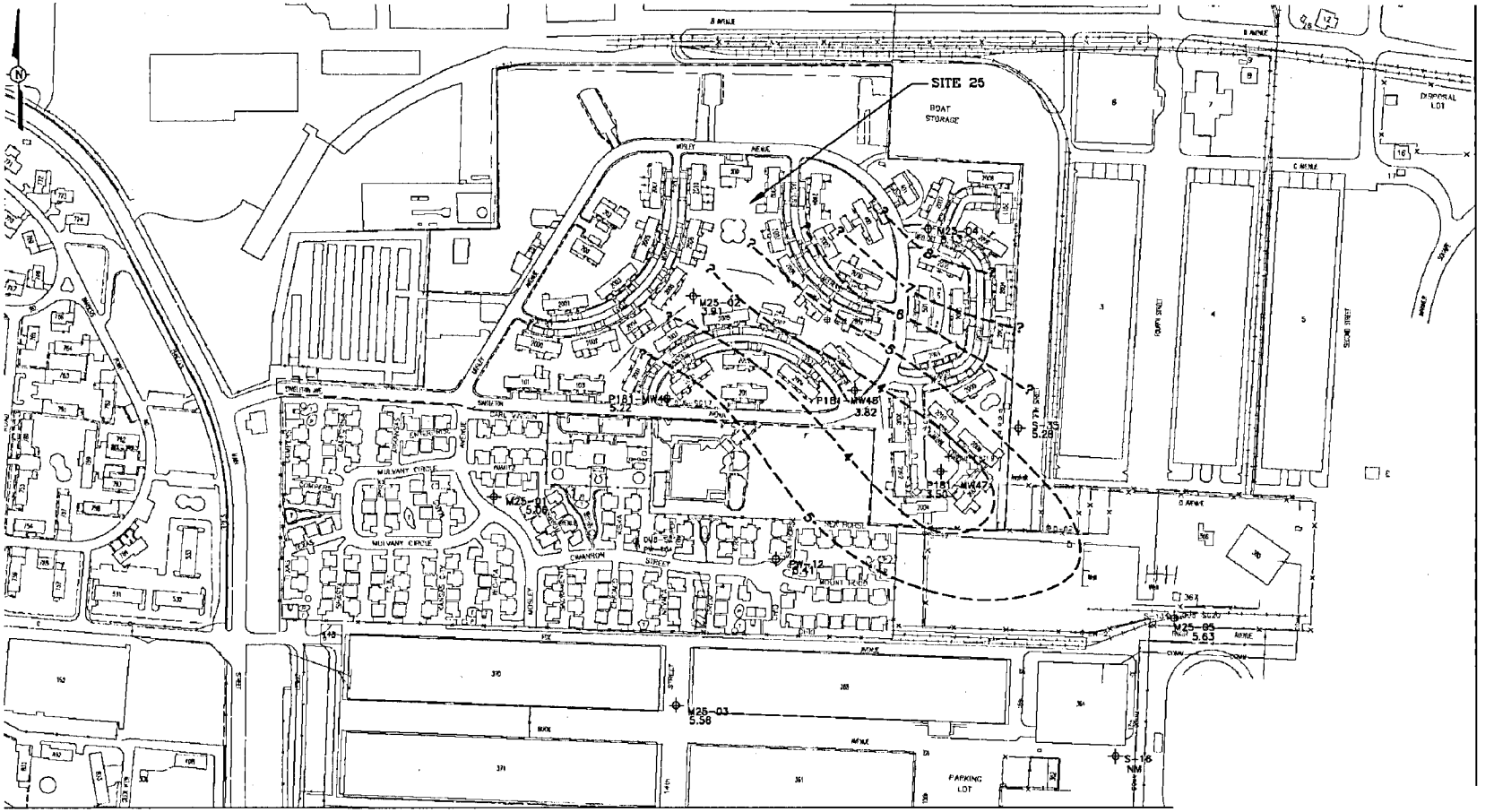
0 5 10 FEET

(VERTICAL EXAGGERATION = 60x)

REFERENCE:
IT CORPORATION, ET AL
OPERABLE UNIT 5 REMEDIAL
INVESTIGATION REPORT
JULY 12, 2002

ERRG Engineering/Remediation Resources Group, Inc. 185 Mason Circle, Suite A Concord, California 94520 (925) 969-0750	DRAWN BY: L.H. 6/22/04	GEOLOGIC CROSS SECTION B-B'	
	DESIGNEDED BY: C.L. 6/22/04	CLIENT: NAVY SWDIV	FIGURE: 2-2
	CHECKED BY: C.L. 6/22/04	DWG. NO. 22-052-FIGURE 2-2	

FILE: P:\2002 Projects\22-052 RI FS Alameda Point\Figures\Draft version\4 Sep 03\22-052-Figure 2-2 2000.dwg USER: nwong Aug 13, 2004 1:05pm



LEGEND

- PROGRAM MONITORING WELL
- MONITORING WELL NOT IN PROGRAM OR NOT SCREENED IN SPECIFIED HYDROLOGIC UNIT
- CERCLA SITE BOUNDARY
- GROUNDWATER ELEVATION IN FEET ABOVE MEAN SEA LEVEL, QUERIED WHERE UNCERTAIN
- 8.10 GROUNDWATER ELEVATION
- CONTOUR INTERVAL 1 FOOT
- NM NOT MEASURED (WELL NOT ACCESSIBLE)

SCALE: 0 150 300 FEET

NOTE:

1. THE WINTER 2002 WATER LEVELS WERE MEASURED ON DECEMBER 11 AND 12, 2002.

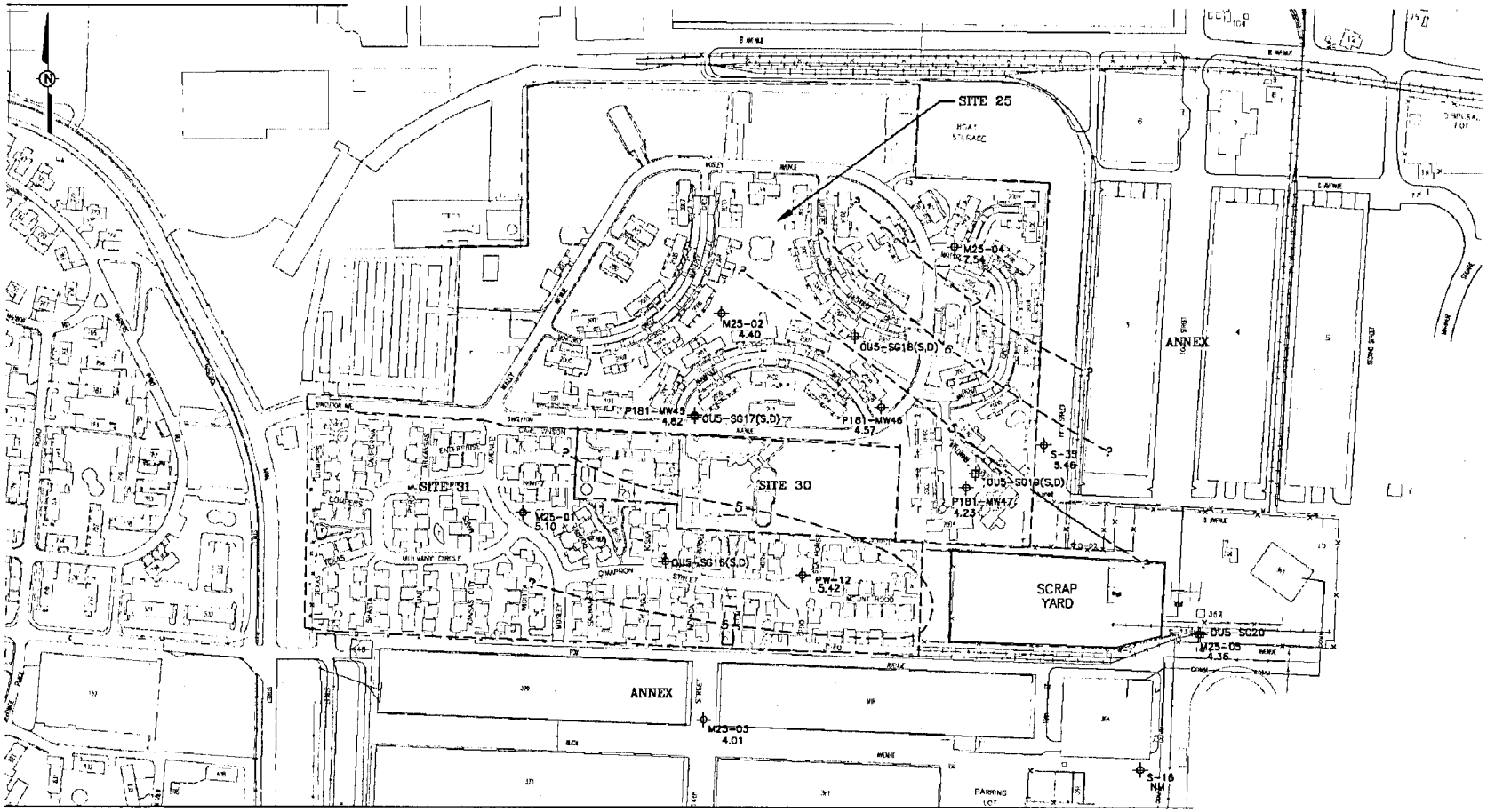
REFERENCE:

SHAW ENVIRONMENTAL, INC., GROUNDWATER MONITORING REPORT, INSTALLATION RESTORATION SITE 25 GROUP, SUMMER 2002 TO SPRING 2003, ALAMEDA POINT, ALAMEDA, CALIFORNIA, NOVEMBER 11, 2003.

ERRG Engineering/Remediation Resources Group, Inc.
185 Mason Circle, Suite A
Concord, California 94520
(925) 969-0750

DRAWN BY: L.H. 6/22/04	GROUNDWATER ELEVATION MAP WINTER 2002	
DESIGNEDED BY: C.L. 6/22/04	CLIENT: NAVY SWDIV	FIGURE: 2-3
CHECKED BY: C.L. 7/1/04	DWG. NO. 22-052-FIGURE 2-3	

FILE: P:\2002 Projects\22-052 RI FS Alameda Point\Figures\Draft version\Jun 04\Fig 2-3 Gdwater Elevation Map Winter 2002.dwg USER: rwong Jul 02, 2004 11:34am



LEGEND

- PROGRAM MONITORING WELL
- MONITORING WELL NOT IN PROGRAM OR NOT SCREENED IN SPECIFIED HYDROLOGIC UNIT
- CERCLA SITE BOUNDARY
- GROUNDWATER ELEVATION IN FEET ABOVE MEAN SEA LEVEL, QUERIED WHERE UNCERTAIN
- 7.04 GROUNDWATER ELEVATION
- CONTOUR INTERVAL 1 FOOT
- NM NOT MEASURED
- NESTED SOIL GAS WELL (S,M,D)
- S: SHALLOW (UPPER VADOSE ZONE)
- D: DEEP (LOWER VADOSE ZONE)

SCALE
0 150 300 FEET

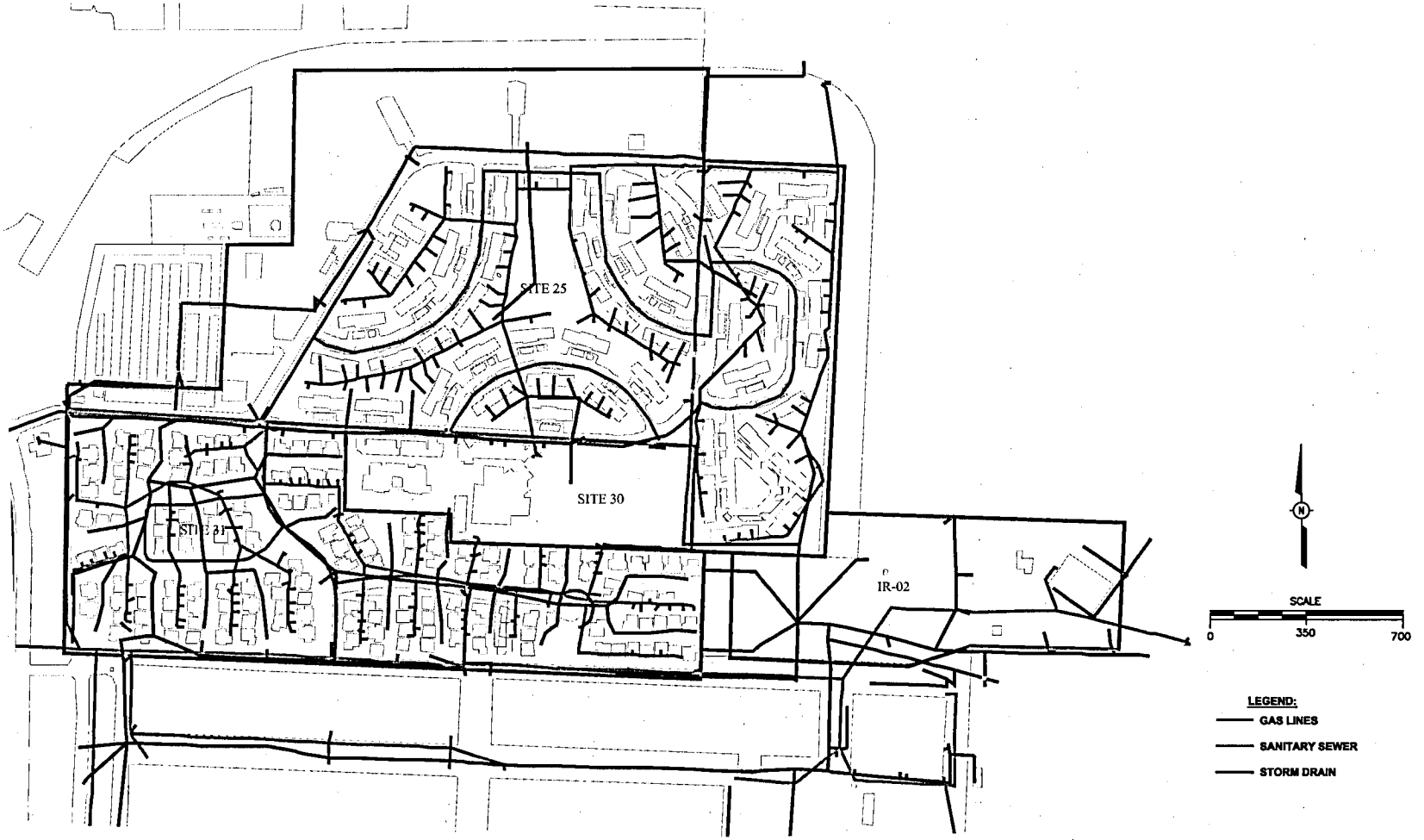
NOTE:
1. THE SUMMER 2003 WATER LEVELS WERE MEASURED ON JUNE 24, 2003.

REFERENCE:
SHAW ENVIRONMENTAL, INC., GROUNDWATER MONITORING REPORT, INSTALLATION RESTORATION SITE 25 GROUP, SUMMER 2003 TO SPRING 2004, ALAMEDA POINT, ALAMEDA, CALIFORNIA, APRIL 16, 2004.

ERRG
Engineering/Remediation Resources Group, Inc.
185 Mason Circle, Suite A
Concord, California 94520
(925) 969-0750

DRAWN BY: L.H. 6/22/04	GROUNDWATER ELEVATION MAP SUMMER 2003	
DESIGNEDED BY: C.L. 6/22/04	CLIENT: NAVY SWDIV	FIGURE: 2-4
CHECKED BY: C.L. 7/1/04	DWG. NO. 22-052-FIGURE 2-4	

FILE: P:\2002 Projects\22-052 RI FS Alameda Point\Figures\Draft version\Jun 04\Fig 2-4 Groeter Elevation Map Summer 2003.dwg USER: rerong Jul 02, 2004 11:45am



ERRG Engineering/Remediation Resources Group, Inc. 185 Mason Circle, Suite A Concord, California 94520 (925) 969-0750	DRAWN BY: R.W. 6/28/04	SUBSURFACE UTILITIES MAP	
	DESIGNEDED BY: C.L. 6/28/04	CLIENT: NAVY SWDIV	FIGURE: 2-5
	CHECKED BY: P.F. 6/28/04	DWG. NO. 22-052-FIGURE 2-5	

FILE: P:\2002 Projects\22-052 RI FS Alameda Point\Figures\Draft version\Jun 04\Fig 2-5 Subsurface Utilities Map.dwg USER: mong Aug 23, 2004 1:12pm

3. PREVIOUS INVESTIGATIONS

The discovery and characterization phases of the CERCLA cleanup process have been completed for the Site, and a FS was also completed to address the Marsh Crust and Alameda Point groundwater. The purpose of this report is to perform a comprehensive study that evaluates groundwater contamination in both Alameda Point Site 25 and Alameda Annex IR-02.

To streamline and focus this report, only summarized results from previous investigations have been included. However, results from previous investigations were called upon extensively to perform the evaluations included in this document. For example, the groundwater analytical data set used in this report was compiled from multiple previous investigations by different consultants, reported in varying data formats.

The previous investigations used for reference in this report are summarized in the sections that follow and in Table 3-1.

3.1. PREVIOUS GROUNDWATER INVESTIGATIONS

Though groundwater beneath the Site is present in one contiguous unit, it historically has been investigated under two separate programs: one addressing Alameda Point Site 25, and the other addressing Alameda Annex IR-02. The groundwater investigations performed previously under each program are summarized in the sections that follow.

3.1.1. Previous Alameda Point Groundwater Investigations

The previous Alameda Point Site 25 groundwater investigations were summarized in the following reports:

- *Data Summary Report, Site 25 Remedial Investigation, Alameda Point* (TtEMI, 1999a)
- *Final Determination of Beneficial Uses of Groundwater, Alameda Point* (TtEMI, 2000b)
- *Final Comprehensive Guide to the Environmental Baseline Survey* (IT, 2001j)
- *Parcel Evaluation Data Summary, Phase 2B Sampling, Zone 16: The Housing Zone, Parcel 182, Alameda Point* (IT, 2001f)
- *Draft Field Summary Report for OU-5 Addendum Activities* (IT, 2001k)
- *Storm Sewer Study Tech Memo Addendum and Responses to Comments on the Draft Final Storm Sewer Study Report* (TtEMI, 2001a)
- *Draft Final Remedial Investigation Work Plan for OU-5, Alameda Point* (Neptune et al., 2001)
- *Draft Final Remedial Investigation, Alameda Point OU-5* (IT et al., 2002)

Table 3-1
Supporting Document Summary
Alameda Point Site 25/Alameda Annex IR-02 Groundwater RI/FS
Page 1 of 3

Installation	Site	Investigation Type	Author	Date	Title	Status (draft/final)
Alameda Annex	Parcels 178, 179, 180 and Warehouse Area	Soil gas	PRC	11/27/1989	Shallow Soil Gas Investigation: Parcels 178/179/180 and Alameda Annex Warehouse Area	Draft*
Alameda Annex	Parcel 178	Soil gas	PRC	10/2/1990	Risk Assessment Report (Parcel 178, Marina Village Housing)	Draft*
Alameda Annex	IR-02	Groundwater	PRC	2/1/1993	Alameda Annex and Screening Lot and Scrap Yard, Sampling Results Technical Memorandum	Draft*
Alameda Annex	Basewide	Groundwater	PRC and Versar	1/1/1996	Final Remedial Investigation	Draft*
Alameda Annex	Basewide	Groundwater	TtEMI	10/2/1998	Final Technical Memorandum, Groundwater Contaminant Fate and Transport Modeling, Alameda Annex	Final
Alameda Annex	Basewide	Groundwater	TtEMI	11/2/1999	Groundwater Beneficial Uses Evaluation, Alameda Annex	Draft*
Alameda Annex	Basewide	Groundwater	NewFields	1/14/2000	Baseline Human Health Risk Assessment	Draft*
Alameda Point	Site 25	Groundwater	TtEMI	1/29/1999	Data Summary Report, Site 25 Remedial Investigation	Draft*
Alameda Point	Basewide	Groundwater	TtEMI	7/1/2000	Final Determination of Beneficial Uses of Groundwater	Final
Alameda Point	Zone 16 (including Parcels 178 - 184)	Soil, Air	IT	1/1/2001	Zone Evaluation Data Summary, Zone 16: Housing Zone, Alameda Point, Alameda, California	Final
Alameda Point	Parcel 178	Soil, Air	IT	1/1/2001	Parcel Evaluation Data Summary, Phase 2A Sampling, Zone 16: Housing Zone, Parcel 178: Family Housing, Alameda Point, Alameda, California	Final
Alameda Point	Parcel 179	Soil, Air	IT	1/1/2001	Parcel Evaluation Data Summary, Phase 2A Sampling, Zone 16: Housing Zone, Parcel 179: George P. Miller Elementary School, Alameda Point, Alameda, California	Final
Alameda Point	Parcel 180	Soil, Air	IT	1/1/2001	Parcel Evaluation Data Summary, Phase 2A Sampling, Zone 16: Housing Zone, Parcel 180: NAS Alameda Child Day Care, Alameda Point, Alameda, California	Final

Table 3-1
Supporting Document Summary
Alameda Point Site 25/Alameda Annex IR-02 Groundwater RI/FS
Page 2 of 3

Installation	Site	Investigation Type	Author	Date	Title	Status (draft/final)
Alameda Point	Parcel 181	Soil, Air	IT	1/1/2001	Parcel Evaluation Data Summary, Phase 2A Sampling, Zone 16: Housing Zone, Parcel 181: Multiple Unit Housing, Alameda Point, Alameda, California	Final
Alameda Point	Parcel 182	Soil, Groundwater, Air	IT	1/1/2001	Parcel Evaluation Data Summary, Phase 2A Sampling, Zone 16: Housing Zone, Parcel 182: Open Space, Alameda Point, Alameda, California	Final
Alameda Point	Parcel 182	Soil, Groundwater, Air	IT	1/1/2001	Parcel Evaluation Data Summary, Phase 2B Sampling, Zone 16: Housing Zone, Parcel 182: Open Space, Alameda Point, Alameda, California	Final
Alameda Point	Parcel 183	Soil, Air	IT	1/1/2001	Parcel Evaluation Data Summary, Phase 2A Sampling, Zone 16: Housing Zone, Parcel 183: Building 545, Alameda Point, Alameda, California	Final
Alameda Point	Parcel 184	Soil, Air	IT	1/1/2001	Parcel Evaluation Data Summary, Phase 2A Sampling, Zone 16: Housing Zone, Parcel 184: Building 172 - Demolished, Alameda Point, Alameda, California	Final
Alameda Point	OU-5/Site 25 (Parcels 181-183)	Soil, Groundwater, Soil gas	Neptune et al.	5/9/2001	Draft Final Remedial Investigation Work Plan for OU-5, Alameda Point	Draft Final
Alameda Point	Basewide	Soil, Groundwater, Air	IT	6/29/2001	Final Comprehensive Guide to the Environmental Baseline Survey, Alameda Point, Alameda, California	Final
Alameda Point	OU-5/Site 25 (Parcels 181-183)	Groundwater	IT	7/23/2001	Draft Field Summary Report for OU-5 Addendum Activities	Draft
Alameda Point	Basewide	Groundwater	TtEMI	8/30/2001	Storm Sewer Study Tech Memo Addendum and Responses to Comments on the Draft Final Storm Sewer Study Report	Draft*
Alameda Point	Basewide	Groundwater	TtEMI	11/1/2001	Summary of Background Concentrations in Soil and Groundwater	Draft*
Alameda Point	Coast Guard Housing	Soil gas	Tetra Tech, Inc.	7/1/2002	Residential Risk Evaluation for U.S. Coast Guard Housing, Alameda, California	Draft*

Table 3-1
Supporting Document Summary
Alameda Point Site 25/Alameda Annex IR-02 Groundwater RI/FS
Page 3 of 3

Installation	Site	Investigation Type	Author	Date	Title	Status (draft/final)
Alameda Point	OU-5/Site 25 (Parcels 181-183)	Soil, Groundwater, Soil gas	IT et al.	7/12/2002	Draft Final Remedial Investigation, Alameda Point OU-5	Draft Final
Alameda Point	Site 25	Soil	FW	11/1/2002	Draft Project Closeout Report, Comprehensive Environmental Response, Compensation, and Liability Act Time-Critical Removal Action at IR Site 25	Draft
Alameda Point	OU-5/Site 25 (Parcels 181-183)	Soil	CDM Federal	8/15/2003	Draft Soil Feasibility Study	Draft
Alameda Point	Basewide	Groundwater, Soil gas	Shaw	2/6/2004	Final Work Plan for the Basewide Groundwater Monitoring Program, Alameda Point	Final
Alameda Point	Site 25	Groundwater, Soil gas	Shaw	2/27/2004	Groundwater Monitoring Report for Installation Restoration Site 25 Group, Summer 2002 to Spring 2003, Alameda Point	Draft*
Alameda Point	Site 25	Groundwater, Soil gas	Shaw	4/16/2004	Groundwater Monitoring Report for Installation Restoration Site 25 Group Summer 2003 to Spring 2004, Alameda Point	Draft*
Alameda Point and Alameda Annex	Site 25/IR-02, Parcel 179	Soil gas	TtEMI	10/20/1999	Updated Alameda Point/Alameda Annex Benzene Soil Gas Investigation Summary and Summary of Crawl Space Benzene Air Sampling at Parcel 179	Updated
Alameda Point and Alameda Annex	Basewide	Groundwater	TtEMI	3/31/2000	Final FS for the Marsh Crust and Groundwater at FISCA, and FS for the Marsh Crust and Former Subtidal Area, Alameda Point	Final
Alameda Point and Alameda Annex	IR-02	Groundwater	TtEMI	12/27/2001	Final Technical Memorandum on the Groundwater and Benzene Soil Gas Investigation at Installation Restoration Site 02 Fleet and Industrial Supply Center Oakland, Alameda Facility/Alameda Annex	Final

** Status not specified; listed as draft to indicate that no subsequent version of the document has been issued*
FISCA = Fleet and Industrial Supply Center Oakland, Alameda Annex/Alameda Facility
IR = Installation Restoration Site
IT = International Technology Corporation
IT et al. = IT, Neptune and Company, Inc., and Environ
Neptune et al. = Neptune and Company, Inc., IT, and Environ
OU = Operable Unit
PRC = PRC Environmental Management
TtEMI = Tetra Tech EM Inc.

- *Final Work Plan for the Basewide Groundwater Monitoring Program, Alameda Point* (Shaw, 2004a)
- *Groundwater Monitoring Report for Installation Restoration Site 25 Group, Summer 2002 to Spring 2003, Alameda Point* (Shaw, 2004b)
- *Groundwater Monitoring Report for Installation Restoration Site 25 Group Summer 2003 to Spring 2004, Alameda Point* (Shaw, 2004c)

Following is a brief summary of the findings of the above reports, as they relate to site groundwater.

Data Summary Report, Site 25 Remedial Investigation, Alameda Point (TtEMI, 1999a): The report describes the results of a soil and groundwater characterization effort, performed in the northern portion of Alameda Point Site 25 (Parcel 182, Estuary Park), north of the site that is the subject of this report. Benzene was detected twice in groundwater, with a maximum concentration of 28 µg/L.

Final Determination of Beneficial Uses of Groundwater, Alameda Point (TtEMI, 2000b): The report determined that shallow groundwater beneath the Site had no potential beneficial reuse, based on high TDS concentrations, well yield, reuse plans, and other factors.

Parcel Evaluation Data Summary, Phase 2B Sampling, Zone 16: The Housing Zone, Parcel 182, Alameda Point (IT, 2001f): Four Hydropunch™ groundwater samples were collected from Parcel 182 in October 1995 as part of the EBS. The samples were analyzed for total petroleum hydrocarbons (TPH)-purgeable, TPH-extractable, and semi-volatile organic compounds (SVOCs). Five SVOCs were detected (acenaphthene, fluoranthene, naphthalene, pyrene, and phrenanthrene). The maximum concentration of naphthalene detected was estimated at 1 µg/L. No other groundwater samples were collected at adjacent parcels during the EBS.

Final Comprehensive Guide to the Environmental Baseline Survey (IT, 2001j): The report was used as a reference in this RI/FS for Alameda Point cleanup information and for general information on Marsh Crust contaminants. The background included information on the various phases of investigation performed to date, property reuse planning, Resource Conservation and Recovery Act (RCRA) compliance, the IR program, natural ecological resource evaluation, the history of the area (including Alameda Annex), and the storm drain system.

Draft Field Summary Report for OU-5 Addendum Activities (IT, 2001k): The report describes the techniques and results of a characterization program to assess contamination in soils, groundwater, and soil gas. The groundwater investigation consisted of various Hydropunch™ samples at multiple depths.

Storm Sewer Study Tech Memo Addendum and Responses to Comments on the Draft Final Storm Sewer Study Report (TtEMI, 2001a): This document provided information on storm drain lines in the vicinity of the benzene groundwater contamination. The Alameda Annex RI (PRC and Versar, 1996) also provided information regarding storm drain lines in the area of contamination.

Draft Final Remedial Investigation Work Plan for OU-5, Alameda Point (Neptune et al., 2001): The work plan provided a general background for Alameda Point Site 25. It also contained a brief discussion on soil staining observed in a satellite photo, and its location coincident with a benzene plume center (see Figure 1-5).

Draft Final OU-5 Remedial Investigation, Alameda Point (IT et al., 2002): The Draft Final RI provided information from groundwater and soil gas sampling events conducted in 2001, designed to further characterize both Alameda Point Site 25 and Alameda Annex IR-02 because groundwater contamination is continuous across both areas. The RI also performed a HHRA based on the results of the sampling and analysis program. The Draft Final RI was used extensively in this report as a reference, primarily because it yielded detailed information on the nature and extent of groundwater contamination; specifically, vertical stratification of benzene contamination.

Final Work Plan for the Basewide Groundwater Monitoring Program, Alameda Point (Shaw, 2004a): The groundwater monitoring work plan described the ongoing monitoring program, and its goals to monitor basewide contaminant plumes and degradation and to assess the network of monitoring wells at the Site. The Final Work Plan also provided results from monitored natural attenuation (MNA) field tests and analyses. An inventory of all known monitoring wells at the site was included as Appendix E of the Final Work Plan. As part of the Basewide Groundwater Monitoring Program, groundwater samples continue to be collected on a quarterly and/or semi-annual basis from a system of 12 monitoring wells located within Site 25 and IR-02. Samples are analyzed for VOCs, PAHs, metals, and natural attenuation parameters. This network of wells is assessed on an annual basis, and recommendations are made to install new wells or limit the frequency of sampling. The results of the ongoing monitoring program are reported quarterly in groundwater monitoring reports. Validated data are currently available through March 2004 (Shaw, 2004b and c).

3.1.2. Previous Alameda Annex Groundwater Investigations

Previous Alameda Annex groundwater investigations were summarized in the following reports:

- *Alameda Annex and Screening Lot and Scrap Yard, Sampling Results Technical Memorandum* (PRC, 1993)
- *Final Remedial Investigation, Alameda Annex* (PRC and Versar, 1996)
- *Final Technical Memorandum, Groundwater Contaminant Fate and Transport Modeling, Alameda Annex* (TtEMI, 1998a)
- *Groundwater Beneficial Uses Evaluation, Alameda Annex* (TtEMI, 1999c)
- *Baseline Human Health Risk Assessment, Alameda Annex* (NewFields, 2000)

Following is a brief summary of the findings of the above reports, as they relate to site groundwater.

Alameda Annex and Screening Lot and Scrap Yard, Sampling Results Technical Memorandum (PRC, 1993): The technical memorandum was used for a historical perspective in this report. This document also provides detailed geotechnical and hydrogeologic data for the site.

Final Remedial Investigation, Fleet and Industrial Supply Center Oakland, Alameda Annex (PRC and Versar, 1996): The report provided characterization information for Alameda Annex, including details on the nature and extent of contamination and previous risk assessment results, as well as detailed hydrogeologic data including pumping tests.

Final Technical Memorandum, Groundwater Contaminant Fate and Transport Modeling, FISCA (TtEMI, 1998a): The fate and transport study was used to evaluate plume stability and fate and transport mechanisms in this report. The fate and transport study was performed using analytical data gathered over a 2-year period (1994 to 1996), and indicated that benzene plumes were stable and would recede under biodegradation mechanisms. However, the model indicated that benzene concentrations greater than 1 μg/L would remain on the site after the year 2020.

Groundwater Beneficial Uses Evaluation, Alameda Annex (TtEMI, 1999c): Shallow groundwater beneath Alameda Annex was evaluated for potential beneficial uses. The investigation concluded that there was no potential beneficial use due to high TDS, low well yield, and other factors. The RWQCB concurred with the investigation, and the Annex was exempted from designation as drinking water within the State.

Baseline Human Health Risk Assessment, FISCA (NewFields, 2000): The report was used as a reference for the HHRA performed in this RI/FS. The risk assessment performed by NewFields supplemented the risk assessment performed as part of the Alameda Annex RI, and evaluated some exposure pathways not included in the RI HHRA. The HHRA performed by NewFields evaluated a number of exposure pathways and receptors, including construction workers, irrigation applicators, car wash workers, residents, and children in a school. Hazard indices (HIs) were below 1, and all risk levels were found to be within the USEPA's risk management range (10^{-4} to 10^{-6}), provided site groundwater was not used as a potable water supply.

3.1.3. Previous Groundwater Investigations for Alameda Point and Annex

Previous investigations that addressed both Alameda Point and Alameda Annex include:

- *Final FS for the Marsh Crust and Groundwater at FISCA, and FS for the Marsh Crust and Former Subtidal Area, Alameda Point (TtEMI, 2000a)*
- *Final Technical Memorandum on the Groundwater and Benzene Soil Gas Investigation at Installation Restoration Site 02 Fleet and Industrial Supply Center Oakland Alameda Facility/Alameda Annex (TtEMI, 2001c)*

Final FS for the Marsh Crust and Groundwater at FISCA, and FS for the Marsh Crust and Former Subtidal Area, Alameda Point (TtEMI, 2000a). The FS for the Marsh Crust examined remedial alternatives for PAH contamination entrapped during previous fill operations. It concluded that the Marsh Crust warranted remedial action in the form of institutional controls.

Final Technical Memorandum on the Groundwater and Benzene Soil Gas Investigation at Installation Restoration Site 02 Fleet and Industrial Supply Center Oakland Alameda Facility/Alameda Annex (TtEMI, 2001c). The document summarizes previous groundwater and soil gas investigations, and presents the results of sampling conducted by ERM and the Navy at Alameda Annex IR-02. The results of the 2001 Navy Hydropunch™ sampling presented in this report are discussed in greater detail in the OU-5 RI (IT et al., 2002). ERM conducted a series of investigations in February 2000 and February to March 2001, using a variety of sampling methods including groundwater grab sampling, benzene vertical stratification sampling, and Hydropunch™ sampling (TtEMI, 2001b). This report concluded that, because benzene concentrations are higher with depth, benzene sources are most likely associated with buried fill materials.

3.1.4. Monitoring Well Network and Hydropunch™ Sampling Locations

The reports summarized in the preceding sections present analytical data collected under different programs, at different times, from monitoring wells, Hydropunch™ locations, and soil gas probes. Because the data available for the Site were not generated as part of a consistent program, limitations from inconsistent sample locations should be considered when interpreting the data.

Ideally, a monitoring well network that fully encircles Site contamination would be used to monitor plume stability, and would provide a data set showing contaminant concentrations and trends over time at the same locations. However, different sets of wells were used in each Site groundwater sampling event. In 1996, approximately 65 monitoring wells were in existence at the Site (Figure 3-1). This network was used in TtEMI's fate and transport study (TtEMI, 1998a), and in the Alameda Annex RI (PRC and Versar, 1996). In 2001, considerably fewer monitoring wells were available for sampling (Figure 3-2). Many of the monitoring wells located in 1996 had been abandoned as part of removal actions at Alameda Point Site 25 or construction activities at Alameda Annex IR-02. A monitoring well inventory was conducted by Shaw during development of the Basewide Groundwater Monitoring Plan (Shaw, 2004a), documenting the status of wells remaining on the site. Although limited documentation is available regarding the abandonment or destruction of Site monitoring wells from 1996 to 2002, the ongoing Basewide Groundwater Monitoring Program is tracking all existing Site monitoring wells, and recommendations for abandonment (and possible replacement) are coordinated with the Alameda Point BCT and the Alameda Annex BCT prior to field implementation.

Several separate Hydropunch™ sampling events were also conducted at the Site, yielding data that could be used to characterize the nature and extent of contamination, but could not directly be used to track contaminant concentrations over time. Two Hydropunch™ sampling investigations were conducted at

the Site on behalf of the Navy: the first in 1993 as part of the Environmental Baseline Survey (IT, 1998) (Figure 3-3), and the second in 2001 as part of the Alameda Point Site 25 RI (Figure 3-4). The second Hydropunch™ sampling event generated the majority of data regarding stratification of contamination at the Site. Additional Hydropunch™ sampling was also conducted at Alameda Annex IR-02 by ERM in 2000 and 2001; however, the quality of this data, with respect to Navy quality control standards, is unknown.

Also, additional monitoring wells and soil gas probes were installed at the Site as part of the ongoing Alameda Point Basewide Groundwater Monitoring Program (shown in Figure 3-5). Additional wells and probes are proposed based on quarterly analytical results as part of the ongoing program.

Past investigations at Alameda Point and Alameda Annex have emphasized groundwater characterization efforts using monitoring wells, and the ongoing groundwater monitoring being performed throughout Alameda Point will continue to use groundwater monitoring wells. Samples collected as part of the basewide monitoring program use low-flow groundwater sampling methods. In this method, groundwater is pumped from the well slowly to draw water at approximately the rate that the natural groundwater flow would pass through the well. This minimizes mixing of water from the entire screened interval.

Despite the varied approaches used to gather groundwater data at the site, the volume and density of the data are sufficient to draw conclusions about the spatial extent of the groundwater plume and the behavior of the plume over time. These conclusions form the basis of the assessment that sufficient data exist to evaluate remedial alternatives within this report.

3.1.5. Groundwater Analytical Data Set

The groundwater data generated from the reports discussed in the previous sections were collected and combined into a central database. The data of primary concern in this study are the benzene and naphthalene detections in groundwater. They are the two primary human health risk drivers, as discussed in Section 6. Tables A-1 through A-5 in Appendix A provide summary tables for benzene and naphthalene concentrations detected in groundwater. An electronic copy of the groundwater database is also provided on a CD within Appendix A.

3.2. PREVIOUS SOIL GAS AND INDOOR AIR INVESTIGATIONS

Similar to groundwater, soil gas and indoor air have been monitored in both Alameda Point and Alameda Annex. Results from previous soil gas and indoor air investigations have been reported in the following documents:

- *Shallow Soil Gas Investigation: Parcels 178/179/180 and Alameda Annex Warehouse Area* (PRC, 1989)
- *Risk Assessment Report (Parcel 178, Marina Village Housing)* (PRC, 1990)

- *Alameda Annex and Screening Lot and Scrap Yard, Sampling Results Technical Memorandum* (PRC, 1993)
- *Environmental Baseline Survey, Draft Evaluation Summaries – Zone 16 Housing* (IT, 1998)
- *Updated Alameda Point/Alameda Annex Benzene Soil Gas Investigation Summary and Summary of Crawl Space Benzene Air Sampling at Parcel 179* (TtEMI, 1999b)
- *Alameda Point OU-5 RI* (IT et al., 2002)
- *Residential Risk Evaluation for U.S. Coast Guard Housing, Alameda, California* (Tetra Tech, Inc., 2002)
- *Groundwater Monitoring Report for Installation Restoration Site 25 Group, Summer 2002 to Spring 2003, Alameda Point* (Shaw, 2004b)
- *Groundwater Monitoring Report for Installation Restoration Site 25 Group, Summer 2003 to Spring 2004, Alameda Point* (Shaw, 2004c)

A brief summary of the findings of the above reports, as they relate to site soil gas and indoor air, is provided below. Additional analysis of these data, including a vapor intrusion analysis, is provided in Section 4.2.

Shallow Soil Gas Investigation: Parcels 178/179/180 and Alameda Annex Warehouse Area (PRC, 1989): Forty-one soil gas samples were collected around the perimeter of a proposed housing site and analyzed for benzene. Soil gas sample locations and concentrations are presented in Figure 3-6 of this report and in Figure 2 and Appendix A of the TtEMI benzene soil gas investigation summary (TtEMI, 1999b). Of the 41 samples collected, benzene was detected in 5, at concentrations ranging from 40 to 300 micrograms per cubic meter ($\mu g/m^3$). All five of the detections were located outside the known benzene groundwater contamination area. Benzene was not detected in the remaining 36 samples, including samples that were collected directly above known benzene groundwater contamination. The Johnson and Ettinger model was used with the soil gas analytical results, with conservative risk factors, and the associated human health risk was found to range from 8.3×10^{-8} to 1.1×10^{-8} assuming migration of vapors through a concrete building slab, and 1.9×10^{-8} to 2.5×10^{-9} assuming migration of vapors through a concrete perimeter foundation with a vented crawl space (TtEMI, 1999b).

Risk Assessment Report: Parcels 178/179/180 and Alameda Annex Warehouse Area (PRC 1990): Thirty-six soil gas samples were collected and analyzed for benzene at Parcel 178. Soil gas sample locations and concentrations are presented in Figure 3-6 of this report and in Figure 3 and Appendix A of the TtEMI benzene soil gas investigation summary (TtEMI, 1999b). Benzene was detected in 14 samples, at concentrations ranging from 10 to 400 $\mu g/m^3$. Eleven of the soil gas detections were located outside the known area of benzene groundwater contamination. Three were located within an area of low benzene groundwater contamination. Benzene was not detected in the remaining 22 samples, including 6 within the known area of benzene groundwater contamination. Using the Johnson and Ettinger model, with conservative risk factors, human health risks were found to range from 1.1×10^{-7} to 2.8×10^{-9} assuming

migration of vapors through a concrete building slab, and 2.5 x 10^{-8} to 6.3 x 10^{-10} assuming migration of vapors through a concrete perimeter foundation with a vented crawl space (TtEMI, 1999b).

Alameda Annex and Screening Lot and Scrap Yard, Sampling Results Technical Memorandum (PRC, 1993): A total of 214 soil gas samples were collected at 50-foot centers across the screening lot and scrap yard (Alameda Annex IR-02), at depths between 2 feet and 6 feet bgs, and analyzed for benzene. Soil gas sample locations and concentrations are presented in Figure 3-6 of this report and in Figure 4 and Appendix A of the TtEMI benzene soil gas investigation summary (TtEMI, 1999b). Benzene was detected in 13 samples at concentrations ranging from 50 to 17,000 $\mu g/m^3$. The highest reading, obtained from the scrapyard area of IR-02, was considered an anomaly by TtEMI, given that prior testing throughout the Alameda Point housing and Alameda Annex IR-02 areas ranged between 10 and 400 $\mu g/m^3$, and that benzene was not detected in any of the eight surrounding samples collected at distances of 50 to 70 feet. Recent soil gas sampling results further support this conclusion. Over the past 2 years, benzene concentrations have ranged from 0.5 to 262 $\mu g/m^3$ in samples from the shallow soil gas probe OU5-SG-20S, and 5,588 $\mu g/m^3$ in the deep probe at the same location, approximately 150 feet west of the sampling location that yielded the high benzene result. The highest reading is likely attributable to volatilization from the plume center located at monitoring well EW-2. The Quarterly Groundwater Monitoring Program will continue to collect data in this area to evaluate the previous conclusion.

Benzene was not detected in the remaining 201 samples, 62 of which were located within the known area of benzene groundwater contamination. Indoor air risk was also calculated using the soil gas analytical data (including the highest detection) and the Johnson and Ettinger model with conservative risk factors, and found to be 4.7 x 10^{-6} for migration of vapors through a concrete building slab, and 1.1 x 10^{-6} for migration of vapors through a concrete perimeter foundation with a vented crawl space. Excluding the outlier data point, the maximum calculated risk was 8.3 x 10^{-8} (TtEMI, 1999b).

Environmental Baseline Survey, Draft Evaluation Summaries – Zone 16 Housing (IT, 1998): In 1994 and 1995, 27 soil gas samples were collected as part of the environmental baseline survey in Parcels 178, 179, 180, and 181. Fifteen of the soil gas samples were collected in areas with known benzene groundwater contamination. Soil gas sample locations and concentrations are presented in Figure 3-6 of this report and in Figures 5a through 5d and Appendix A of the TtEMI benzene soil gas investigation summary (TtEMI, 1999b). In addition to soil gas samples, 10 air samples were collected to determine if benzene was accumulating in the crawl spaces beneath the George P. Miller Elementary School. Eight samples were collected from three different crawl spaces beneath the school, and two ambient air samples were collected outside the school building. Benzene was not detected in any of the soil gas, crawl space, or ambient air samples. Because benzene was not detected, a HHRA was not performed.

Benzene Soil Gas Investigation Summary (TtEMI, 1999b): In 1999, TtEMI summarized 10 years of previous soil gas investigations. The Johnson and Ettinger model was applied using the previous soil gas

data to predict indoor air concentrations and the associated human health risks. The results of these evaluations are detailed in the applicable investigation summaries above.

Alameda Point OU-5 RI (IT et al., 2002): As part of the Alameda Point OU-5 RI, 42 soil gas samples were collected at 32 locations and analyzed from depths of approximately 2 feet and 5 feet bgs. Soil gas sample locations and concentrations are presented in Figure 3-6 of this report, and in Figure 3-5 and Table D-3 of the Alameda Point OU-5 RI (IT et al., 2002). Detected concentrations of benzene were low, with a maximum detection of 20 $\mu g/m^3$ at 2 feet bgs and 15 $\mu g/m^3$ at 5 feet bgs. The highest naphthalene detections were 54 $\mu g/m^3$ at 2 feet bgs and 180 $\mu g/m^3$ at 5 feet bgs. Methyl tertiary butyl ether (MTBE) was detected in various soil gas samples, at concentrations ranging from 6.6 $\mu g/m^3$ (2 feet bgs) to a maximum of 170 $\mu g/m^3$ (5 feet bgs). MTBE was detected in approximately 65 percent of soil gas samples and appeared to be widespread in soil gas. The maximum concentration was located in the scrapyard area of IR-02. The relatively low volatility of MTBE, and its low detection frequency in groundwater suggests that its occurrence in soil gas may be due to surface rather than groundwater sources. Soil gas samples collected during the RI were co-located with groundwater samples to provide an indication of whether VOCs in groundwater were migrating into soil gas. In general, there appeared to be little correlation between benzene groundwater contamination and benzene soil gas detections (as was seen in previous soil gas investigations), indicating that volatilization of dissolved-phase benzene was not occurring. There also appeared to be more detections of MTBE in soil gas than in groundwater, indicating that MTBE contamination at the Site may be due more substantially to surface discharges than groundwater volatilization.

U.S. Coast Guard Housing Risk Evaluation (Tetra Tech, Inc., 2002): In 2002, the USCG used the Johnson and Ettinger Model to calculate indoor air concentrations based on the Alameda Point OU-5 RI (IT et al., 2002) soil gas, Hydropunch™, and groundwater monitoring well data. A screening risk evaluation was performed, and the estimated risk based on soil gas and Hydropunch™ data were below a cancer risk of 1×10^{-5}. However, because the estimated risk associated with the groundwater monitoring well data was above 1×10^{-5} (the allowable risk level used in that evaluation) crawl space, indoor air, and ambient air samples were collected. An electronic copy of this report is included as Appendix B.

Between February and May 2002, 53 crawl space, indoor, and ambient air samples were collected from three different housing areas: North Housing, Kollmann Circle, and Marina Housing. Sample locations and results are presented in Figure 6 and Tables 9 and 10 of the U.S. Coast Guard Housing Risk Evaluation (Tetra Tech, Inc., 2002). The results indicated that VOC concentrations in crawl spaces did not differ from indoor air concentrations, and indoor air VOC concentrations were consistent with outdoor air concentrations and ambient air measurements collected by the California Air Resources Board (ARB). Therefore, it was determined that the risks to USCG personnel residing at Alameda Point are not likely to differ from other individuals residing in the San Francisco Bay Area. A recommendation was made to revisit the conclusion if groundwater concentrations increased over time.

Basewide Groundwater Monitoring Report for Installation Restoration Site 25 Group (Shaw, 2004b and c): As part of the Basewide Groundwater Monitoring Program, soil gas and groundwater samples are being collected on a quarterly or semi-annual basis. Soil gas samples are collected from five deep and five shallow soil gas monitoring locations for VOCs. Sampling locations and results are presented in Figure 3-6 of this report, and in Table 4-51 and Figure 1-2 of the Basewide Groundwater Monitoring Reports (Shaw, 2004b and 2004c). The results of the ongoing monitoring program are being incorporated into the Groundwater Monitoring Report on a quarterly basis. Validated data are currently available through March 2004. Benzene has been detected in all soil gas probes, at concentrations ranging from 0.1 to 5,588 $\mu g/m^3$.

3.3. PREVIOUS SOIL INVESTIGATIONS AND REMOVAL ACTIONS

The previous investigation of soil contamination and soil removal actions at the Site are summarized in the following reports:

- *Parcel Evaluation Data Summaries, Phase 2A/2B Sampling, Zone 16: The Housing Zone, Parcel 178, 179, 180, 181, 182, 183, and 184, Alameda Point* (IT, 2001b through IT, 2001i)
- *Data Summary Report, Site 25 Remedial Investigation, Alameda Point* (TtEMI, 1999a)
- *Final FS for the Marsh Crust and Groundwater at FISCA, and FS for the Marsh Crust and Former Subtidal Area, Alameda Point* (TtEMI, 2000a)
- *Draft Final Remedial Investigation, Alameda Point OU-5* (IT et al., 2002)
- *Draft Project Closeout Report, Comprehensive Environmental Response, Compensation, Liability Act (CERCLA) Time-Critical Removal Action (TCRA) at IR Site 25* (Foster Wheeler Environmental Corporation [FWENC] 2002)
- *Draft Soil FS, OU-5, Alameda Point* (CDM Federal, 2003)

Parcel Evaluation Data Summaries, Phase 2A/2B Sampling, Zone 16: The Housing Zone, Parcel 178, 179, 180, 181, 182, 183, and 184, Alameda Point (IT, 2001b-i). The EBS involved collection of surface soil, subsurface soil, groundwater, and soil gas samples from locations across the site. A total of 31 surface soil samples and 5 subsurface soil samples were collected from Parcels 178, 179, 180, 181, and 182. The analyses performed on each sample varied based on the sample location. Analyses included TPH-purgeable and -extractable, SVOCs, metals, pesticides, PCBs, dioxins, and furans. Only one subsurface soil sample was analyzed for VOCs; the sampling regime relied almost exclusively on soil gas results to characterize subsurface VOCs. This investigation identified elevated TPH-motor oil and PAHs in surface soil, and subsurface soil. Pesticides (4,4'-DDT, 4,4'-DDD, chlordane, and endosulfan sulfate) were detected at concentrations below the Preliminary Remediation Goal (PRGs). The only metals detected above background levels were arsenic and beryllium (see Figures 179-2 and 180-2 in the Parcel Evaluation reports for Parcels 179 and 180) (IT, 2001c and d). A total of 19 SVOCs were detected, and concentrations of 12 SVOCs exceeded PRGs in samples from Parcel 182, as shown in Figure 182-2 of the EBS report (IT, 2001g). Naphthalene was only detected in three samples, at concentrations ranging from 80 to 660 µg/kg. No VOCs were detected in the one soil sample analyzed for VOCs.

Data Summary Report, Site 25 Remedial Investigation, Alameda Point (TtEMI, 1999a). The Site 25 RI conducted by Tetra Tech focused primarily on Parcel 182 (Estuary Park), with some sampling on the west edge of Parcel 181 to further investigate elevated concentrations of TPH and SVOCs identified in the EBS. As part of this investigation, 90 soil samples were collected from 35 borings at depths of 1, 4, 7, and 10 feet bgs. Samples were analyzed for PAHs; TPH as diesel, motor oil, and gasoline; and benzene, toluene, ethylbenzene, and xylene (BTEX). PAHs and TPH as motor oil were detected with a high frequency in the upper 7 feet of soil, and did not follow a plume pattern but appeared randomly distributed, as shown in Figures 3 to 19 of the Site 25 RI Data Summary Report (TtEMI, 1999a).

Final FS for the Marsh Crust and Groundwater at FISCA, and FS for the Marsh Crust and Former Subtidal Area, Alameda Point (TtEMI, 2000a). The Marsh Crust FS used the results of several previous investigations at the site to evaluate remedial alternatives to treat entrapped contamination. The results indicated that the marsh crust covers a large geographic area that exceeds 700 acres, and occurs at depths ranging from 4 to 18 feet bgs, as shown in Figure 1-6 of the Marsh Crust FS (TtEMI, 2000a). This evaluation focused primarily on benzo(a)pyrene (BaP), benzo(a)anthracene, ideno(1,2,3-cd)pyrene, and benzo(b)fluoranthene, due to their high frequency of occurrence and potential risks to human health. Concentrations of these substances in soil are shown in Figures 1-7 to 1-10 of the FS (TtEMI, 2000a). The risk assessments reviewed in this investigation indicated that SVOCs at the surface of the marsh crust did not currently pose a risk to human health or the environment, because no completed exposure pathways exist. However, exposure through construction activities or pumping of shallow groundwater would pose unacceptable risks. Institutional controls were the selected remedial alternative because institutional controls would protect human health. More aggressive alternatives involving excavation were determined to provide no greater effectiveness and grossly excessive costs compared to institutional controls.

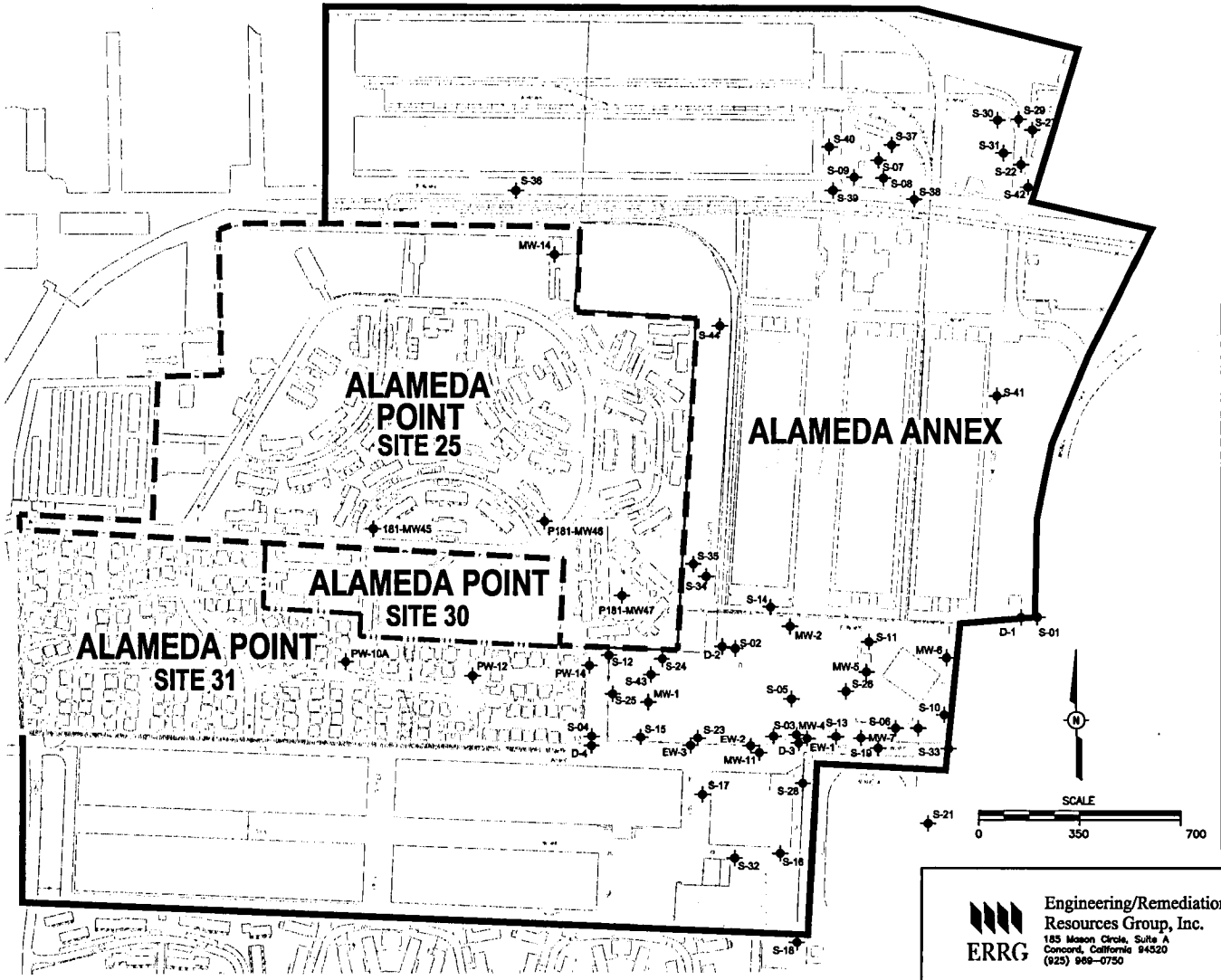
Draft Final Remedial Investigation, Alameda Point OU-5 (IT et al., 2002). As part of the OU-5 RI, 559 samples were collected from 168 borings collected primarily in Parcel 181. All of the samples were analyzed for PAHs. In addition, 143 samples from 60 borings were analyzed for metals, arsenic, and cyanide. The OU-5 RI also reported the results of two removal actions within Parcel 181, a limited action in 2000, and a larger-scale TCRA in 2001-2002.

In October 2000, a health mitigation action was performed to address soils with elevated levels of PAHs. PAHs were detected in soils from the Clover Park play area from 0 to 6 inches bgs, with BaP-equivalent concentrations in the range of 1.7 to 5.6 mg/kg. To eliminate risk to children in the play area, soils within the play area were excavated to a depth of 4 feet and transported off site to an approved landfill. An estimated 900 cubic yards of soil was removed. A high-density polyethylene liner was placed in the bottom of the excavation and covered with clean fill from 4 feet bgs to 1.25 feet bgs and compacted to 90 percent relative compaction. Pea gravel was then placed from 1 to 1.25 feet bgs. Fall zone material was placed from 1 foot bgs to final grade by the USCG following installation of a new play structure.

Draft Project Closeout Report, CERCLA TCRA at IR Site 25 (FWENC 2002). A time-critical removal action occurred in winter 2001 to spring 2002. This action involved removal of soils with elevated concentrations of PAHs to a depth of 2 feet bgs. The area was then backfilled with clean imported fill, top soil, and sod. The excavated soils were disposed of at an off-site disposal facility. Soils were removed from all contiguous housing complex areas where at least one near-surface sample was determined to have BaP-equivalent concentrations of 1.8 mg/kg or greater (FWENC 2002). The extent of the soil removal activities included the majority of Parcel 181 and is shown on Figure 2-8 of the OU-5 RI Report (IT et al., 2002).

Draft Soil FS OU-5, Alameda Point (CDM Federal 2003). The draft FS evaluated human health risk associated with both pre- and post-TCRA soil conditions to develop and evaluate remedial alternatives for residual soil contamination at OU-5. The remedial alternatives evaluated were institutional controls and additional soil excavation (to different depths). A revised draft soil FS for OU-5 is currently being prepared to address agency comments on the draft FS.

This page intentionally left blank



LEGEND

- HISTORICAL GROUNDWATER MONITORING WELLS
- ALAMEDA ANNEX
- ALAMEDA POINT SITE 31
- ALAMEDA POINT SITE 25
- ALAMEDA POINT SITE 30

HISTORICAL MONITORING WELLS

WELL ID	SCREENED INTERVAL	WELL ID	SCREENED INTERVAL
D-1	109.0'-119.0'	S-12	4.0'-19.0'
D-2	95.0'-105.0'	S-13	3.5'-13.5'
D-3	44.0'-54.0'	S-14	3.8'-18.8'
D-4	59.0'-69.0'	S-15	4.0'-14.0'
EW-1	4.7'-14.7'	S-16	3.7'-13.7'
EW-2	3.0'-18.0'	S-17	3.7'-13.7'
EW-3	3.0'-18.0'	S-18	3.7'-13.7'
MW-1	14.4'-24.5'	S-19	3.7'-13.7'
MW-2	9.0'-19.0'	S-20	4.5'-14.5'
MW-3	11.5'-21.5'	S-21	4.7'-14.7'
MW-4	9.5'-19.5'	S-22	3.0'-13.0'
MW-5	9.5'-19.5'	S-23	3.0'-18.0'
MW-6	9.5'-19.5'	S-24	3.0'-18.0'
MW-7	9.5'-19.5'	S-25	3.0'-18.0'
MW-11	NA	S-26	3.0'-18.0'
MW-14	NA	S-27	3.0'-13.0'
P181-MW45	16.0'-18.5'	S-28	4.0'-14.0'
P181-MW46	9.0'-19.0'	S-29	3.0'-13.0'
P181-MW47	13.5'-18.5'	S-30	3.0'-13.0'
PW-10A	12.0'-17.0'	S-31	3.0'-13.0'
PW-12	12.0'-17.0'	S-32	4.0'-14.0'
PW-14	13.0'-18.0'	S-33	4.0'-14.0'
S-01	5.0'-15.0'	S-34	4.0'-14.0'
S-02	6.5'-16.5'	S-35	3.5'-18.5'
S-03	6.5'-16.5'	S-36	3.0'-13.0'
S-04	6.5'-16.5'	S-37	3.0'-13.0'
S-05	4.5'-14.5'	S-38	3.0'-13.0'
S-06	3.5'-13.5'	S-39	3.0'-13.0'
S-07	3.0'-13.0'	S-40	3.0'-13.0'
S-08	3.7'-13.7'	S-41	4.5'-19.5'
S-09	3.7'-13.7'	S-42	4.0'-14.0'
S-10	3.7'-13.7'	S-43	15.5'-18.0'
S-11	3.7'-13.7'	S-44	6.0'-21.0'

ERRG Engineering/Remediation Resources Group, Inc.
185 Mason Circle, Suite A
Concord, California 94520
(925) 969-0750

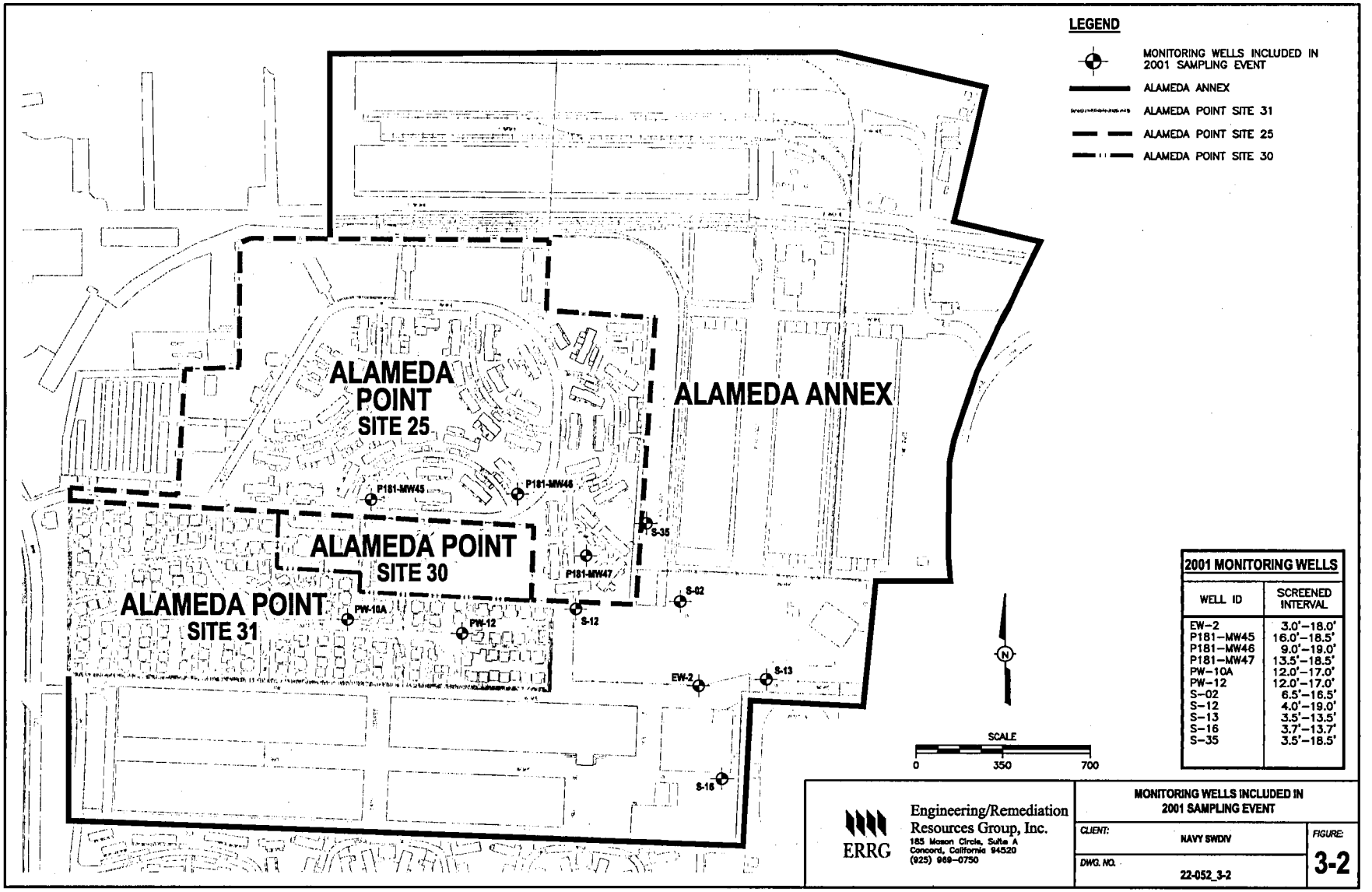
HISTORICAL GROUNDWATER MONITORING WELLS

CLIENT: NAVY SWDIV

DWG. NO.: 22-052-FIGURE 3-1

FIGURE: 3-1

XREF: Ala1base_orig
FILE: P:\2002 Projects\22-052 RI FS Alameda Point\Figures\Prelim Draft Version\Figures 3-1_3-5\22-052_3-1.dwg USER: rwong Jul 08, 2004 6:24pm



2001 MONITORING WELLS	
WELL ID	SCREENED INTERVAL
EW-2	3.0'-18.0'
P181-MW45	16.0'-18.5'
P181-MW46	9.0'-19.0'
P181-MW47	13.5'-18.5'
PW-10A	12.0'-17.0'
PW-12	12.0'-17.0'
S-02	6.5'-16.5'
S-12	4.0'-19.0'
S-13	3.5'-13.5'
S-16	3.7'-13.7'
S-35	3.5'-18.5'

ERRG
Engineering/Remediation Resources Group, Inc.
185 Mason Circle, Suite A
Concord, California 94520
(925) 969-0750

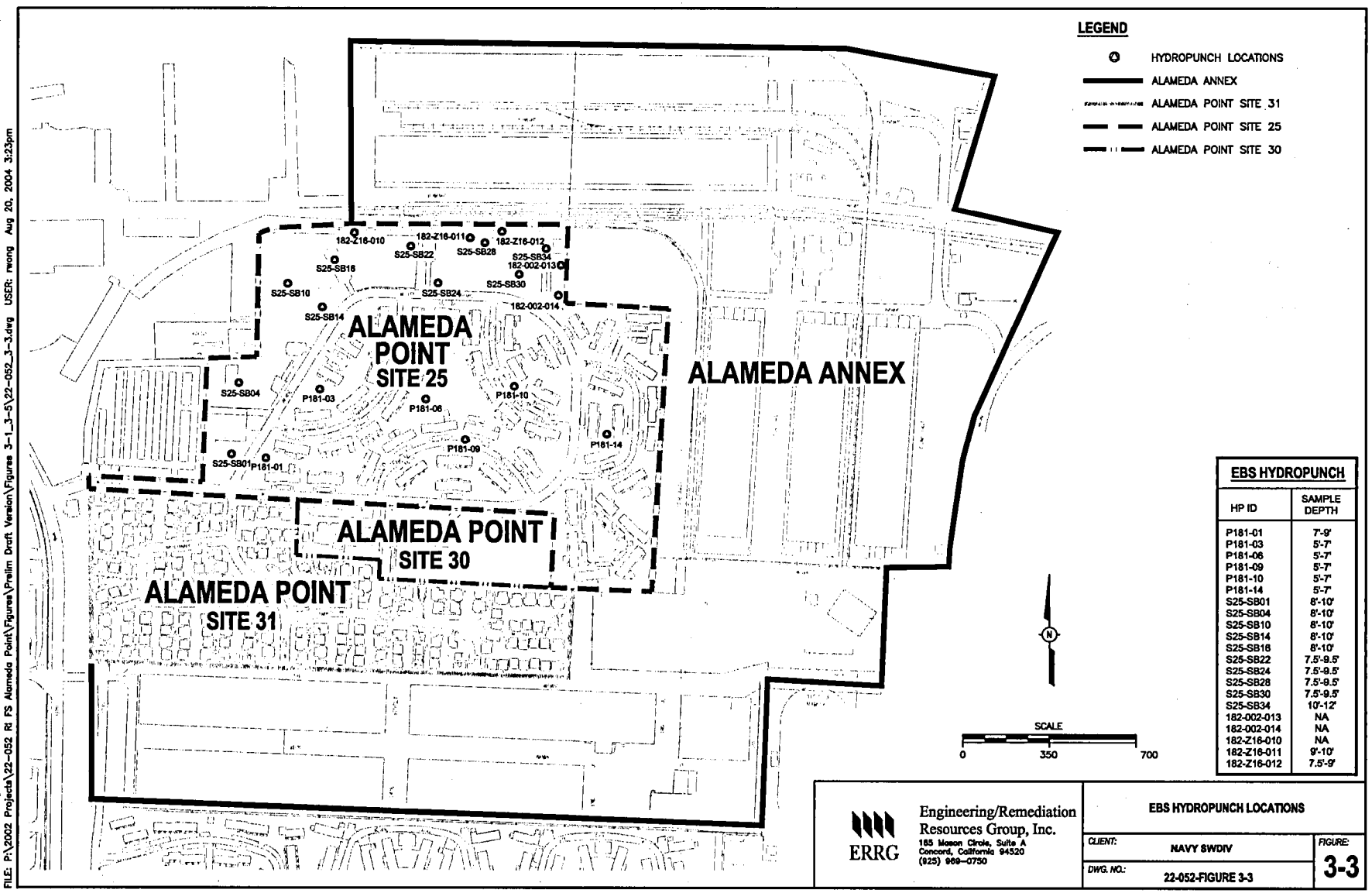
MONITORING WELLS INCLUDED IN 2001 SAMPLING EVENT

CLIENT: NAVY SWDIV

DWG. NO. 22-052_3-2

FIGURE: 3-2

XREF: Alg1base_orig
FILE: P:\2002 Projects\22-052 RI FS Alameda Point\Figures\Prelim Draft Version\Figures 3-1_3-5\22-052_3-2.dwg USER: rwong Jul 08, 2004 6:32pm



EBS HYDROPUNCH

HP ID	SAMPLE DEPTH
P181-01	7'-9'
P181-03	5'-7'
P181-06	5'-7'
P181-09	5'-7'
P181-10	5'-7'
P181-14	5'-7'
S25-SB01	8'-10'
S25-SB04	8'-10'
S25-SB10	8'-10'
S25-SB14	8'-10'
S25-SB16	8'-10'
S25-SB22	7.5'-9.5'
S25-SB24	7.5'-9.5'
S25-SB28	7.5'-9.5'
S25-SB30	7.5'-9.5'
S25-SB34	10'-12'
182-002-013	NA
182-002-014	NA
182-Z16-010	NA
182-Z16-011	9'-10'
182-Z16-012	7.5'-9'

ERRG

Engineering/Remediation Resources Group, Inc.
185 Mason Circle, Suite A
Concord, California 94520
(925) 969-0750

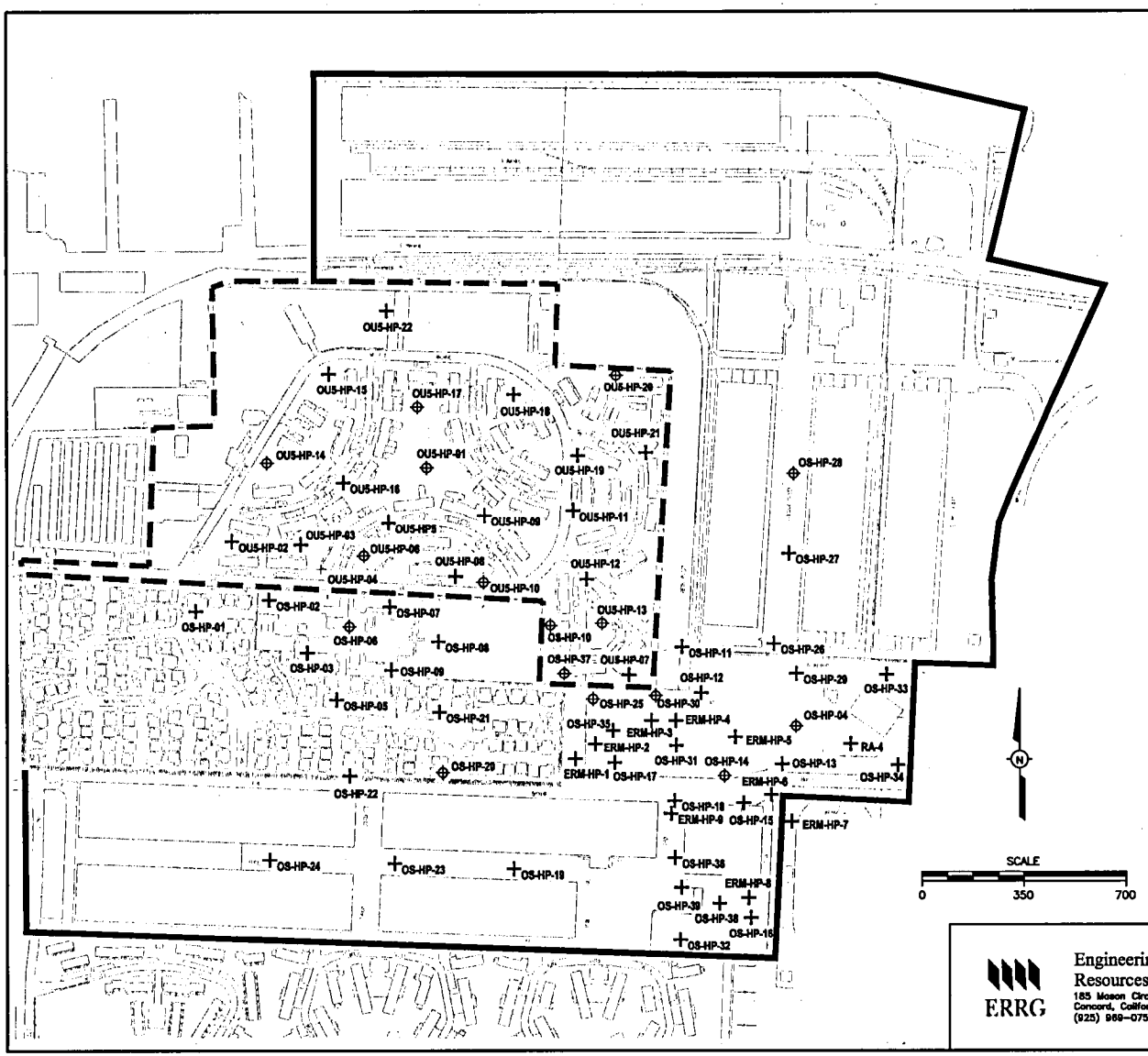
EBS HYDROPUNCH LOCATIONS

CLIENT: NAVY SWDIV

DWG. NO.: 22-052-FIGURE 3-3

FIGURE: 3-3

XREF: Ala1base_orig
FILE: P:\2002 Projects\22-052 RI FS Alameda Point\Figures\Prelim Draft Version\Figures 3-1_3-5\22-052_3-3.dwg USER: rwong Aug 20, 2004 3:23pm



LEGEND

- ALAMEDA ANNEX
- ALAMEDA POINT RESIDENTIAL PARCELS
- ALAMEDA POINT OU-5
- OU5-HP-20 — HYDROPUNCH GROUNDWATER SAMPLING LOCATION SAMPLED FOR NATURAL ATTENUATION PARAMETER
- OU5-HP-22 — HYDROPUNCH GROUNDWATER SAMPLING LOCATION

2001 HYDROPUNCH

HP ID	SCREENED INTERVAL	HP ID	SCREENED INTERVAL
OS-HP-02	8'-12';12'-16'	OU5-HP-01	6'-10';10'-14';14'-16'
OS-HP-03	12'-16';16'-20'	OU5-HP-02	8'-12';12'-16'
OS-HP-04	12'-16';16'-20'	OU5-HP-03	8'-12';12'-16'
OS-HP-05	12'-16'	OU5-HP-04	8'-12';12'-16'
OS-HP-06	6'-10';10'-14'	OU5-HP-05	12'-16';16'-20'
OS-HP-07	10'-14';14'-18'	OU5-HP-06	6'-10';10'-14';14'-18'
OS-HP-08	6'-10';11'-15';15'-19'	OU5-HP-07	6'-10';10'-14'
OS-HP-09	8'-12';12'-16';16'-20'	OU5-HP-08	8'-12';12'-16';16'-20'
OS-HP-10	6'-10';9'-13';14'-18'	OU5-HP-09	8'-12';12'-16';16'-20'
OS-HP-11	8'-12';12'-16';16'-20';20'-24'	OU5-HP-10	8'-10';10'-14';14'-18'
OS-HP-12	5.5'-9.5';10'-14';16'-20'	OU5-HP-11	8'-12';12'-16';16'-20'
OS-HP-13	16'-20'	OU5-HP-12	8'-12';12'-16';16'-20'
OS-HP-14	12'-16';16'-19'	OU5-HP-13	8'-12';12'-15';15'-17.5'
OS-HP-17	8'-12';12'-16';16'-20'	OU5-HP-14	8'-10';10'-14';14'-18'
OS-HP-18	17.5'-20'	OU5-HP-15	7'-11';12'-16'
OS-HP-20	16'-20'	OU5-HP-16	8'-12';12'-16';16'-20'
OS-HP-21	12'-16'	OU5-HP-17	6'-10;10'-14';14'-18'
OS-HP-22	16'-20'	OU5-HP-18	8'-12';12'-16';16'-20';20'-24'
OS-HP-25	12'-16';16'-20'	OU5-HP-19	8'-12';12'-16';16'-20'
OS-HP-26	12'-16';16'-20-;20'-24'	OU5-HP-20	6'-10';10'-14';15'-19'
OS-HP-27	12'-16';16'-20'	OU5-HP-21	8'-12';12'-16';16'-20'
OS-HP-28	8'-12';12'-16';16'-20';20'-24'	OU5-HP-22	8'-12';12'-16'
OS-HP-29	12'-16';17'-21'	RA-1	5',9',18'
OS-HP-30	12'-16';17'-21'	ERM-HP-1	8',13',18'
OS-HP-31	12'-16';16'-20'	ERM-HP-2	10',15',20'
OS-HP-35	16'-20'	ERM-HP-3	10',15',20'
OS-HP-36	8'-12';12'-16';16'-19'	ERM-HP-4	9',14',19'
OS-HP-37	6'-10';10'-14';14'-18'	ERM-HP-5	8',13',18'
OS-HP-39	12'-16'	ERM-HP-6	8',13',18'
		ERM-HP-7	8',13',18'
		ERM-HP-8	9',13',18'
		ERM-HP-9	8',13',18'

ERRG

Engineering/Remediation Resources Group, Inc.
185 Mason Circle, Suite A
Concord, California 94520
(925) 969-0750

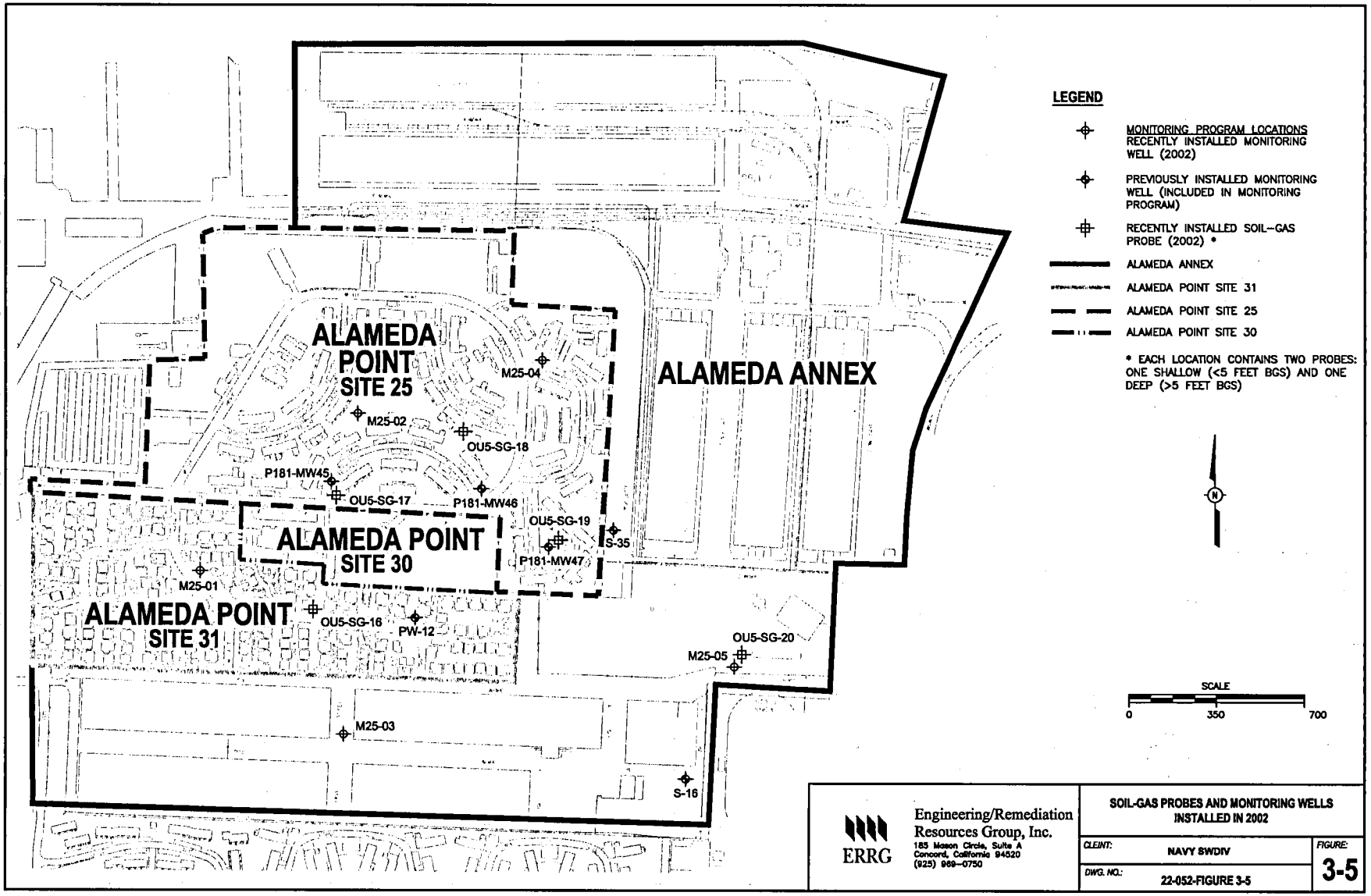
2001 HYDROPUNCH LOCATIONS

Client: NAVY SWDIV

DWG. NO. 22-052-FIGURE 3-4

FIGURE: 3-4

XREF: Ala1base_orig
FILE: P:\2002 Projects\22-052 RI FS Alameda Point\Figures\Prelim Draft Version\Figures 3-1_3-5\22-052_3-4.dwg USER: rwong Jul 02, 2004 2:00pm



ERRG

Engineering/Remediation Resources Group, Inc.
185 Mason Circle, Suite A
Concord, California 94520
(925) 969-0750

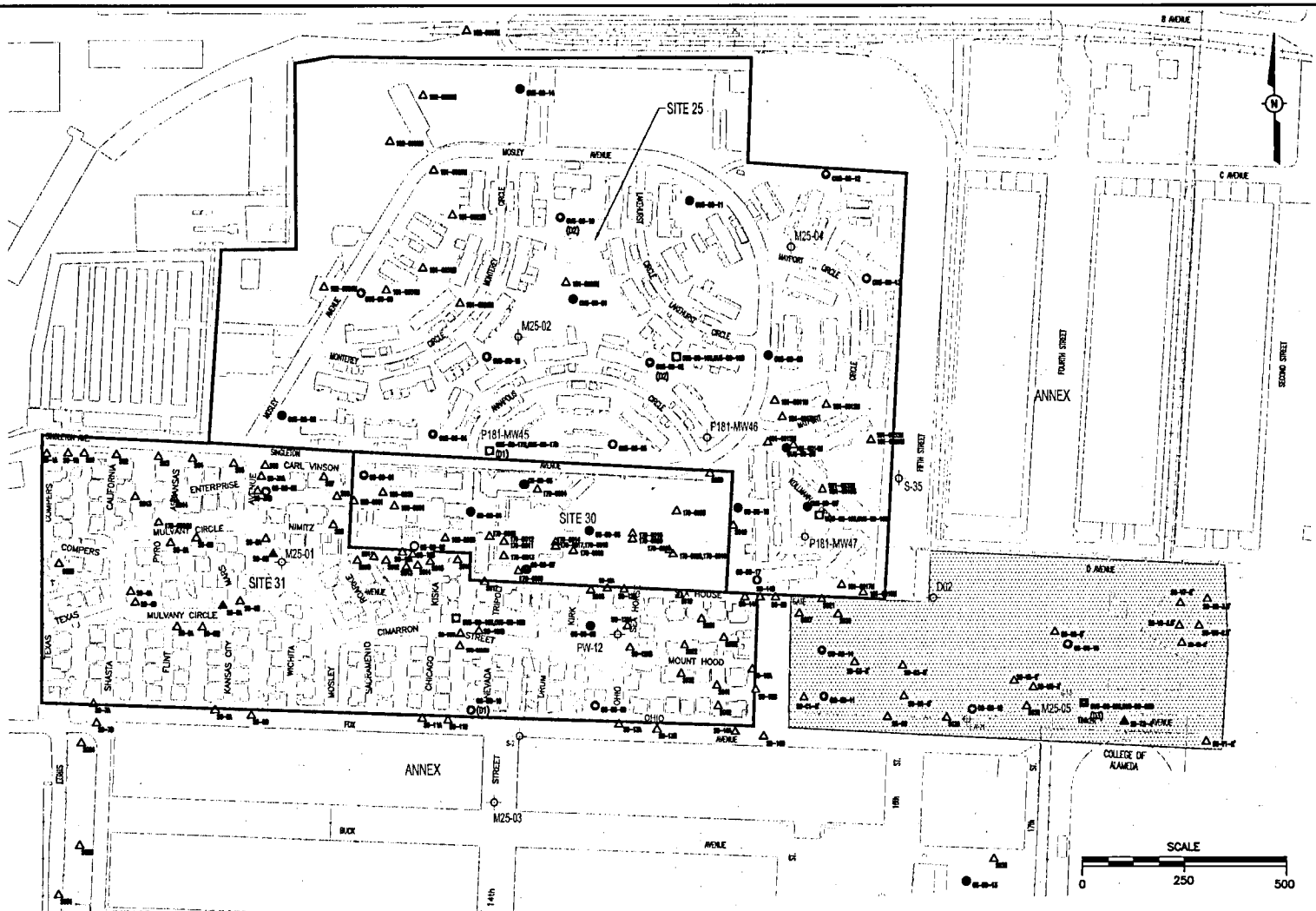
SOIL-GAS PROBES AND MONITORING WELLS INSTALLED IN 2002

CLEINT: NAVY SWDIV

DWG. NO.: 22-052-FIGURE 3-5

FIGURE: 3-5

XREF: Ala1base_orig
FILE: P:\2002 Projects\22-052 RI FS Alameda Point\Figures\Prelim Draft Version\Figures 3-1_3-5\22-052_3-5.dwg USER: rwong Aug 11, 2004 9:30am



LEGEND:

- PROGRAM MONITORING WELL LOCATION
- MONITORING WELL NOT IN PROGRAM
- HISTORIC SOIL GAS SAMPLING LOCATION (1989-1995)
- OU-5 RI SAMPLING LOCATION (2001)
- BASEWIDE MONITORING LOCATION (2002-2003)
- 201 ND SAMPLES FROM PRC 1993 INVESTIGATION WITH RL < 0.19 µg/m³ (SAMPLES WITH DETECTABLE BENZENE CONCENTRATIONS ARE SHOWN; 214 SAMPLES COLLECTED AT 50-FOOT CENTERS ACROSS AREA)
- ND NOT DETECTED
- RL REPORTING LIMIT

BENZENE CONCENTRATION IN SOIL GAS: (In µg/m³)

- ND RL<3.1
- ND RL≥3.1
- <3.1, >0
- <31
- <310
- <1000
- ≥1000

NOTES:

1. MAXIMUM CONCENTRATION AT EACH LOCATION IS SHOWN.
2. SAMPLE COLLECTED FROM SHALLOW SOIL GAS (<5 FEET BELOW GROUND SURFACE, BGS) UNLESS OTHERWISE NOTED.
3. CONCENTRATION RANGES SHOWN BASED ON RISK-BASED CRITERIA (EPA 2002 VAPOR INTRUSION GUIDANCE - SEE TABLE BELOW).

RISK THRESHOLD	RISK-BASED SCREENING VALVES FOR BENZENE IN SHALLOW SOIL GAS (µg/m³)
$1X10^{-6}$	3.1
$1X10^{-5}$	31
$1X10^{-4}$	310

D1 MAXIMUM CONCENTRATION DETECTED >5 FT BGS; CO-LOCATED SHALLOW SAMPLE <3.1 µg/m³

D2 MAXIMUM CONCENTRATION DETECTED >5 FT BGS; NO CO-LOCATED SHALLOW SAMPLE

D3 MAXIMUM CONCENTRATION DETECTED >5 FT BGS; CO-LOCATED SHALLOW SAMPLE <310 µg/m³

ERRG
Engineering/Remediation Resources Group, Inc.
185 Mason Circle, Suite A
Concord, California 94520
(925) 969-0750

DRAWN BY: L.H. 6/21/04	BENZENE CONCENTRATIONS IN SOIL GAS	
DESIGNED BY: C.L. 6/25/04	CLIENT: NAVY SWDIV	FIGURE: 3-6
CHECKED BY: P.F. 6/25/04	DWG. NO. 22-052-FIGURE 3-6	

FILE: P:\2002 Projects\22-052 RI FS Alameda Point\Figures\Draft version\Jun 04\Fig 3-6 Benzene Concentration revised.dwg USER: rwong Aug 12, 2004 9:31am

4. NATURE AND EXTENT OF CONTAMINATION

This chapter provides an overview of the nature and extent of contamination at the Site. Site contamination, which has been thoroughly investigated and reported in numerous previous studies (see Section 3), can be summarized as follows:

- Dissolved-phase benzene contamination in the FWBZ. One plume with three plume centers extends from Alameda Annex IR-02 into Alameda Point Site 25, with higher contamination concentrations at depths near 20 feet bgs.
- Low- to mid-level PAH contamination, primarily naphthalene, in the FWBZ.
- Limited correlation between benzene groundwater contamination and soil gas sample results.
- Low to mid-level benzene concentrations in soil gas, with localized elevated detections near the Alameda Annex IR-02 plume center.

4.1. GROUNDWATER CONTAMINATION

As described in Section 1, benzene and naphthalene contamination have been detected within the Site's FWBZ. Results from previous groundwater characterization efforts have been presented in other reports (PRC and Versar, 1996; IT et al., 2002) and are summarized in this section.

All previous groundwater analytical results for Alameda Point Site 25 and Alameda Annex IR-02 were compiled electronically to facilitate preparation of this report (see Appendix A). Tables summarizing benzene and naphthalene data from recently sampled monitoring wells and Hydropunch™ sampling locations are also included in Appendix A, Tables A-1 through A-4. A summary of the characteristics for the benzene data set (e.g., number of detections compared to total number of samples) is presented in Table A-5 in Appendix A.

The following sections discuss the determination of benzene and naphthalene as the primary COPCs at the Site; the lateral and vertical extent of contamination; trends in COPC concentrations over time; MNA data indicating biodegradation activity at the Site; and a conceptual site model of groundwater contamination.

4.1.1. Contaminants of Potential Concern in Groundwater

During the history of groundwater investigations conducted at the Site, a number of COPCs have been identified. The OU-5 RI reported that the following analytes had been previously detected in groundwater at the Site (IT et al., 2002):

- 16 PAHs
- 48 SVOCs, not including PAHs

- BTEX
- MTBE
- 29 VOCs, not including BTEX and MTBE
- Three categories of TPH

The Basewide Monitoring Program (Shaw, 2004a) includes the following analytes as COPCs for the Site:

- PAHs: fluoranthene, pyrene, acenaphthene, and naphthalene
- VOCs: benzene, toluene, ethylbenzene, and xylenes
- Metals: chromium, lead, and nickel

Of these COPCs, the only contaminants consistently detected above drinking water action levels (MCLs or PRGs) are benzene and naphthalene. These two contaminants represent approximately 90 percent of the calculated human health risks associated with the Site, primarily from the groundwater ingestion pathway (see Section 6 for additional details). Therefore, these substances have been retained as the primary risk drivers for the Site. As discussed in Section 6, all analytes with a frequency of detection above 5 percent were retained as COPCs for the HHRA. As discussed further in Section 4.5.4 and Section 6, laboratory detection limits have varied between investigations, and for some analytes were higher than drinking water action levels.

There have been isolated detections of both MTBE and 1,2-DCA above drinking water action levels; however, these detections appear anomalous and not correlated with the benzene and naphthalene plumes.

MTBE detections are localized, and have only exceeded the California-modified tap water PRG (6.2 µg/L) in one monitoring well (P181-MW46), located north of the main plume. This well has been sampled and analyzed for MTBE ten times—from February 1999 to December 2003. The results from this well are summarized below:

- MTBE concentrations were detected in monitoring well P181-MW46 at 12 µg/L and 19 µg/L in December 1999 and May 2001, respectively.
- MTBE concentrations from the eight subsequent sampling events at well P181-MW46 have been below the California-modified tap water PRG, including the seven most recent MTBE concentrations that were not detected above the laboratory reporting limits.

Samples from 17 monitoring wells throughout the Alameda Point Site 25 and Alameda Annex IR Site 02 groundwater study area have been analyzed for MTBE. With the exception of the MTBE detections at well P181-MW46, MTBE concentrations at all other wells were below the California-modified tap water PRG, as summarized below:

- There have been no historic detections of MTBE in 14 of the 17 wells.

- Maximum concentrations detected at the other two wells (P181-MW45 and PW-12) were 5 µg/L, or below the California-modified tap water PRG.

In addition, MTBE was analyzed for in 122 samples collected at 61 Hydropunch™ borings during the 2001 RI, and none of the sample concentrations were above the laboratory reporting limits. Figures 4-47 through 4-49 of the OU-5 RI show the Hydropunch™ and monitoring well data collected in 2001, when the maximum concentration of MTBE was detected (IT et al., 2002). Figure 4-1 summarizes MTBE data for the three wells that have contained detectable concentrations of MTBE, and shows the median detection limit for all other monitoring wells that have been sampled for MTBE.

Likewise, 1,2-DCA detections were detected with no consistent spatial correlation to the benzene plume and have not been persistent over time. A review of the 1,2-DCA data revealed that 1,2-DCA was only detected in 2001 and has had a relatively low frequency of detection:

- 1,2-DCA was detected above the MCL (5 µg/L) in 7 of the 61 Hydropunch™ borings conducted in 2001. There detections were located randomly across the Site with no spatial pattern. The maximum concentration was 50 µg/L, detected in the 16- to 19-foot interval from boring OS-HP-14 in the southeast corner of the Site, located adjacent to the EW-2 plume center well.
- 1,2-DCA was detected below the MCL in an additional 6 borings.
- Samples from the majority of the Hydropunch™ borings (48 of 61) contained no detectable concentrations of 1,2-DCA.
- 1,2-DCA has been detected in four monitoring wells, to a maximum concentration of 39 µg/L in monitoring well P181-MW47, in samples collected on May 31, 2001. All four samples collected from P181-MW47, the plume center well located in Mayport/Kollman Circle, since May 2001 have contained no detectable concentrations of 1,2-DCA.

Concentrations of 1,2-DCA exceeding the MCL are shown in Figure 4-39 of the OU-5 RI Report (IT et al., 2002). All of the 1,2-DCA detections occurred in 2001. Before 2001, analysis for 1,2-DCA had only been conducted on four Hydropunch™ samples from Parcel 182. 1,2-DCA was not detected in any of the Hydropunch™ samples above the reporting limit of 0.5 µg/L. No 1,2-DCA has been detected in any sample since 2001.

The available data indicate that the concentrations of MTBE and 1,2-DCA previously detected were localized and have not been replicated during numerous subsequent sampling events. For this reason, MTBE and 1,2-DCA are not considered COPCs for the remedial alternatives analyzed in this report. However, they were included as COPCs in the HHRA discussed in Section 6 and ongoing sampling conducted under the Basewide Groundwater Monitoring Program continues to analyze samples from Site monitoring wells on a quarterly or semi-annual basis for both of these analytes as part of the standard VOC analyte list (Shaw, 2004a).

Because of benzene's contribution to the human health risks calculated for the Site, and its frequency of detection, mobility in groundwater, and toxicity (it is a known carcinogen), it has been used as the

primary COPC for this investigation. Naphthalene is co-located with benzene, and is also a primary human health risk driver (see risk assessment results in Section 6). The remedial alternatives evaluated in this report address naphthalene as well as benzene contamination. Any variations in remedial alternative effectiveness due to differences between benzene and naphthalene properties are addressed in the detailed analysis of the proposed alternatives (Section 9).

4.1.2. Benzene Contour Maps Presented in Previous Reports

Various reports prior to this RI/FS have generated isoconcentration maps, which are referred to as contour maps, to depict benzene contamination in the FWBZ. The most significant hand-drawn benzene plume maps generated prior to this report include:

- Alameda Point/Annex 1999 contours (TtEMI, 1999a): A plume map using 1999 groundwater analytical data was included as part of the soil gas summary report. Contours were hand-drawn based on data gathered primarily from shallow Alameda Annex monitoring wells.
- Alameda Point Draft Final RI Work Plan (Neptune et al., 2001), Figure 5-4: Benzene contours were hand-drawn using 1999 groundwater analytical data.
- Alameda Point OU-5 RI (IT et al., 2002): A 2001 groundwater analytical data set was used, based on samples collected from monitoring wells and Hydropunch™ samples. Hand-drawn benzene contours were generated and presented as Figures 4-40 through 4-43; computer-modeled benzene contour maps were also included as Figure B-22.
- Alameda Point Basewide Groundwater Monitoring Program Work Plan (Shaw, 2004a): A hand-drawn plume was included in the work plan, estimating the location of the 1-µg/L isoconcentration line (1 µg/L is the State MCL for benzene, which is being used as a decision point in the ongoing groundwater monitoring program).
- Alameda Point Basewide Groundwater Monitoring Program Quarterly Results (Shaw, 2004b). Hand drawn contour maps are generated on a quarterly basis based on the results of groundwater sampling each quarter.

In addition, computer-generated benzene contour maps were included as part of a previous fate and transport study (TtEMI, 1998a). A more detailed discussion of that study and its results is presented in Section 5.4

Four primary sets of data were used to generate the above-listed figures:

- Data generated from 1994-96 as part of the Alameda Annex RI (PRC and Versar, 1996). These data were generated using samples collected from a network of approximately 65 monitoring wells, located at Alameda Annex and also within portions of Alameda Point OU-5.
- Data generated from a 1999 groundwater-sampling event. Groundwater samples were collected from fewer monitoring wells than in the previous data set.
- Data generated from the Alameda Point OU-5 RI (IT et al., 2002). The RI included groundwater sampling from both monitoring wells and Hydropunch™ locations within Alameda Point OU-5 and Alameda Annex IR-02. To evaluate the vertical distribution of contaminants, Hydropunch™ samples were collected at 4-foot intervals to 20 feet bgs. Soil gas samples were also collected at

various locations to evaluate whether benzene in groundwater was volatilizing into the vadose zone or beyond.

- Data generated from the quarterly groundwater sampling conducted under the Basewide Groundwater Monitoring Program (Shaw, 2004b and 2004c).

4.1.3. Benzene Contour Maps Prepared for this Report

To compare benzene groundwater contamination over time and in a consistent manner, several computer-generated contour maps were produced, using Surfer® contouring software, with data compiled from the previous investigations. The Surfer® concentration contour maps were generated by first using the default modeling parameters (point kriging using a linear semi-variogram model, with anisotropy angle of 0, anisotropy ratio of 0, and variogram slope of 1), and then manually adjusting them (by a registered geologist) to more accurately and realistically reflect site conditions. The computer-generated contour maps minimize the subjectivity of purely hand-drawn contour maps, and normalize, to the maximum extent possible, the parameters used to plot and compare the extent of benzene contamination in groundwater over time.

The contour maps produced for this report include:

- **Figure 4-2:** 1994 Benzene Contour Map; Shallow Monitoring Well Data
- **Figure 4-3:** 1999 Benzene Contour Map; Shallow Monitoring Well Data
- **Figure 4-4:** 2001 Benzene Contour Map; Shallow Monitoring Well Data
- **Figure 4-5:** 2001 Benzene Contour Map; 12-16 feet bgs Hydropunch™ Data
- **Figure 4-6:** 2001 Benzene Contour Map; 16-20 feet bgs Hydropunch™ Data
- **Figure 4-7:** 2001 Benzene Contour Map; 20-24 feet bgs Hydropunch™ Data
- **Figure 4-8:** 2003 Benzene Contour Map; Shallow Monitoring Well Data

Figures 4-5 to 4-7 indicate that benzene contamination at the Site is stratified, or vertically distributed, as well as laterally distributed. Generally, benzene concentrations have been found to increase with depth, with the highest concentrations detected in Hydropunch™ samples collected from approximately 20 feet bgs. Figure 4-7 (obtained from the OU-5 RI report) details that four Hydropunch™ samples collected from between 20 and 24 feet bgs in the eastern portion of the Site have either non-detectable or low benzene concentrations (estimated below the laboratory reporting limit). Additional Hydropunch™ sampling was attempted in this depth interval, but there was insufficient water volume due to the low-permeability materials present at depth. Soils below 20 feet bgs are predominantly Bay Mud, which is present across the Site at thickness ranging from 25 to 100 feet (as discussed in Section 2) and serves as an effective aquitard to limit downward migration of contaminants.

The plume maps based on monitoring well data (Figures 4-2, 4-3, 4-4, and 4-8) were generated using analytical data collected from differing sets of monitoring wells. The original monitoring well network at the Site consisted of approximately 65 wells. The well inventory conducted by Shaw in 2001 during

development of the Basewide Monitoring Program identified 23 wells remaining at the Site. In 2002, Shaw installed five additional wells as part of the Quarterly Groundwater Monitoring Program (Shaw 2004a). Despite these variations in well sets, over time, shallow monitoring well data have consistently indicated three plume centers. General characterization of the plume centers and plume delineation is described in the following paragraphs. Detailed discussion of trend analyses in and around the plume is provided in Section 4.1.5.

Plume Centers: The highest concentrations of benzene consistently have been detected at monitoring well P181-MW47, located in Kollmann Circle, up to a maximum concentration of 1,620 µg/L in May 2001. A second plume center is located near the historic scrapyard (Alameda Annex IR-02) at monitoring well EW-2. A third plume center is located at the west of the Site near wells P181-MW45 and M25-01. As discussed in more detail in Section 4.5.5, additional characterization will be performed to more accurately define the location of the plume centers and the area requiring treatment prior to implementation of a remedy; however, additional characterization is not expected to substantially change the treatment area nor to alter the selection of a remedial technology.

Wells Bounding Plume Centers: The plume center at P181-MW47 is surrounded by four wells (P181-MW46, S-35, S-12, and PW-12) that bound well P181-MW47 as a plume center. The benzene concentrations in these wells have remained at least 6 times lower than the maximum concentration of benzene in monitoring well P181-MW47. Three of these wells continue to be sampled as part of the Basewide Groundwater Monitoring Program. The plume center at well EW-2 is bounded by four wells (S-02, S-13, M25-05, and S-16-2). The benzene concentrations in these wells have remained over 3 times lower than the maximum concentration in the plume center. Two of these wells continue to be sampled as part of the Basewide Groundwater Monitoring Program. The western plume center, located near wells P181-MW45 and M25-01 is bounded to the southeast by well PW-10A. The Basewide Groundwater Monitoring Program has recommended installing three additional wells to the west of wells P181-MW45 and M25-01 to further define this plume center (Shaw, 2004c).

Overall Plume Bounding: Benzene concentrations in monitoring wells M25-02, M25-03, and M25-04 have consistently been at or below 1 µg/L since they were first sampled in September 2002. Figure 4-8 shows that benzene concentrations at the western edge (M25-01) and the southeastern corner (M25-05) of the plume are 650 µg/L and 140 µg/L, respectively. The significance of these elevated concentrations, and any related expansion of the groundwater monitoring network in these areas, will be evaluated under the Basewide Groundwater Monitoring Program. The extent of benzene concentrations in groundwater at these locations is not anticipated to affect the remedial alternative evaluated in this report.

Vertical Extent of Contamination: While Hydropunch™ sampling has indicated that concentrations of benzene increase with depth up to 20 feet bgs within the FWBZ, benzene concentrations in the four Hydropunch™ samples screened from 20 to 24 feet bgs were all below the detection limit of 2 µg/L (IT et al., 2002). As shown on Figure 4-7, during the 2001 Hydropunch™ sampling event, sample collection

was attempted from a number of locations at depths below 20 feet bgs; however, due to poor recharge within the Bay Mud materials, the samples could not be collected. The Bay Mud layer, present across the Site at thicknesses ranging from 25 to 100 feet, serves to limit downward migration of contaminants. Benzene has not been detected in monitoring well D-02, screened in the SWBZ. Therefore, the FWBZ and SWBZ do not appear to be connected, and benzene contamination is confined to the FWBZ.

4.1.4. Naphthalene Contour Maps

A naphthalene contour map, based on 2001 Hydropunch™ sample analytical data (for the 16- to 20-feet-bgs depth range) is presented in Figure 4-9. Figure 4-10 shows the naphthalene analytical data from shallow monitoring well sampling conducted as part of the Basewide Groundwater Monitoring Program in December 2003 (Shaw, 2004c). Both of these figures are comparable to the corresponding contour maps for benzene, indicating that the plumes are generally co-located.

Similar to the vertical distribution of benzene concentrations in the FWBZ, naphthalene concentrations in the four Hydropunch™ samples screened from 20 to 24 feet bgs were all well below the Health Advisory level of 100 µg/L. As summarized in Appendix A (Table A-4), two of the four samples were below the detection limit of 2 µg/L, while the other two samples had detected naphthalene concentrations of 5.1 and 29 µg/L (IT et al., 2002). Naphthalene has not been detected in monitoring well D-02 (Appendix A, Table A-3) at concentrations above the laboratory reporting limits, with the exception of the two most recent samples. In December 2003, naphthalene was detected at 2 µg/L. In March 2004, naphthalene was detected at an approximate concentration of 0.95 µg/L. These samples were analyzed for naphthalene using USEPA Method 8310; however, the samples were also analyzed for naphthalene using USEPA Method 8260 and were below the method detection limit of 0.3 µg/L. These low-level detections of naphthalene, just above the laboratory reporting limit, are not considered significant, particularly considering the non-detected results obtained using USEPA Method 8260.

4.1.5. Time-Series Evaluation of Benzene and Naphthalene in Groundwater

To evaluate the nature and extent of benzene in Site groundwater over time, concentrations in monitoring wells over time (time-series plots) were graphed, and Mann-Kendall trend evaluations were performed.

The time-series plots are presented in Figures 4-11 through 4-26. As can be seen in these plots and in Table 4-1, benzene concentrations are generally stable, and in some cases decreasing, in Site monitoring wells.

Table 4-1
Benzene Plume Delineation Summary
Alameda Point Site 25/Alameda Annex IR-02 Groundwater RI/FS
Page 1 of 3

Well	Location (Trend Plot Figure Number)	Mann-Kendall Result		Max Benzene Concentration (µg/L)	Summary of Plume Stability and Delineation
		Trend Direction	Statistically Significant[1]		
Plume Center Wells					
P181-MW47[2]	Kollmann Circle - Site 25 (Figure 4-14)	Negative	Yes	1,620	**Decreasing.** While concentrations have been variable in this plume center well, concentrations have decreased from 1,620 µg/L to 570 µg/L over the past 2 years.
EW-2	Scrapyard Area – IR-02 (Figure 4-11)	Positive	No	730	**Stable.** Concentrations in this plume center well have fluctuated between 400 and 730 µg/L over the past 10 years.
P181-MW45[2]	Singleton Avenue and Annapolis Circle – Site 25 (Figure 4-12)	Negative	Yes	180	**Stable.** Concentrations over the past 4 years have fluctuated between 77 and 160 µg/L.
M25-01[2]	Mosely Avenue and Mulvany Circle – Site 31 (Figure 4-22)	NA[3]	NA	520	**Stable.** Concentrations have been variable in this well, and have shown no clear trend. This is a possible plume center location; however, more characterization is needed to define the plume center location and western extent.
Wells Bounding P181-MW47 Plume Center					
P181-MW46[2]	Northwest of P181-MW47 (Figure 4-13)	Negative	No	120	**Stable.** Concentrations have been variable in this well, with a peak in December 2002. Concentrations have remained low relative to P181-MW47.
S-35[2]	Northeast of P181-MW47 (Figure 4-20)	Negative	Yes	270	**Decreasing.** Concentrations have fluctuated in this well with a peak of 250 µg/L in 1996. Since, then concentrations have decreased to below the detection limit of 0.2 µg/L.

Table 4-1
Benzene Plume Delineation Summary
Alameda Point Site 25/Alameda Annex IR-02 Groundwater RI/FS
Page 2 of 3

Well	Location (Trend Plot Figure Number)	Mann-Kendall Result		Max Benzene Concentration (µg/L)	Summary of Benzene Plume Stability and Delineation
		Trend Direction	Statistically Significant[1]		
S-12	South of P181-MW47 (Figure 4-17)	Negative	No	74	**Stable.** Concentrations in this well have fluctuated between the detection limit of 0.5 µg/L and 74 µg/L.
PW-12[2]	Southwest of P181-MW47 (Figure 4-15)	Negative	Yes	76	**Decreasing.** Concentrations in this well have generally decreased from 76 µg/L to 19 µg/L
Wells Bounding EW-2 Plume Center					
S-02	Northwest of EW-2 (Figure 4-16)	Negative	Yes	14	**Decreasing.** Concentrations have decreased from a maximum of 14 µg/L to below the detection limit of 0.5 µg/L.
S-13	East of EW-2 (Figure 4-18)	Negative	No	38	**Stable.** Concentrations have fluctuated, but remained low compared to the EW-2 plume center.
M25-05[2]	East of EW-2 (Replacing S-13) (Figure 4-26)	NA[3]	NA	200	**Stable.** Concentrations have ranged between 140 and 200 µg/L, and remain low relative to the EW-2 plume center. While Hydropunch™ sampling delineated the plume extent to the southeast, elevated concentrations in M25-05 indicate that further monitoring well coverage to the southeast could be beneficial.
S-16/S-16-2[2]	South of EW-2 (Figure 4-19)	Negative	Yes	15	**Stable.** Concentrations have fluctuated below 15 µg/L in this well over the past 10 years, and remained low compared to concentrations in well EW-2.
Wells Bounding Western Plume Center					
PW-10A	South of P181-MW45 (Figure 4-21)	Negative	Yes	10	**Decreasing.** Concentrations have decreased from 10 to 0.8 µg/L. This well bounds this plume center to the southeast, but additional well coverage is needed to bound the plume to the west.

Table 4-1
Benzene Plume Delineation Summary
Alameda Point Site 25/Alameda Annex IR-02 Groundwater RI/FS
Page 3 of 3

Well	Location (Trend Plot Figure Number)	Mann-Kendall Result		Max Benzene Concentration (µg/L)	Summary of Plume Stability and Delineation
		Trend Direction	Statistically Significant[1]		
Wells Bounding the Overall Plume to the North and South					
M25-02[2]	Northwest of P181-MW45 (Figure 4-23)	NA[3]	NA	0.2 J	**Stable.** Concentrations in these wells have been at or below 1 µg/L since they were installed. These wells document that the plume has remained consistently bounded to the north and south over the past 2 years.
M25-04[2]	North of P181-MW47 (Figure 4-25)	NA[3]	NA	0.1 J	
M25-03[2]	South of P181-MW45 (Figure 4-24)	NA[3]	NA	1.0	
Wells Bounding Vertical Extent					
D-02[2]	Scrapyard Area	NA[3]	NA	ND (<0.5)	**Stable.** Benzene has not migrated into the SWBZ.

[1] Based on Mann-Kendall trend analysis using a 90 percent confidence interval (see Appendix C)
[2] Well continues to be sampled under the Basewide Groundwater Monitoring Program (Shaw, 2004a)
[3] Trend analysis not performed due to insufficient data.
J = Approximate value
ND = Not detected above the detection limit shown in parentheses

The Mann-Kendall trend evaluations were performed for all benzene data above the detection limit in recently sampled monitoring wells at the Site, with the exception of the five wells installed in 2002 as part of the Basewide Groundwater Monitoring Program (M25-01 through M25-05). There are insufficient data to perform rigorous trend analyses for the newly-installed monitoring wells; however, as discussed in Section 4.1.3, elevated benzene concentrations have been detected at wells M25-01 and M25-05 located on the west and east edges of the plume, respectively. Benzene concentrations in wells M25-02, M25-03, and M25-04 have been consistently at or below 1 µg/L, indicating that the plume is consistently bounded on the north and south. Benzene concentration trends in these wells will continue to be evaluated as part of the Basewide Groundwater Monitoring Program.

Mann-Kendall evaluations are statistical calculations that produce an indicator parameter, S, for a series of data over time. The S value indicates whether an increasing or decreasing trend is occurring. The Mann-Kendall is purely a mathematical model to indicate whether a series of data tends to increase or decrease over time; it does not take into account the magnitude of the increase, uncertainty of the data, or other factors that cause the data to fluctuate (such as changing water levels). For small data sets, the possible error due to natural fluctuations is high; therefore, a confidence level is also calculated for each trend, based on the S value and the number of sample points in each data set, to determine if an apparent trend is statistically significant (Gilbert, 1987). For purposes of this evaluation, a 90 percent confidence

interval was considered statistically significant. The results of the Mann-Kendall analyses for benzene are presented in Table 4-1, and Appendix C.

The results of the Mann-Kendall tests indicate a significant downward trend for benzene concentrations within two of the three plume centers. Although concentrations in well P181-MW45exihibit a statistically-significant downward trend, this well is considered stable because the decrease is small compared to the variability in the data. All wells bounding the plume centers are stable or decreasing. Continuing monitoring conducted under the Basewide Groundwater Monitoring Program will continue to monitor the trends in these wells. There have not been significant increases in benzene concentrations identified in any wells. Stable or decreasing benzene concentrations throughout the Site support the assessment that benzene concentrations are decreasing through degradation processes, and not migrating outside of the original plume extent.

Mann-Kendall trend evaluations for naphthalene concentrations indicated that:

- The naphthalene concentrations in three monitoring wells (P181-MW45 and P181-MW47, plume center wells; and PW-12, located to the southwest) exhibit statistically-significant downward trends.
- Naphthalene concentrations in four monitoring wells (P181-MW46, PW-10A, S-12, and EW-2) exhibit downward trends that are not statistically significant. This includes the other plume center and some of the bounding wells.
- Naphthalene concentrations in three monitoring wells (S-02, S-16/S-16-2, and S-35) exhibit upward trends that are not statistically significant. However, concentrations in these wells remain low relative to the plume centers, and the plume centers remain delineated.

Naphthalene concentrations in well S-13 exhibited statistically-significant upward trends. However, naphthalene results for samples from this well have been widely variable. Naphthalene concentrations in monitoring well S-13 ranged from an approximate values of 1 µg/L in 1994 to a maximum value of 140 µg/L in 1996 and back to 19 µg/L in 2001. Overall concentrations in this well remained low relative to concentrations in well EW-2 .

The time-series data discussed above were also evaluated with respect to the site layout. Figure 4-27 presents a site map overlain with benzene time-series plots. The purpose of the map is to demonstrate benzene concentration trends across the Site. Figure 4-27 illustrates that benzene concentrations are stable throughout the plume, and are decreasing in some locations. The plume is bounded to the north and south. Additional characterization of the western edge of the plume and southeast corner of the plume is needed and will be performed as part of the Basewide Groundwater Monitoring Program.

Apparent increases in benzene concentrations were observed in several wells in 2001, concurrent with the maximum detection of MTBE. This may indicate that a recent source, such as a surface spill, may have contributed, at least in part, to the benzene and naphthalene plume. However, there may be other explanations for the apparent increase in groundwater concentrations. Some of the fluctuations in

benzene and naphthalene concentrations are correlated with fluctuations in groundwater elevations. Two Site groundwater contour maps are presented as Figures 2-3 and 2-4, indicating that groundwater has high local variability but generally flows to the west or northwest. In general, as groundwater depth fluctuates over time, benzene concentrations within a given well correlate with depth to groundwater; as depth to groundwater increases, concentrations of benzene in the groundwater samples also increase. This is consistent with higher concentrations of benzene in groundwater at depth, as observed in the Hydropunch™ sampling. Figure 4-28 shows the correlation between depth to groundwater and concentration for monitoring well M25-05.

The concentration trends in the plume centers, combined with the fact that benzene concentrations are not significantly increasing in any well, indicate that the benzene plume is overall stable to decreasing. Likewise, naphthalene concentrations are decreasing in one plume center, and concentrations in the bounding wells remain low relative to the plume centers. This supports the conceptual site model of an aged plume that is naturally attenuating. A more detailed discussion of fate and transport is presented in Section 5. Quarterly monitoring conducted under the Basewide Groundwater Monitoring Program will continue to monitor trends in benzene and naphthalene concentrations in the existing well network, and new wells are proposed in the western portion of the Site to further delineate the extent of contamination on the western edge.

4.1.6. Monitored Natural Attenuation Parameters

As discussed above, the benzene groundwater analytical data indicate that fate and transport mechanisms are reducing contaminant concentrations. Because biodegradation often is a primary component of fate and transport mechanisms, monitoring of MNA parameters provides useful site data.

MNA relies on biodegradation, dispersion, dilution, sorption, volatilization, and/or chemical and biochemical stabilization to effectively reduce toxicity, mobility, or volume to levels that are protective of human health and the environment. MNA requires periodic evaluation of groundwater analytical data to monitor contaminant concentrations and attenuation indicator trends, and predict long-term migration.

The typical MNA monitoring parameters are: electron acceptors (dissolved oxygen [DO], nitrate, sulfate); metabolic by-products (methane, ferrous iron, and manganese); and general indicators of biological activity (alkalinity and oxidation-reduction potential [ORP]). Monitoring results of these parameters, in addition to groundwater analytical data, typically are used to evaluate the effectiveness of natural attenuation occurring at the Site.

For chlorinated solvents such as trichloroethylene (TCE), it is common to monitor degradation products such as cis-1,2-dichloroethylene (cis-1,2-DCE) and vinyl chloride; however, it is not common to monitor for intermediate or end products of petroleum hydrocarbon degradation. The ultimate degradation products of benzene and naphthalene are carbon dioxide and water, which are ubiquitous in the

environment. The intermediate degradation byproducts such as catechol are not standard analytes included in USEPA-approved analytical methods.

MNA data have been collected as part of the Alameda Point OU-5 RI (IT et al., 2002), and as part of the ongoing Alameda Point Basewide Groundwater Monitoring Program (Shaw, 2004b and c). The DO and ORP data collected as part of the OU-5 RI are summarized in Figures 4-29 and 4-30, and Table 4-2. Figure 4-29 shows that DO decreases as a function of depth. As seen in Figure 4-29, DO readings decrease to approximately 1 mg/L at approximately 20 feet bgs, indicating an anaerobic environment. Likewise, ORP is more negative at this depth, which also is typical of anaerobic conditions. Figures 4-31 and 4-32 show MNA parameters across north/south and east/west plume transects, respectively. These graphs indicate that DO is low across the entire benzene plume. Sulfate concentrations are high upgradient of the plume, and are reduced to below the detection limit within the plume. This indicates that biodegradation is occurring under sulfate-reducing conditions. Methane concentrations are relatively high across the Site (0.47 to 6.3 mg/L), indicating that some biodegradation is also occurring through methanogenesis. These data indicate that anaerobic conditions are predominant across the site, particularly at depth within the benzene plume. Anaerobic degradation under sulfate-reducing or methanogenic conditions generally proceeds at a much slower rate than aerobic degradation (see Section 5 for a more detailed explanation).

While the available data are sufficient to evaluate the spatial extent of MNA parameters, limited data are available to allow analysis of MNA parameters over time. Several rounds of MNA sampling have been conducted as part of the quarterly monitoring program, and additional monitoring should be conducted to provide a clearer understanding of changes in MNA parameters over time. This recommendation was also included in the Alameda Point OU-5 RI Report (IT et al., 2002).

4.1.7. Groundwater Conceptual Site Model

Based on Site data gathered to date, a general conceptual Site model can be constructed to describe FWBZ contamination. The conceptual Site model, graphically depicted in Figure 4-33, includes the following key elements:

- Benzene and naphthalene contamination are found within the FWBZ (10 to 20 feet bgs) in the dissolved phase. Neither benzene nor naphthalene have been detected above site action levels (see Table 7-2) in wells from the SWBZ (see well D-02 in Tables A-1 and A-3).
- The historic sources of the benzene and naphthalene contamination are uncertain at this time. Contamination is likely due, at least in part, to surface discharges from stained soil in the Kollmann Circle area observed in an aerial photograph dated April 1968 (see Figure 1-6), and to localized buried inclusions or dispersed contaminated fill trapped in the subsurface during fill operations that occurred from 1915 to 1930. More discussion of possible sources is included in Section 4.4.
- Naphthalene is more soluble and adheres less to soils and organic matter than most PAHs. Naphthalene may be present at higher concentrations than other PAHs because it has migrated farther from historic point sources.

This page intentionally left blank

Table 4-2
Evaluation of MNA Parameters in 2001 Hydropunch™ Samples
Alameda Point Site 25/Annex IR-02 RI/FS
Page 1 of 2

Sample	OS-HP-04	OS-HP-04	OS-HP-06	OS-HP-06	OS-HP-10	OS-HP-10	OS-HP-10	OS-HP-14	OS-HP-14	OS-HP-20	OS-HP-25	OS-HP-25	OS-HP-28	OS-HP-28	OS-HP-28	OS-HP-28	OS-HP-30	OS-HP-37	OS-HP-37	OS-HP-37
Depth (feet bgs)	12 to 16	16 to 20	6 to 10	10 to 14	6 to 10	9 to 13	14 to 18	12 to 16	16 to 20	16 to 20	12 to 16	16 to 20	8 to 12	12 to 16	16 to 20	20 to 24	12 to 16	6 to 10	10 to 14	14 to 18
Date collected	6/11/2001	6/11/2001	6/16/2001	6/16/2001	6/12/2001	6/12/2001	6/12/2001	6/11/2001	6/11/2001	6/11/2001	6/16/2001	6/12/2001	6/12/2001	6/12/2001	6/12/2001	6/12/2001	6/8/2001	6/13/2001	6/13/2001	6/13/2001
Benzene (µg/L)	12	45	1 U	148	4.2 J	2.4	6000 J	742	1970	17	2U	270 UJ	2 U	2 U	0.24 J	2 U	21	1	39	1,770
Methane (µg/L)	2800	4200	1200	6800	9200	NM	NM	7200	NM	3000	160	2100	4400	4700	7000	3200	NM	2,000	1,100	6,800
Alkalinity (mg/L)	3530	3960	260	260	3280	NM	NM	3640	NM	3280	400	1740	374	426	1720	2770	NM	478	465	1,740
Sulfide (mg/L)	1.6	0.2 U	0.2	0.2	3.2	NM	NM	2.9	NM	1.9	1 U	1	2.08	5.69	1.99	3.79	NM	0.20	0.20	0.20
Nitrate (mg/L)	5	6	0.8 U	0.8 U	2 U	NM	NM	7	NM	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	2.5 U	NM	0.08	0.20	4
Sulfate (mg/L)	70	60	28 U	10 U	340	NM	NM	50 U	NM	1800	175	0.76	0.47 J	0.46 J	0.56 J	0.33 J	NM	27	57	50
Ferrous Iron (mg/L)	2.5	> 10	NM	NM	NM	NM	NM	NM	NM	10.0	1	10	1.6	2.6	> 10	> 10	NM	4.20	1.20	> 10
ORP (milivolts)	-214	-172	NM	NM	-10	-125	-123	-187	-151	-128	-145	-168	-77	-172	-175	-183	-143	-51	-143	-118
DO (ppm)	NM	NM	NM	NM	8.31	0.53	1.77	NM	NM	NM	19.99*	2.74	NM	NM	0.93	1	7.87	6.61	0.94	3.52

DO = Dissolved Oxygen
J = detected below the calibration range of the instrument
NM = not measured
ORP = Oxidation-Reduction Potential
ppm = parts per million
U = not detected above listed value
** This reading is greater than the saturation concentration of oxygen in water, and is therefore treated as anomalous.*

Notes:
1. Data collected as part of the OU-5, Alameda Point, Remedial Investigation in 2001, from Hydropunch™ samples.
2. Natural degradation processes typically have increases in ferrous iron, alkalinity, methane, and sulfide, with accompanied decreases in DO, ORP, nitrate, and sulfate.

Table 4-2
Evaluation of MNA Parameters in 2001 Hydropunch™ Samples
Alameda Point Site 25/Annex IR-02 RI/FS
Page 2 of 2

Sample	OU5-HP01	OU5-HP01	OU5-HP01	OU5-HP06	OU5-HP06	OU5-HP06	OU5-HP-10	OU5-HP-10	OU5-HP-10	OU5-HP-13	OU5-HP-13	OU5-HP-13	OU5-HP-14	OU5-HP-14	OU5-HP-14	OU5-HP-17	OU5-HP-17	OU5-HP-17	OU5-HP-20	OU5-HP-20	OU5-HP-20
Depth (feet bgs)	6 to 10	10 to 14	14 to 18	6 to 10	10 to 14	14 to 18	8 to 10	10 to 14	14 to 18	8 to 12	12 to 15	15 to 17.5	6 to 10	10 to 14	14 to 18	6 to 10	10 to 14	14 to 18	6 to 10	10 to 14	15 to 19
Date collected	6/13/2001	6/13/2001	6/13/2001	6/14/2001	6/14/2001	6/14/2001	6/14/2001	6/14/2001	6/14/2001	6/12/2001	6/12/2001	6/12/2001	6/14/2001	6/14/2001	6/14/2001	6/13/2001	6/13/2001	6/13/2001	6/13/2001	6/13/2001	6/13/2001
Benzene (µg/L)	2	2	3.2	2	9.1	110	2	5.9	180	2 U	560 J	4100 J	2 U	2 U	2 U	1 U	1 U	2	0.4 J	1 U	1 U
Methane (µg/L)	850	2800	5300	390	1300	5800	1500	1400	3800	2100	6700	5700	53	4700	5100	20	780	8400	310	1300	10000
Alkalinity (mg/L)	262	1660	3690	379	636	2410	164	636	3030	274	974	1990	461	1040	NM	270	469	2610	280	999	999
Sulfide (mg/L)	1	1	1	1	1.8	2.62	1	1	2.4	1.08 J	1 UJ	1.99 J	1 U	1.62	NM	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Nitrate (mg/L)	0.1	0.1	20	0.5	0.5	0.44	0.5	0.5	0.5	0.1 U	0.1 U	0.1 U	0.5 U	0.5 U	NM	0.4 U	0.4 U	4 U	0.1 U	0.2 U	4 U
Sulfate (mg/L)	540	110	0.36	98	140	0.34	1200	1200	0.79	3.7	0.86	0.51	690	140	NM	266	150	50 U	13	8	50 U
Ferrous Iron (mg/L)	4.1	10	> 10	NM	> 10	> 10	> 10	> 10	> 10	2.6	2.8	> 10	> 10	> 10	NM	3.0	4.1	>10	2.4	2.0	3.0
ORP (milivolts)	-128	-160	-156	-49	-137	-138	-116	-93	-131	-190	-178	-140	-181	-110	NM	-49	-142	-165	-113	-79	-160
DO (ppm)	4.75	3.27	1.43	NM	NM	NM	NM	NM	NM	3.62	5.25	1.52	NM	NM	NM	3.77	8.42	2.56	4.08	2.89	1.24

DO = Dissolved Oxygen
J = detected below the calibration range of the instrument
NM = not measured
ORP = Oxidation-Reduction Potential
ppm = parts per million
U = not detected above listed value

Notes:
1. Data collected as part of the OU-5, Alameda Point, Remedial Investigation in 2001, from Hydropunch™ samples.
2. Natural degradation processes typically have increases in ferrous iron, alkalinity, methane, and sulfide, with accompanied decreases in DO, ORP, nitrate, and sulfate.

- Benzene and naphthalene are both present in soil gas beneath the Site. The locations of benzene and naphthalene detections in soil gas roughly correlate with the location of the groundwater plume, indicating that contamination in groundwater may be volatilizing.
- Benzene concentrations throughout the plume are generally decreasing or remaining stable in the majority of the plume, consistent with an aged plume that is naturally attenuating.
- Naphthalene concentrations in site monitoring wells (see Table A-3) also appear to be generally decreasing; however, not as significantly as benzene.
- Natural attenuation data indicate that both aerobic and anaerobic degradation have been occurring at the Site. Currently, conditions at the Site are largely anaerobic and are undergoing sulfate-reducing or methanogenic biodegradation, which is much slower than aerobic degradation.

If Site conditions remain similar over time, the above conceptual site model can be expected to remain valid. Contamination will likely continue to degrade slowly through fate and transport mechanisms, of which sulfate-reducing and methanogenic biodegradation are the primary mechanisms. As discussed in more detail in Section 5, anaerobic degradation will proceed at a much slower rate than aerobic degradation.

4.2. SOIL GAS CONTAMINATION

As discussed in Section 3.2, results from previous investigations have revealed some VOC contamination in soil gas at the Site. Previous soil gas analytical results for Alameda Point Site 25 and Alameda Annex IR-02 were compiled electronically for this report (See Appendix A). The following subsections summarize the determination of benzene and naphthalene as the primary COPCs in soil gas, the results of a vapor intrusion evaluation, and a description of soil gas contamination as it relates to groundwater.

4.2.1. Contaminants of Potential Concern in Soil Gas

During the history of soil gas investigations conducted at the Site, a number of COPCs have been identified.

The OU-5 RI reported that the following analytes had been previously detected in soil gas at the Site (IT et al., 2002):

- BTEX
- MTBE
- 15 VOCs, not including BTEX and MTBE

The Basewide Groundwater Monitoring Program (Shaw, 2004a) includes the following analytes as COPCs in soil gas:

- VOCs: primarily benzene, but also toluene, ethylbenzene, and toluene

While not specifically listed as a COPC, methane has also been detected in soil gas during sampling as part of the Basewide Groundwater Monitoring Program. Methane concentrations in shallow soil gas ranged from 0.48 percent to below the detection limit of 0.0001 percent by volume, well below the Title 27 standard (27 California Code of Regulations [Cal. Code Regs.], Section 21160) to control potentially explosive landfill gases within structures (1.25 percent by volume). Methane concentrations in deep soil gas have ranged from 60 percent to 0.0024 percent by volume. While concentrations in deep soil gas have exceeded the 1.25 percent by volume standard and the lower explosive limit of methane (5 percent by volume), concentrations in samples from the co-located shallow soil gas sampling ports have all been within acceptable limits, indicating that methane is being diluted before traveling to the surface and does not pose an unacceptable risk.

The following subsection discusses a vapor intrusion evaluation that was performed as part of this report, which identified benzene and naphthalene as the primary COPCs for the Site based on previous detections in soil gas with respect to USEPA vapor intrusion screening criteria. Section 4.5.4 discusses laboratory detection limits for soil gas samples, which have varied between investigations and, particularly for older investigations, were frequently higher than corresponding USEPA vapor intrusion screening criteria.

4.2.2. Vapor Intrusion Evaluation

An evaluation of the soil gas data was performed using the *Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway From Groundwater and Soils (Subsurface Vapor Intrusion Guidance)* (USEPA, 2002) to determine the primary COPCs in soil gas and to determine if soil gas contamination poses any significant human health inhalation risks. A summary of the Tier 1 (primary screening) and Tier 2 (secondary screening) evaluation is presented in Appendix D. Data from all previous investigations were compiled, and maximum concentrations for each detected compound, shown in Table 4-3, were compared to the Tier 2 generic screening values. Benzene, naphthalene, chloroform, and TCE soil gas concentrations, as well as benzene and naphthalene groundwater concentrations, were found to exceed the generic screening values, corresponding to a 10^{-6} risk by a factor greater than 50. As discussed in Section 3.2, VOCs were detected in indoor air samples collected from three residential neighborhoods in 2001; however, inhalation risks were ruled out because the indoor air concentrations were consistent with ambient air concentrations. Figure 4-34 presents the soil gas sampling locations and benzene concentrations that exceed the screening values by a factor greater than 50. Based on these exceedances, the guidance recommends a site-specific evaluation. Human health risk via the inhalation pathway, using both soil gas and groundwater results, were calculated in the HHRA for the Site and are summarized in Section 6 and Appendix E.

Chloroform and TCE each exceeded the screening criteria in only one shallow sample location, and both of the exceedances were from samples collected during the Alameda Point OU-5 RI in 2001. Chloroform

Table 4-3
Summary of Historic Soil Gas Data – Detected Compounds
Alameda Point Site 25/Alameda Annex IR-02 Groundwater RI/FS
Page 1 of 2

	1989 PRC[a]		1990 PRC[a]		1992 PRC[a]		1994-1995 IT EBS[a]		2001 Shaw RI Data[b]				2002-2003 Basewide Groundwater Monitoring Program[c]					
Constituents	shallow [1] max (µg/m³)	Well ID, Depth	shallow [1] max (µg/m³)	Well ID, Depth	shallow [1] max (µg/m³)	Well ID, Depth	shallow[1] max (µg/m³)	Well ID, Depth	shallow max (µg/m³)	Well ID, Depth	deep max (µg/m³)	Well ID, Depth	shallow max (µg/m³)	Well ID, Depth	deep max (µg/m³)	Well ID, Depth	Overall Shallow Max (µg/m³)	Overall Deep Max (µg/m³)
1,1,1-Trichloroethane	NA	-	NA	-	NA	-	11U - 5,000U	-	27	OS-SG-16, 2'	2U - 6U	-	1.64	OU5-SG-20S, 2-4'	1.1U - 125U	-	27	ND
1,1-Dichloroethane	NA	-	NA	-	NA	-	8U - 5,000U	-	38	OS-SG-09, 2'	6	OS-SG-09, 5.5'	0.8U - 121U	-	0.49	OU-SG-20D, 6-8'	38	6
1,1-Dichloroethylene	NA	-	NA	-	NA	-	8U - 5,000U	-	2U - 10U	-	3.9	OU5-SG-10, 5.5'	1.55	OU5-SG-19D, 4.5-6.5'	0.8U - 91U	-	1.55	3.9
2-Butanone	NA	-	NA	-	NA	-	29U - 10,000U	-	240	OS-SG-05, 2'	30	OS-SG-16, 5.5'	20	OU5-SG-18S, 2-4'	3U - 354U	-	240	30
2-Hexanone	NA	-	NA	-	NA	-	16U - 10,000U	-	29	OS-SG-06, 2'	2U - 6U	-	1.6U - 614U	-	1.6U - 491U	-	29	ND
4-Methyl-2-Pentanone	NA	-	NA	-	NA	-	16U - 10,000U	-	19	OS-SG-06, 2'	78	OS-SG-16, 5.5'	1.76	OU5-SG-17S, 1-2.5'-	2.21	OU-SG-20D, 6-8'	19	78
Acetone	NA	-	NA	-	NA	-	43	179-0004, 3'	310	OS-SG-01, 2'	140	OS-SG-16, 5.5'	9,735	OU5-SG-19S, 1.5-3.5'	166	OU-SG-20D, 6-8'	9,735	166
Benzene	300	SG-43	400	SG-6A	300	SG-O6-5'	6U - 5,000U	-	20	OS-SG-01, 2'	15	OS-SG-14, 7'	262	OU5-SG-20S, 2-4'	5588	OU-SG-20D, 6-8'	400	5,588
Carbon Tetrachloride	NA	-	NA	-	NA	-	13U - 5,000U	-	2U - 10U	-	2U - 6U	-	0.61 J	OU5-SG-16S, 2-3.5'	0.36	OU5-SG-20D, 6-8'	0.61	0.36
Chlorobenzene	NA	-	NA	-	NA	-	9U - 5,000U	-	28	OS-SG-12, 2'	2U - 6U	-	120	OU5-SG-19D, 4.5-6.5'	0.9U - 106U	-	120	ND
Chloroethane	NA	-	NA	-	NA	-	11U - 10,000U	-	5.2	OS-SG-06, 2'	2U - 6U	-	1.1U - 100U	-	1.1U - 61U	-	5.2	ND
Chloroform	NA	-	NA	-	NA	-	15	180-0030, 2'	92	OS-SG-03, 2'	2U - 6U	-	54	OU5-SG-18S, 2-4'	1.02	-	92	1.02
Chloromethane	NA	-	NA	-	NA	-	8U - 10,000U	-	2U - 10U	-	2U - 6U	-	9.29	OU5-SG-20S, 2-4'	0.8U - 47U	-	9.29	ND
cis-1,2-Dichloroethylene	NA	-	NA	-	NA	-	8U - 5,000U	-	2U - 10U	-	19	OS-SG-09, 5.5'	0.8U - 119U	-	0.8U - 91U	-	ND	19
Cumene	NA	-	NA	-	NA	-	NA	-	NA	-	NA	-	157	OU5-SG-20S, 2-4'	5.41	OU5-SG-18D, 5-7'	157	5.41
Ethylbenzene	NA	-	NA	-	NA	-	9U - 5,000U	-	390	OS-SG-02, 2'	290	OS-SG-16, 5.5'	868	OU5-SG-20S, 2-4'	4427	OU5-SG-20D, 6-8'	868	4,427
m-Xylene	NA	-	NA	-	NA	-	NA	-	2000	OS-SG-02, 2'	420	OS-SG-16, 5.5'	NA	-	NA	-	2000	420
p-Xylene	NA	-	NA	-	NA	-	NA	-					NA	-	NA	-		
o-Xylene	NA	-	NA	-	NA	-	5,000U	-	810	OS-SG-02, 2'	360	OS-SG-16, 5.5'	NA	-	NA	-	810	360
Total Xylenes	NA	-	NA	-	NA	-	82	180-0002, 2'	NA		NA		990	OU5-SG-20S, 2-4'	4110	OU5-SG-20D, 6-8'	990	4,110
Methyl tertiary butyl ether	NA	-	NA	-	NA	-	NA	-	77	OU5-SG-12, 2'	170	OS-SG-14, 7'	112	OU5-SG-19D, 4.5-6.5'	793	OU5-SG-20D, 6-8'	112	793
Methylene Chloride	NA	-	NA	-	NA	-	7U - 20,000U	-	2U - 10U	-	2U - 6U	-	6.25	OU5-SG-19D, 4.5-6.5'	0.59	OU5-SG-18D, 5-7'	6.25	0.59
Naphthalene	NA	-	NA	-	NA	-	NA	-	54	OU5-SG-04, 2'	180	OS-SG-16, 5.5'	2,106	OU5-SG-20S, 2-4'	362	OU5-SG-18D, 5-7'	2,106	362
Styrene	NA	-	NA	-	NA	-	9U - 5,000U	-	7.2	OS-SG-01, 2'	2U - 6U	-	20.9	OU5-SG-20S, 2-4'	192.00	OU5-SG-20D, 6-8'	20.9	192
Tetrachloroethylene	NA	-	NA	-	NA	-	14U - 5,000U	-	65	OS-SG-13, 2'	86	OS-SG-11, 6'	5.69	OU5-SG-20S, 2-4'	1.4U - 156U	-	65	86

Table 4-3
Summary of Historic Soil Gas Data – Detected Compounds
Alameda Point Site 25/Alameda Annex IR-02 Groundwater RI/FS
Page 2 of 2

Constituents	1989 PRC[a]		1990 PRC[a]		1992 PRC[a]		1994-1995 IT EBS[a]		2001 Shaw RI Data[b]				2002-2003 Basewide Groundwater Monitoring Program[c]				Overall Shallow Max (µg/m³)	Overall Deep Max (µg/m³)
	shallow [1] max (µg/m³)	Well ID, Depth	shallow [1] max (µg/m³)	Well ID, Depth	shallow [1] max (µg/m³)	Well ID, Depth	shallow[1] max (µg/m³)	Well ID, Depth	shallow max (µg/m³)	Well ID, Depth	deep max (µg/m³)	Well ID, Depth	shallow max (µg/m³)	Well ID, Depth	deep max (µg/m³)	Well ID, Depth		
Toluene	NA	-	NA	-	NA	-	32	179-0004, 3'	300	OS-SG-12, 5'	230	OS-SG-14, 7'	298	OU5-SG-20S, 2-4'	3029.00	OU5-SG-20D, 6-8'	300	3,029
Trichloroethylene	NA	-	NA	-	NA	-	11U - 5,000U	-	130	OS-SG-02, 2'	2U	-	2.63	OU5-SG-18S, 2-4'	1.1U - 124U	-	130	ND
Vinyl Acetate	NA	-	NA	-	NA	-	60U - 50,000U	-	76	OS-SG-06, 2'	2U	-	3.5U - 331U	-	3.5U - 81U	-	76	ND
4-Ethyltoluene	NA	-	NA	-	NA	-	40	180-0030, 2'	NA	-	NA	-	NA	-	NA	-	40	ND

Notes:
1 Only shallow soil gas samples collected
MW = molecular weight
ND = not detected above method reporting limits
NA = not analyzed
NE = not established
- = not applicable
shallow = less than or equal to 5 feet bgs
deep = greater than 5 feet bgs
*Concentration (µg/m3) = Concentration (PPBv) * MW/24.46 @ 25°C*
µg/m³ = micrograms per cubic meter

Data Sources:
a) TtEMI, 1999b. Updated Alameda point/Alameda Annex Benzene Soil Gas Investigation Summary and Summary of Crawl Space Benzene Air Sampling at Parcel 179. Document contains summaries of the following investigation reports:
IT Corporation, 1998. Environmental Baseline Survey, Draft Final Data Evaluation Summaries, Volume IX - Zone 16, Alameda Point.
PRC Environmental Management, Inc. (PRC), 1989. Shallow Soil Gas Investigation, Military Housing Site, Naval Supply Center Oakland, Alameda Annex.
PRC, 1990. Risk Assessment Report, Military Housing Site. Naval Supply Center Oakland, Alameda Annex.
PRC, 1993. Sampling Results Technical Memorandum, Screening Lot and Scrapyard Area, Naval Supply Center Oakland, Alameda Annex and Facility.
PRC and Versar, 1996. Final Remedial Investigation Report, Fleet and Industrial Supply Center Oakland, Alameda Facility/Alameda Annex.
b) IT, 2001. Draft Final Operable Unit 5 Remedial Investigation Report, Alameda Point, Alameda, CA. (Table D-3)
c) Shaw, 2004c. Groundwater Monitoring Report for Installation Restoration Site 25 Group, Summer 2003 to Spring 2004, Alameda Point. April 16.
Shaw, 2004b. Groundwater Monitoring Report for Installation Restoration Site 25 Group, Summer 2002 to Spring 2003, Alameda Point. February 27.

and TCE concentrations have been below the screening criteria in all recent samples collected during the Basewide Groundwater Monitoring Program, and are not considered to be primary COPCs. Soil gas will continue to be monitored for chloroform and TCE during future sampling events.

Naphthalene exceeded the screening criteria in two shallow sample locations. Both of the exceedances were from recent samples collected during the Basewide Groundwater Monitoring Program. Because naphthalene is a COPC in groundwater and has been detected recently in soil gas at concentrations exceeding the screening criteria, it is selected as a primary COPC in soil gas and will continue to be monitored during future sampling events.

Benzene exceeded the screening criteria in nine sample locations. Eight of the nine benzene exceedances were from samples collected prior to 1992. However, there are no soil gas sample probes in the western portion of the Site to confirm or deny the presence of benzene at elevated concentrations in that area. Therefore, benzene is selected as a primary COPC in soil gas.

4.2.3. Soil Gas Contamination Related to Groundwater

Given the distribution of benzene concentrations with respect to previously known areas of benzene groundwater contamination, there had appeared to be little correlation between groundwater and soil gas contamination, as shown in Figures 4-70 to 4-84 of the Alameda Point OU-5 RI Report (IT et al., 2002). However, as depicted in Figure 4-34, the majority of the locations where benzene concentrations exceeded screening values were within the 1-µg/L boundary of the benzene plume in groundwater. The maximum concentrations of benzene detected in soil gas have been detected near plume center EW-2. This suggests a slight correlation between groundwater and soil gas contamination. However, the concentrations of benzene in soil gas in the vicinity of well EW-2 measured by the basewide groundwater monitoring program has fluctuated from below the detection limit of 0.5 $\mu g/m^3$ to a maximum of 5,588 $\mu g/m^3$.

The previous lack of correlation between soil gas and groundwater contamination may have been due to several factors. First, VOC concentrations in groundwater increase with depth as conditions become increasingly anaerobic; therefore, relatively low concentrations of VOCs are available to volatilize into soil gas between the surface and 12 feet bgs. Second, the soils within the upper groundwater interval are typically fine- to very fine-grained, containing silts and clays, and the fine-grained soils are likely to impede the movement of vapors within the vadose zone. As discussed in Section 2.4, permeable bedding material potentially used for sewers or storm drains at Alameda Point does not appear to be acting as a preferential conduit for soil gas contaminant migration based on previous and ongoing soil gas monitoring (Figure 3-6). Finally, many of the deeper soil samples had moderate to high soil moisture content, which also inhibits the upward movement of soil vapor by decreasing the air-filled porosity of the soil. This is supported by the lower success rates in obtaining soil gas samples from deeper intervals, primarily due to the water encountered in the 5-foot sample interval.

4.3. SOILS CONTAMINATION RELATED TO GROUNDWATER

In addition to determining the extent of groundwater contamination at the Site, several characterization efforts have also been performed to determine the extent of soil contamination. The results of these investigations were similar to those of groundwater: low detections of metals in soils, widespread detections of PAHs in soils, and occasional detections of petroleum hydrocarbons in soils (IT et al., 2002). However, there is generally little correlation between groundwater and soil contamination at the Site.

Although low-level metals contamination exists in soil, metals concentrations in the FWBZ generally do not exceed USEPA tap water PRGs or drinking water MCLs, with the exception of arsenic, iron, manganese, and thallium (Shaw, 2004c). However, concentrations of arsenic, iron, manganese, and thallium in groundwater are consistent with their corresponding background concentrations reported in a 2001 study for Alameda Point (TtEMI, 2001b).

Some VOC data are available for near surface soils. However, previous investigations at the Site have involved the collection of soil gas samples rather than soil samples for VOCs in the vadose zone. Therefore, limited data are available for VOC concentrations in soil. The available data indicate that benzene and other volatile contaminants had a low frequency of detection in soils, and the detection locations do not appear to correlate with groundwater contamination. This is consistent with the volatility and mobility of benzene, and the relative assumed age of site contaminants.

Naphthalene data available for on-site soils generally correlate with concentrations of naphthalene observed in groundwater. However, comparison of soil and groundwater samples taken concurrently at monitoring wells P181-MW45, P181-MW46, and P181-MW47 when they were installed in 1994 indicate that naphthalene concentrations in soil and groundwater are not in equilibrium. As summarized in Table 4-4, concentrations of naphthalene in shallow soils (less than approximately 20 feet bgs) are lower than the concentrations that would be expected in equilibrium with the concentrations of naphthalene detected in groundwater. This is based on a partitioning coefficient of 20 (μg/kg)/(μg/L) to 40 (μg/kg)/(μg/L) calculated from the organic carbon partitioning coefficient of 2,000 and the typical range of organic carbon in Oakland soils (Oakland Public Works Department, 2000). These results indicated that the majority of naphthalene contamination is apparently dissolved in groundwater, and not adsorbed onto soil. This is consistent with a conceptual site model of an aging plume and naphthalene migrating away from historic point source discharges.

In October 2000, a health mitigation action was performed to address soils with elevated levels of PAHs. PAHs were detected in soils from the Clover Park play area from 0 to 6 inches bgs, with BaP-equivalent concentrations in the range of 1.7 to 5.6 mg/kg. To eliminate risk to children in the play area, soils within the play area were excavated to a depth of 4 feet and transported off-site to an approved landfill. An estimated 900 cubic yards of soil was removed. A high-density polyethylene liner was placed in the bottom of the excavation and covered with clean fill from 4 to 1.23 feet bgs and compacted to 90 percent

relative compaction. Pea gravel was then placed from 1 to 1.25 feet bgs. Fall zone material was placed from 1 foot bgs to final grade by the USCG following installation of a new play structure.

Table 4-4
Naphthalene Concentrations in Co-Located Saturated Soil and Groundwater Samples
Alameda Point Site 25/Alameda Annex IR-02 Groundwater RI/FS

Sample Point	Location	Concentration in Groundwater (µg/L)	Concentration in Saturated Soil (µg/kg)	Expected soil Concentration in Equilibrium with Groundwater (µg/kg)
P181-MW45	OU-5 West side of Annapolis Circle	3,400 J	51,000 – 13 feet bgs	68,000-136,000
P181-MW46	OU-5 East side of Annapolis Circle	1,100	19,000 – 15 feet bgs	22,000-44,000
P181-MW47	OU-5 Kollmann Circle	8,400 J	20,000 – 14.5 feet bgs 14,000 – 16 feet bgs	168,000-336,000

J = Approximate value
OU-5 = Operable Unit 5
µg/L = micrograms per liter
µg/kg = micrograms per kilogram

From winter 2001 to spring 2002, a time-critical removal action was performed at Parcel 181 to remove soils with elevated concentrations of PAHs from soils 0 to 2 feet bgs. The area was then backfilled with clean imported fill, top soil, and sod. The excavated soils were disposed of at an off-site disposal facility. Soils were removed from all contiguous housing complex areas where at least one near-surface sample was determined to have BaP-equivalent concentrations of 1.8 mg/kg or greater. The extent of the soil removal activities is shown on Figure 2-8 of the RI Report (IT et al., 2002).

The available soil and groundwater data indicate that the majority of contamination is portioned into the groundwater phase, and there is likely no remaining soil source. Despite the surficial soil removal actions that have occurred on the Site, concentrations of benzene and naphthalene remain in groundwater exceeding drinking water action levels.

4.4. EVALUATION OF POSSIBLE CONTAMINANT SOURCES

While several previous characterization efforts have been conducted, none have conclusively determined the source(s) of groundwater contamination in the FWBZ. There are four possible sources of shallow groundwater contamination at the Site:

- Contaminated fill material which was used to fill in marshland and create the Site.
- Burred inclusions of high-concentration material trapped near the marsh crust surface during creation of the Site.

- A layer of petroleum-related contamination on the historic shoreline, marshland, and tidal channels underlying the Site, referred to as the Marsh Crust.
- Point-source discharges such as fuel spills.

The viability of each of these possible sources is discussed in the following sections.

4.4.1. Contaminated Fill Materials and Buried Inclusions

Historic dredge and fill operations are believed to have removed sediments from portions of the Oakland Inner Harbor and the San Francisco Bay, which contained contaminants from a nearby manufactured gas plant, refinery, and other industrial operations. In addition, historical photographs of early industrial operations show large piles of materials, suggesting that heavily-contaminated waste was directly used as fill (IT, 1998). Efforts to "fingerprint" ten soil samples from OU-5 indicated that the PAHs in OU-5 soil are characteristic of "Monterey Crude," the petroleum used for the manufactured gas plant (IT et al., 2002). Depending on the aquifer dynamics, as the Site was created, these materials could have formed pockets of contamination or source areas that would leach contamination.

The premise that groundwater contamination at the Site is due to contaminated fill material is supported by the distinct plume centers evident on benzene contour maps and by contamination increases with depth. However, natural degradation processes favoring shallower, more aerobic environments also could explain the greater contamination at depth (see Section 5 for a discussion of fate and transport).

Some fill material within the northern section of Alameda Point OU-5 has already been excavated to address PAH contamination during previous removal actions. However, soils in the north portion of the Site were shallow, and are not believed to be the source of the groundwater contamination evaluated in this report.

4.4.2. Marsh Crust

Pacific Coast Oil Refinery operated from approximately 1864 to 1899 at the western tip of pre-fill Alameda, and a manufactured gas plant that used oil existed on the waterfront in Oakland. Releases of oil and byproducts associated with manufacturing operations from these and other industries in the vicinity may have resulted in widespread contamination of the former Oakland Inner Harbor shoreline, marshland, and tidal channels. This layer of petroleum-related contamination on the historic shoreline, marshland, and tidal channels is referred to as the Marsh Crust. The Marsh Crust may be contributing, in part, to the benzene and naphthalene contamination observed in groundwater beneath the Site. However, the Marsh Crust is not considered a primary source of contamination at the Site because the types and concentrations of PAHs in the groundwater, most notably naphthalene, did not reflect the types and concentrations of PAHs found in the marsh crust. More details regarding the nature and extent of hazardous substances present in the Marsh Crust can be found in the Marsh Crust FS (TtEMI, 2000a).

4.4.3. Point-Source Discharges

The most prominent evidence supporting previous point-source discharges as the source of Site groundwater contamination is the presence of three distinct plume centers on the benzene contour maps (see Figures 4-2 through 4-8). Because benzene is mobile in groundwater and concentrations generally decrease with increasing distance from plume centers, it can be deduced that a point-source discharge of contaminants (either surface or subsurface) occurred previously.

In a 1968 aerial photograph, a stained area appears to support the point-source discharge theory. The stained area was observed near the present location of a benzene plume center (see Figure 1-6)

The low-level detections of fuel additive contaminants (MTBE and 1,2-DCA) at the Site may indicate a more recent spill of petroleum hydrocarbons, such as gasoline. While recent surface spills may be contributing in part to the contamination at the Site, as discussed in Section 4.2.1, the detections of MTBE and 1,2-DCA do not correlate well with the primary risk driver chemicals at the Site, and are not likely associated with the principal origin of benzene and naphthalene contamination at the Site. As discussed in Section 4.1.1, the low-level concentrations of MTBE and 1,2-DCA previously detected were localized and have not been replicated during numerous subsequent sampling events. For this reason, MTBE and 1,2-DCA are not considered COPCs for the remedial alternatives analyzed in this report.

To date, naphthalene has been detected at higher concentrations than other PAHs in groundwater samples. Naphthalene is generally more mobile in groundwater than other PAHs, and would migrate more readily from a localized discharge, creating plumes similar to those observed.

4.4.4. Summary – Possible Contaminant Sources

The main sources of groundwater contamination at the Site likely are a combination of previous point-source discharges, disperse contaminants within the fill, and more localized buried inclusions of contaminated materials near the marsh crust surface.

The most likely sources of groundwater contamination at the Site are localized in nature and do not appear to be acting as ongoing source material. The term *source material* refers to contamination that would continue to leach contaminants to groundwater, causing plumes to enlarge and concentrations in groundwater to increase. Rather, Site contamination appears to be weathered, indicating that the sources have diminished and that biodegradation appears to be addressing dissolved-phase contaminants. Contaminant migration from sources is often accelerated by the presence of subsurface utilities that provide preferential pathways for contaminant migration. As discussed in Section 2.4, a number of subsurface utilities exist at the Site; however, based on ongoing groundwater monitoring data, they do not appear to be acting as preferential pathways.

4.5. ASSESSMENT OF ADEQUACY OF DATA

The existing data from previous characterization efforts are adequate for preparation of this groundwater RI/FS. Sufficient quality assurance and quality control documentation (such as Level 4 Contract Laboratory Program type data packages) exists for all data used in this RI/FS and demonstrate that the data are of acceptable quality, usable for the objectives of this report with the following exception. The quality of the data collected by ERM in 2000 and 2001 is not certain. It is not documented whether these data have been validated or whether sufficient quality assurance and quality control documentation exists to allow data from this investigation to be validated. Therefore, the ERM data have only been used qualitatively (to assist in defining contour maps).

Because the data used in this investigation were generated during multiple investigations, there are some limitations on the comparability and completeness of the data, including:

- Inconsistent sampling depths during the 2001 Hydropunch™ field event. Samples were not collected at certain depths in some of the Hydropunch™ locations due to local heterogeneities.
- Limited MNA parameter monitoring.
- Monitoring well screening depths do not directly correlate with Hydropunch™ sample depths.

4.5.1. Hydropunch™ Sampling Depth Inconsistencies

The Hydropunch™ sampling performed by IT in 2001 was the first comprehensive groundwater investigation at the Site that attempted to characterize groundwater contamination as a function of depth. The purpose of the sampling program was to collect groundwater samples from standardized depths at each Hydropunch™ location. However, because of local heterogeneities, resulting in inadequate sample recovery, samples were collected from differing depths at various sample locations. Therefore, the Hydropunch™ field event yielded sufficient data to characterize groundwater contamination as a function of depth, but sampling of additional depth intervals would have provided additional useful data.

4.5.2. MNA Parameter Monitoring

The evaluation of MNA parameters can range from simple analysis of parameters such as DO and ORP to microcosm studies using site soils to predict site-specific biodegradation rates. Monitoring for MNA parameters not only assists in predicting biodegradation rates, but also provides an understanding of the various conditions within the plume (e.g., locations of aerobic and anaerobic zones).

Some data have been collected to monitor MNA parameters. Three rounds of sampling for MNA parameters have been conducted as part of the Basewide Groundwater Monitoring Program. Data from summer 2002, winter 2002, and summer 2003 are summarized quarterly (Shaw, 2004b and c).

MNA parameter monitoring at the Site continues to be performed as part of the Basewide Groundwater Monitoring Program for Alameda Point. A more rigorous statistical analysis of MNA is recommended

after the groundwater monitoring program generates additional MNA parameter data. This recommendation was also included in the recent Alameda Point OU-5 RI Report (IT et al., 2002). Microcosm studies are not recommended at this time due to the large data set documenting contaminant degradation.

4.5.3. Correlation of Monitoring Well and Hydropunch™ Data

Groundwater samples from previous investigations were collected from monitoring wells and from Hydropunch™ borings. Samples from monitoring wells are representative of the entire screened interval (approximately 10 feet), while Hydropunch™ samples were typically collected from several smaller intervals in each boring. Because Hydropunch™ samples are collected from temporary borings, data collected from Hydropunch™ sampling provide a one time "snapshot" of groundwater at the Site, and are not intended to be used to track trends in contamination over time. In general, Hydropunch™ data are used to provide vertical and spatial delineation of the plume, while monitoring data are used to document the lateral extents of the plume and track changes over time. Because the screened intervals were not consistent between these methods and the data were generated for different purposes, there is some difficulty in comparing plume maps based on monitoring wells with plume maps based on Hydropunch™ samples. Therefore, this report has only qualitatively compared the two data sets.

4.5.4. Detection Limits Above Risk Based Criteria

The data used for this evaluation were generated under a number of separate programs with differing data quality objectives. The Remedial Action Objectives (RAOs) specified in Section 8 are based on protecting human health and the environment through vapor inhalation or groundwater ingestion (if groundwater is potentially used as a potable water source). USEPA vapor intrusion screening criteria for soil gas were not established at the time of the previous investigations at the Site (most notably the OU-5 RI), and risk-based groundwater screening levels used in previous investigations did not project groundwater ingestion as being a viable exposure pathway.

The project-required detection limits for groundwater samples collected during the OU-5 RI were designed to meet risk-based threshold criteria based on exposure through the inhalation pathway rather than the ingestion pathway; therefore, typical detection limits for approximately 15 percent of analytes in groundwater exceeded MCLs (Neptune et al., 2001; IT et al., 2002). However, current groundwater monitoring conducted at the Site under the Basewide Groundwater Monitoring Program is typically achieving detection limits below MCLs for all analytes except 1,2-bromoethane. Typical laboratory methods are not capable of detecting 1,2-bromoethane at concentrations near the MCL.

Elevated detection limits do not affect the usability of the data for the two primary risk driver chemicals, benzene and naphthalene, because there are numerous detections of these analytes, as well as numerous data with detection limits below the action levels. Although elevated detection limits may have resulted in other analytes being inadvertently screened out in the risk assessment due to low frequency of

detection, this possibility is not considered significant because: (1) reporting limits typically have been below MCLs during the Basewide Groundwater Monitoring Program and these data are also included in the risk assessment, and (2) the incremental risk associated with chemical concentrations equivalent to the elevated detection limits are much lower than the risk associated with benzene and naphthalene. Therefore, while some data may have elevated reporting limits, sufficient data with low detection limits are available for the majority of analytes (with the exception of 1,2-bromoethane), and future data collected at the Site will be useable for comparison to drinking water action levels.

Likewise, detection limits for soil gas analyses in previous investigation have ranged greatly. Method detection limits for benzene for the 1989 and 1990 soil gas investigations conducted by PRC were 40 and 60 $\mu g/m^3$, respectively (TtEMI, 1999b). Detection limits for soil gas samples collected as part of the EBS ranged from 6.4 to 5,000 $\mu g/m^3$. These limits are above the 3.1 $\mu g/m^3$ screening level for benzene in shallow soil gas specified by the USEPA vapor intrusion guidance (USEPA, 2002). While detected benzene concentrations are usable data, data with no benzene concentrations detected above the detection limit are of limited use, because they cannot be directly compared to the screening criteria. However, some investigations conducted at the Site achieved acceptable detection limits for benzene. Benzene detection limits reported by the 1993 soil gas investigation at IR-02 ranged from 0.09 to 0.19 $\mu g/m^3$ (TtEMI, 1999b). Reporting limits for benzene achieved in the OU-5 RI were typically 2 $\mu g/m^3$ (IT et al., 2002). Reporting limits for benzene in the Basewide Groundwater Monitoring Program have ranged from 0.2 to 23 $\mu g/m^3$, but have been below the applicable shallow or deep screening level in 84 percent of the samples with no detectable benzene.

In addition to benzene, detection limits for other analytes in soil gas have been elevated. In the OU-5 RI, the reporting limits for 1,1,2,2-tetrachloroethane, 1,1,2-trichloroethane, 1,2-dichloroethane, bromodichloromethane, carbon tetrachloride, and dibromochloromethane were elevated above shallow soil gas screening criteria in all of the soil gas samples. Reporting limits for tetrachloroethylene, trichloroethylene, and chloroform were elevated with respect to soil gas screening criteria in a significant portion (40 to 60 percent) of the shallow soil gas samples.

Although the soil gas reporting limits in the OU-5 RI were elevated, soil gas data collected under the Basewide Groundwater Monitoring Program are using analytical methods with reporting limits below the shallow soil gas screening criteria. While some individual samples have had elevated reporting limits due to matrix interferences or dilutions, at least 50 percent of the reporting limits for every analyte have been below the shallow soil gas screening criteria (Shaw, 2004b and 2004c). Therefore, while some of the OU-5 RI data are not directly comparable to screening criteria because of elevated detection limits, sufficient soil gas data are available to support the conclusions of this RI/FS. Future soil gas monitoring conducted under the Basewide Groundwater Monitoring Program will continue to use analytical methods with reporting limits below shallow soil gas screening criteria.

4.5.5. Data Gaps

Despite the large amount of data generated by previous investigations, further investigation and characterization at the Site would be beneficial to address the following data gaps:

- Further delineation of the west and southeast plume edges
- Investigation of potential soil sources near P181MW-47 and western plume centers
- Addressing anticipated changes to site conditions in EW-2 plume center
- Verifying concentration trends in soil gas using data with appropriate detection limits

Further delineation of the west and southeast plume edges: The existing network of monitoring wells does not completely bound the plume, and additional wells would be required in the west and southeast portions of the Site to provide complete bounding. While Hydropunch™ sampling has delineated the southeast portion of the plume, periodic sampling of monitoring wells is needed to document that the plume remains bounded to the southeast. Likewise, additional wells on the western side of the Site are needed to determine the extent of the plume, and location of the plume center. The Basewide Groundwater Monitoring Program has recommended installing additional wells in the western portion of the Site (Shaw 2004b). Further delineation of the western and southeastern portions of the Site is necessary to define the treatment area and is necessary before a remedial design is finalized; however, the existing data set provides sufficient data to document the nature and extent of contamination in the majority of the plume and to select a remedy for the groundwater contamination at the Site. Additional characterization will be done as part of the Basewide Groundwater Monitoring Program, or during the remedial design.

Investigation of potential soil sources near P181MW-47 plume center: Concentrations of benzene have remained stable in many parts of the plume. Stable benzene concentrations appear to be attributable to the fact that subsurface conditions are predominantly anaerobic, and biodegradation is occurring at a slow rate under sulfate-reducing or methanogenic conditions. However, stable concentrations could also be explained by the presence of a continuing source of contamination. Decreases observed in some wells, such as P181-MW47, located at the plume center in Mayport/Kollmann circle, suggest that there is not likely a remaining source.

Investigation of potential soil sources near the western plume center: For the western plume center, the collection of additional soil data is planned at Sites 30 and 31 as part of the ongoing soil RI for those sites. These data will assist in determining if there is soil contamination near the western plume center that is contributing to the groundwater contamination at the Site. For the plume center at P181-MW47, additional soil sampling will be conducted during the remedial design stage to determine whether any high-concentration source material remains. Despite the decreasing concentrations at well P181-MW47, the potential for source material remains based on the 1968 aerial photo that showed stained soil in the general area. If source material were present in either of these areas, it would not prohibit the use of any

of the technologies evaluated in Section 9; however, presence of source material may require slight modification of the selected remedy or increase timeframes needed to reduce concentrations to levels that are protective of human health and the environment.

Address anticipated changes to site conditions at EW-2 plume center: Ongoing residential development at Alameda Annex requires the construction of a new system of subsurface utilities. The developer has recently submitted a draft proposal to construct a sewer pump station in the vicinity of EW-2. The plans indicate that the pumping station will be approximately 35 feet deep, and 60 feet by 40 feet wide, and will receive drainage from a network of storm drains throughout the development at depths ranging from 8 to 12 feet bgs (ERM and Catellus, 2004). At a recent meeting, the Alameda Point BCT concurred that the work planned by Catellus will likely impact Site conditions and, therefore, additional sampling by the Navy at the remedial design stage of a groundwater treatment remedy would be more beneficial than additional sampling to support this RI/FS (Navy, 2004).

Verify concentration trends in soil gas using data with appropriate detection limits: While much of the older soil gas data are not usable due to elevated detection limits, Figure 3-6 shows a thorough distribution of benzene data with detectable concentrations or non-detects with detection limits below the soil gas screening level. Continued sampling is conducted from five deep and five shallow soil gas monitoring points as part of the Basewide Groundwater Monitoring Program. These five wells are spaced through the center and eastern portions of the plume. The existing data provide sufficient spatial coverage to characterize migration of contaminants from groundwater to soil gas at the Site. As discussed in Section 4.5.4, the current data are using analytical methods with reporting limits below the shallow soil gas screening criteria. Additional soil gas sampling would be required as part of a remedial activity such as biosparging that would increase the volatilization of contaminants from groundwater. This sampling would be conducted as part of the remedial action.

4.6. SUMMARY – NATURE AND EXTENT OF CONTAMINATION

The primary COPCs at the Site, based on risk assessment results, are dissolved-phase benzene and naphthalene. The affected area of the Site is approximately 42 acres (plan view of the benzene plume). There are three primary plume centers, with contaminant concentrations decreasing or remaining relatively stable. Biodegradation continues to degrade benzene and naphthalene slowly under anaerobic, sulfate-reducing, or methanogenic conditions.

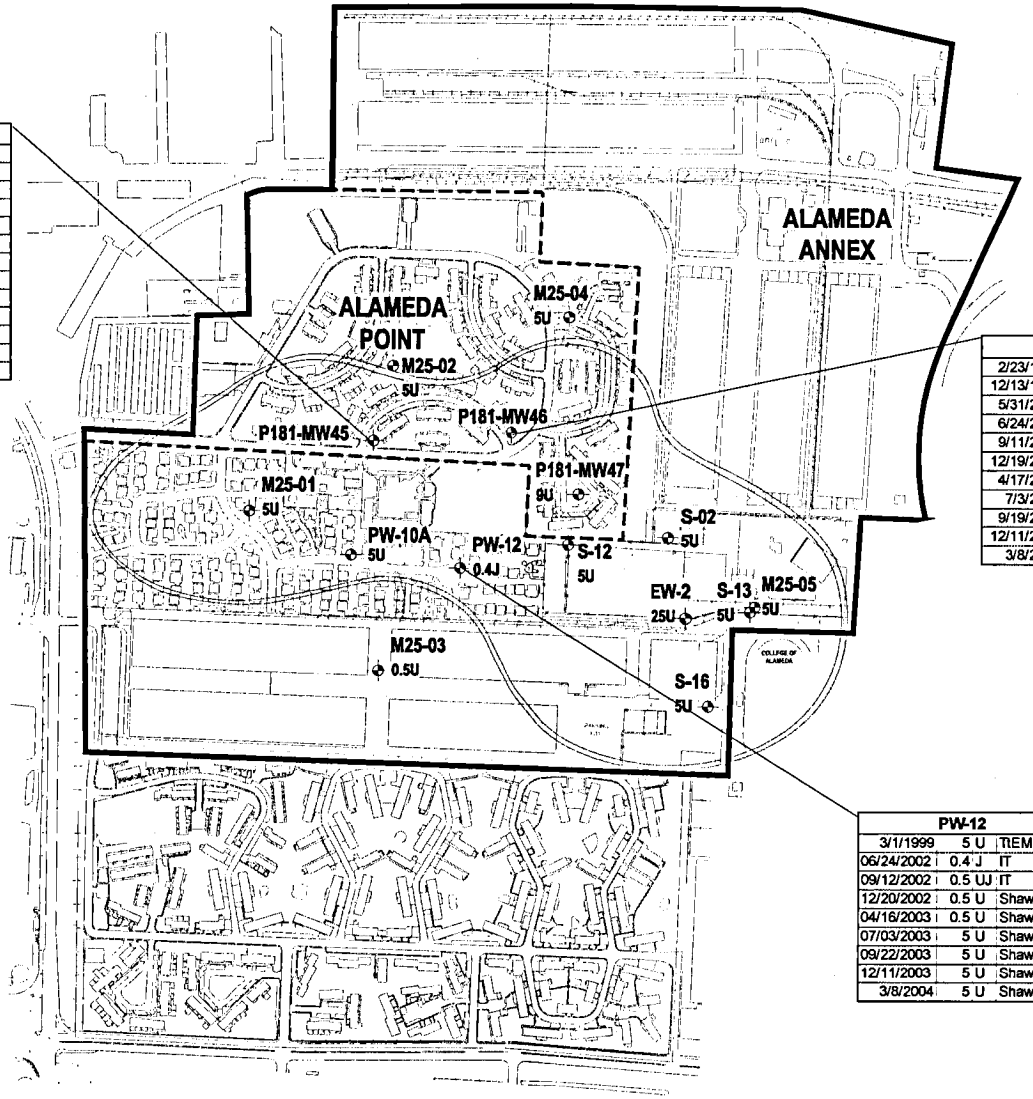
The probable sources of contamination are point-source discharges and contaminated fill materials used to create the Site. Neither appears to be acting as an ongoing source responsible for plume expansion or contaminant concentration increases. However, it is possible that a source such as aged buried contamination could remain, and that compensating processes such as biodegradation are lessening the effect of that source.

No contamination was found in the SWBZ above drinking water action levels. Groundwater contamination in the FWBZ can be summarized as follows:

- Free product (light non-aqueous phase liquid) has not been detected at the Site.
- Dissolved-phase benzene has been found in groundwater. A plume spreads from Alameda Annex IR-02 into Alameda Point Site 25. The affected area is approximately 42 acres, with an approximate aquifer thickness of 10 feet. Benzene concentrations appear to increase with depth (the highest detections were at approximately 20 feet bgs).
- PAH contamination (specifically naphthalene) is co-located with dissolved-phase benzene at the Site. The naphthalene plume has been correlated with the benzene distribution pattern, suggesting a common source.

Historical data, including results from the 308 samples taken during the OU-5 RI, indicate that benzene and naphthalene are present in groundwater. The highest detected concentrations are located in three plume centers: one in the southeast portion of Alameda Point Site 25 (monitoring well P181-MW47); one within Alameda Annex IR-02 (monitoring well EW-2); and one on the west end of the Site (monitoring well P181-MW45 and MW25-01). The three plume centers indicate possible point-source discharges from past site operations, or specific locations where contaminated fill was used.

This page intentionally left blank



P181-MW45		
2/23/1999	5 U	TtEMI
12/13/1999	6	IT
06/24/2002	10 U	IT
06/24/2002	6.3 U	IT
09/11/2002	0.2 UJ	IT
09/11/2002	0.2 UJ	IT
12/19/2002	6.3 U	Shaw
12/19/2002	1.3 U	Shaw
04/17/2003	6.3 U	Shaw
07/03/2003	5 U	Shaw
09/19/2003	5 U	Shaw
12/11/2003	5 U	Shaw
3/8/2004	50 U	Shaw

P181-MW46		
2/23/1999	5 U	TtEMI
12/13/1999	12	IT
5/31/2001	19	IT
6/24/2002	4.8	Shaw
9/11/2002	1.8 UJ	Shaw
12/19/2002	4.2 U	Shaw
4/17/2003	4.2 U	Shaw
7/3/2003	5 U	Shaw
9/19/2003	5 U	Shaw
12/11/2003	0.62 J	Shaw
3/8/2004	0.3 J	Shaw

PW-12		
3/1/1999	5 U	TtEMI
06/24/2002	0.4 J	IT
09/12/2002	0.5 UJ	IT
12/20/2002	0.5 U	Shaw
04/16/2003	0.5 U	Shaw
07/03/2003	5 U	Shaw
09/22/2003	5 U	Shaw
12/11/2003	5 U	Shaw
3/8/2004	5 U	Shaw

LEGEND

- APPROXIMATE (1 µg/L) OUTLINE OF BENZENE PLUME IN FWBZ (DECEMBER 2003)
- ALAMEDA POINT SITE 23 BOUNDARY
- ALAMEDA POINT / ANNEX INVESTIGATION AREA BOUNDARY
- MONITORING WELLS

MONITORING WELLS

EW-2
P181-MW45
P181-MW46
P181-MW47
PW-10A
PW-12
S-02
S-12
S-13
S-16
M25-01
M25-02
M25-03
M25-04
M25-05

NOTES:

1. ALL DATA IN µg/L.
2. ALL MTBE DATA IS SHOWN FOR WELLS WITH DETECTED CONCENTRATIONS OF MTBE. SAMPLES FROM OTHER WELLS SHOWN HAVE BEEN ANALYZED FOR MTBE AT LEAST ONCE AND HAVE NOT CONTAINED MTBE ABOVE THE REPORTING LIMIT (0.5 TO 120 µg/L). MEDIAN DETECTION LIMITS ARE SHOWN.

U = NOT DETECTED ABOVE THE DETECTION LIMIT SHOWN.

J = APPROXIMATE VALUE.

SCALE
0 300 600

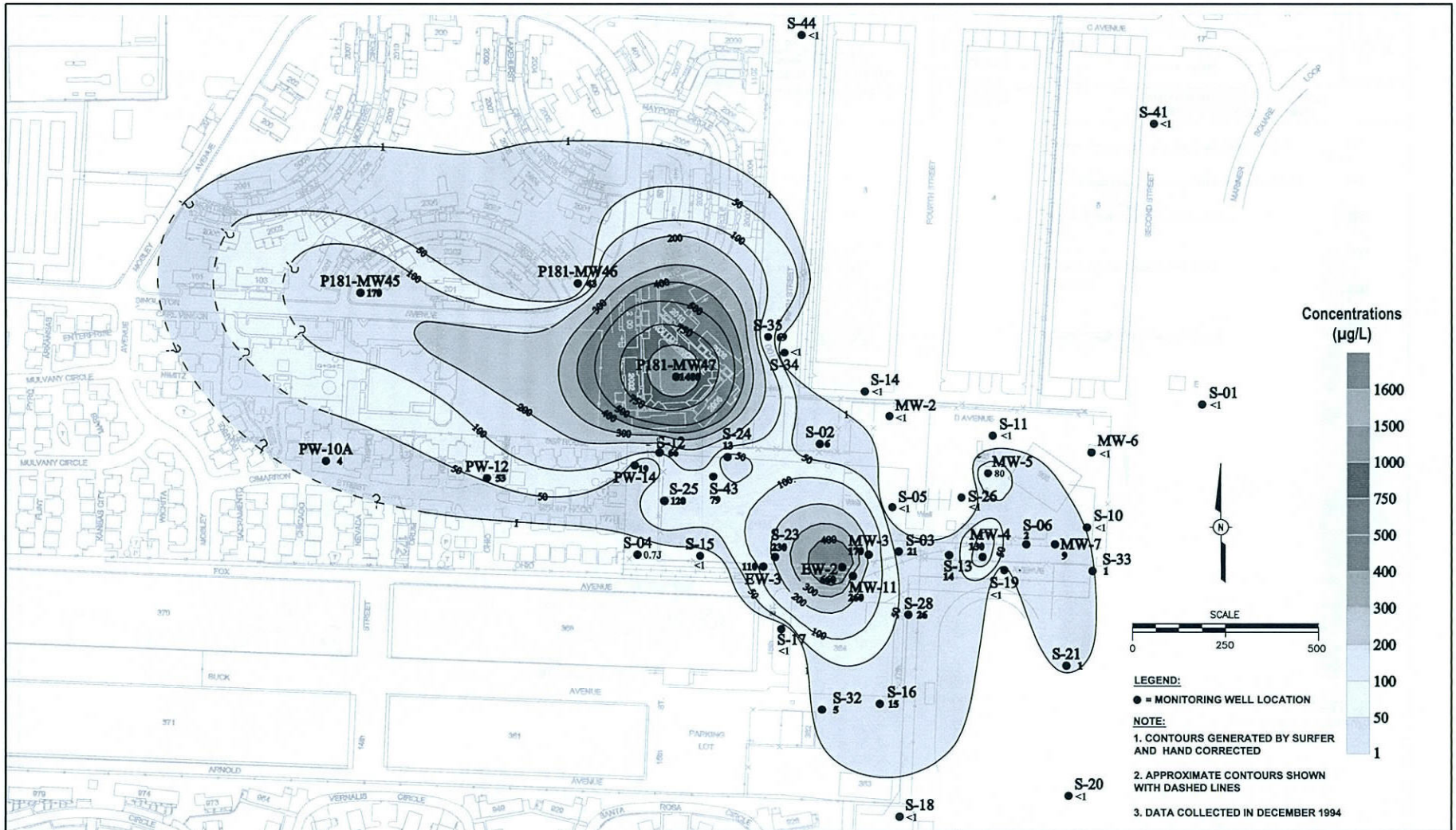
ERRG
Engineering/Remediation Resources Group, Inc.
185 Moore Drive, Suite A
Carmand, California 94529
(925) 969-0750

MTBE CONCENTRATIONS IN SHALLOW MONITORING WELLS

ALAMEDA POINT / ANNEX GROUNDWATER RI / FS

DWG. NO. 22-052-FIGURE 4-1

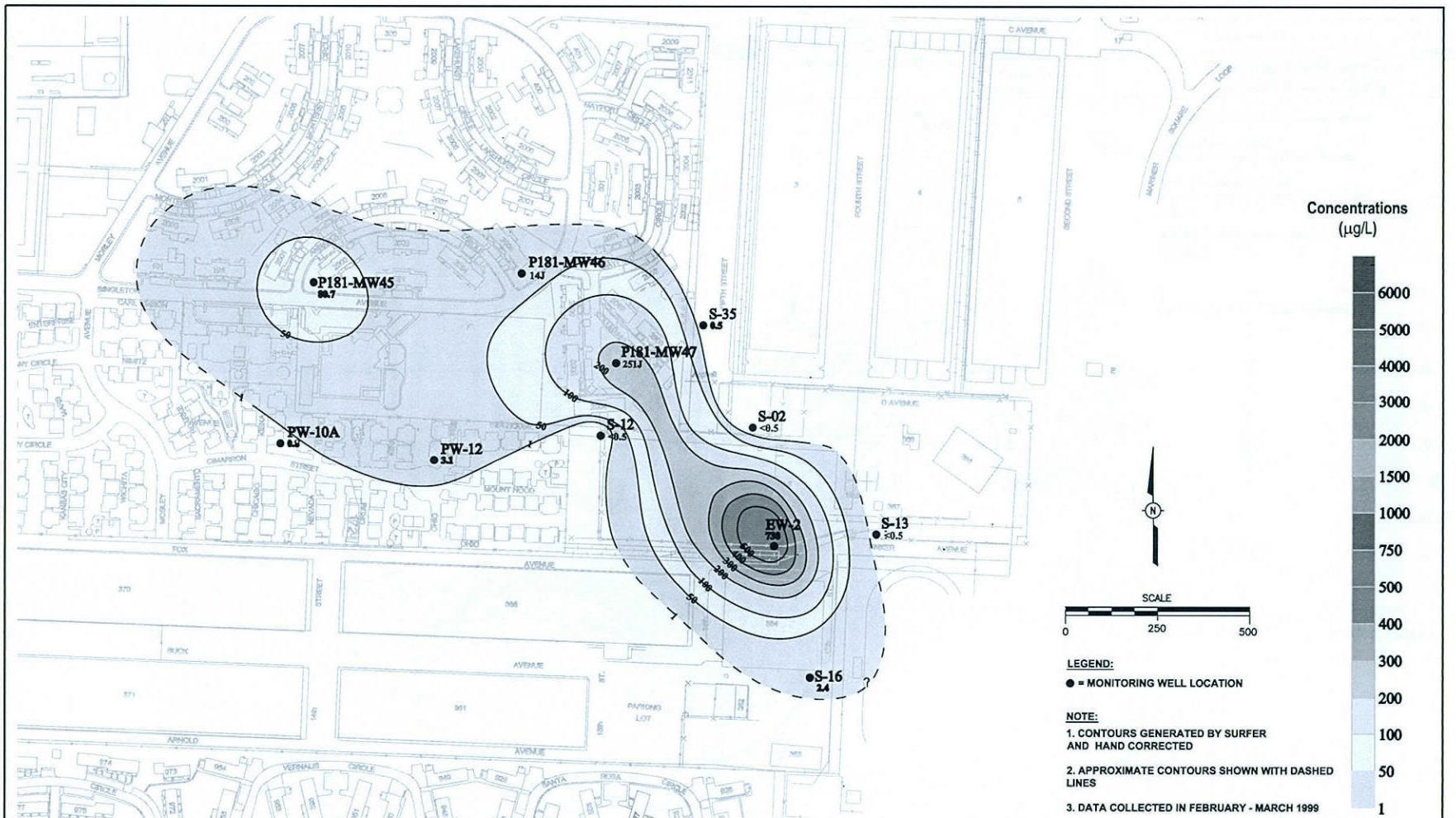
FIGURE 4-1



FILE: P:\2002 Projects\22-052 RI FS Alameda Point\Figures\Draft version\Jun 04\Revised Session 4\Fig 4-2 1994 Benzene Shallow MW.dwg USER: rwong Aug 10, 2004 1:41pm

ERRG
Engineering/Remediation Resources Group, Inc.
185 Mason Circle, Suite A
Concord, California 94520
(925) 969-0750

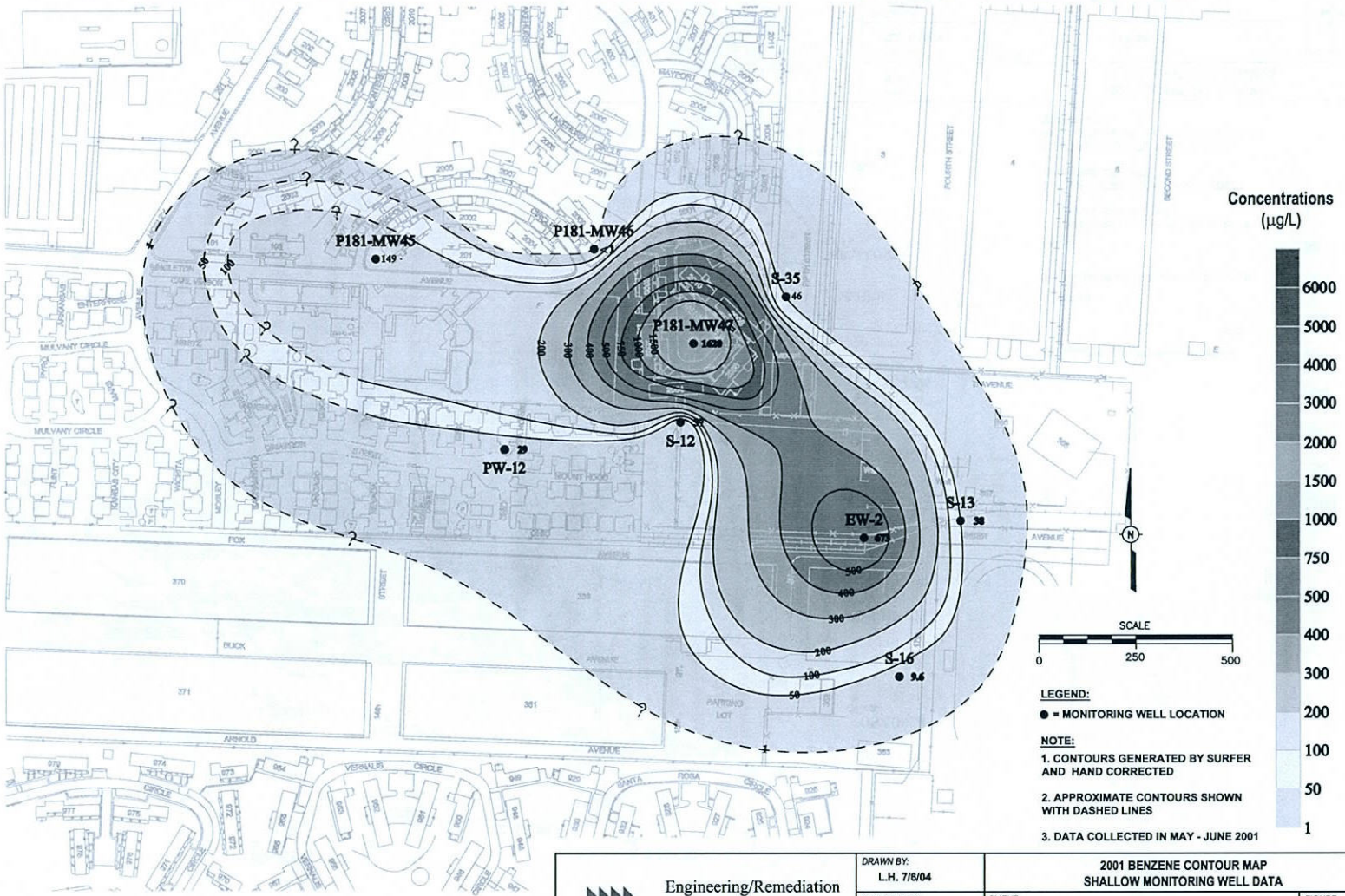
DRAWN BY: L.H. 7/6/04	1994 BENZENE CONTOUR MAP SHALLOW MONITORING WELL DATA	
DESIGNED BY: C.L.7/6/04	CLIENT: NAVY SWDIV	FIGURE: 4-2
CHECKED BY: P.F. 7/6/04	DWG. NO. 22-052-FIGURE 4-2	



ERRG Engineering/Remediation Resources Group, Inc.
185 Mason Circle, Suite A
Concord, California 94520
(925) 969-0750

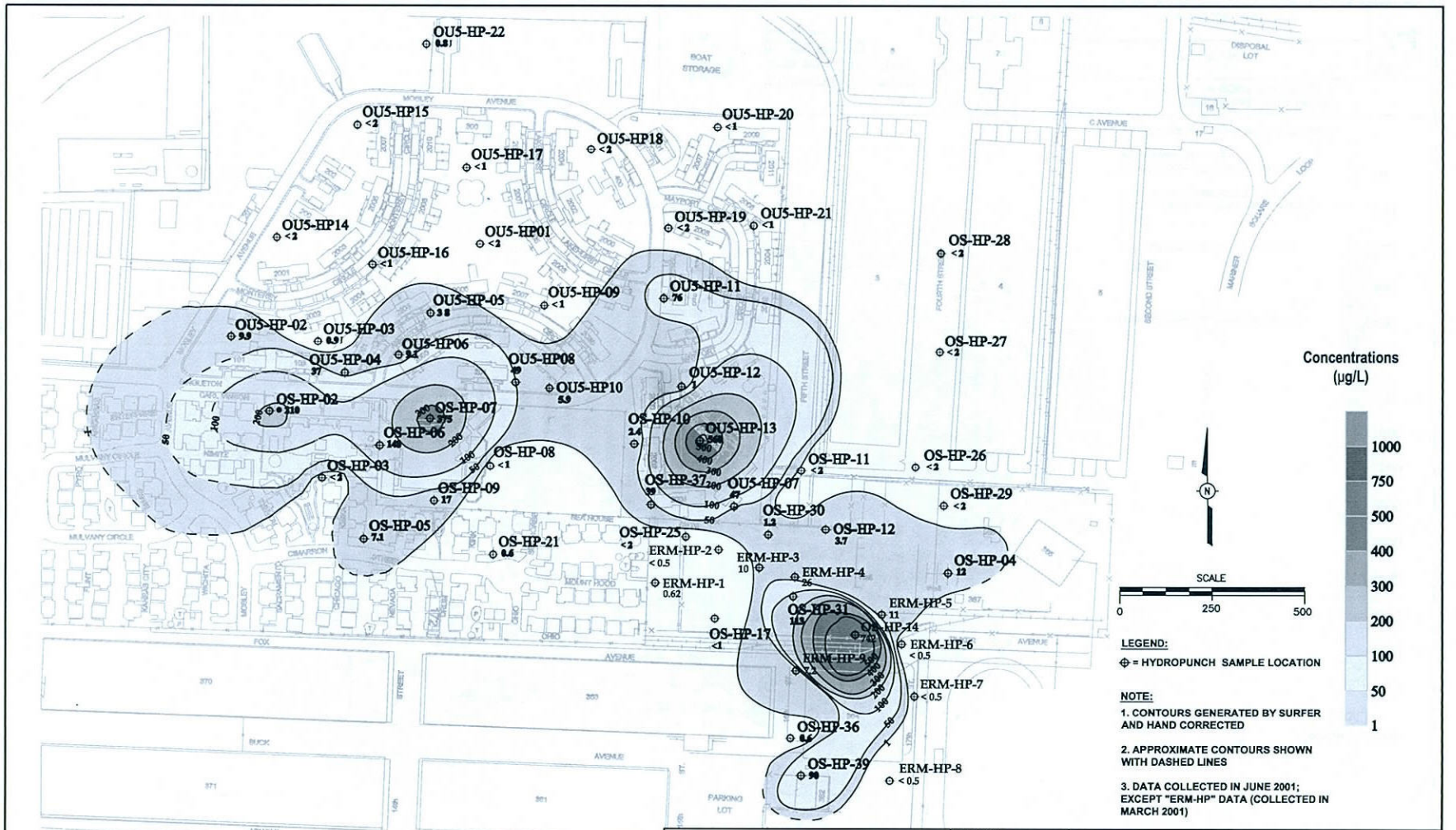
DRAWN BY: L.H. 6/10/04	1999 BENZENE CONTOUR MAP SHALLOW MONITORING WELL DATA	
DESIGNED BY: C.L. 6/14/04	CLIENT: NAVY SWDIV	FIGURE: 4-3
CHECKED BY: P.F. 6/16/04	DWG. NO. 22-052-FIGURE 4-3	

FILE: P:\2002 Projects\22-052 RI FS Alameda Point\Figures\Draft version\Jun 04\Revised Session 4\Fig 4-3 1999 Benzene Shallow MW.dwg USER: neong Aug 11, 2004 1:12pm



ERRG Engineering/Remediation Resources Group, Inc. 185 Mason Circle, Suite A Concord, California 94520 (925) 969-0750	DRAWN BY: L.H. 7/6/04	2001 BENZENE CONTOUR MAP SHALLOW MONITORING WELL DATA	
	DESIGNED BY: C.L. 7/6/04	CLIENT: NAVY SWDIV	FIGURE: 4-4
	CHECKED BY: P.F. 7/6/04	DWG. NO. 22-052-FIGURE 4-4	

FILE: P:\2002 Projects\22-052 RI FS Alameda Point\Figures\Draft version\Jun 04\Revised Session 4\Fig 4-4 2001 Benzene Shallow MW.dwg USER: rwong Aug 11, 2004 1:14pm

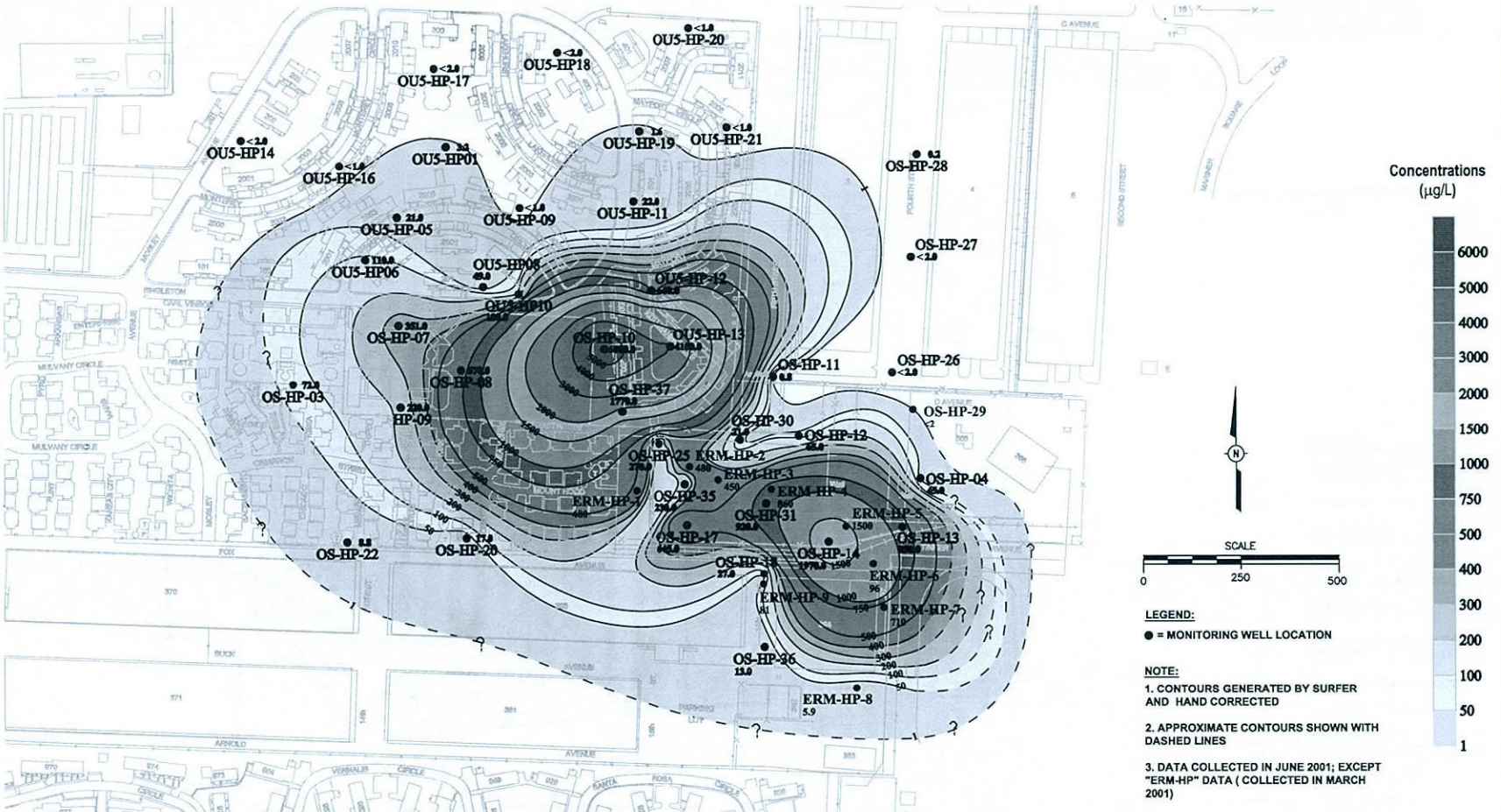


ERRG

Engineering/Remediation Resources Group, Inc.
185 Mason Circle, Suite A
Concord, California 94520
(925) 969-0750

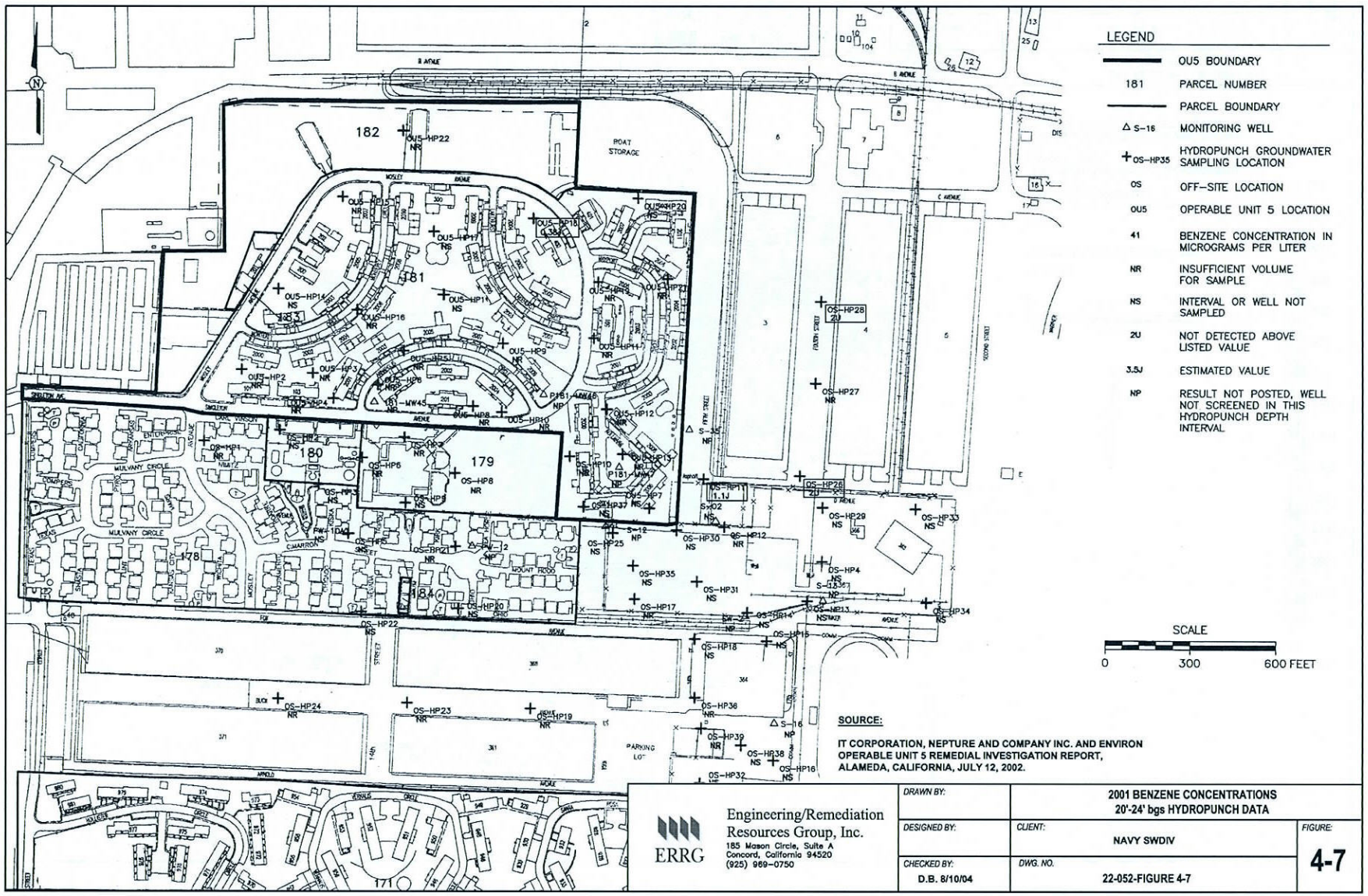
DRAWN BY: R.W. 6/15/04	2001 BENZENE CONTOUR MAP 12'-16' bgs HYDROPUNCH DATA	
DESIGNED BY: C.L. 6/15/04	CLIENT: NAVY SWDIV	FIGURE: 4-5
CHECKED BY: P.F. 6/15/04	DWG. NO. 22-052-FIGURE 4-5	

FILE: P:\2002 Projects\22-052 RI FS Alameda Point\Figures\Draft version\Jun 04\Revised Session 4\Fig 4-5 2001 Benzene 12-16 ft HP.dwg USER: nwong Aug 11, 2004 1:16pm



ERRG Engineering/Remediation Resources Group, Inc. 185 Mason Circle, Suite A Concord, California 94520 (925) 969-0750	DRAWN BY: R.W. 6/16/04	2001 BENZENE CONTOUR MAP 16'-20' bgs HYDROPUNCH DATA	
	DESIGNED BY: C.L. 6/16/04	CLIENT: NAVY SWDIV	FIGURE: 4-6
	CHECKED BY: P.F. 6/22/04	DWG. NO. 22-052-FIGURE 4-6	

FILE: P:\2002 Projects\22-052 RI FS Alameda Point\Figures\Draft version\Jun 04\Revised Session A\Fig 4-6 2001 Benzene 16-20 ft HP.dwg USER: rwong Aug 11, 2004 1:20pm



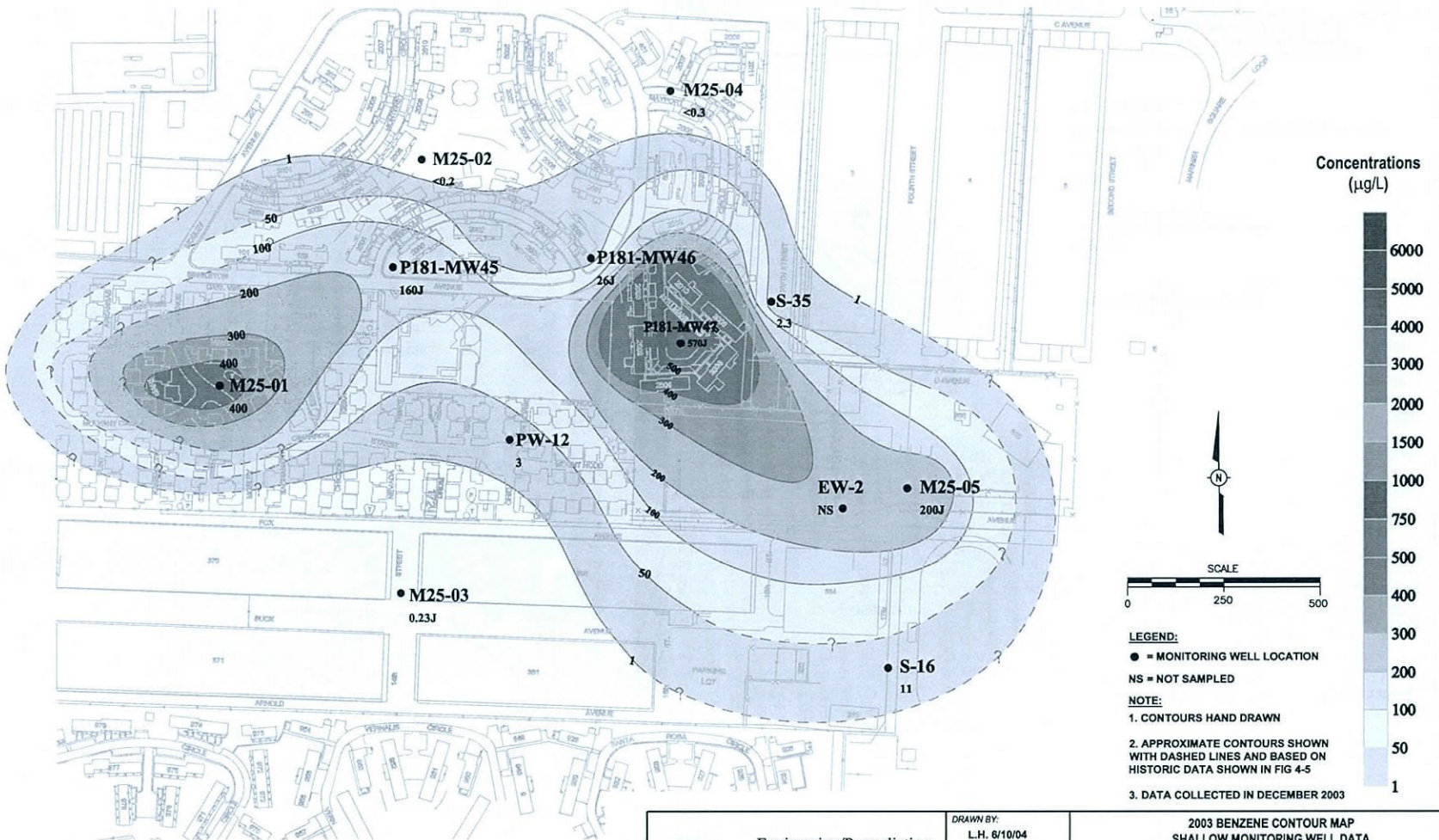
SOURCE:

IT CORPORATION, NEPTURE AND COMPANY INC. AND ENVIRON
OPERABLE UNIT 5 REMEDIAL INVESTIGATION REPORT,
ALAMEDA, CALIFORNIA, JULY 12, 2002.

ERRG
Engineering/Remediation Resources Group, Inc.
185 Mason Circle, Suite A
Concord, California 94520
(925) 969-0750

DRAWN BY:	2001 BENZENE CONCENTRATIONS 20'-24' bgs HYDROPUNCH DATA	
DESIGNED BY:	CLIENT: NAVY SWDIV	FIGURE: 4-7
CHECKED BY: D.B. 8/10/04	DWG. NO. 22-052-FIGURE 4-7	

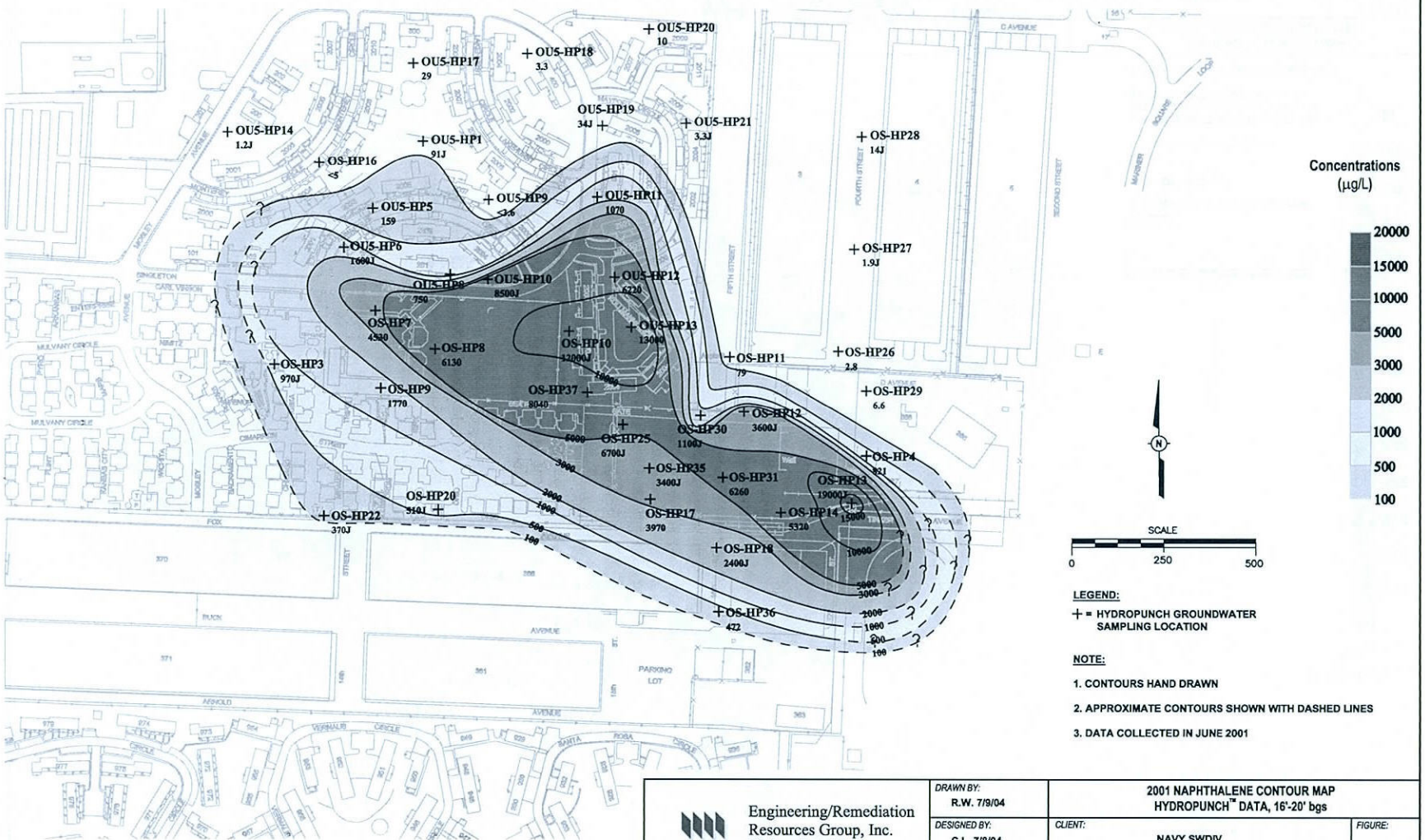
FILE: P:\2002 Projects\22-052 RI FS Alameda Point\Figures\Draft version\Jun 04\Revised Session 4\Fig 4-7 2001 Benzene 20-24 ft HP NEW.dwg USER: rwong Aug 11, 2004 1:25pm



ERRG
Engineering/Remediation Resources Group, Inc.
185 Mason Circle, Suite A
Concord, California 94520
(925) 969-0750

DRAWN BY: L.H. 6/10/04	2003 BENZENE CONTOUR MAP SHALLOW MONITORING WELL DATA	
DESIGNED BY: C.L. 6/10/04	CLIENT: NAVY SWDIV	FIGURE: 4-8
CHECKED BY: P.F. 6/16/04	DWG. NO. 22-052-FIGURE 4-8	

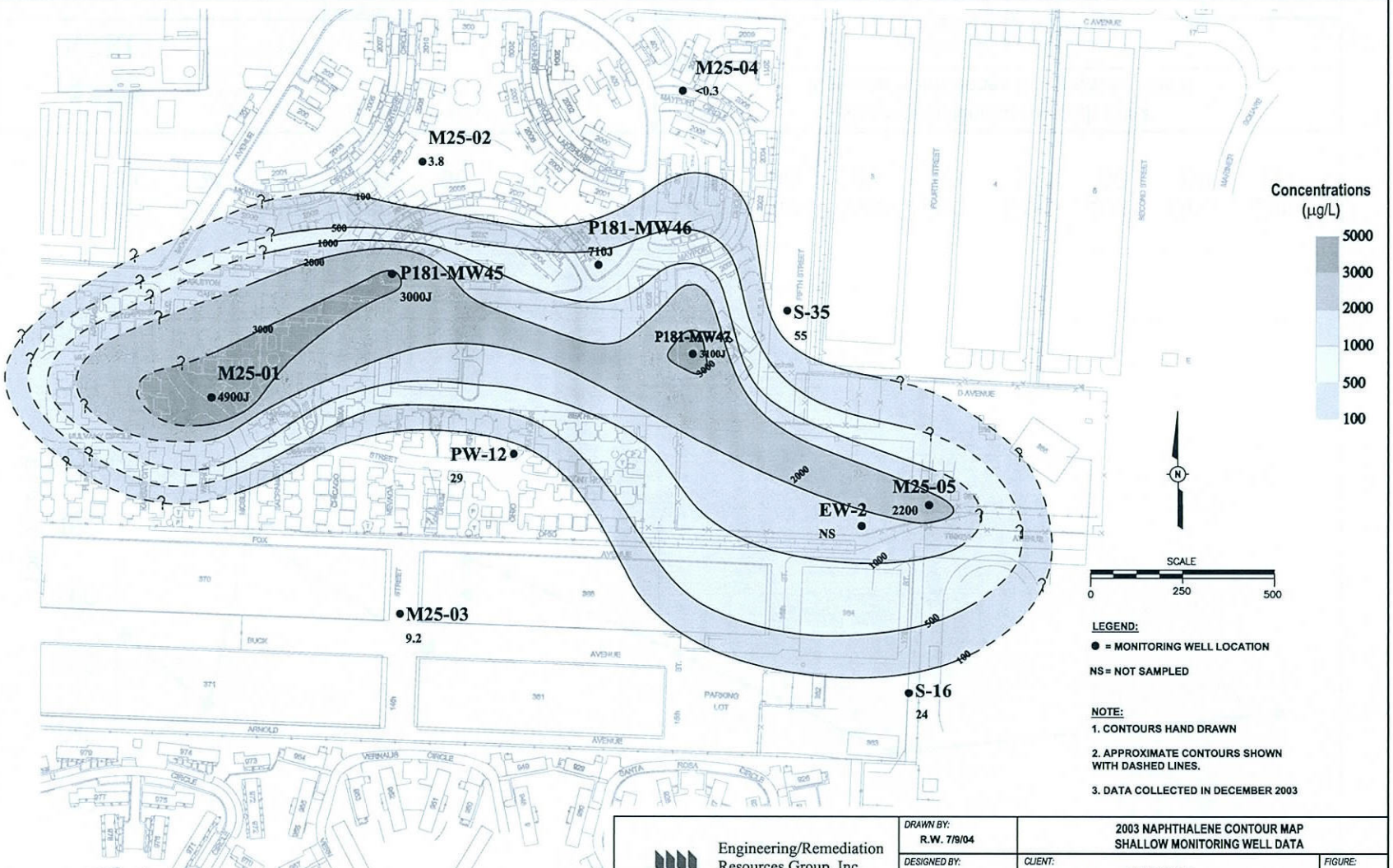
FILE: P:\2002 Projects\22-052 RI FS Alameda Point\Figures\Draft version\Jun 04\Revised Session 4\Fig 4-8 2003 Benzene Shallow MW.dwg USER: rwong Aug 11, 2004 1:32pm



ERRG
Engineering/Remediation Resources Group, Inc.
185 Mason Circle, Suite A
Concord, California 94520
(925) 969-0750

DRAWN BY: R.W. 7/9/04	2001 NAPHTHALENE CONTOUR MAP HYDROPUNCH™ DATA, 16'-20' bgs	
DESIGNED BY: C.L. 7/8/04	CLIENT: NAVY SWDIV	FIGURE: 4-9
CHECKED BY: P.F. 7/9/04	DWG. NO. 22-052-FIGURE 4-9	

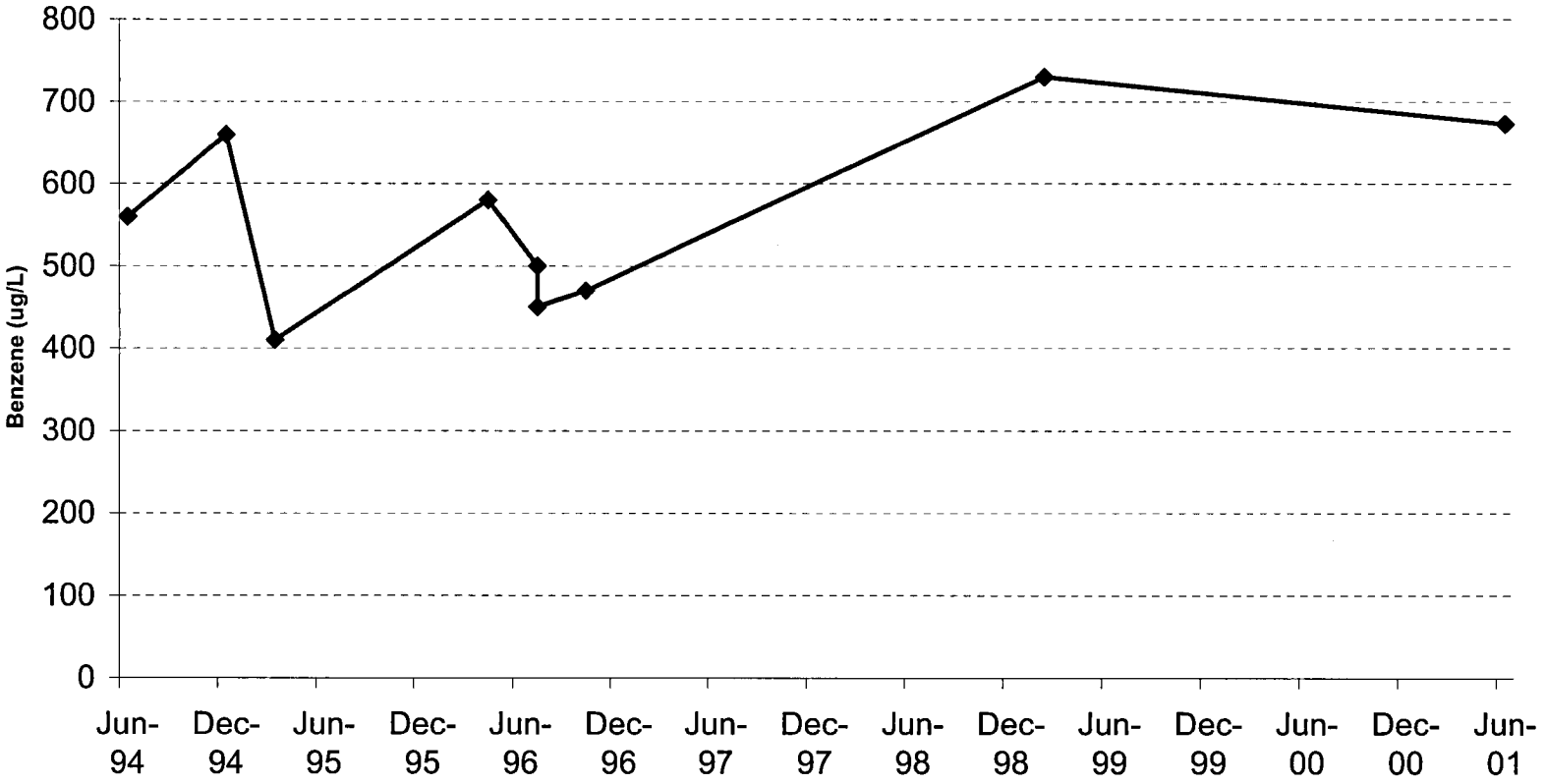
FILE: P:\2002 Projects\22-052 RI FS Alameda Point\Figures\Draft version\Jun 04\Revised Session 4\Fig 4-9 Groeater Naphthalene.dwg USER: rwong Aug 11, 2004 1:34pm



ERRG Engineering/Remediation Resources Group, Inc. 185 Mason Circle, Suite A Concord, California 94520 (925) 969-0750	DRAWN BY: R.W. 7/9/04	2003 NAPHTHALENE CONTOUR MAP SHALLOW MONITORING WELL DATA	
	DESIGNED BY: C.L. 7/8/04	CLIENT: NAVY SWDIV	FIGURE: 4-10
	CHECKED BY: P.F. 7/9/04	DWG. NO. 22-052-FIGURE 4-10	

FILE: P:\2002 Projects\22-052 RI FS Alameda Point\Figures\Draft version\Jun 04\Revised Session 4\Fig 4-10 2003 Naphthalene Shallow MW.dwg USER: nwong Aug 11, 2004 1:35pm

Monitoring Well EW-2



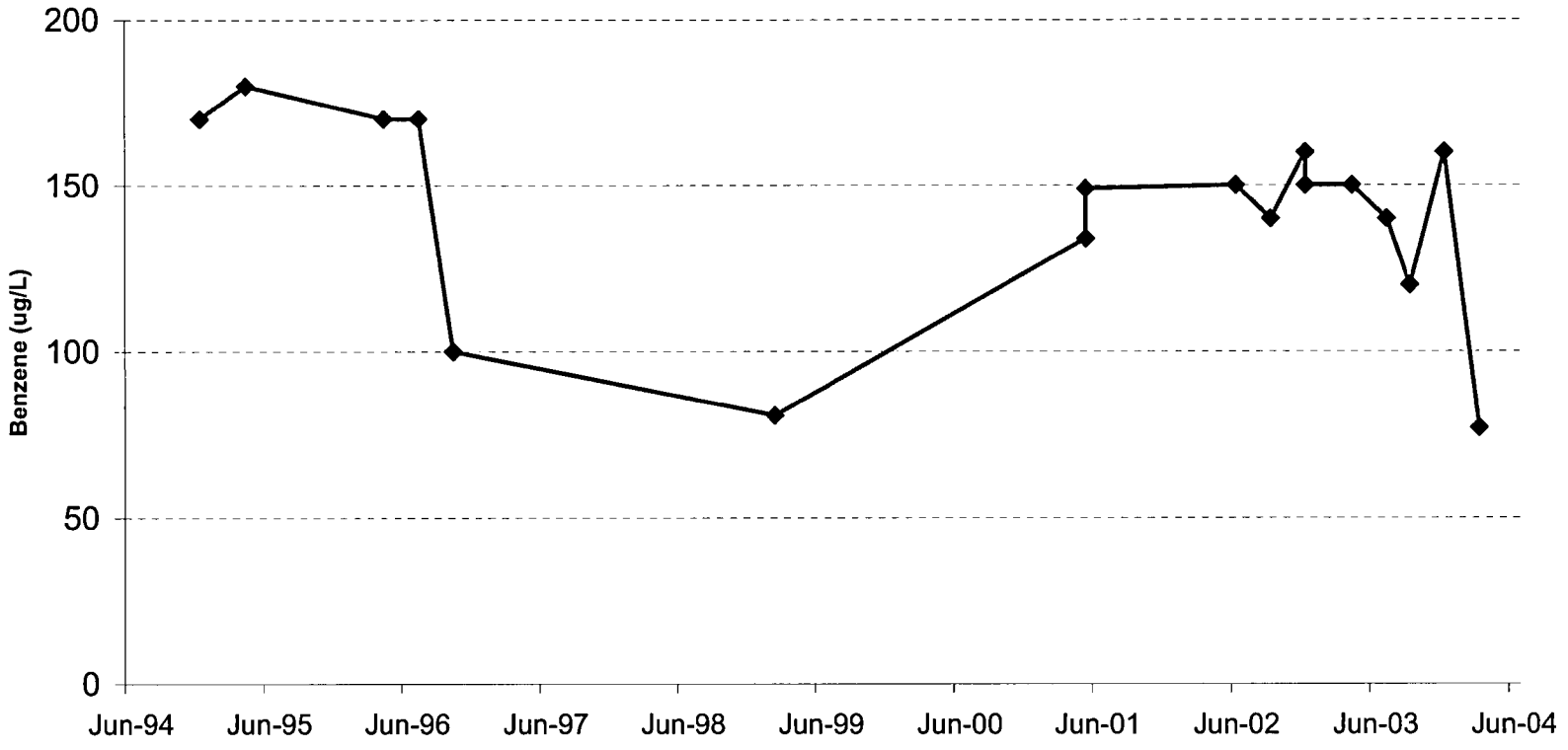
ERRG

Engineering/Remediation Resources Group, Inc.
185 Mason Circle, Suite A, Concord, CA 94520
Main: (925) 969-0750
Fax (925) 969-0751

Benzene in Monitoring Well EW-2
Alameda Point/Annex Groundwater RI/FS

CLIENT: UNITED STATES NAVY, SOUTHWEST DIVISION
NAVAL FACILITIES ENGINEERING COMMAND

SCALE:	DRAWING NO.:	LOCATION:			
not applicable	02-052_4-11	ALAMEDA POINT SITE 25/ ALAMEDA ANNEX IR-02			4-11
REFERENCE: I:\Projects\2002 Projects\22-052 RI FS Alameda Point\Figures\Figure 5-x time series plots		DESIGNED BY: RW	DRAWN BY: RW	RG/PE: DB	FIGURE:



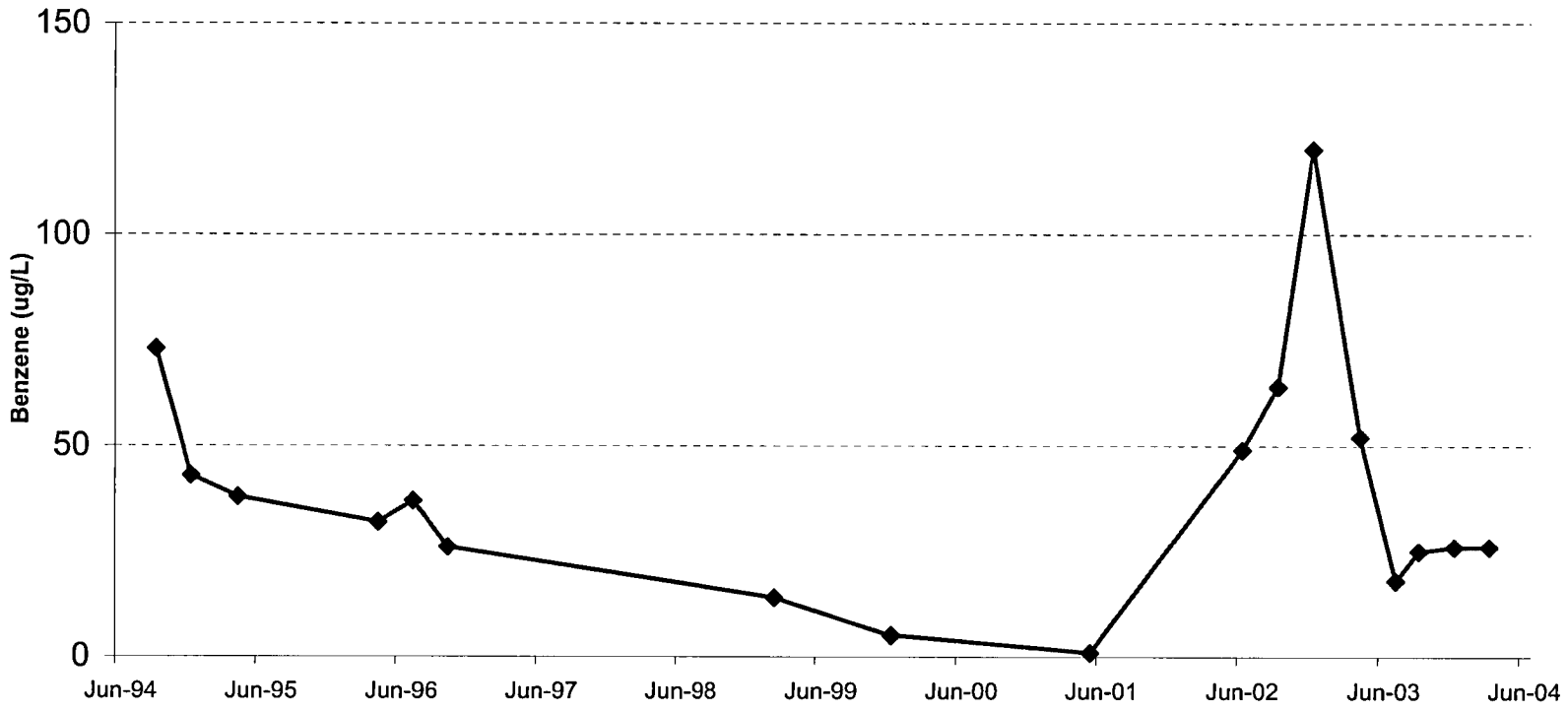
ERRG
Engineering/Remediation Resources Group, Inc.
185 Mason Circle, Suite A, Concord, CA 94520
Main: (925) 969-0750
Fax (925) 969-0751

Benzene in Monitoring Well P181-MW45
Alameda Point/Annex Groundwater RI/FS

CLIENT: UNITED STATES NAVY, SOUTHWEST DIVISION
NAVAL FACILITIES ENGINEERING COMMAND

SCALE:	DRAWING NO.:	LOCATION:			FIGURE:
not applicable	02-052_4-12	ALAMEDA POINT SITE 25/ ALAMEDA ANNEX IR-02			4-12
REFERENCE: P:\2002 Projects\22-052 RI FS Alameda Point\Figures\Prelim Draft Version\Figure 5-10 to 5-21 time series plots		DESIGNED BY: RW	DRAWN BY: RW	RG/PE: DB	

Monitoring Well P181-MW46



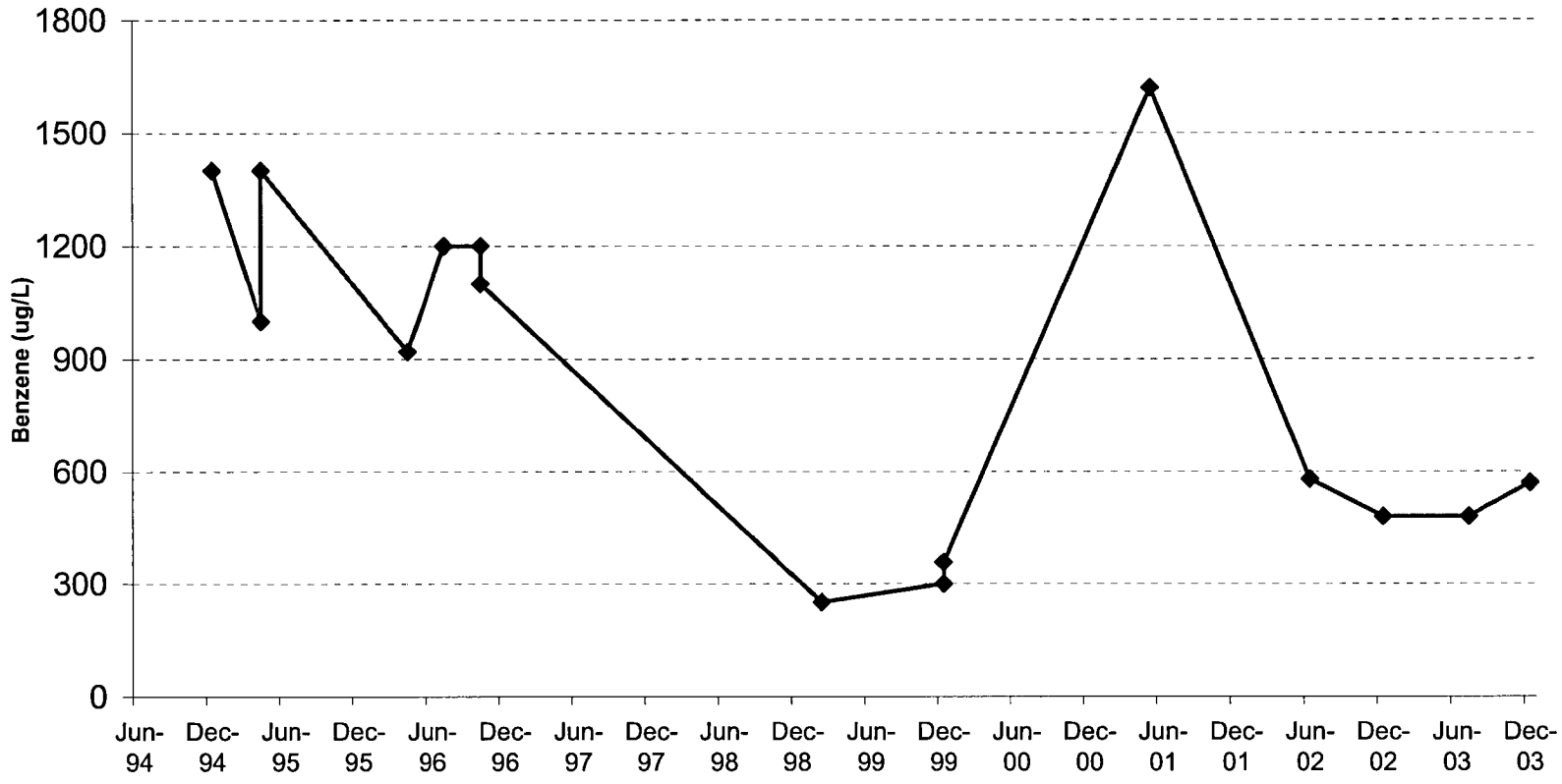
ERRG
Engineering/Remediation Resources Group, Inc.
185 Mason Circle, Suite A, Concord, CA 94520
Main: (925) 969-0750
Fax (925) 969-0751

Benzene in Monitoring Well P181-MW46
Alameda Point/Annex Groundwater RI/FS

CLIENT: UNITED STATES NAVY, SOUTHWEST DIVISION
NAVAL FACILITIES ENGINEERING COMMAND

SCALE:	DRAWING NO.:	LOCATION:			FIGURE:
not applicable	02-052_4-13	ALAMEDA POINT SITE 25/ ALAMEDA ANNEX IR-02			4-13
REFERENCE: I:\Projects\2002 Projects\22-052 RI FS Alameda Point\Figures\Figure 5-x time series plots		DESIGNED BY: RW	DRAWN BY: RW	RG/PE: DB	

Monitoring Well P181-MW47



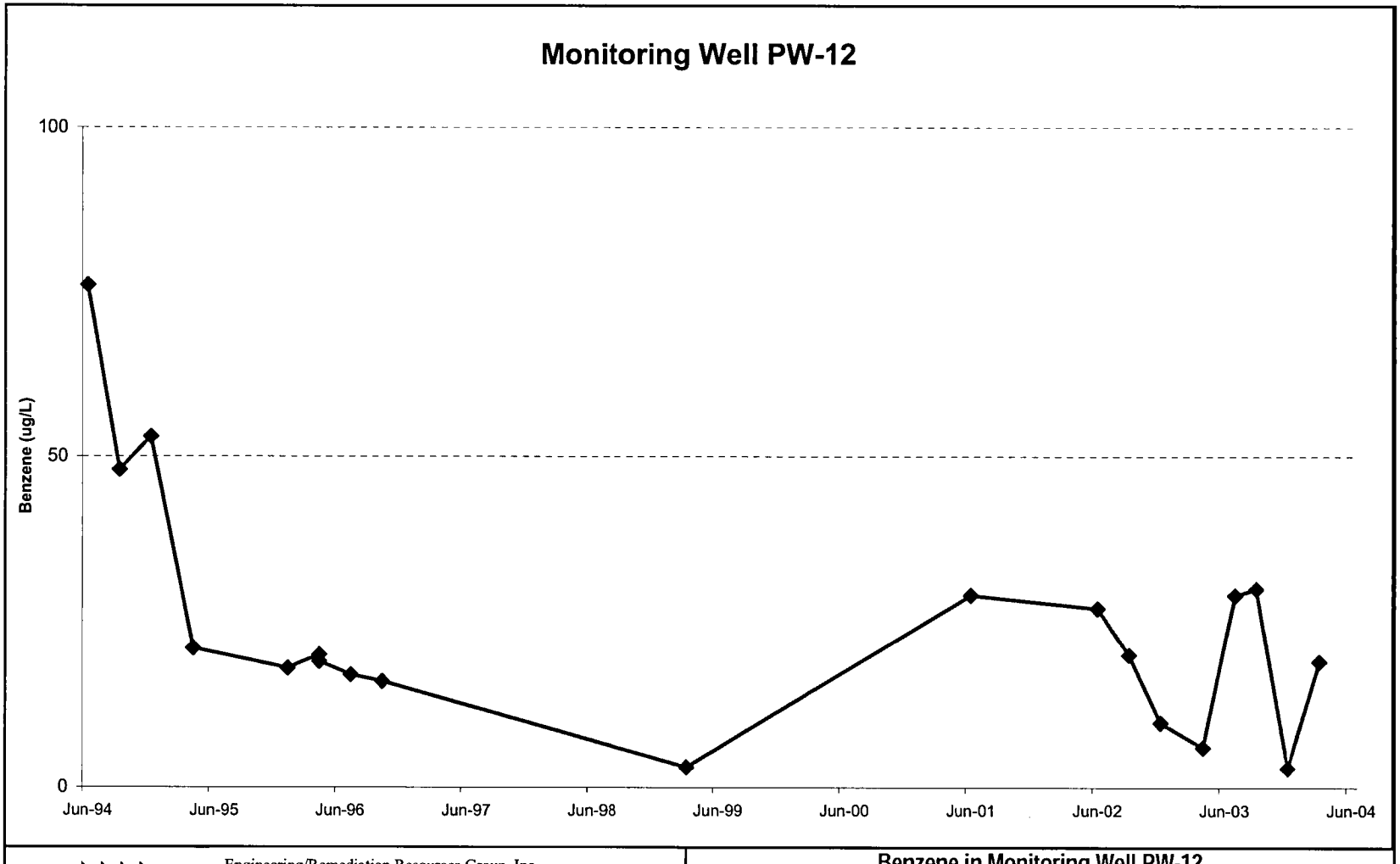
ERRG

Engineering/Remediation Resources Group, Inc.
185 Mason Circle, Suite A, Concord, CA 94520
Main: (925) 969-0750
Fax (925) 969-0751

Benzene in Monitoring Well P181-MW47
Alameda Point/Annex Groundwater RI/FS

CLIENT: UNITED STATES NAVY, SOUTHWEST DIVISION
NAVAL FACILITIES ENGINEERING COMMAND

SCALE:	DRAWING NO.:	LOCATION:			FIGURE:
not applicable	02-052_4-14	ALAMEDA POINT SITE 25/ ALAMEDA ANNEX IR-02			4-14
REFERENCE: I:\Projects\2002 Projects\22-052 RI FS Alameda Point\Figures\Figure 5-x time series plots		DESIGNED BY: RW	DRAWN BY: RW	RG/PE: DB	

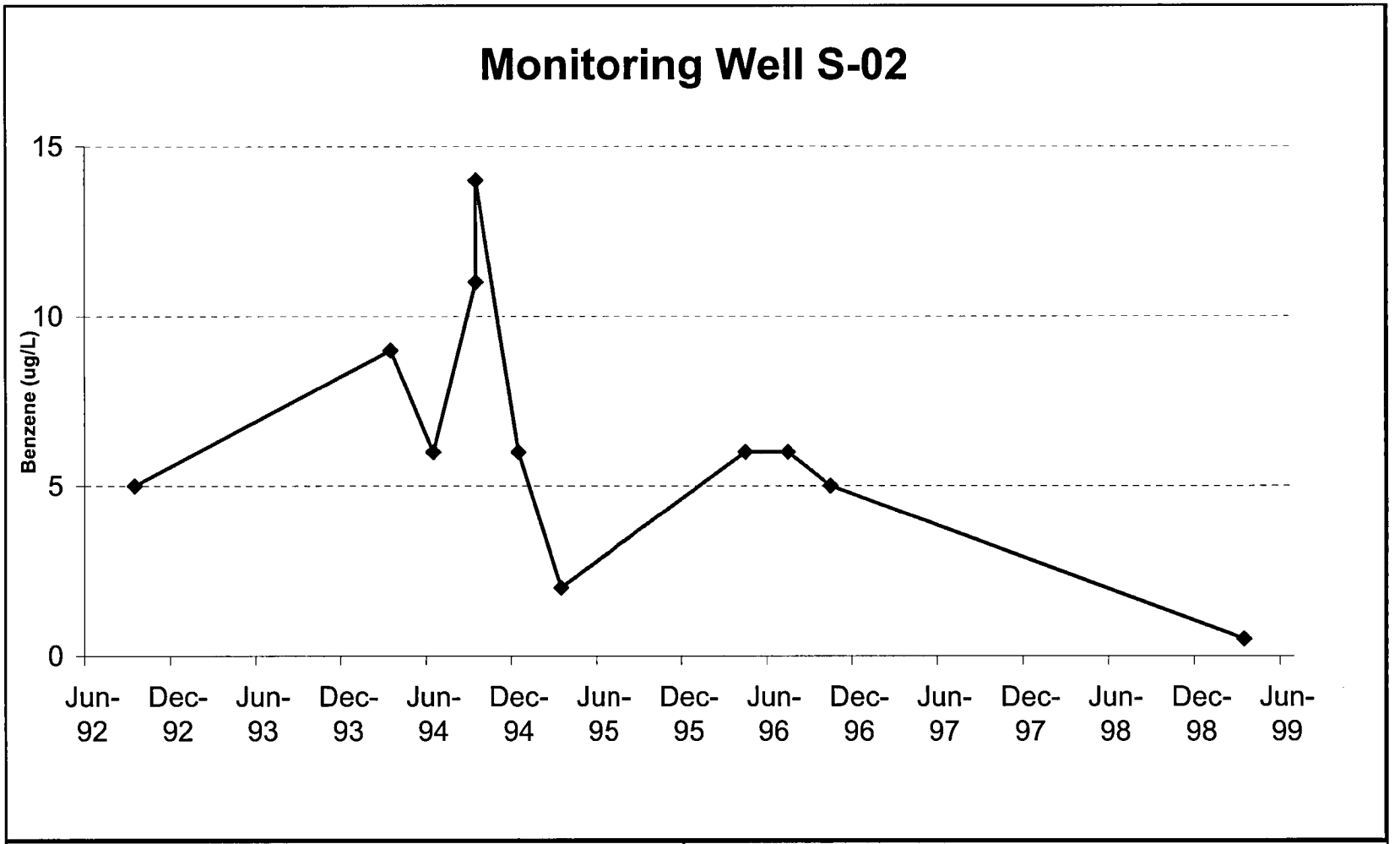


ERRG
Engineering/Remediation Resources Group, Inc.
185 Mason Circle, Suite A, Concord, CA 94520
Main: (925) 969-0750
Fax (925) 969-0751

Benzene in Monitoring Well PW-12
Alameda Point/Annex Groundwater RI/FS

CLIENT: UNITED STATES NAVY, SOUTHWEST DIVISION
NAVAL FACILITIES ENGINEERING COMMAND

SCALE:	DRAWING NO.:	LOCATION:			
not applicable	02-052_4-15	ALAMEDA POINT SITE 25/ ALAMEDA ANNEX IR-02			4-15
REFERENCE: I:\Projects\2002 Projects\22-052 RI FS Alameda Point\Figures\Figure 5-x time series plots		DESIGNED BY: RW	DRAWN BY: RW	RG/PE: DB	FIGURE:



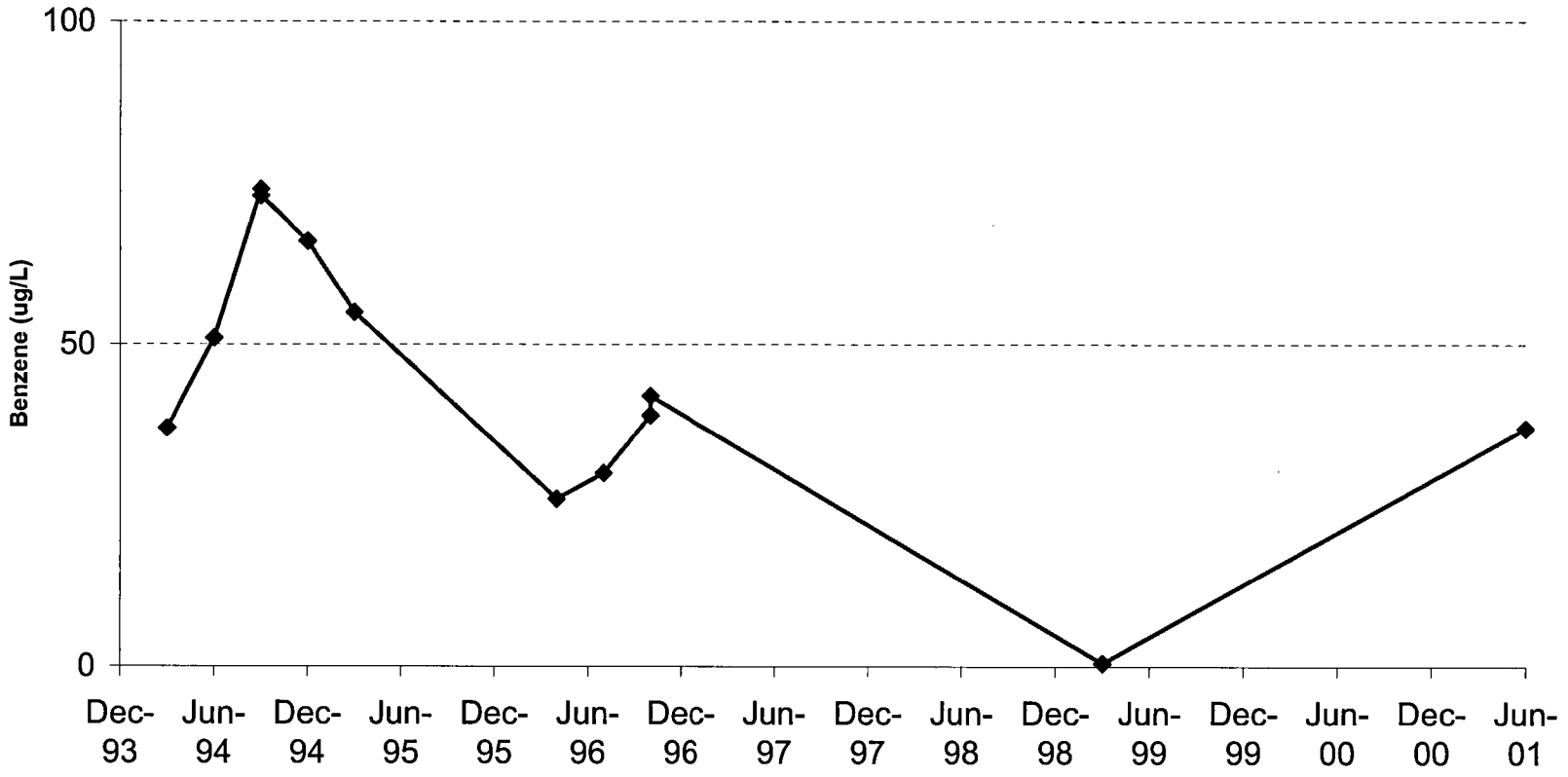
ERRG
Engineering/Remediation Resources Group, Inc.
185 Mason Circle, Suite A, Concord, CA 94520
Main: (925) 969-0750
Fax (925) 969-0751

Benzene in Monitoring Well S-02
Alameda Point/Annex Groundwater RI/FS

CLIENT: UNITED STATES NAVY, SOUTHWEST DIVISION
NAVAL FACILITIES ENGINEERING COMMAND

SCALE:	DRAWING NO.:	LOCATION:			
not applicable	02-052_4-16	ALAMEDA POINT SITE 25/ ALAMEDA ANNEX IR-02			4-16
REFERENCE: I:\Projects\2002 Projects\22-052 RI FS Alameda Point\Figures\Figure 5-x time series plots		DESIGNED BY: RW	DRAWN BY: RW	RG/PE: DB	FIGURE:

Monitoring Well S-12



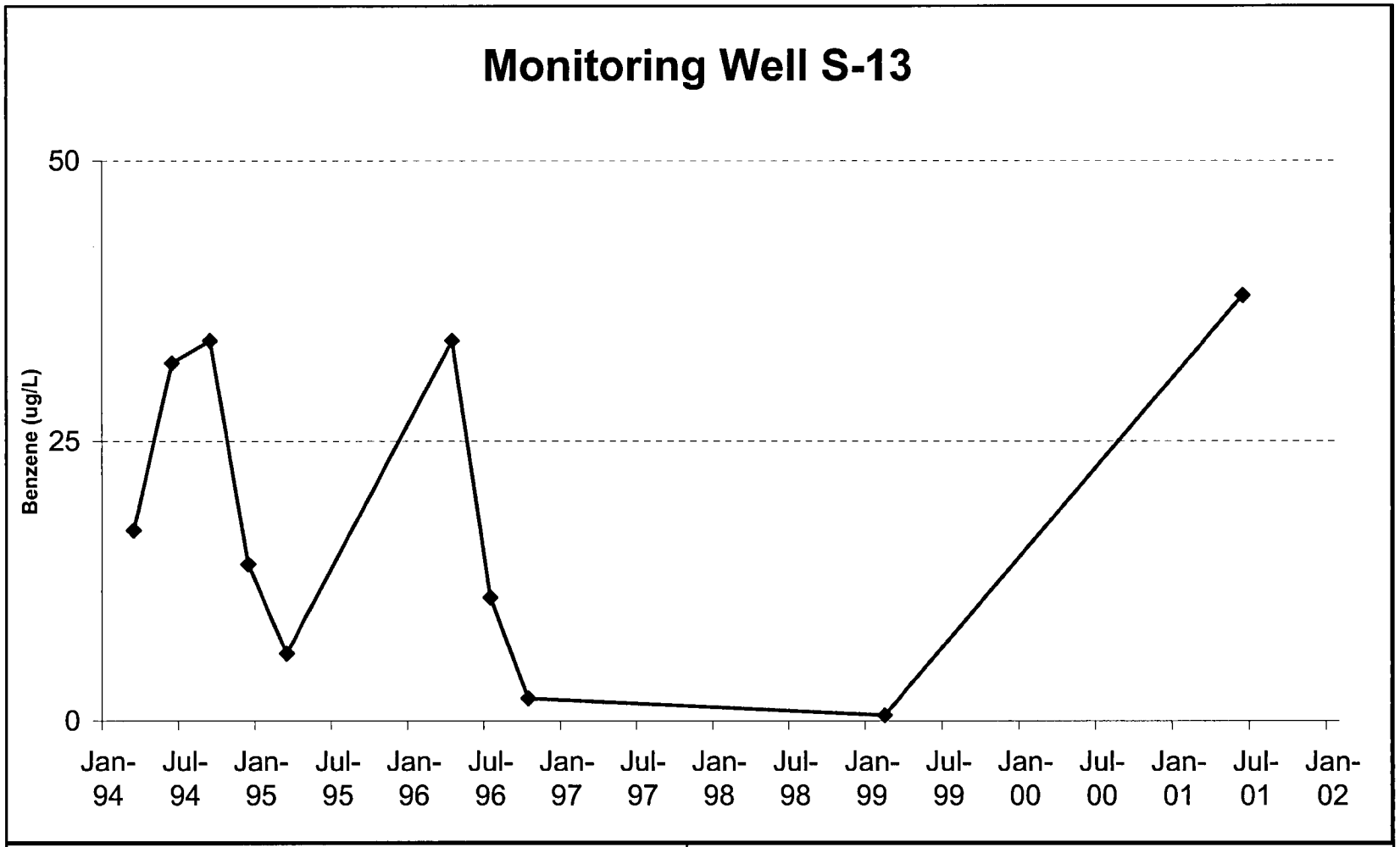
ERRG

Engineering/Remediation Resources Group, Inc.
185 Mason Circle, Suite A, Concord, CA 94520
Main: (925) 969-0750
Fax (925) 969-0751

Benzene in Monitoring Well S-12
Alameda Point/Annex Groundwater RI/FS

CLIENT: UNITED STATES NAVY, SOUTHWEST DIVISION
NAVAL FACILITIES ENGINEERING COMMAND

SCALE:	DRAWING NO.:	LOCATION:				
not applicable	02-052_4-17	ALAMEDA POINT SITE 25/ ALAMEDA ANNEX IR-02				4-17
REFERENCE: I:\Projects\2002 Projects\22-052 RI FS Alameda Point\Figures\Figure 5-x time series plots		DESIGNED BY: RW	DRAWN BY: RW	RG/PE: DB	FIGURE:	



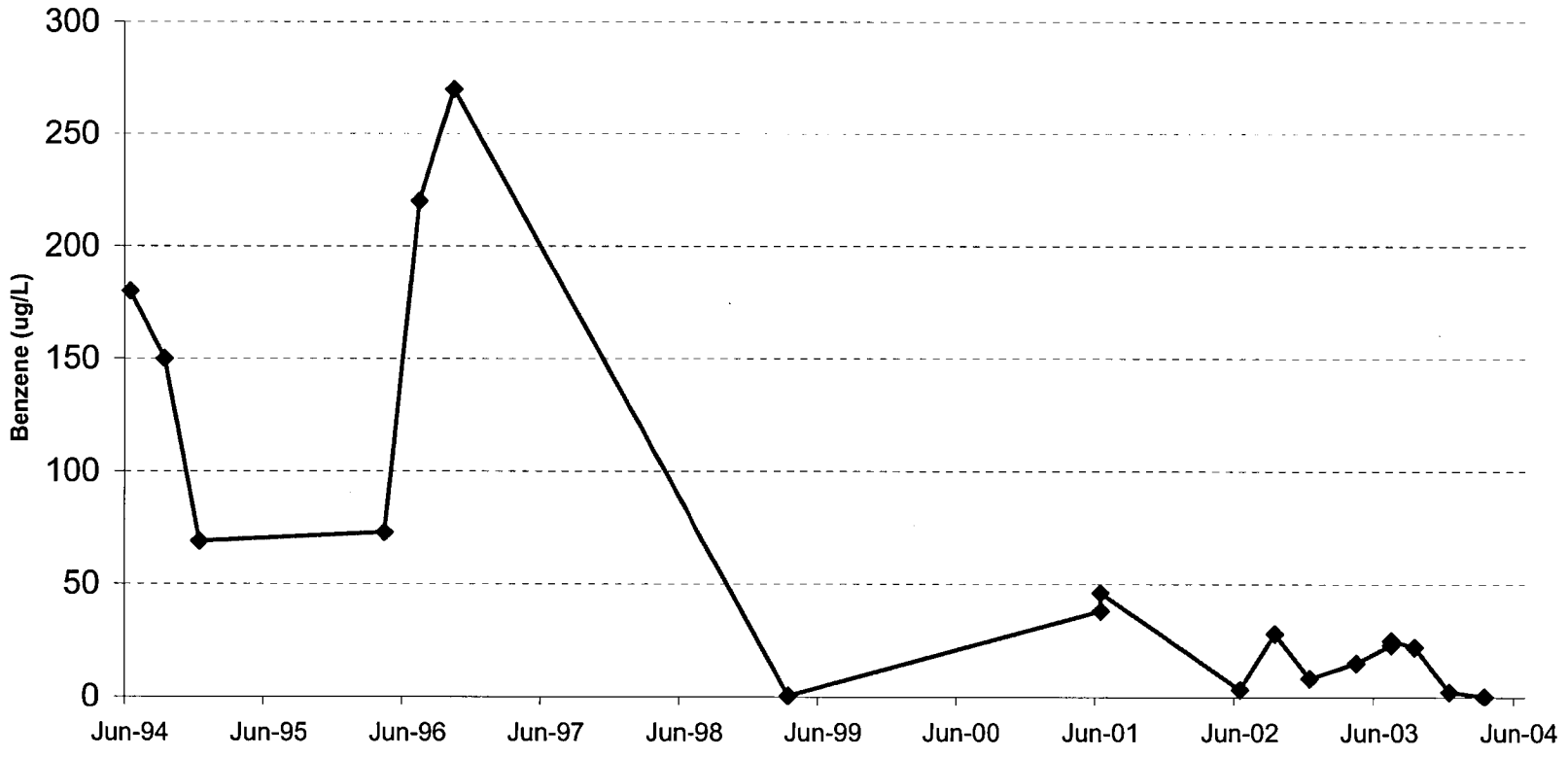
ERRG
Engineering/Remediation Resources Group, Inc.
185 Mason Circle, Suite A, Concord, CA 94520
Main: (925) 969-0750
Fax (925) 969-0751

Benzene in Monitoring Well S-13
Alameda Point/Annex Groundwater RI/FS

CLIENT: UNITED STATES NAVY, SOUTHWEST DIVISION
NAVAL FACILITIES ENGINEERING COMMAND

SCALE:	DRAWING NO.:	LOCATION:			
not applicable	02-052_4-18	ALAMEDA POINT SITE 25/ ALAMEDA ANNEX IR-02			4-18
REFERENCE: I:\Projects\2002 Projects\22-052 RI FS Alameda Point\Figures\Figure 5-x time series plots		DESIGNED BY: RW	DRAWN BY: RW	RG/PE: DB	FIGURE:

Monitoring Well S-35



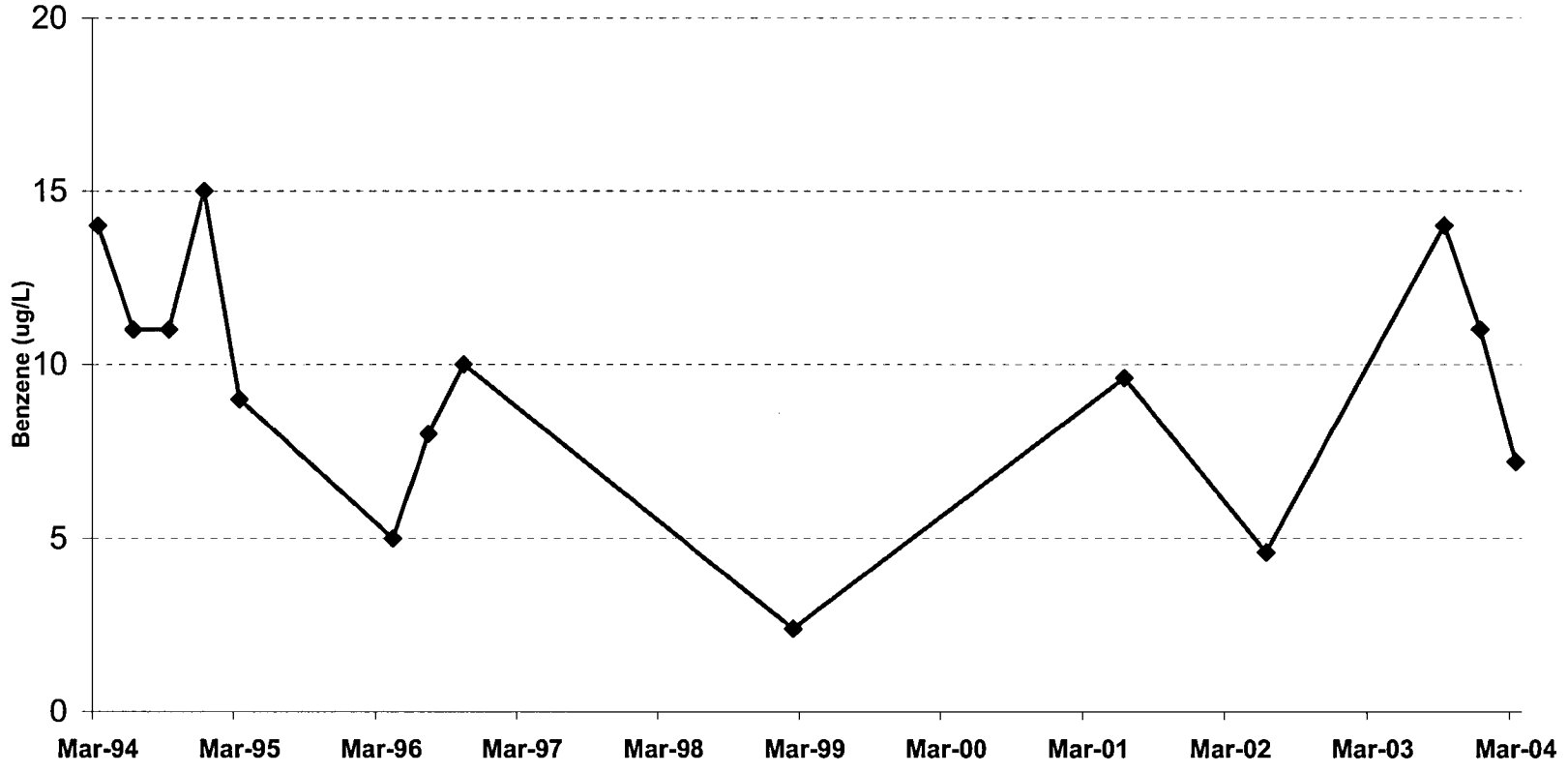
ERRG
Engineering/Remediation Resources Group, Inc.
185 Mason Circle, Suite A, Concord, CA 94520
Main: (925) 969-0750
Fax (925) 969-0751

Benzene in Monitoring Well S-35
Alameda Point/Annex Groundwater RI/FS

CLIENT: UNITED STATES NAVY, SOUTHWEST DIVISION
NAVAL FACILITIES ENGINEERING COMMAND

SCALE:	DRAWING NO.:	LOCATION:			
not applicable	02-052_4-19	ALAMEDA POINT SITE 25/ ALAMEDA ANNEX IR-02			4-19
REFERENCE: I:\Projects\2002 Projects\22-052 RI FS Alameda Point\Figures\Figure 5 x time series plots		DESIGNED BY: RW	DRAWN BY: RW	RG/PE: DB	FIGURE:

Monitoring Well S-16/S-16-2



ERRG
Engineering/Remediation Resources Group, Inc.
185 Mason Circle, Suite A, Concord, CA 94520
Main: (925) 969-0750
Fax (925) 969-0751

Benzene in Monitoring Well S-16/S-16-2[a]
Alameda Point/Annex Groundwater RI/FS

CLIENT: UNITED STATES NAVY, SOUTHWEST DIVISION
NAVAL FACILITIES ENGINEERING COMMAND

SCALE: not applicable

NOTE: [a] S-16 replaced by S-16-2 due to access problems

DRAWING NO.: 02-052_4-20

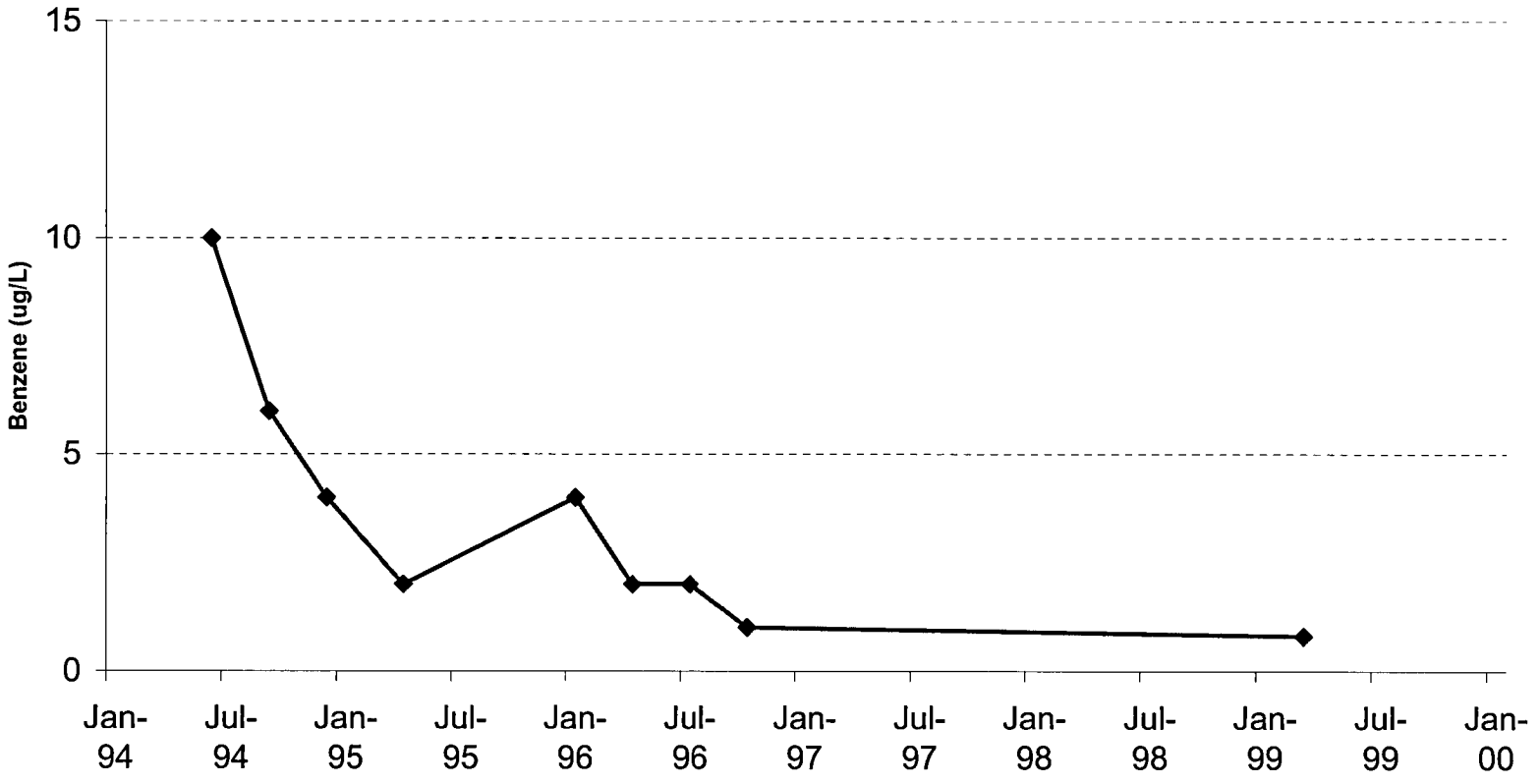
LOCATION: ALAMEDA POINT SITE 25/
ALAMEDA ANNEX IR-02

REFERENCE: I:\Projects\2002 Projects\22-052 RI FS Alameda Point\Figures\Figure 5-x time series plots

DESIGNED BY: RW | DRAWN BY: RW | RG/PE: DB | FIGURE:

4-20

Monitoring Well PW-10A



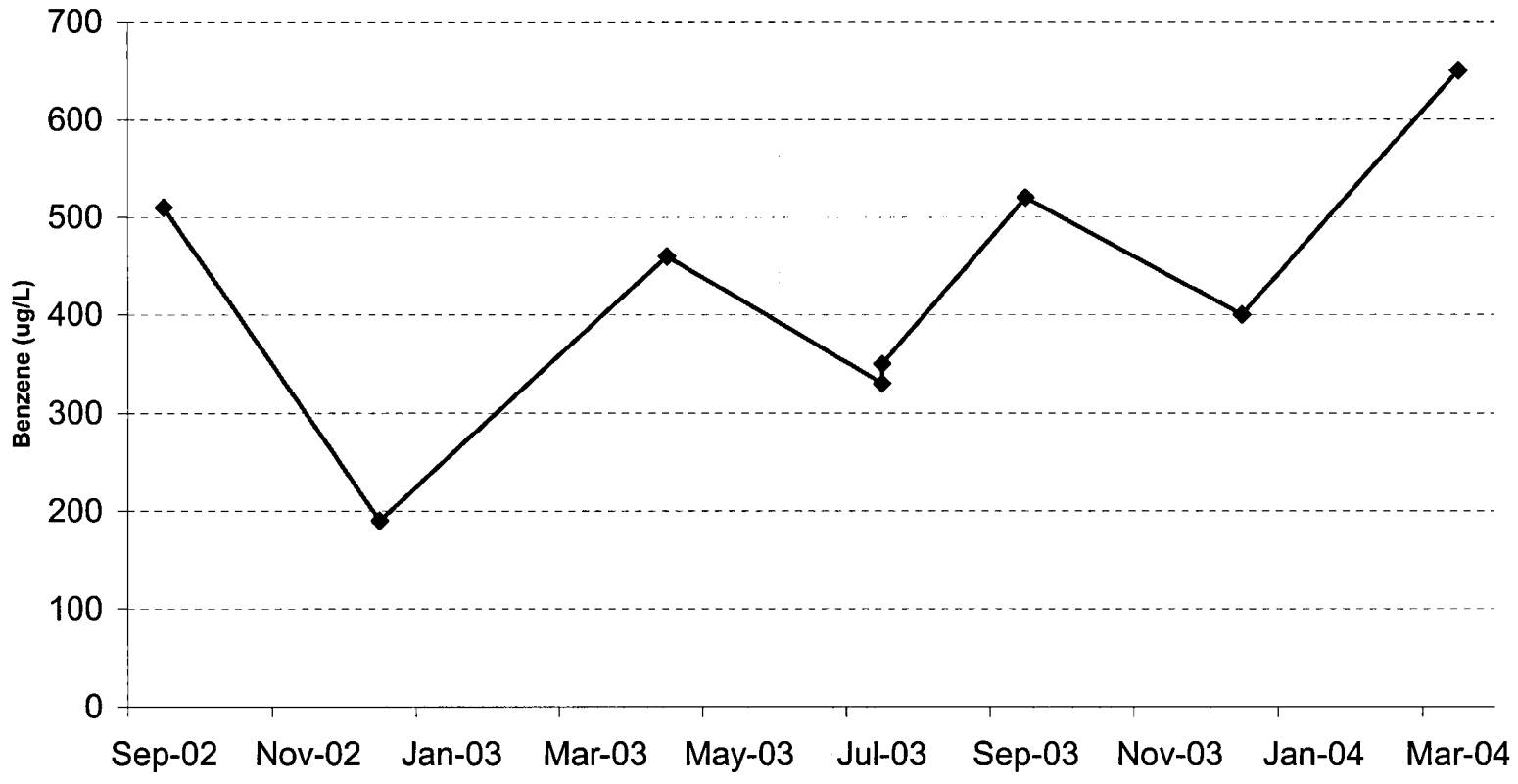
ERRG

Engineering/Remediation Resources Group, Inc.
185 Mason Circle, Suite A, Concord, CA 94520
Main: (925) 969-0750
Fax (925) 969-0751

Benzene in Monitoring Well PW-10A
Alameda Point/Annex Groundwater RI/FS

CLIENT: UNITED STATES NAVY, SOUTHWEST DIVISION
NAVAL FACILITIES ENGINEERING COMMAND

SCALE:	DRAWING NO.:	LOCATION:			FIGURE:
not applicable	02-052_4-21	ALAMEDA POINT SITE 25/ ALAMEDA ANNEX IR-02			4-21
REFERENCE: I:\Projects\2002 Projects\22-052 RI FS Alameda Point\Figures\Figure 5-x time series plots		DESIGNED BY: RW	DRAWN BY: RW	RG/PE: DB	



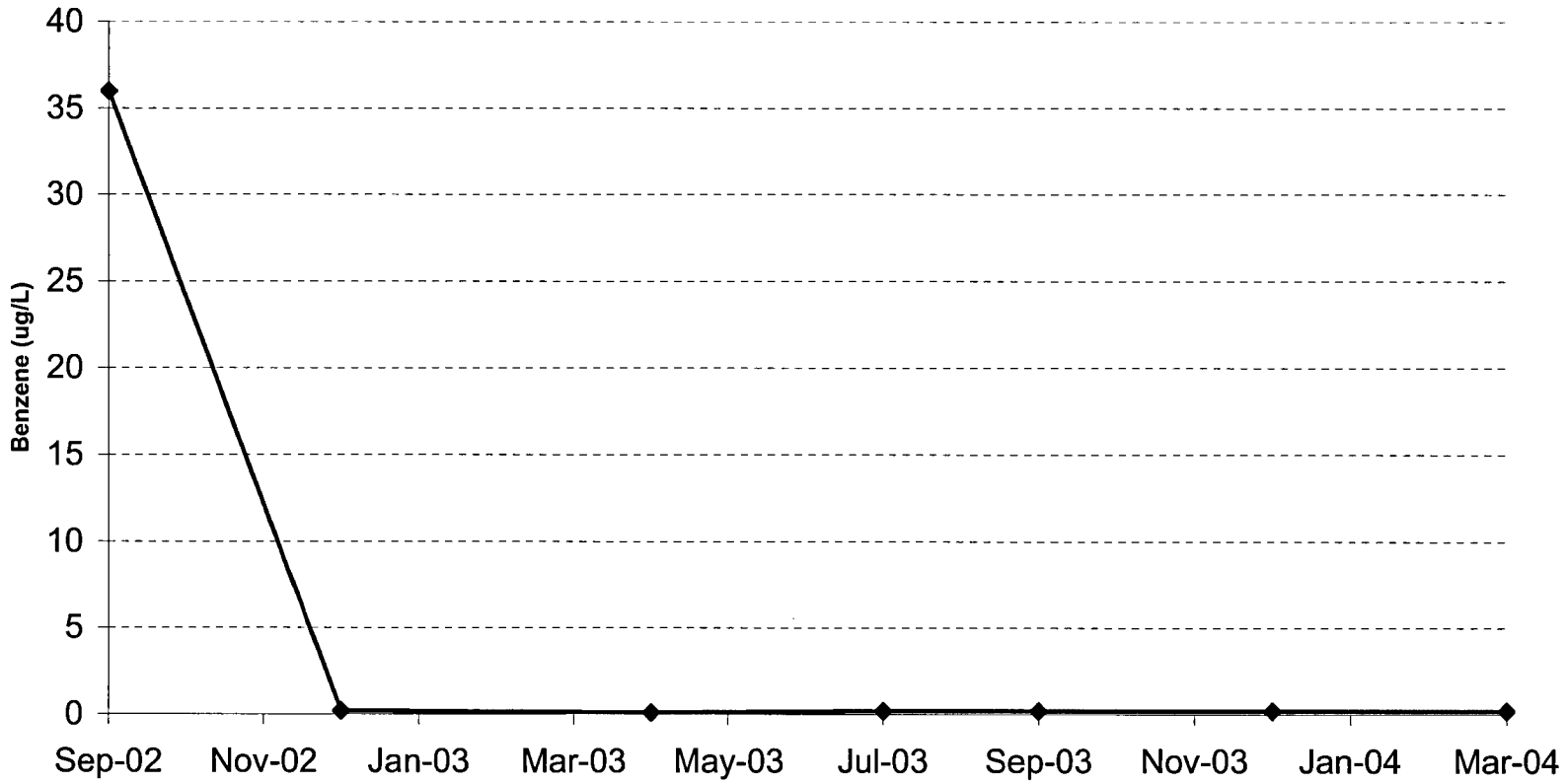
ERRG
Engineering/Remediation Resources Group, Inc.
185 Mason Circle, Suite A, Concord, CA 94520
Main: (925) 969-0750
Fax (925) 969-0751

Benzene in Monitoring Well MW25-01
Alameda Point/Annex Groundwater RI/FS

CLIENT: UNITED STATES NAVY, SOUTHWEST DIVISION
NAVAL FACILITIES ENGINEERING COMMAND

SCALE:	DRAWING NO.:	LOCATION:			
not applicable	02-052_4-22	ALAMEDA POINT SITE 25/ ALAMEDA ANNEX IR-02			4-22
REFERENCE: I:\Projects\2002 Projects\22-052 RI FS Alameda Point\Figures\Figure 5-x time series plots		DESIGNED BY: RW	DRAWN BY: CL	RG/PE: DB	FIGURE:

Monitoring Well MW25-02



ERRG

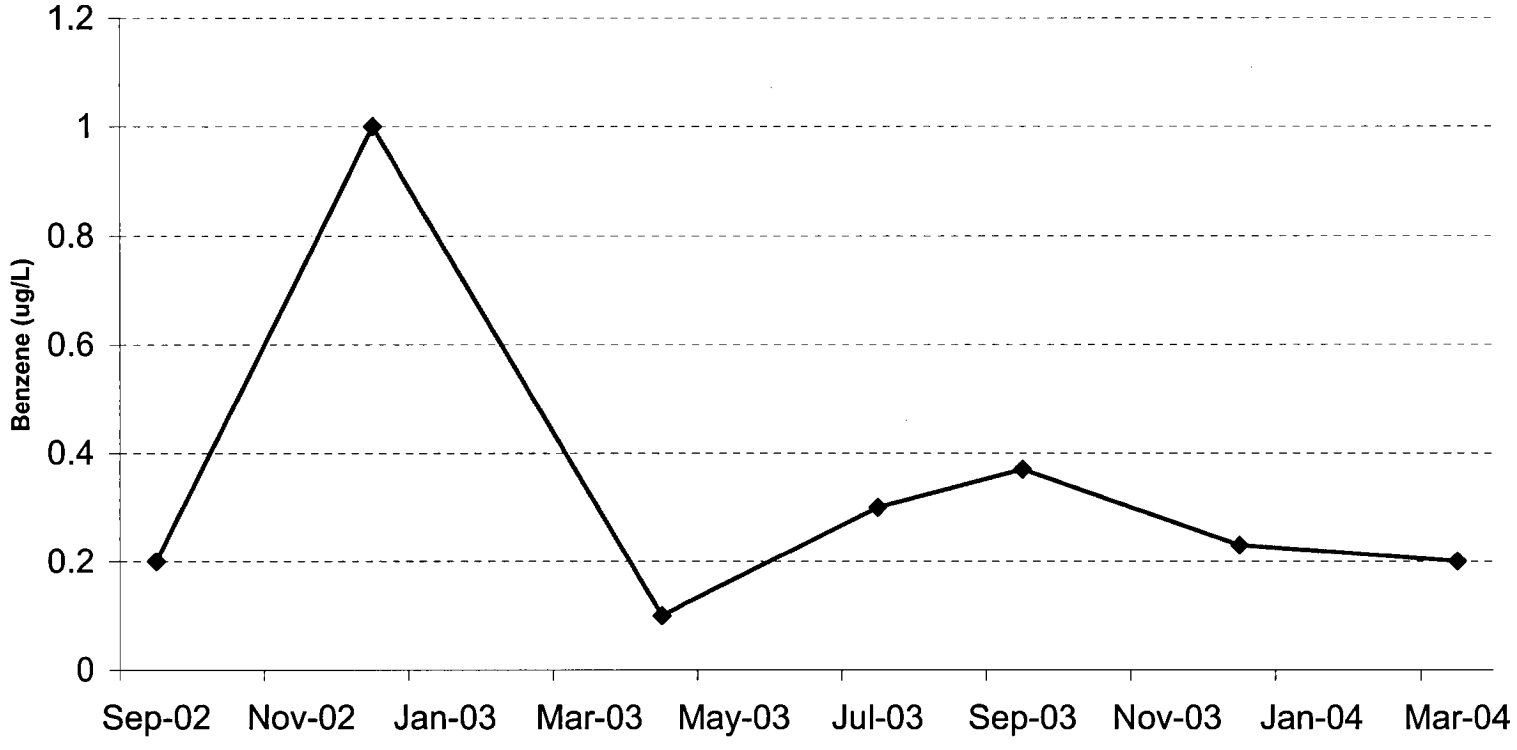
Engineering/Remediation Resources Group, Inc.
185 Mason Circle, Suite A, Concord, CA 94520
Main: (925) 969-0750
Fax (925) 969-0751

Benzene in Monitoring Well MW25-02
Alameda Point/Annex Groundwater RI/FS

CLIENT: UNITED STATES NAVY, SOUTHWEST DIVISION
NAVAL FACILITIES ENGINEERING COMMAND

SCALE:	DRAWING NO.:	LOCATION:			
not applicable	02-052_4-23	ALAMEDA POINT SITE 25/ ALAMEDA ANNEX IR-02			FIGURE: 4-23
REFERENCE:P:\2002 Projects\22-052 RI FS Alameda Point\Report Text\Draft Final Submittal, 2004\Figures\Fig4_11_to_4_26_Time_Series_Plots-revise		DESIGNED BY: RW	DRAWN BY: CL	RG/PE: DB	

Monitoring Well MW25-03



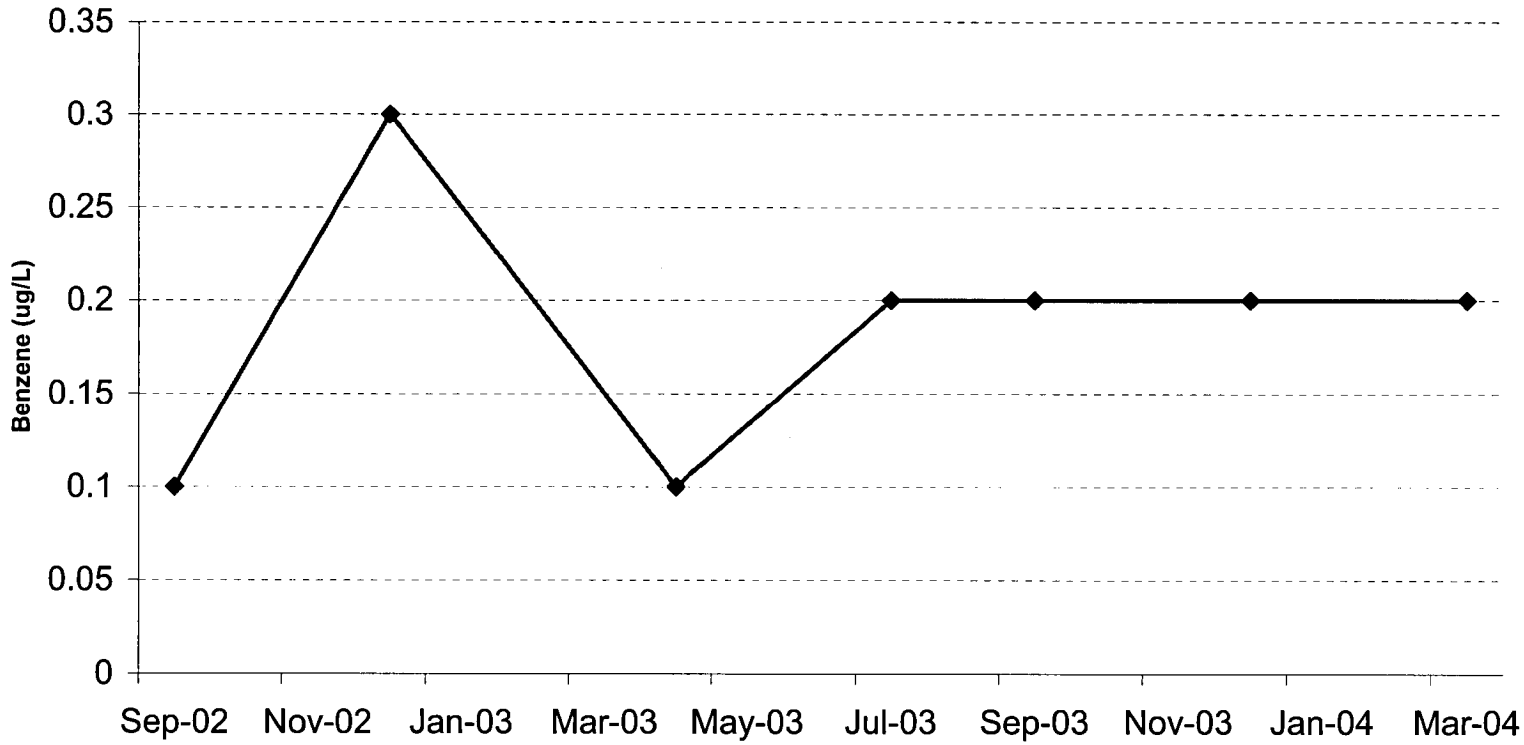
ERRG
Engineering/Remediation Resources Group, Inc.
185 Mason Circle, Suite A, Concord, CA 94520
Main: (925) 969-0750
Fax (925) 969-0751

Benzene in Monitoring Well MW25-03
Alameda Point/Annex Groundwater RI/FS

CLIENT: UNITED STATES NAVY, SOUTHWEST DIVISION
NAVAL FACILITIES ENGINEERING COMMAND

SCALE:	DRAWING NO.:	LOCATION:			
not applicable	02-052_4-24	ALAMEDA POINT SITE 25/ ALAMEDA ANNEX IR-02			4-24
REFERENCE:P:\2002 Projects\22-052 RI FS Alameda Point\Report Text\Draft Final Submittal, 2004\Figures\Fig4_11_to_4_26_Time_Series_Plots-revise		DESIGNED BY: RW	DRAWN BY: CL	RG/PE: DB	FIGURE:

Monitoring Well MW25-04



ERRG
Engineering/Remediation Resources Group, Inc.
185 Mason Circle, Suite A, Concord, CA 94520
Main: (925) 969-0750
Fax (925) 969-0751

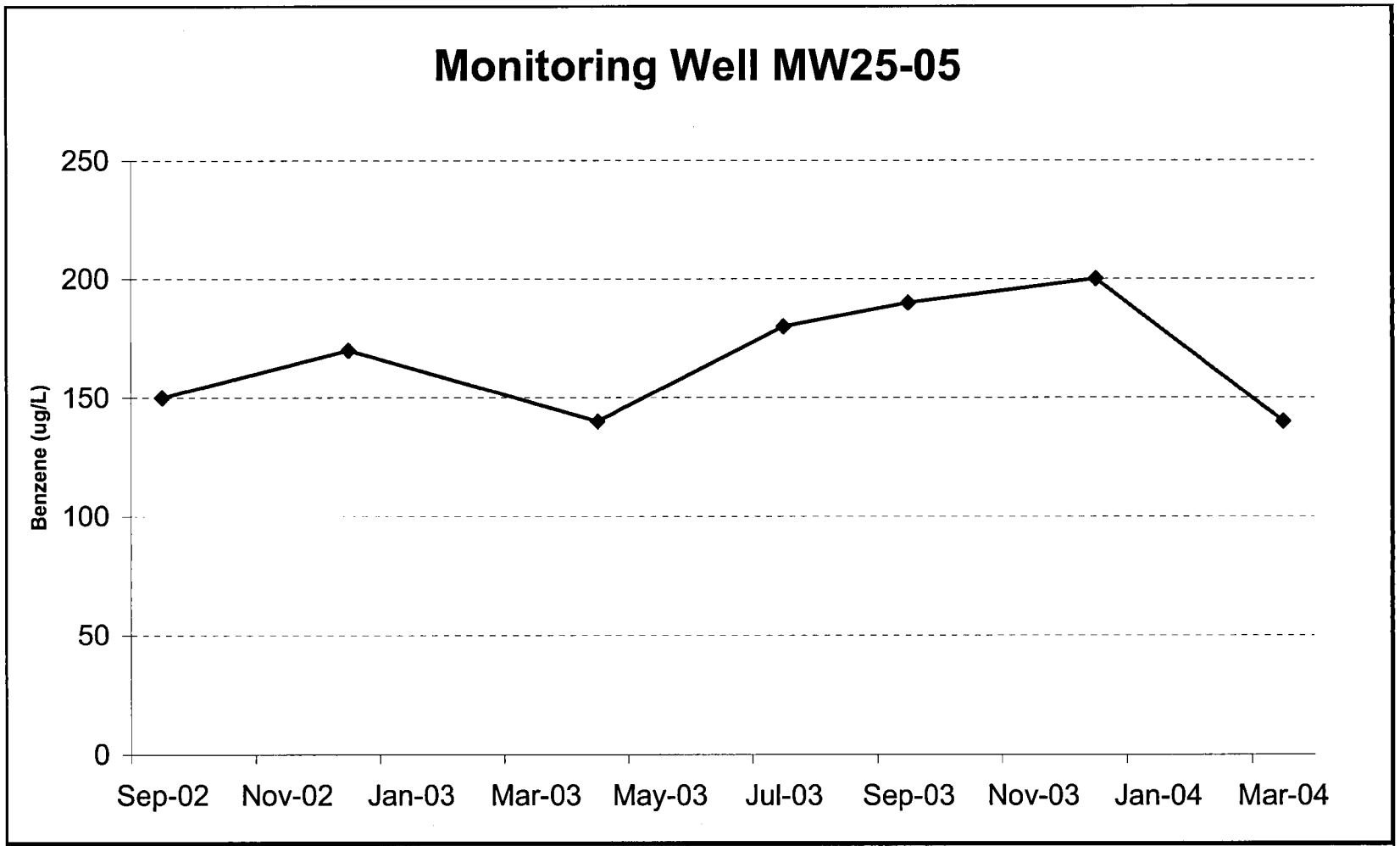
Benzene in Monitoring Well MW25-04
Alameda Point/Annex Groundwater RI/FS

CLIENT: UNITED STATES NAVY, SOUTHWEST DIVISION
NAVAL FACILITIES ENGINEERING COMMAND

SCALE:	DRAWING NO.:	LOCATION:	
not applicable	02-052_4-25	ALAMEDA POINT SITE 25/ ALAMEDA ANNEX IR-02	4-25

REFERENCE:P:\2002 Projects\22-052 RI FS Alameda Point\Report Text\Draft Final Submittal, 2004\Figures\Fig4_11_to_4_26_Time_Series_Plots-revise

DESIGNED BY: RW	DRAWN BY: CL	RG/PE: DB	FIGURE:

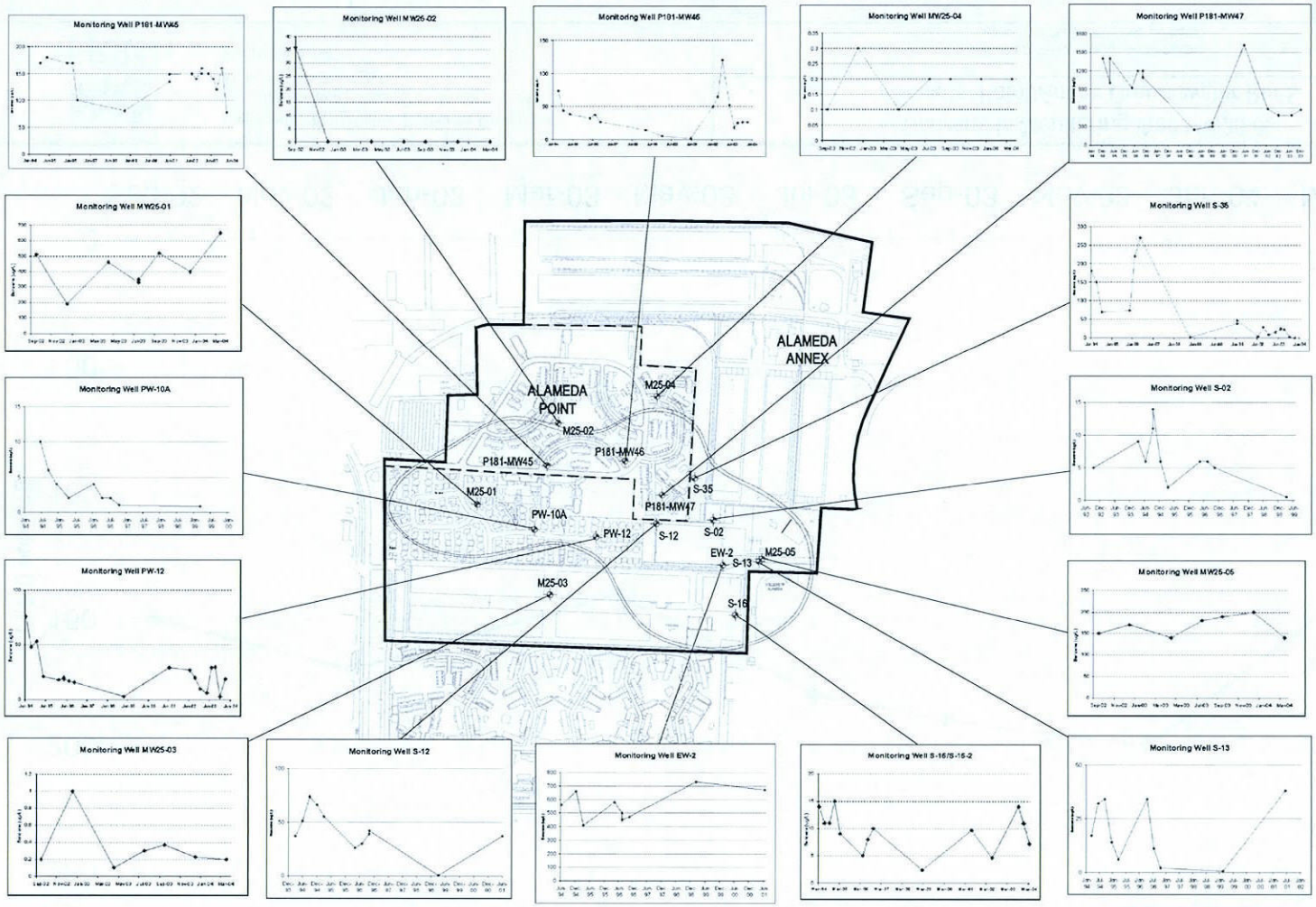


ERRG
Engineering/Remediation Resources Group, Inc.
185 Mason Circle, Suite A, Concord, CA 94520
Main: (925) 969-0750
Fax (925) 969-0751

Benzene in Monitoring Well MW25-05
Alameda Point/Annex Groundwater RI/FS

CLIENT: UNITED STATES NAVY, SOUTHWEST DIVISION
NAVAL FACILITIES ENGINEERING COMMAND

SCALE:	DRAWING NO.:	LOCATION:			
not applicable	02-052_4-26	ALAMEDA POINT SITE 25/ ALAMEDA ANNEX IR-02			4-26
REFERENCE:P:\2002 Projects\22-052 RI FS Alameda Point\Report Text\Draft Final Submittal, 2004\Figures\Fig4_11_to_4_26_Time_Series_Plots revise		DESIGNED BY: RW	DRAWN BY: CL	RG/PE: DB	FIGURE:



LEGEND

APPROXIMATE (1 µg/L) OUTLINE OF BENZENE PLUME IN FWBZ (DECEMBER 2003)

ALAMEDA POINT (OU5) BOUNDARY

ALAMEDA POINT / ANNEX INVESTIGATION AREA BOUNDARY

MONITORING WELLS

MONITORING WELLS

EW-2
P181-MW45
P181-MW46
P181-MW47
PW-10A
PW-12
S-02
S-12
S-13
S-16
S-35
M25-01
M25-02
M25-03
M25-04
M25-05

SCALE
0 350 700

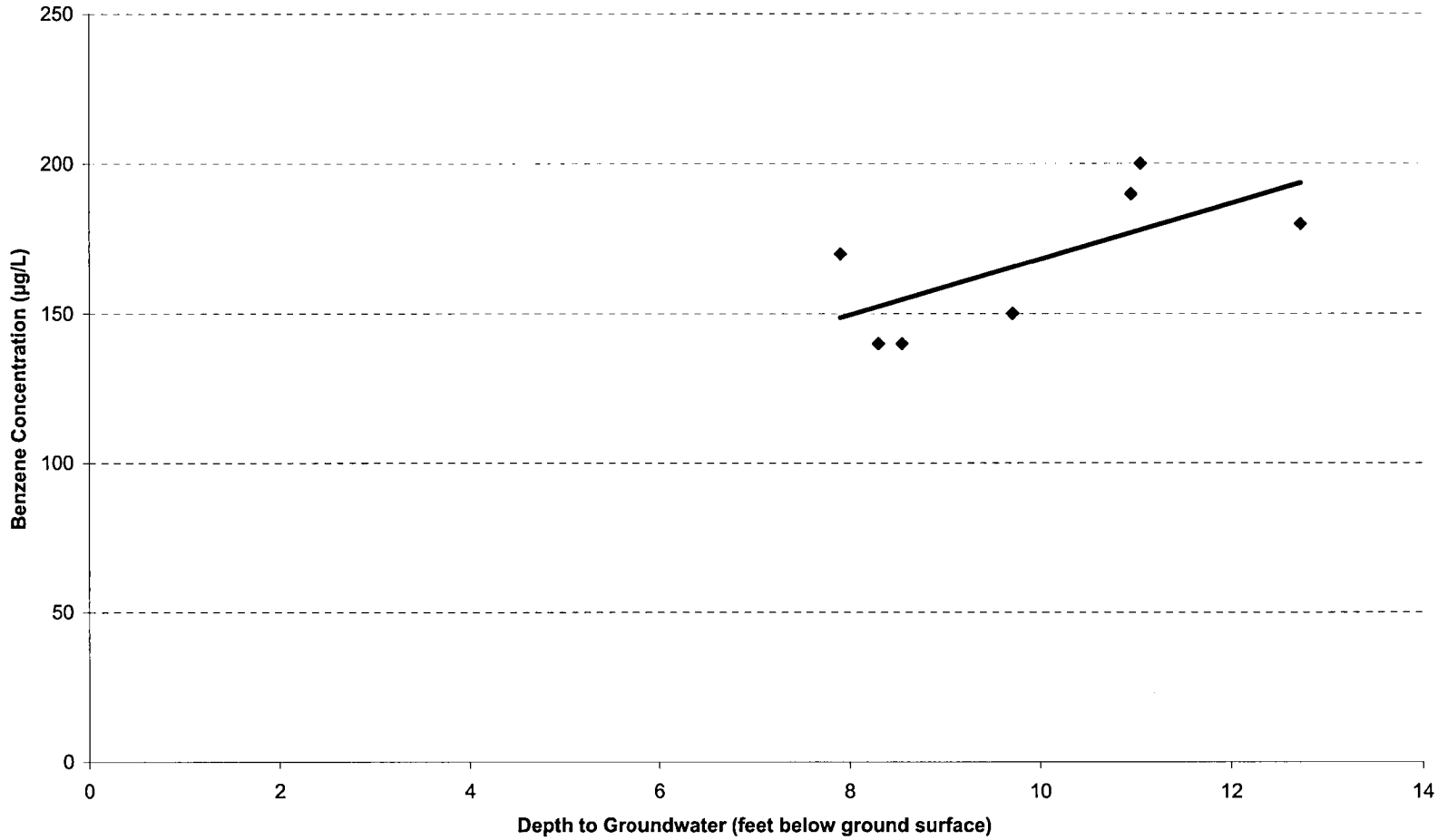
ERRG
Engineering/Remediation Resources Group, Inc.
185 Mason Circle, Suite A
Concord, California 94520
(925) 969-0750

MONITORING WELLS
TIME - SERIES DATA FOR BENZENE

ALAMEDA POINT / ANNEX
GROUNDWATER RI / FS

DWG NO 22-052-FIGURE 4-27

FIGURE 4-27



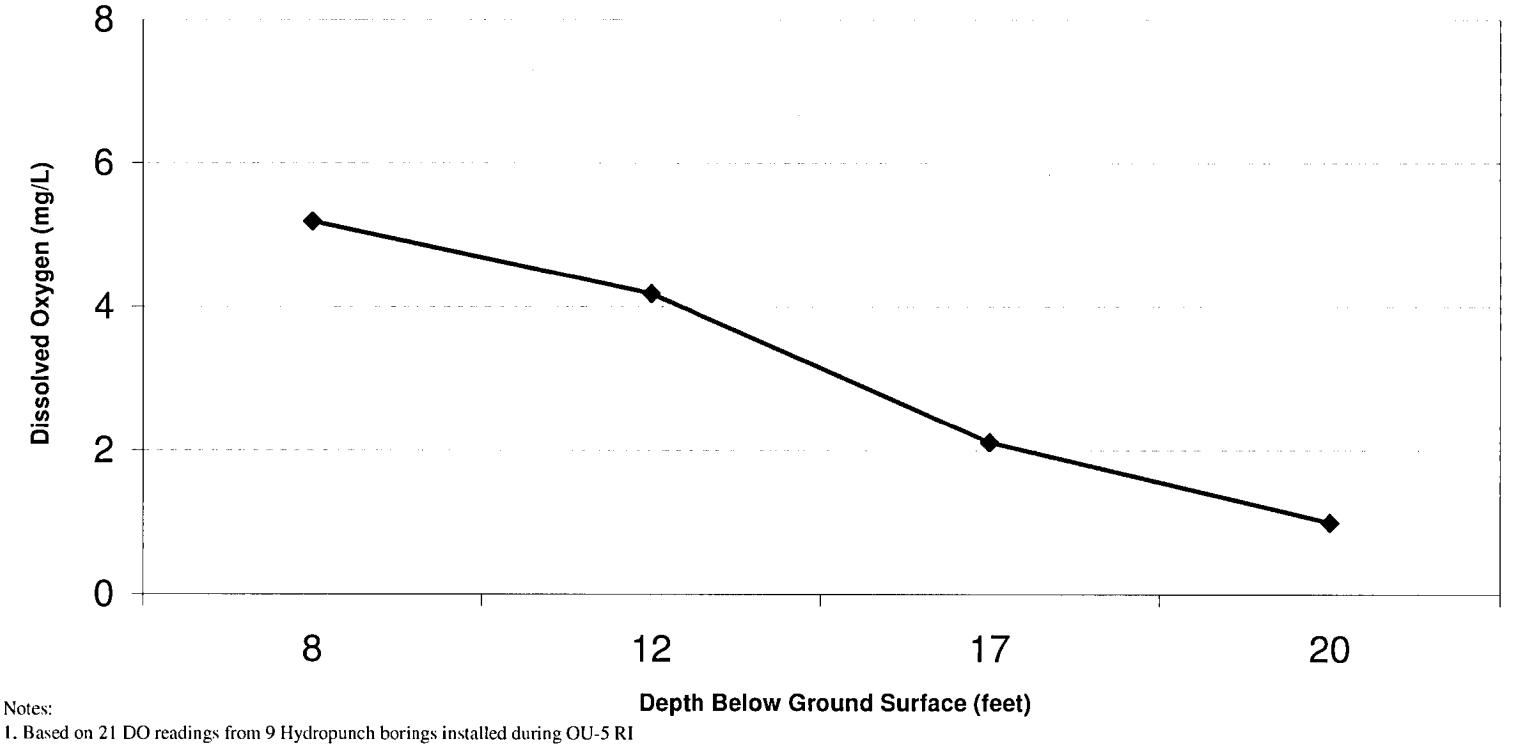
ERRG
Engineering/Remediation Resources Group, Inc.
185 Mason Circle, Suite A, Concord, CA 94520
Main: (925) 969-0750
Fax (925) 969-0751

Correlation of Benzene Concentrations with Depth to Groundwater in Monitoring Well M25-05
Alameda Point/Annex Groundwater RI/FS

CLIENT: UNITED STATES NAVY, SOUTHWEST DIVISION
NAVAL FACILITIES ENGINEERING COMMAND

SCALE:	DRAWING NO.:	LOCATION:			FIGURE:
not applicable	02-052_4-28	ALAMEDA POINT SITE 25/ ALAMEDA ANNEX IR-02			4-28
REFERENCE:P:\2002 Projects\22-052 RI FS Alameda Point\Report Text\Draft Final Submittal, 2004\Figures\Fig4-28_and_Figs5_1_to_5_11_Time_Series		DESIGNED BY: RW	DRAWN BY: CL	RG/PE:	

Dissolved Oxygen (DO) as a Function of Depth

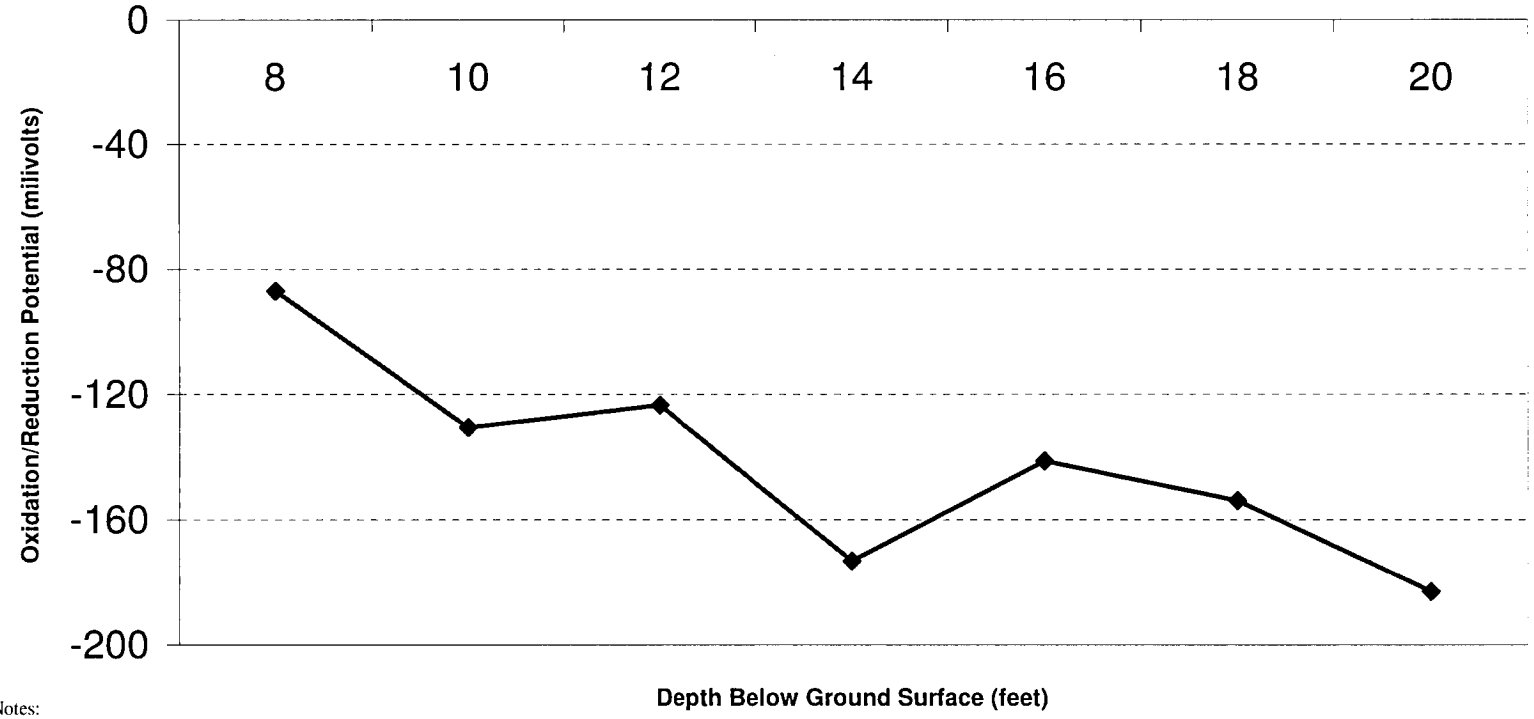


Notes:
1. Based on 21 DO readings from 9 Hydropunch borings installed during OU-5 RI
2. Average DO reading and average depth shown; anomolous DO reading at OS-HP-25 excluded

ERRG
Engineering/Remediation Resources Group, Inc.
185 Mason Circle, Suite A, Concord, CA 94520
Main: (925) 969-0750
Fax (925) 969-0751

Dissolved Oxygen as a Function Of Depth	
CLIENT:	UNITED STATES NAVY, SOUTHWEST DIVISION NAVAL FACILITIES ENGINEERING COMMAND
SCALE: not applicable	DRAWING NO.: 02-052_4-29
LOCATION:	ALAMEDA POINT SITE 25/ ALAMEDA ANNEX IR-02
REFERENCE:P:\2002 Projects\22-052 RI FS Alameda Point\Report Text\Draft Final Submittal, 2004\Figures\[Figures 4-29 and 4-30.xls]DO by depth	DESIGNED BY: RW; DRAWN BY: RW; RG/PE: DB; FIGURE:
FIGURE:	4-29

Oxidation/Reduction Potential (ORP) By Depth



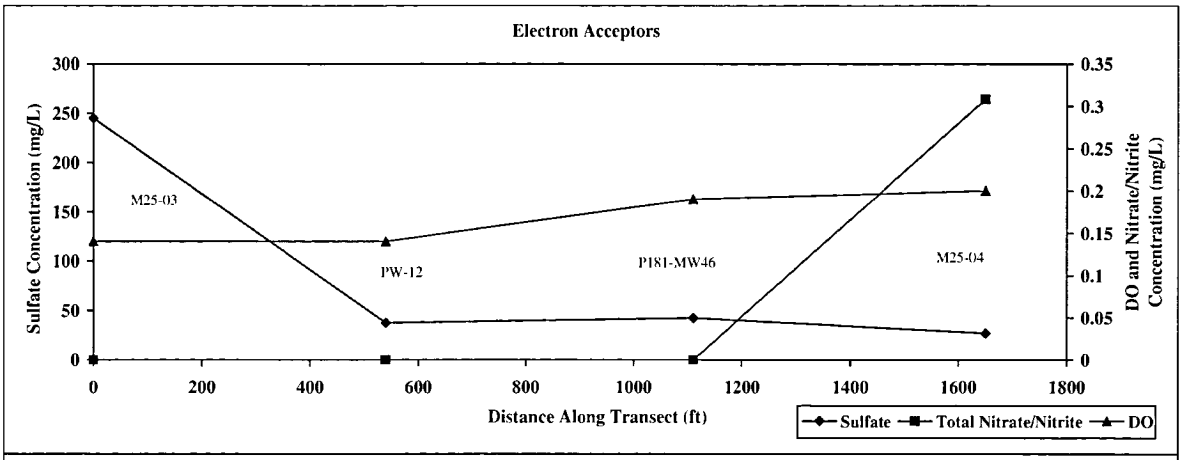
Notes:
1. Based on 38 ORP readings from 15 Hydropunch borings installed during OU-5 RI
2. Average ORP reading and average depth shown; not all Hydropunch depths yielded data

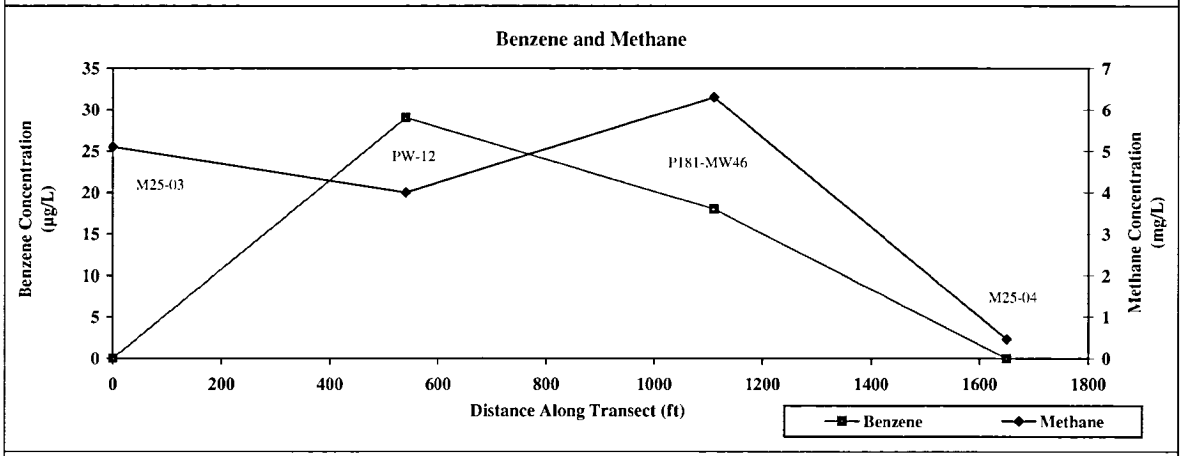
ERRG
Engineering/Remediation Resources Group, Inc.
185 Mason Circle, Suite A, Concord, CA 94520
Main: (925) 969-0750
Fax (925) 969-0751

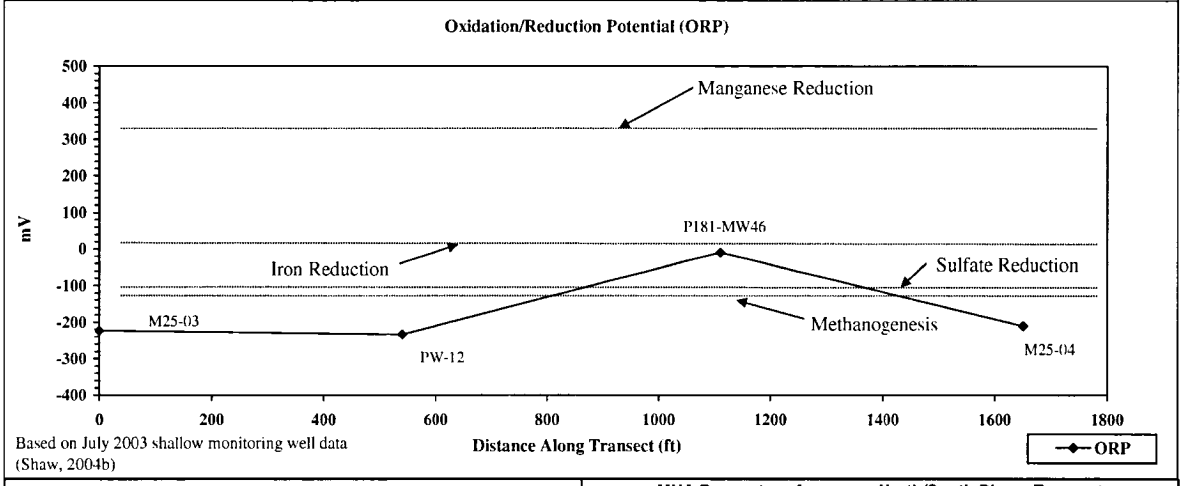
Oxidation/Reduction Potential As A Function Of Depth

CLIENT: UNITED STATES NAVY, SOUTHWEST DIVISION NAVAL FACILITIES ENGINEERING COMMAND

SCALE:	DRAWING NO.:	LOCATION:			FIGURE:
not applicable	02-052_4-30	ALAMEDA POINT SITE 25/ ALAMEDA ANNEX IR-02			4-30
REFERENCE:P:\2002 Projects\22-052 RI FS Alameda Point\Report Text\Draft Final Submittal, 2004\Figures\Figures 4-29 and 4-30.xls]ORP by depth		DESIGNED BY: RW	DRAWN BY: RW	RG/PE: DB	







Based on July 2003 shallow monitoring well data (Shaw, 2004b)

ERRG

Engineering/Remediation Resources Group, Inc.
185 Mason Circle, Suite A, Concord, CA 94520
Main: (925) 969-0750
Fax (925) 969-0751

MNA Parameters Across an North/South Plume Transect
Alameda Point/Annex Groundwater RI/FS

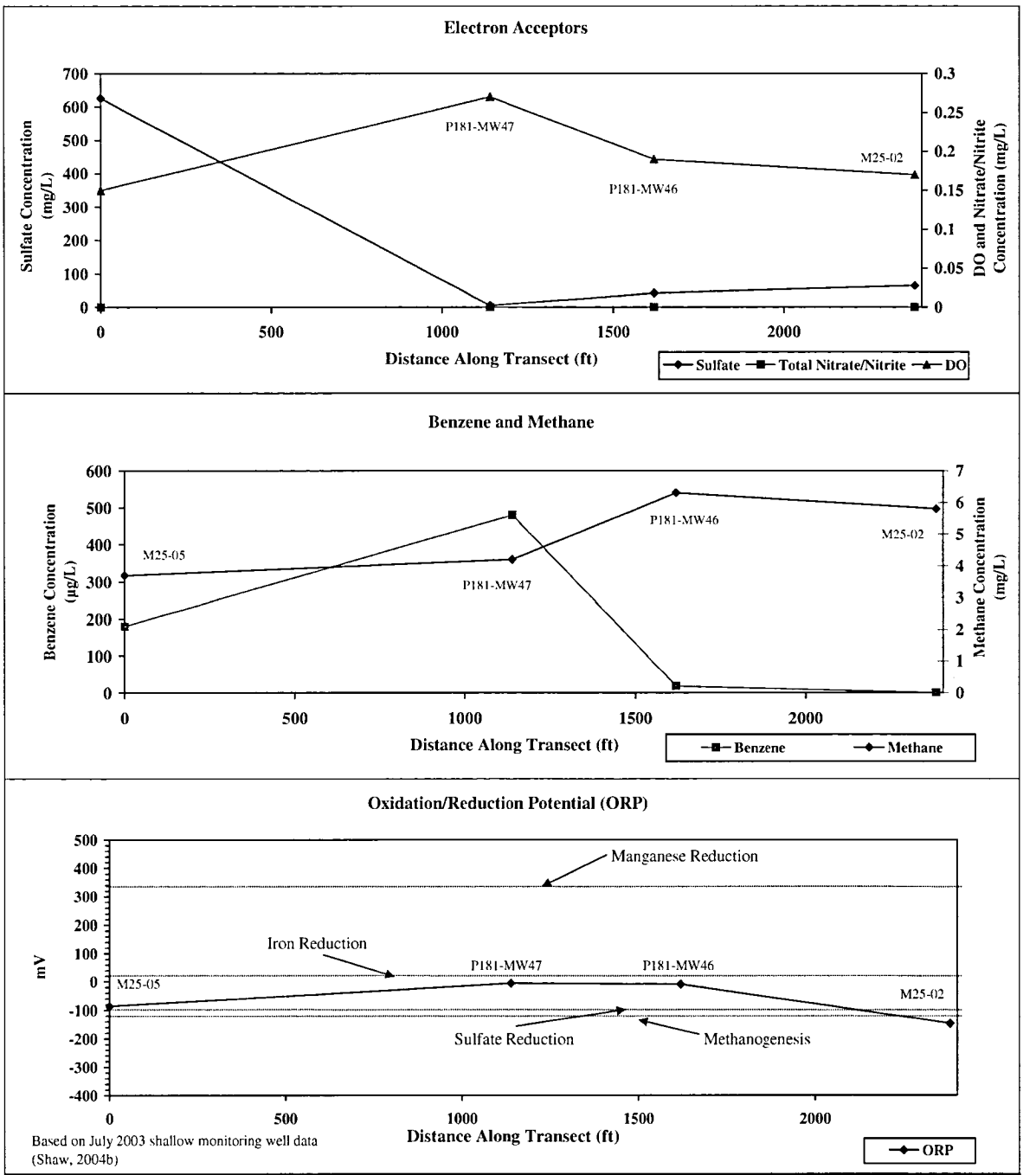
CLIENT: UNITED STATES NAVY SOUTHWEST DIVISION NAVAL FACILITIES ENGINEERING COMMAND

SCALE: not applicable | 02-052_4-32 | 02-052_4-31

LOCATION: ALAMEDA POINT SITE 25/ ALAMEDA ANNEX IR-02

DESIGNED BY: RW | DRAWN BY: RW | RG/PE: | FIGURE: **4-31**

REFERENCE: P:\2002 Projects\22-052 RI FS Alameda Point\Report Text\Draft Final Submittal_2004\Figures\[Fig4_31 and 32 MNA.xls]Fig 4-31



Based on July 2003 shallow monitoring well data (Shaw, 2004b)

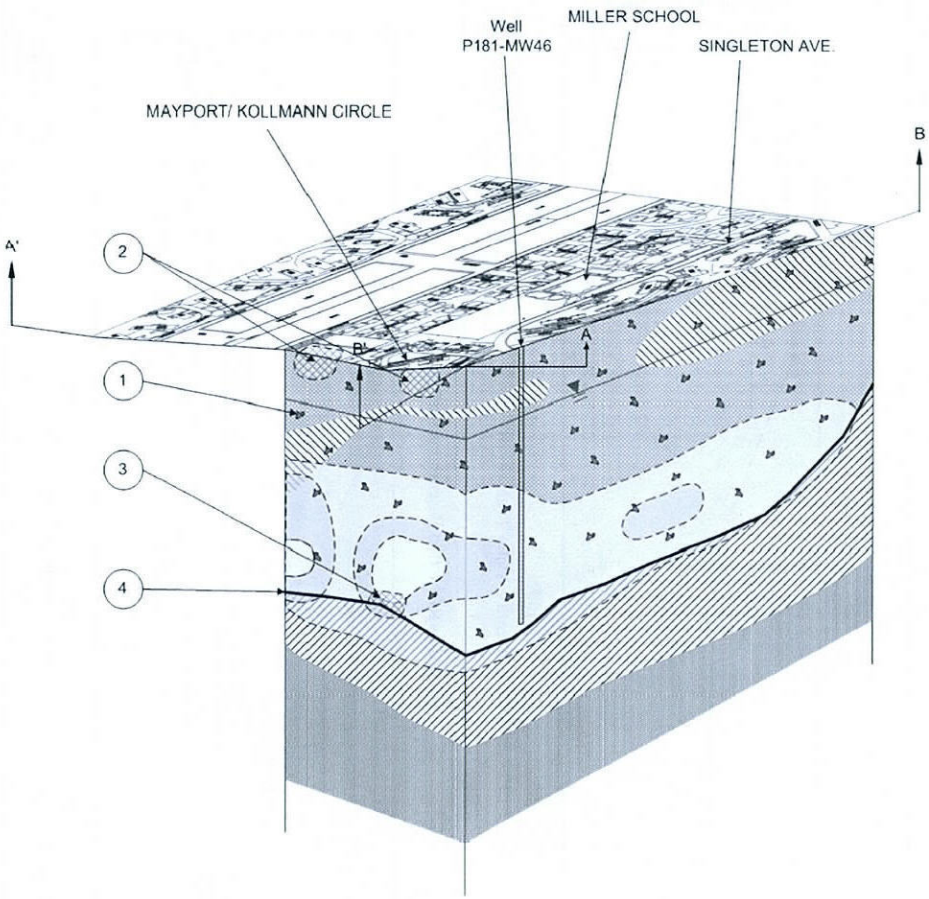
ERRG

Engineering/Remediation Resources Group, Inc.
185 Mason Circle, Suite A, Concord, CA 94520
Main: (925) 969-0750
Fax (925) 969-0751

MNA Parameters Across an East/West Plume Transect
Alameda Point/Annex Groundwater RI/FS

CLIENT: UNITED STATES NAVY, SOUTHWEST DIVISION NAVAL FACILITIES ENGINEERING COMMAND

SCALE:	DRAWING NO.:	LOCATION:			
not applicable	02-052_4-32	ALAMEDA POINT SITE 25/ ALAMEDA ANNEX IR-02			4-32
REFERENCE:P:\2002 Projects\22-052 RI FS Alameda Point\Report Text\Draft Final Submittal, 2004\Figures\[Fig4_31 and 32 MNA.xls]Fig 4-32		DESIGNED BY: RW	DRAWN BY: RW	RG.PE:	FIGURE



Benzene in Groundwater (µg/L)

- 1,000
- 100
- 5

Artificial fill soil types:

- CLAY-FILL(QAF)
- SILTY SAND - FILL(QAF)
- BAY MUD AQUITARD
- MERRITT SAND
- MARSH CRUST
- POSSIBLE DISCRETE SOURCES OF CONTAMINATION

1. POSSIBLE CONTAMINATED FILL MATERIAL
2. HISTORIC STAINED SOIL
3. POSSIBLE BURIED INCLUSION
4. POSSIBLE CONTAMINATION IN MARSH CRUST SURFACE

WATER LEVEL IN UNCONFINED FIRST WATER BEARING ZONE

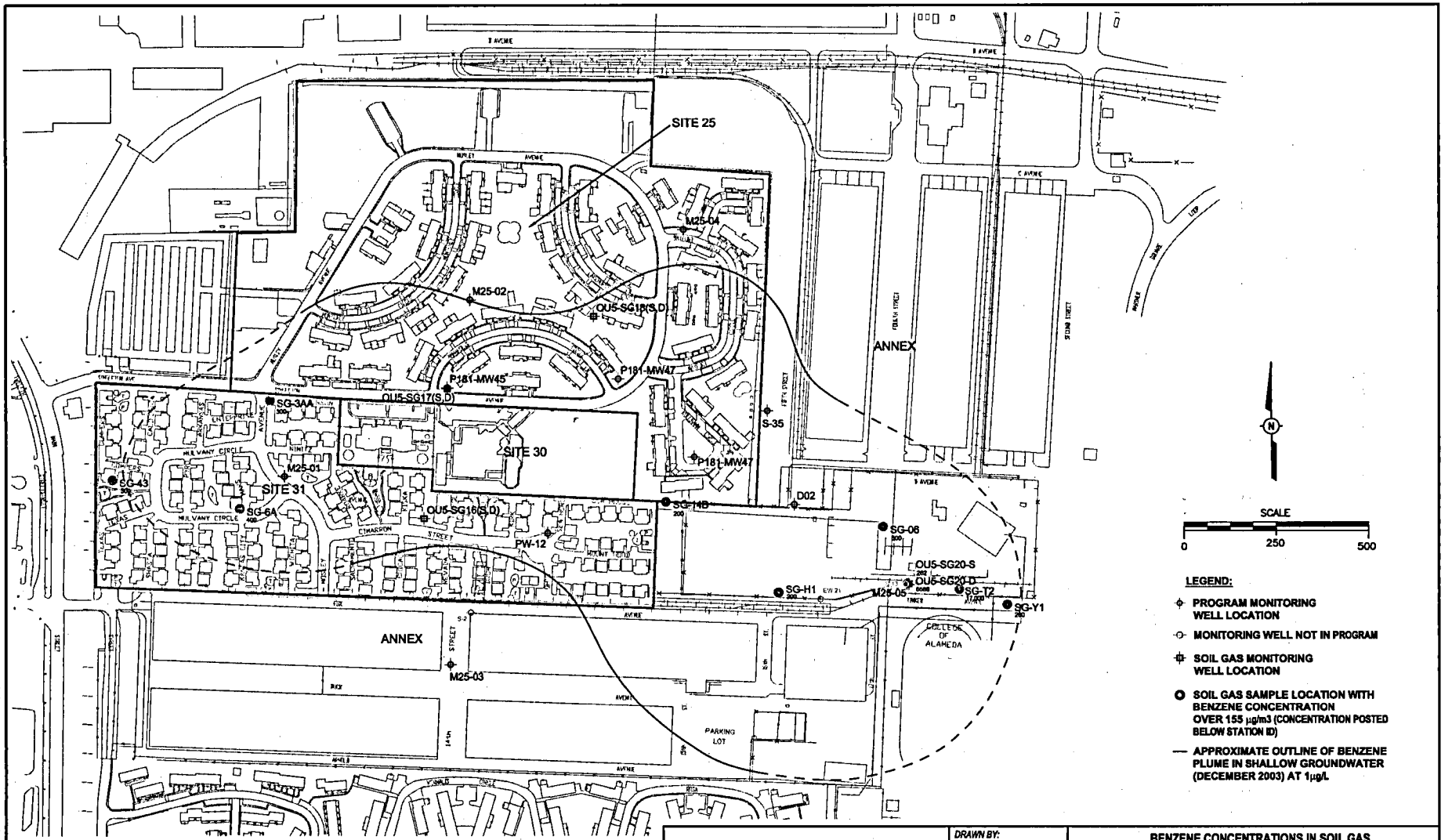
Note: Cross-Sections A-A' (Figure 2-1) and B-B' (Figure 2-2)

NOT TO SCALE

ERRG
Engineering/Remediation Resources Group, Inc.
185 Mason Circle, Suite A
Concord, California 94520
(925) 969-0750

DRAWN BY: B.H. 7/1/04	CONCEPTUAL SITE MODEL		
DESIGNED BY: C.L. 6/21/04	CLIENT: NAVY SWDIV	FIGURE: 4-33	
CHECKED BY: P.F. 7/7/04	DWG. NO. 22-052-FIGURE 4-33		

FILE: P:\2002 Projects\22-052 RI FS Alameda Point\Figures\Draft version\Jun 04\Revised Session 4\Fig 4-33 CSM BH.dwg USER: nwong Jul 23, 2004 11:53am



ERRG
Engineering/Remediation Resources Group, Inc.
185 Mason Circle, Suite A
Concord, California 94520
(925) 969-0750

DRAWN BY: L.H. 6/21/04	BENZENE CONCENTRATIONS IN SOIL GAS EXCEEDING SCREENING LEVELS	
DESIGNED BY: C.L. 6/25/04	CLIENT: NAVY SWDIV	FIGURE: 4-34
CHECKED BY: P.F. 7/1/04	DWG. NO. 22-052-FIGURE 4-34	

FILE: P:\2002 Projects\22-052 RI FS Alameda Point\Figures\Draft version\Jun 04\Revised Session 4\Fig 4-34 Benzene Shallow MW.dwg USER: rwong Aug 11, 2004 1:42pm

5. CONTAMINANT FATE AND TRANSPORT

Section 4 of this report presented the nature and extent of contaminants at the Site. This section discusses the general fate and transport mechanisms of site contaminants, and evaluates possible exposure pathways to human or ecological receptors.

5.1. FATE AND TRANSPORT MECHANISMS

The processes that affect the fate and transport of dissolved-phase benzene and PAHs include advection, hydrodynamic dispersion (mechanical dispersion and diffusion), sorption, biodegradation, infiltration, and volatilization (Wiedemier, et al., 1995). These processes are summarized in Table 5-1, which also includes a comment relating each process to the Site.

The environmental fate and transport of a contaminant is controlled primarily by its physical and chemical properties and the nature of the subsurface media. Physical and chemical properties of a contaminant include water solubility, vapor pressure, Henry's Law constant, organic carbon/water partition coefficient, soil/water distribution coefficient, and octanol/water partition coefficient. Properties of the subsurface media through which contaminants have the potential to migrate include hydraulic conductivity, porosity, total organic carbon content, bulk density, and ambient groundwater geochemistry. A summary of these physical and chemical properties, and Site-specific comments, are provided in Table 5-2.

Of the fate and transport mechanisms listed in Table 5-1, biodegradation appears to be the most significant in addressing contamination at the Site, and lateral migration appears to be a less significant mechanism (see Section 4). The other fate and transport mechanisms listed in Table 5-1 are occurring, or have occurred; however, the benzene plume has been shown to be relatively stable, and little volatilized benzene has been found in the vadose zone (IT et al., 2002). In addition, little water infiltration is occurring because most of the Site (specifically Alameda Point Sites 25, 30, and 31) is paved or covered by residential housing. Therefore, the primary fate and transport mechanism of interest is biodegradation.

Mathematical and/or computer methods are available to estimate contaminant fate and transport. However, because a computer simulation has already been performed (TtEMI, 1998a), and because a large characterization data set is available that provides more of an empirical basis for evaluating site contaminant fate and transport, the mathematical/computer methods are not included as part of this report.

5.2. BIODEGRADATION MECHANISMS FOR BENZENE AND NAPHTHALENE

Petroleum hydrocarbons, of which benzene and naphthalene are constituents, are biodegraded by biological oxidation when electron donors and electron acceptors are combined to produce energy for

Table 5-1
Summary of Fate and Transport Mechanisms
Alameda Point Site 25/Annex IR-02 Groundwater RI/FS
Page 1 of 2

Process	Description	Dependencies	Effect	Comment
Advection	Movement of solute by bulk groundwater movement.	Dependent on aquifer properties, mainly hydraulic conductivity, effective porosity, and hydraulic gradient.	Main mechanism driving contaminant movement in the subsurface.	Benzene plume is now relatively stable. Advection caused plume to spread to the northwest/west and is now likely being countered by biodegradation and other processes.
Dispersion	Fluid mixing due to groundwater movement and aquifer heterogeneities.	Dependent on aquifer properties and scale of observation.	Causes longitudinal, transverse, and vertical spreading of the plume. Reduces solute concentration.	--
Diffusion	Spreading and dilution of contaminant due to molecular diffusion.	Dependent on contaminant properties and concentration gradients. Described by Fick's Law.	Diffusion of contaminant from areas of relatively high concentration to areas of relatively low concentration. Generally unimportant at most groundwater flow velocities.	--
Sorption	Reaction between aquifer matrix and solute; the relatively hydrophobic PAH compounds become sorbed to organic carbon or clay minerals.	Dependent on aquifer matrix properties (organic carbon and clay mineral content, bulk density, specific surface area, and porosity) and contaminant properties (solubility, hydrophobicity, octanol-water partitioning coefficient).	Tends to reduce solute transport rate and remove solutes from the groundwater via sorption to the aquifer matrix.	Sorption is a significant influence for PAHs (naphthalene), but lesser influence for benzene. Sorption is high in the marsh crust due to higher organic carbon content, but lower in low organic content fill materials.
Infiltration (Simple Dilution)	Infiltration of water from the surface into the subsurface.	Dependent on aquifer matrix properties, depth to groundwater, and climate.	Causes dilution of the contaminant plume and replenishes electron acceptor concentrations, especially dissolved oxygen.	Approximately 50 to 60 percent of the site is uncovered and allows infiltration into the subsurface.
Volatilization	Volatilization of BTEX from aqueous phase in groundwater to vapor phase in soil gas.	Dependent on the chemical's vapor pressure and Henry's Law constant.	Causes removal of dissolved-phase volatile contaminants from groundwater.	Benzene volatilizes much easier than PAHs (naphthalene).

Table 5-1
Summary of Fate and Transport Mechanisms
Alameda Point Site 25/Annex IR-02 Groundwater RI/FS
Page 2 of 2

Process	Description	Dependencies	Effect	Comment
Biodegradation	Microbially mediated oxidation-reduction reactions that transform BTEX to carbon dioxide and water.	Dependent on groundwater geochemistry, microbial population, and contaminant properties. BTEX is biodegradable under aerobic and anaerobic conditions. Aerobic degradation faster.	Breaks down BTEX to carbon dioxide and water. Most important process in contaminant mass reduction.	Biodegradation appears to already be underway at the Site.
Partitioning from LNAPL	Partitioning from LNAPL into groundwater. LNAPL plumes tend to act as a continuing source of groundwater contamination.	Dependent on aquifer matrix (relative permeability, capillary pressure, and residual saturation) and contaminant properties (solubility, mass fraction, volatility, density, interfacial tension).	Dissolution of BTEX from LNAPL represents the primary source of dissolved BTEX in groundwater.	No LNAPL at site. Only residual dissolved phase is present.

Source: Technical Protocol for Implementing Intrinsic Remediation with Long-Term Monitoring for Natural Attenuation of Fuel Contamination Dissolved in Groundwater (Weidemeier, et al, 1995).

Table 5-2
Physical/Chemical Properties Affecting Contaminant Fate and Transport
Alameda Point Site 25/Alameda Annex IR-02 Groundwater RI/FS
Page 1 of 2

Chemical Property of Contaminant	General Description	Site-Specific Comment
Water solubility	The ability of a chemical to dissolve into a water substrate.	Benzene has a high water solubility, while PAHs (naphthalene) are less soluble. Site plume migration reflects this difference.
Vapor pressure	Defined as the pressure of the vapor over a liquid at equilibrium.	At 20 °C, the vapor pressure for benzene is 76 mm Hg and 0.5 mm Hg for naphthalene. Therefore, benzene will volatilize more readily than naphthalene.
Henry's law constant	The ratio of the aqueous-phase concentration of a chemical to its equilibrium partial pressure in the gas phase.	The Henry's Law Constant for benzene is 5.5×10^{-3} (atm-m^3/mol) and 4.6×10^{-4} (atm-m^3/mol) for naphthalene, indicating that benzene is more volatile than naphthalene.
Log organic carbon/water partition coefficient (log K_{oc})	The partitioning constant between the amount of a substance sorbed to organic carbon and dissolved in water. Log K_{OC} can be combined with the total organic carbon content of the soil to determine the soil/ water distribution coefficient for Site soils.	The log K_{oc} for benzene is 1.8-1.9 and 2.97 for naphthalene, indicating that PAHs (naphthalene) will adsorb more readily to the organic carbon in the soil.
Soil/water distribution coefficient	Defined as the ratio of the sorbed contaminant concentration to the dissolved contaminant concentration.	The ratio for benzene is lower than for PAHs (naphthalene), and varies based on the organic carbon content of Site soils.
Log octanol/water partition coefficient (log K_{ow})	A measure of the equilibrium concentration of a compound between octanol and water that is highly correlated with the potential for partitioning into soil organic matter (i.e., a high K_{ow} indicates a compound that will preferentially partition into soil organic matter rather than water). K_{ow} is inversely related to the solubility of a compound in water.	The log K_{ow} for benzene is 2.13 and 3.29 for naphthalene, indicating that PAHs (naphthalene) are likely partitioning to organic matter at the site more than benzene.
Physical Property of Media	**General Description**	**Site-Specific Comment**
Indigenous bacterial populations	Bacterial populations can use a variety of energy sources, including contaminants, which results in their degradation.	Studies have shown that most sites have ample bacterial populations capable of biodegrading BTEX compounds. Biodegradation already appears to be occurring at the site, indicating sufficient indigenous bacterial populations.
Hydraulic conductivity	Measure of the potential of water-bearing soils to conduct groundwater.	Previous studies calculated that hydraulic conductivity in the shallow aquifer ranges from 0.36 to 11.94 feet/day (TtEMI, 1998a).
Porosity	Measure of the pore space present in a water-bearing formation.	Porosity for the site was previously estimated at 0.1 to 0.3 (TtEMI, 1998a). These values represent unconsolidated coarse- and fine-grained lithologies discovered in past investigations.

Table 5-2
Physical/Chemical Properties Affecting Contaminant Fate and Transport
Alameda Point Site 25/Alameda Annex IR-02 Groundwater RI/FS
Page 2 of 2

Physical Property of Media	General Description	Site-Specific Comment
Total organic carbon content	Measure of the amount of in situ organic carbon.	Organic carbon content is high within the marsh crust due to entrapped plant material, and very low in imported fill material.
Ambient groundwater geochemistry	Includes items such as background concentrations of inorganics, salt content, etc.	The Site is influenced by the nearby Bay and former existence as a marsh.

microbial growth. Petroleum hydrocarbons serve as electron donors in microbial metabolism (Wiedemeier et al., 1998).

The biodegradation of benzene is primarily limited by its electron acceptor availability; generally, benzene biodegradation will proceed until all contaminants that are biochemically accessible to the microbes are oxidized (Wiedemeier et al., 1998). Electron acceptors are generally used in the following order (based on the energy provided): oxygen, nitrogen, iron, sulfate, and carbon dioxide (methanogenesis). Subsurface environments that contain sufficient DO to serve as electron acceptors are considered aerobic. Subsurface environments that have lower DO concentrations (DO readings of 0.5 mg/L or lower) and/or use other electron acceptors are referred to as anaerobic (Weidemeier et al., 1998). At any given location, the dominant mechanism of benzene biodegradation depends on the availability of electron acceptors and influences the oxidation/reduction potential of the environment.

To date, numerous laboratory and field studies have shown that microorganisms indigenous to the subsurface environment can degrade a variety of hydrocarbons, including components of gasoline, kerosene, diesel, and jet fuel (Wiedemeier, et al., 1995). Furthermore, an adequate supply of these microorganisms is typically present in the subsurface (Wiedemeier, et al., 1995; Sutherson, 1999). Under ideal conditions, the biodegradation rates of low- to moderate-weight aliphatic, alicyclic, and aromatic compounds (e.g., benzene and naphthalene) can be very high. As the molecular weight of the compound increases, so does the resistance to biodegradation (Wiedemeier, et al., 1995).

A comparison of benzene and PAH biodegradation can be summarized as follows:

- Benzene has been shown to biodegrade most quickly in aerobic environments, and is considered recalcitrant in anaerobic environments (Bennett, 1999).
- PAHs that contain two or three benzene rings (e.g., naphthalene) degrade at reasonable rates in aerobic environments, albeit more slowly than benzene, and are also considered recalcitrant in anaerobic environments (Bennett, 1999).

Sampling for MNA parameters at the Site is conducted semi-annually as part of the Basewide Groundwater Monitoring Program. Data from summer 2002, winter 2002, and summer 2003 have been summarized in the quarterly reports for the Basewide Groundwater Monitoring Program (Shaw, 2004b and c). The following electron acceptor trends were observed:

- DO concentrations have decreased from an average concentration of 2.5 mg/L measured in fall 2002 to an average concentration of 0.18 mg/L in summer 2003, and 0.25 mg/L in spring 2004 (as measured in seven wells). This indicates that oxygen is being consumed. DO concentrations measured during the summer 2003 sampling event were below 0.5 mg/L in every monitoring well sampled at the Site. When sampled in spring 2004, concentrations were anaerobic in all wells except three perimeter wells. This indicates that the predominant conditions at the Site have become anaerobic.

- Some nitrate has been detected at the Site; however, no discernable trend is present. No nitrite has been detected. This may indicate that limited sources of nitrate exist at the Site, so denitrification cannot occur.
- The average ferrous iron concentration was 2.23 mg/L in July of 2003. Ferrous iron concentrations are increasing in monitoring well S-35, indicating that iron reduction may be occurring in the vicinity of that well. Ferrous iron concentrations are generally stable in the other monitoring wells, indicating that little ferric iron remains to serve as an electron donor.
- Sulfate concentrations are generally decreasing across the Site, from an average concentration of 103.5 mg/L in all 11 wells sampled in summer 2003 to an average concentration of 89 mg/L in the same 11 wells in winter 2003. This indicates that biodegradation is occurring across the Site under sulfate-reducing conditions.
- Overall methane concentrations have remained relatively high and stable across the Site, ranging from 1.6 to 13 mg/L in samples from monitoring wells, indicating that some degradation is also occurring under methanogenic conditions (using carbon dioxide as an electron acceptor). Although dissolved phase methane concentrations are relatively high, concentrations of gas phase methane in shallow soil gas are below the lower explosive limit, as discussed in Section 4.2.1.
- Localized ORP readings indicate a variety of conditions across the Site. However, the average ORP reading did not change significantly between fall 2002 and winter 2003. ORP levels in monitoring wells M25-01, M25-02, M25-03, M25-04, M25-05, P181-MW45, and PW-12 range from -86 to -234 mV, consistent with sulfate reduction as the dominant degradation mechanism at these locations.

In summary, the natural attenuation data indicate that the predominant conditions at the Site are anaerobic and that anaerobic biodegradation is occurring, predominantly under sulfate-reducing and methanogenic conditions, which is typically much slower than aerobic degradation.

5.3. EVALUATION OF FATE AND TRANSPORT MECHANISMS – INITIAL RELEASE TO THE PRESENT

The fate and transport mechanisms that have occurred to date are closely related to the initial method of contaminant release into the environment. As discussed in Section 4, benzene and naphthalene contamination present in groundwater is believed to be the result of both surface point-source discharges and the use of contaminated fill to create the Site.

Fate and transport mechanisms for point-source discharges of petroleum hydrocarbons (Bennett, 1999) are as follows:

- Petroleum hydrocarbons separate into four phases: free product, vapor, adsorbed onto soil particles, and aqueous (dissolved in water).
- Subsurface chemical and physical properties affect the distribution of the phases.
- For benzene, approximately 60 percent tends to separate into the vapor phase, 35 percent into the aqueous phase (dissolved in groundwater), and 5 percent adsorbed onto subsurface soil particles.

- The vapor phase, present either on the surface or in the vadose zone, evaporates into the atmosphere over time. Lack of vapor phase contamination would therefore indicate weathered contaminants. It may also indicate that vadose zone biodegradation has been active at the Site.
- The dissolved phase undergoes the fate and transport mechanisms listed in Table 5-1, resulting in a groundwater contaminant plume. If the source of the discharge is not removed, the plume may continue to expand; if the source is removed, the plume typically stabilizes and then recedes under natural degradation processes.
- The adsorbed phase through time undergoes biodegradation, unless there is a lack of electron acceptors (e.g., oxygen) and/or nutrients.

The data presented in Section 4 suggest that there were one or more point-source discharges or areas of contaminated fill. The vapor phase has been largely biodegraded or evaporated in the vadose zone. The dissolved phase continues to undergo the fate and transport mechanisms listed in Table 5-1. The adsorbed phase for benzene is relatively small compared with the other phases. The adsorbed phase for PAHs is larger than that of benzene, but less than would be expected for typical soils (as described in Section 4.3).

Therefore, fate and transport mechanisms to date have biodegraded contamination, removed vapor phase contamination from the Site, and produced a relatively stable benzene plume that continues to undergo biodegradation as the primary fate and transport mechanism, though at a much slower rate than under aerobic biodegradation. To support this conclusion, a summary of the results of a previous computer-simulated fate and transport study (TtEMI, 1998a) is presented in Section 5.4; a more detailed evaluation of benzene plume stability is presented in Section 5.6.

5.4. PREVIOUS FATE AND TRANSPORT STUDY

The fate and transport study reported in 1998 by TtEMI utilized benzene analytical data generated from shallow monitoring wells at the Site to model benzene migration over a 24-year period. Two scenarios were modeled: one assumed that concentrations in the center of the benzene plume (original source area) would remain constant, and the other assumed that benzene concentrations would decline, as seen during groundwater sampling and analyses from 1994 to 1996.

The results of the modeling indicated that, if benzene plume source concentrations remained constant, any benzene contamination reaching the Oakland Inner Harbor would be at non-detectable concentrations (less than 0.25 µg/L), and would through time recede toward the current plume centers. If plume source concentrations decreased, the extent of the plume would decrease at an even more accelerated rate than if the plume center concentrations remained constant. The modeling performed by TtEMI predicted that the benzene plume would recede by the year 2020. However, residual contamination above 1.0 µg/L would still be present. Decreasing and constant source models predicted residual plume areas of approximately 15 acres and 35 acres, respectively. Both models predicted that concentrations will remain elevated at three plume centers located at monitoring wells P181-MW45, P181-MW47, and EW-2, and results to date are generally consistent with the predicted trends at the three plume centers.

5.5. EVALUATION OF FATE AND TRANSPORT MECHANISMS – CURRENT AND FUTURE

As discussed in Section 4, biodegradation, the primary fate and transport mechanism at the Site, continues to address residual contamination. However, it also appears to have largely depleted DO across the Site, converting aerobic conditions to anaerobic, which tends to slow biodegradation rates.

The contamination at the Site will continue to be influenced by the fate and transport mechanisms listed in Table 5-1, but will be most influenced by ongoing biodegradation processes.

If no action is taken at the Site, any available DO will continue to be consumed by aerobic biodegradation, and contaminant mass, as well as concentrations in groundwater, will continue to decrease. However, much of the plume has become anaerobic, and biodegradation is dominated by sulfate reduction and methanogenesis, which will continue to degrade benzene and naphthalene but at a slower rate than for aerobic biodegradation.

Other studies have shown that first-order decay equations can be used to approximate contaminant fate and transport mechanisms for petroleum hydrocarbon constituents in groundwater (Wiedemeier, et al., 1995). An evaluation of benzene concentrations in eleven monitoring wells within the benzene plume revealed that most monitoring wells are exhibiting first-order exponential decay patterns (Figures 5-1 through 5-11).

Therefore, the best-fit, first-order exponential decay curves shown in Figures 5-1 through 5-11 indicate that fate and transport mechanisms are reducing benzene contamination in all of the wells, with the exception of plume center EW-2. Although concentrations have fluctuated in some wells and the fit of the linear decay curves are not ideal, the average of the decay rates calculated is -0.0005/day. If the first-order decay curves were used to estimate the time required to reduce benzene concentrations to below the State MCL of 1.0 µg/L, the resulting timeframe would end in approximately 2060 (assuming first-order decay of -0.0003/day in monitoring well P181-MW47). Previous calculations of decay rate using data through 2001 calculated a decay rate of -0.001/day, and a resulting cleanup timeframe to approximately 2016. This illustrates how degradation rates slow as subsurface conditions become anaerobic. Degradation rates may continue to slow as sulfate is consumed and methanogenesis becomes the predominant biodegradation process. Due to fluctuations in the data, correlation coefficients for many of the decay curves are low. Therefore, this analysis is intended as a qualitative tool to understand likely timeframes for biodegradation under existing conditions.

5.6. PLUME STABILITY EVALUATION

Because benzene is a known carcinogen with high groundwater mobility (solubility) and the largest associated groundwater plume, it is the focus of this plume stability evaluation. PAHs, such as naphthalene, are less soluble in water and tend to adsorb onto organic matter or suspended particulates, making them less mobile than benzene.

Under ideal conditions, adequate monitoring wells are installed within and surrounding a contaminant plume to generate sufficient analytical data to compare contaminant concentrations over time, and subsequently draw conclusions regarding the plume's stability. The Site contains 17 installed monitoring wells that can be used to track plume concentrations over time. However, to provide a more complete data set, particular areas (such as the west portion of the Site) require the installation of additional monitoring wells.

Despite the need for additional monitoring wells, the data collected by previous investigations can be used to perform a plume stability evaluation. As detailed in Section 4, multiple groundwater investigations have been conducted at the Site, and the resulting data can be compared both numerically (concentrations in wells) and graphically (by comparing plume maps from different years).

Numerical comparisons (Mann-Kendall trend evaluations) of benzene concentrations in on-site monitoring wells were presented in Section 4 for 11 of the wells (excluding the 5 newly installed wells, and well D-02 screened in the SWBZ). These comparisons revealed statistically-significant downward trends in benzene concentrations in two of the three plume centers and five bounding wells. No significant increases were detected in any Site-monitoring wells, indicating that there is not likely a continuing source of contamination. Also, earlier in this section, first-order decay curves were plotted using benzene data from 11 monitoring wells to evaluate data trends. Of the comparisons performed, only monitoring well EW-2 was found to have benzene concentrations without a downward-trending decay curve. Likewise, the Mann-Kendal results for well EW-2 indicated that benzene concentrations exhibited a possible upward trend, but it was not significantly increasing. The linear decay curves for benzene concentrations in the remaining wells exhibited a downward trend. Due to fluctuations in the benzene data, the Mann-Kendall trend tests did not significantly establish a trend in four of the wells, and the correlation coefficients of many of the linear decay curves is poor.

The numerical comparisons indicate that, while some fluctuations exist, benzene concentrations are generally stable or decreasing throughout the existing plume. In addition, since benzene concentrations in surrounding wells remain low compared to the plume centers, it can be deduced that the existing benzene contamination is being degraded rather than migrating farther from the plume centers.

Numerical comparisons of naphthalene concentrations (Table A-3) in monitoring wells indicate that naphthalene concentrations are generally stable. The remediation timeframe for naphthalene is expected to be longer than for benzene because of its slower biodegradation rate.

Graphical comparisons can also be made of the lateral extent of the benzene plume over time, by using the results of previous plume maps generated for other reports as well as the plume maps generated for this report.

The first graphical comparison performed for this report involved comparing the plume maps shown in Figures 4-2 through 4-8 with the computer-generated maps (MOC3D) included as part of the previous

fate and transport study[1] performed by TtEMI (TtEMI, 1998a). The fate and transport study maps were not included as part of this report. However, comparing them indicates that the lateral extent of the benzene plume has remained relatively consistent since 1996. The previous fate and transport study relied on a more extensive monitoring well network (65 monitoring wells), much of which now has been abandoned or destroyed. Recent Hydropunch™ results (IT et al., 2002) seem to confirm the plume extents shown in the maps for the previous fate and transport study. While the shapes of the plume contours change based on the set of monitoring wells used in each investigation, the general shape of the plume has remained similar. Two plume centers are consistently observed, centered at wells EW-2 and P181-MW47. However, the third plume center at the western edge of the Site was not well characterized in earlier investigations. Benzene concentrations in wells to the north and south of the plume centers have remained below detection limits, and the plume remains bounded in these directions.

The second graphical comparison performed for this report compared benzene plume extents from 1994, 1999, 2001, and 2003 monitoring well data (Figures 4-2, 4-3, 4-4, and 4-8). Figure 5-14 compares the 1994 plume extent to the 2003 plume extent. This comparison indicates that the 1994 plume extent was smaller in the southeast portion of the Site compared to the 2003 plume extent; however, this is a result of the more dense data distribution in 1994 compared to 2003. Figure 5-14 also shows that the 1994 plume extent was smaller in the western portion of the Site compared to 2003; however, as previously discussed in Section 4.1.3, this is due to the results at monitoring well M25-01 which was installed in 2002. Taking into account data fluctuations caused by sampling in different seasons, and the different set of monitoring wells used during each event, it can be concluded that the benzene plume remained relatively stable from 1994 to 2003. As previously discussed in Section 4.1.3, 2003 benzene concentrations at M25-01 and M25-05 are sufficiently elevated to prevent the precise definition of the contour intervals corresponding to lower benzene concentrations; estimated contour intervals are presented as dashed lines in Figures 4-8 and 5-14.

The third graphical comparison performed for this report compared data from Hydropunch™ samples collected in 2001 at varying depths (Figure 5-15). The Hydropunch™ sampling event included more sampling locations than the monitoring well network, and also provided vertical delineation of contamination. The general shapes of the benzene and naphthalene plumes on the contour maps generated from the Hydropunch™ data are similar to those generated from monitoring well data.

The analytical data from Hydropunch™ sampling indicates that benzene concentrations within the FWBZ increase with depth. Benzene stratification was described in detail in the Alameda Point OU-5 RI (IT et al., 2002). When comparing plumes based on monitoring well data with plume maps based on Hydropunch™ data, it is important to note that the two data sets are not directly comparable because the screened intervals and sample collection procedures vary between the two methods. Hydropunch™ data

[1] Note that the previous computer-generated contour maps were not included with this report; the reader is referred to the fate and transport study performed by Tetra Tech EMI (TtEMI, 1998a) for a general visual comparison.

was therefore used qualitatively in this report to interpret the shape of the plume, and monitoring well data was used to more accurately compare plume boundaries over time.

5.7. PLUME STABILITY SUMMARY

Taking into account all of the site specifics and different sampling regimes, it can be concluded that the lateral extent of benzene contamination in groundwater has been relatively stable from 1994 to the present, and in some areas is decreasing. This is based on numerical comparisons of benzene concentrations in site monitoring wells, and on graphical comparisons of plume maps generated using analytical data from different years. The stability of the benzene plume indicates that naturally-occurring processes are acting to reduce benzene and naphthalene contamination.

5.8. EXPOSURE PATHWAY EVALUATION

Two primary pathways exist at the Site for contaminants to migrate and potentially affect human receptors:

- Soil gas migration: Volatilization of benzene could cause vapor-phase contamination to migrate through the vadose zone and into the atmosphere or indoor air in nearby residences.
- Groundwater migration through shallow well pumping: If wells were installed in or near FWBZ contamination, their use could draw contaminated groundwater from the subsurface and expose end users.

In addition, two primary pathways exist at the Site for contaminants to migrate and potentially affect ecological receptors:

- Lateral groundwater migration through the FWBZ: If contaminated groundwater migrated farther northward, it eventually could discharge to the Oakland Inner Harbor.
- Storm drain system migration: If contaminated groundwater or benzene vapors were to migrate into or along storm drain or other utility lines, they could eventually discharge to the Oakland Inner Harbor, into trenches during site construction work, or into the atmosphere or residences.

These possible exposure pathways are discussed in further detail in the following subsections.

5.8.1. Human Health Exposure Pathways

The two exposure pathways identified for human health exposure to Site contaminants, soil gas inhalation and shallow groundwater ingestion, are considered complete or potentially complete pathways and have been evaluated further in a HHRA presented in Section 6. These pathways are described below in further detail.

5.8.1.1 Soil Gas Migration

Because benzene is a VOC and a known carcinogen, it poses a risk to ecological or human receptors. There is concern that benzene contamination in groundwater could be converted to vapor phase, migrate

through the vadose zone, and either discharge into the atmosphere or (as a worst-case scenario) discharge into local residences. If vapor phase benzene were present at the Site, it might also migrate along preferential pathways such as subsurface utility lines or into construction trenches intersecting the Site.

To date, the frequency of detection of benzene in soil gas has been relatively low (approximately 10 percent) (TtEMI, 1999a; IT et al., 2002). A USCG indoor air sampling event revealed concentrations of benzene near or below detection limits, comparable to concentrations of benzene in ambient air (Tetra Tech Inc., 2002). An evaluation performed by TtEMI in 1999 (TtEMI, 1999a) also indicated human health risk levels within the USEPA's risk management range (10^{-4} to 10^{-6}). Results of the HHRA presented in Section 6, indicate that the risks from migration of contaminants from groundwater to soil gas to indoor air are at or below 10^{-6}. However, the potential risk would increase if air were injected into the subsurface as part of a remedial alternative, and more dissolved-phase benzene were to volatilize into the vadose zone.

5.8.1.2 Groundwater Migration via Shallow Well Pumping

Shallow well pumping could also create a completed exposure pathway if a well were installed in or near the contaminated areas of the FWBZ. Pumping from a shallow well would create a cone of depression in groundwater, and could possibly draw contaminants from the subsurface to the surface. The exposure pathway would be completed if human or ecological receptors were exposed to the extracted groundwater.

Due to volatilization, extraction of contaminated groundwater through shallow well pumping could also cause exposure to vapor-phase benzene. This exposure scenario was modeled as part of the risk assessment performed for this report and is presented in Section 6.

Currently, no extraction wells are installed in the FWBZ; however, wells could be installed in the future. For example, a residential backyard well could be installed for irrigation purposes. However, the likelihood of such an occurrence is low, as potable water is currently available to all residences through a municipal water system and a county ordinance exists prohibiting the installation of water wells, as described in Section 2.3.

5.8.2. Ecological Exposure Pathways

Ecological receptor exposure to contaminants in groundwater is based on the premise of migration of the groundwater to surface water in the adjacent Oakland Inner Harbor. The two potential mechanisms for such a pathway to occur are through lateral groundwater movement and through the existing storm sewer system. Previous investigations and ongoing groundwater monitoring have demonstrated that ecological receptors are not being exposed to contaminated groundwater from the Site, as discussed in the sections below.

Furthermore, the majority of constituents analyzed in the groundwater have been detected at concentrations below applicable aquatic water quality criteria for San Francisco Bay. As shown in Table 5-3, the maximum concentrations for the majority of the constituents detected in groundwater were below their respective aquatic water quality criteria. Of the 44 organic constituents detected in groundwater, 10 had a maximum concentration above the aquatic water quality criteria; however, of those 10 constituents, only naphthalene had a 95th upper confidence limit (UCL) significantly exceeding the aquatic water quality criteria. The other nine organic constituents had 95th UCL concentrations comparable to aquatic water quality criteria. Of the 20 inorganic constituents detected in groundwater, 4 had a maximum concentration above the aquatic water quality criteria; however, of those 4 constituents, only silver had a 95th UCL significantly exceeding the aquatic water quality criteria. Silver was detected in 7 of 54 samples collected to date, and the 95th UCL is generally comparable to corresponding background concentration reported in a 2001 technical memorandum (TtEMI, 2001b). However, the 95th UCL was elevated relative to its aquatic criteria primarily because the standard reporting limit for silver is approximately 5 µg/L, and several non-detect results had reporting limits at or above 10 µg/L. The other three inorganic constituents had 95th UCL concentrations comparable to aquatic water quality criteria.

5.8.2.1 Lateral Groundwater Migration

As discussed in Section 4, the lateral extent of benzene and naphthalene contamination in the FWBZ at the Site is relatively stable or decreasing. Additional monitoring wells are needed on the western edge of the existing benzene plume to completely delineate the plume boundary. However, monitoring wells already in place around the plume indicate that benzene concentrations are well below aquatic water quality criteria. Therefore, concentrations of COPCs in groundwater that may pose a risk to ecological receptors are not migrating toward the Oakland Inner Harbor. The ongoing Groundwater Monitoring Program will continue to verify that migration of groundwater contamination is not occurring.

If contaminants were to migrate laterally, they would do so with the flow of groundwater, which is highly variable but generally flows north/northwest (TtEMI, 1998a) toward the Oakland Inner Harbor, approximately 900 feet away at its nearest location. Groundwater flow and contaminant migration would also be affected by local variations caused by factors such as water line leaks, the presence of former tidal channels, varying permeabilities of imported fill material, and groundwater infiltration.

Table 5-3
Comparison of Concentrations of Maximum Detected Groundwater Concentrations to Ambient Water Quality Criteria
Alameda Point Site 25/Alameda Annex IR-02 Groundwater RI/FS
Page 1 of 2

Analyte	Maximum Concentration (µg/L)	95th UCL[1] (µg/L)	Aquatic Criteria[2] (µg/L)
	Organic Analytes		
1,1,1,2-Tetrachloroethane	200	—	NA
1,2,4-Trimethylbenzene	52	—	NA
1,2-Dichlorobenzene	0.2	—	129
1,2-Dichloroethane	39	—	11,300
1,3,5-Trimethylbenzene	29	—	NA
2-Butanone	3	—	NA
Acenaphthene	120	—	710
Acenaphthylene	660	82.81	30
Acetone	1.6	—	NA
Anthracene	59	—	30
Benzene	6,000	503	510
Benzo(a)anthracene	8.8	—	30
Benzo(a)pyrene	60	4.47	30
Benzo(b)fluoranthene	8	—	30
Benzo(g,h,i)perylene	11	—	30
Benzo(k)fluoranthene	3.6	—	30
Bromodichloromethane	0.22	—	6,400
Carbon disulfide	2.8	—	NA
Chloroform	0.75	—	6,400
Chloromethane	0.6	—	6,400
Chrysene	13	—	30
cis-1,2-Dichloroethene	1.2	—	22,400
Dibenz(a,h)anthracene	3	—	30
Dibromochloromethane	0.23	—	6,400
Dichlorodifluoromethane	20	—	6,400
Ethylbenzene	800	55.29	43
Fluoranthene	280	28.54	16
Fluorene	70	9.79	30
Isopropyl Ether	1.4	—	NA
Methylene chloride	180	—	6,400
MTBE	4.8	—	NA
Naphthalene	19,000	2,200	235
n-Butylbenzene	1,800	—	NA
Nitrate	440	—	NA
n-Propylbenzene	8.1	—	NA
Phenanthrene	250	33.43	30
Pyrene	200	19.25	30
sec-Butylbenzene	0.3	—	NA

Table 5-3
Comparison of Concentrations of Maximum Detected Groundwater Concentrations to Ambient Water Quality Criteria
Alameda Point Site 25/Alameda Annex IR-02 Groundwater RI/FS
Page 2 of 2

Analyte	Maximum Concentration (µg/L)	95th UCL[1] (µg/L)	Aquatic Criteria[2] (µg/L)
Styrene	130	—	NA
Sulfate	110,000	—	NA
Toluene	620	—	5,000
trans-1,2-Dichloroethene	0.25	—	22,400
Vinyl chloride	0.9	—	NA
Xylenes (total)	227	—	NA
Inorganic Analytes			
Aluminum	1,400	—	NA
Antimony	2.67	—	NA
Arsenic	71.8	19.42	36
Barium	2,460	—	NA
Beryllium	1.83	—	NA
Cadmium	3.24	—	9.3
Chromium	22	—	1,030[3]
Cobalt	7.46	—	NA
Copper	11	5.16	3.1
Iron	39,700	—	NA
Lead	2.45	—	8.1
Manganese	19,600	—	NA
Mercury	0.222	—	0.94
Molybdenum	37.4	—	NA
Nickel	16	8.66	8.2
Selenium	13	7.91	8.2
Silver	15	10.45	0.19[4]
Thallium	9.61	—	213
Vanadium	20	—	NA
Zinc	11	—	81

Notes:

NA = Not available (see note 2 below)

[1] For analytes with maximum concentrations exceeding the aquatic water quality criteria, the 95th UCL of the arithmetic mean concentration was calculated. The 95th UCL for benzene and naphthalene, however, were calculated using block kriging techniques as described in Appendix E, *Baseline Human Health Risk Assessment, Alameda Point Site 25/Annex IR-02, Alameda, California.*

[2] The aquatic criteria shown is the California Toxics Rule for saltwater aquatic life in enclosed bays and estuaries (continuous concentration [4-day average]). If this value is not available, the EPA chronic toxicity level is shown. If either of the above criteria are not available, one-tenth of the EPA acute toxicity level is shown. If none of these criteria are available, the applicable water quality criterion is not available and is denoted as "NA." The source of these criteria is the August 2003 revision of "*A Compilation of Water Quality Goals*" prepared by the RWQCB, Central Valley Region.

[3] One-tenth of EPA acute toxicity (lowest observed effect) level for saltwater aquatic life protection. Criterion is for chromium III; no criterion exists for total chromium.

[4] One-tenth of EPA recommended criteria, instantaneous maximum for saltwater aquatic life protection.

Water line leaks were identified in areas where low TDS were measured in previous investigations. These water lines have since been repaired (TtEMI, 1999b). The Basewide Groundwater Monitoring Program identified possible leaking water lines near monitoring well S-35 (Shaw, 2004b). If water line leaks are occurring, they would likely cause groundwater mounding, which would alter the direction of groundwater flow. Depending on the leak location, groundwater migration toward the Oakland Inner Harbor could either be slowed or accelerated.

In addition, when the Site was created by filling in existing marsh lands, placement of fill materials in tidal channels created areas that are heterogeneous and affect groundwater flow (IT et al., 2002). Previous investigations have concluded that, due to the non-uniform fill process, on-site soils should be assumed heterogeneous and the varying permeability may create preferential pathways for groundwater flow and contaminant migration.

The primary source of groundwater recharge is lateral groundwater flow from the south. Groundwater infiltration such as rainfall seeping into the Site theoretically could also affect groundwater flow and contaminant migration. However, rainfall infiltration at the Site is limited by the portion of the Site that is paved or occupied by residential units. Approximately 60 percent of the Site is uncovered.

Modeling conducted by TtEMI in 1998 concluded that no detectable concentrations of benzene from the Site would reach the Oakland Inner Harbor (TtEMI, 1998a). As discussed in Section 5.7, the lateral extent of the plume has been relatively stable since 1994. Therefore, lateral migration of contaminated groundwater to potential receptors is unlikely.

5.8.2.2 Storm Drain System Migration

Given that storm drain lines intersect groundwater contamination in some areas of the Site and the majority of the storm drain lines are present below the water table, migration of dissolved-phase and volatilized contamination through the storm drain system is possible. If leaks occurred in storm drain lines, and if the water table were high enough, contaminated groundwater could enter storm drains and subsequently discharge to the Oakland Inner Harbor. Bedding material for the storm drains could also act as a preferential pathway for contaminant migration. Monitoring wells already in place north of the plume (in the direction of the storm drain main line as it exits the Site) indicate that benzene concentrations are well below aquatic water quality criteria. Therefore, concentrations of COPCs in groundwater that may pose a risk to ecological receptors are not migrating toward the Oakland Inner Harbor via storm drains. The ongoing Groundwater Monitoring Program will continue to verify that migration via the storm drain lines is not occurring.

As discussed in Section 2.4, two storm drain system investigations have been conducted for the Site (TtEMI, 2001a). Storm drains within Alameda Point Site 25 were found to be intact and not acting as a preferential pathway for groundwater contamination. Sampling of sediments and stormwater was also performed in Alameda Annex, and no ecological risk was found. Investigation of storm drains in other

areas of Alameda Point indicate that typical bedding material used for storm drains at Alameda Point does not provide preferential pathways for contaminant migration (TtEMI, 2002). As discussed in Section 2.4, these off-site studies do not support definitive conclusions regarding potential contaminant migration via storm drain bedding material, but ongoing groundwater monitoring has shown that such migration is not occurring.

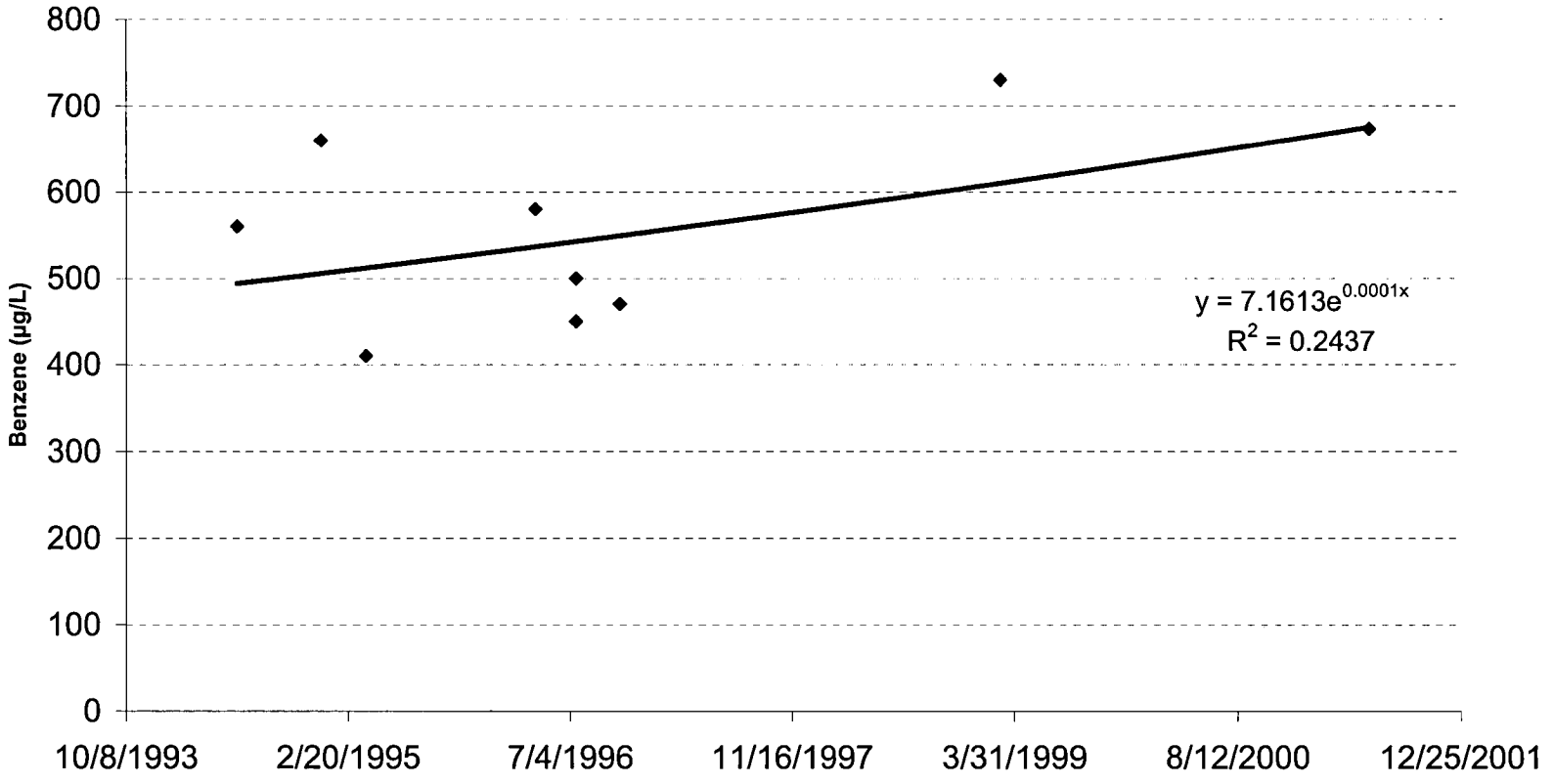
5.9. FATE AND TRANSPORT SUMMARY

Through numerical and graphical methods presented in this section of the report, it was determined that groundwater contamination is not migrating laterally, is not migrating through other transport pathways such as storm drains and volatilization, and is undergoing natural biodegradation processes.

A plume stability evaluation revealed that the lateral extent of benzene contamination at the Site is generally stable or decreasing. This indicates that the groundwater plume is attenuating naturally; however, additional sampling is needed to confirm the extent of contamination in the far western and southeast portions of the Site.

The numerical and graphical evaluations performed for this report are also supported by a previous computer-modeled fate and transport study (TtEMI, 1998a), which concluded that Site contamination, if left to natural degradation processes, would remain stable in the short term and decrease over time.

Anaerobic biodegradation is occurring at the Site, predominantly under sulfate-reducing and methanogenic conditions, which provides less energy and acts more slowly than aerobic biodegradation.

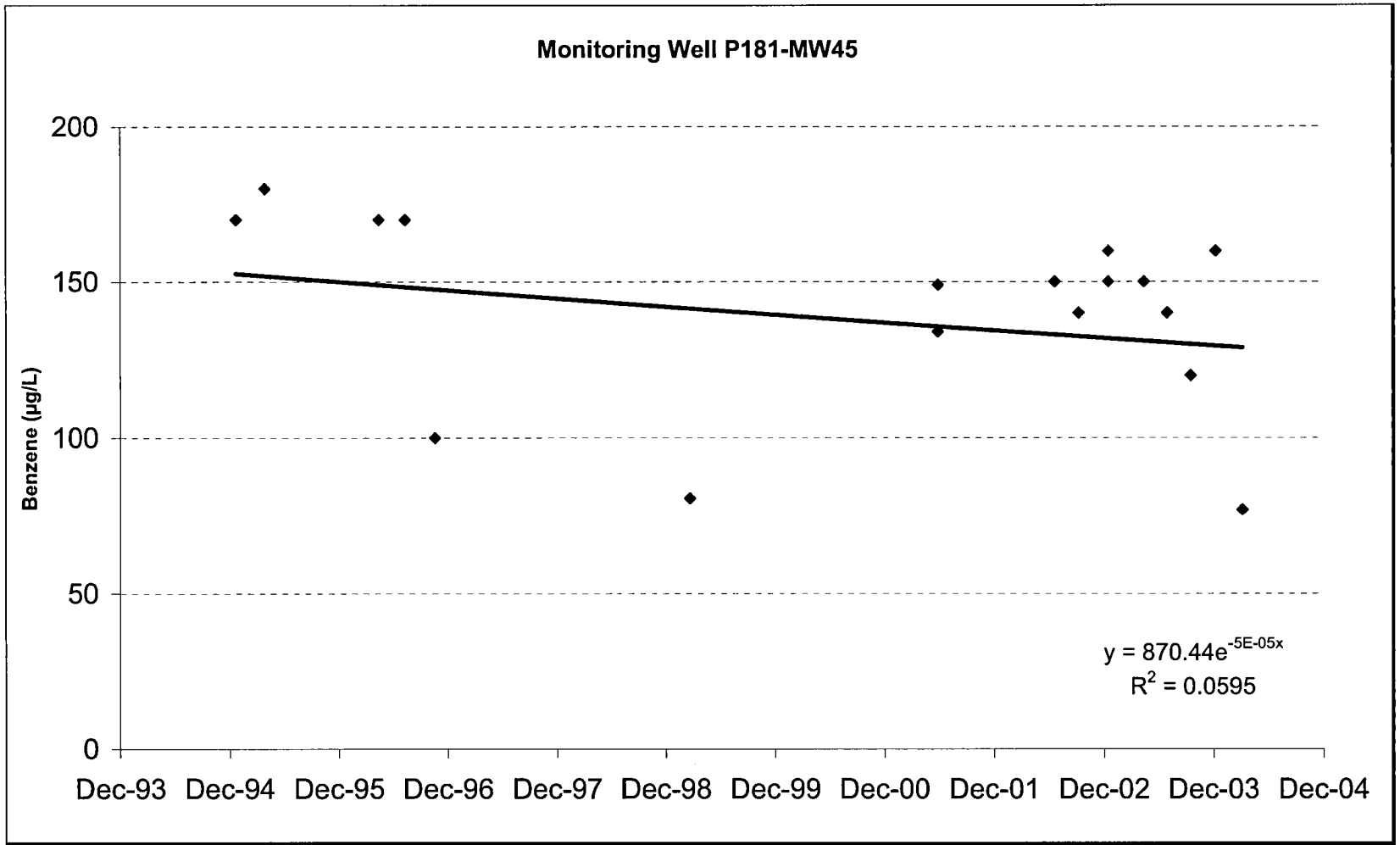


ERRG
Engineering/Remediation Resources Group, Inc.
185 Mason Circle, Suite A, Concord, CA 94520
Main: (925) 969-0750
Fax (925) 969-0751

First-Order Decay of Benzene in Monitoring Well EW-2
Alameda Point/Annex Groundwater RI/FS

CLIENT: UNITED STATES NAVY, SOUTHWEST DIVISION
NAVAL FACILITIES ENGINEERING COMMAND

SCALE:	DRAWING NO.:	LOCATION:			FIGURE:
not applicable	02-052_5-10	ALAMEDA POINT SITE 25/ ALAMEDA ANNEX IR-02			5-1
REFERENCE: I:\Projects\2002 Projects\22-052 RI FS Alameda Point\Figures\Figure 5-x time series plots		DESIGNED BY: RW	DRAWN BY: RW	RG/PE: CL	

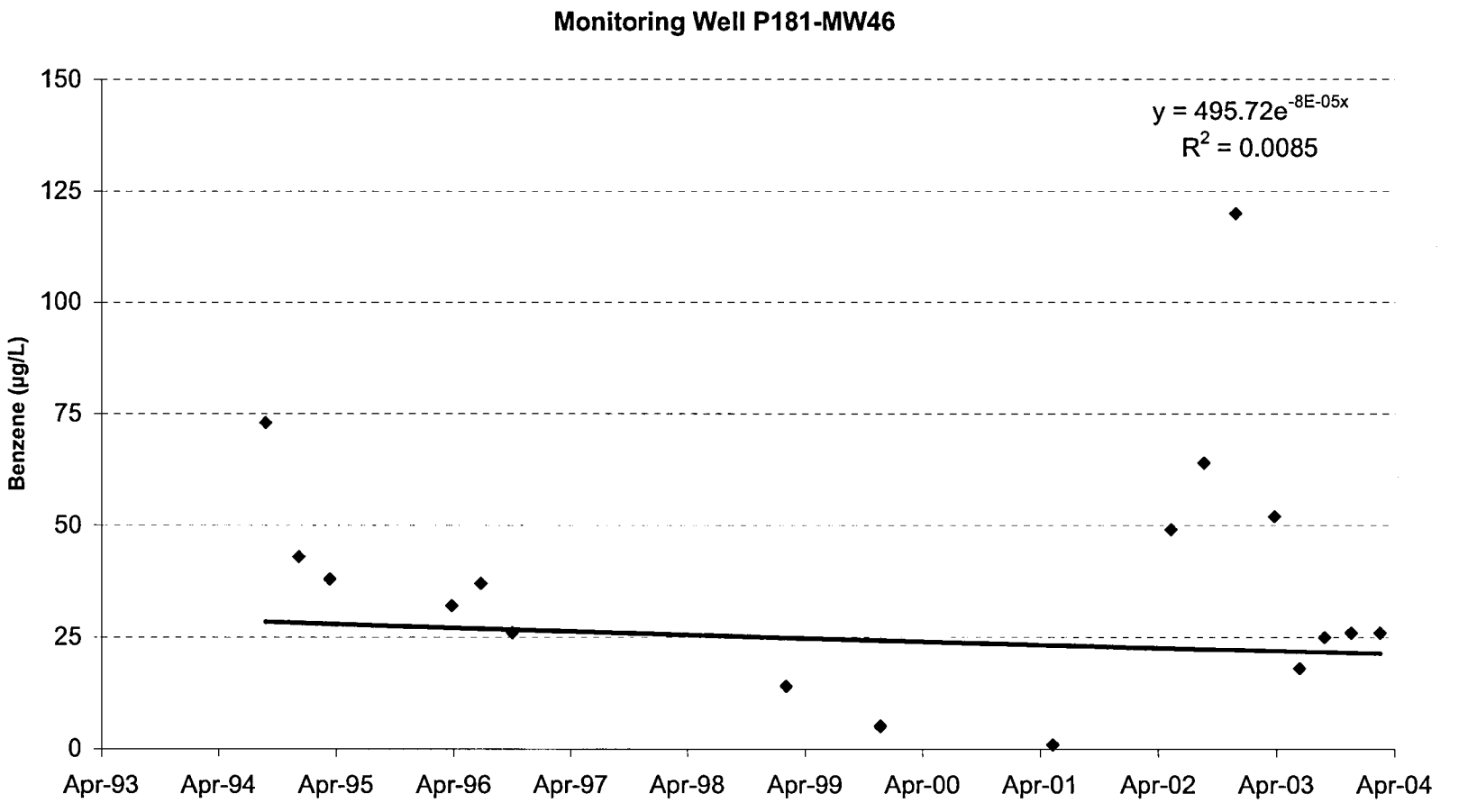


ERRG
Engineering/Remediation Resources Group, Inc.
185 Mason Circle, Suite A, Concord, CA 94520
Main: (925) 969-0750
Fax (925) 969-0751

First-Order Decay of Benzene in Monitoring Well P181-MW45
Alameda Point/Annex Groundwater RI/FS

CLIENT: UNITED STATES NAVY, SOUTHWEST DIVISION
NAVAL FACILITIES ENGINEERING COMMAND

SCALE:	DRAWING NO.:	LOCATION:			FIGURE:
not applicable	02-052_5-11	ALAMEDA POINT SITE 25/ ALAMEDA ANNEX IR-02			5-2
REFERENCE: I:\Projects\2002 Projects\22-052 RI FS Alameda Point\Figures\Figure 5-x time series plots		DESIGNED BY: RW	DRAWN BY: RW	RG/PE: CL	

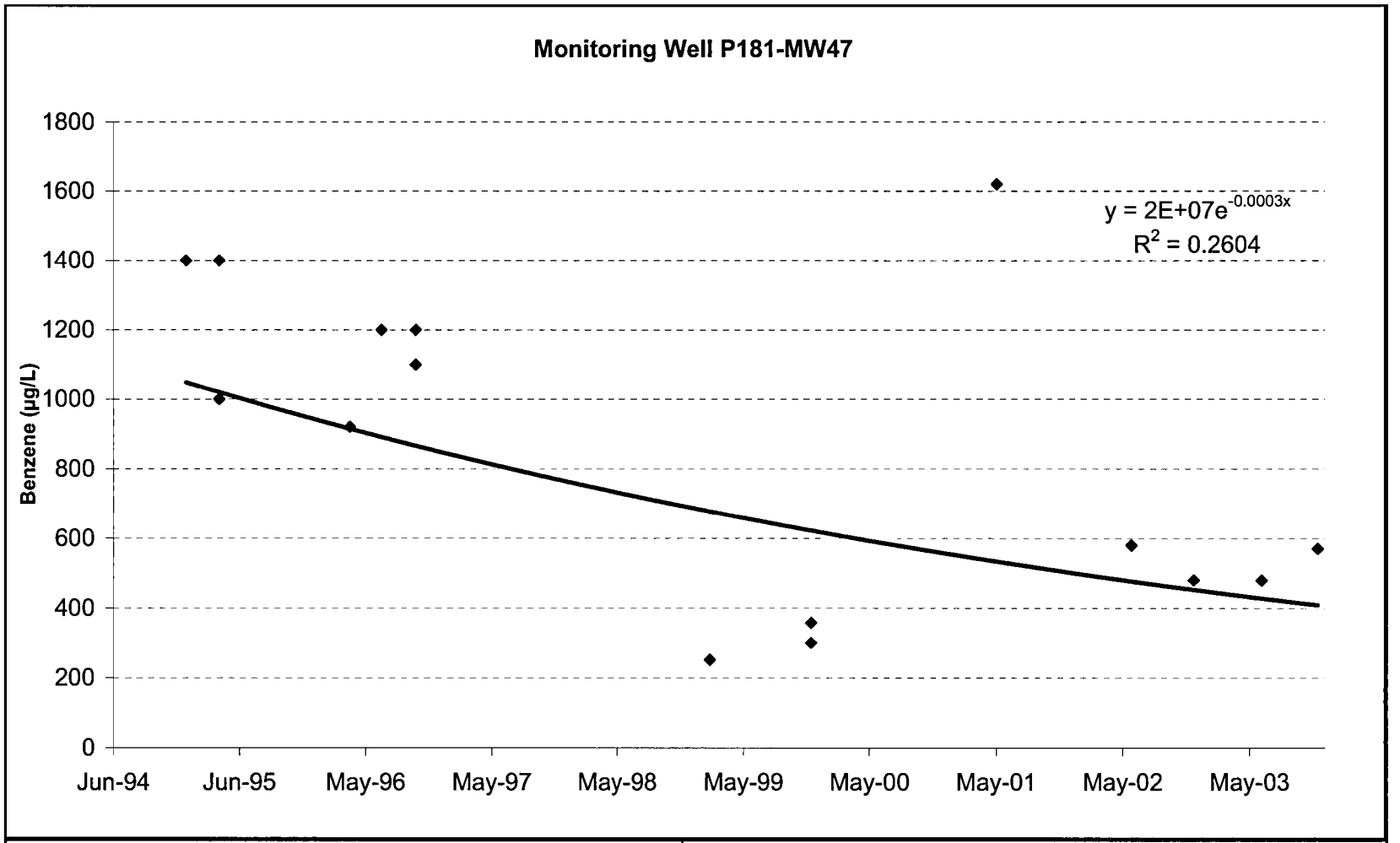


ERRG
Engineering/Remediation Resources Group, Inc.
185 Mason Circle, Suite A, Concord, CA 94520
Main: (925) 969-0750
Fax (925) 969-0751

First-Order Decay of Benzene in Monitoring Well P181-MW46
Alameda Point/Annex Groundwater RI/FS

CLIENT: UNITED STATES NAVY, SOUTHWEST DIVISION
NAVAL FACILITIES ENGINEERING COMMAND

SCALE:	DRAWING NO.:	LOCATION:			FIGURE:
not applicable	02-052_5-1	ALAMEDA POINT SITE 25/ ALAMEDA ANNEX IR-02			5-3
REFERENCE: I:\Projects\2002 Projects\22-052 RI FS Alameda Point\Figures\Figure 5-x time series plots		DESIGNED BY: RW	DRAWN BY: RW	RG/PE: CL	

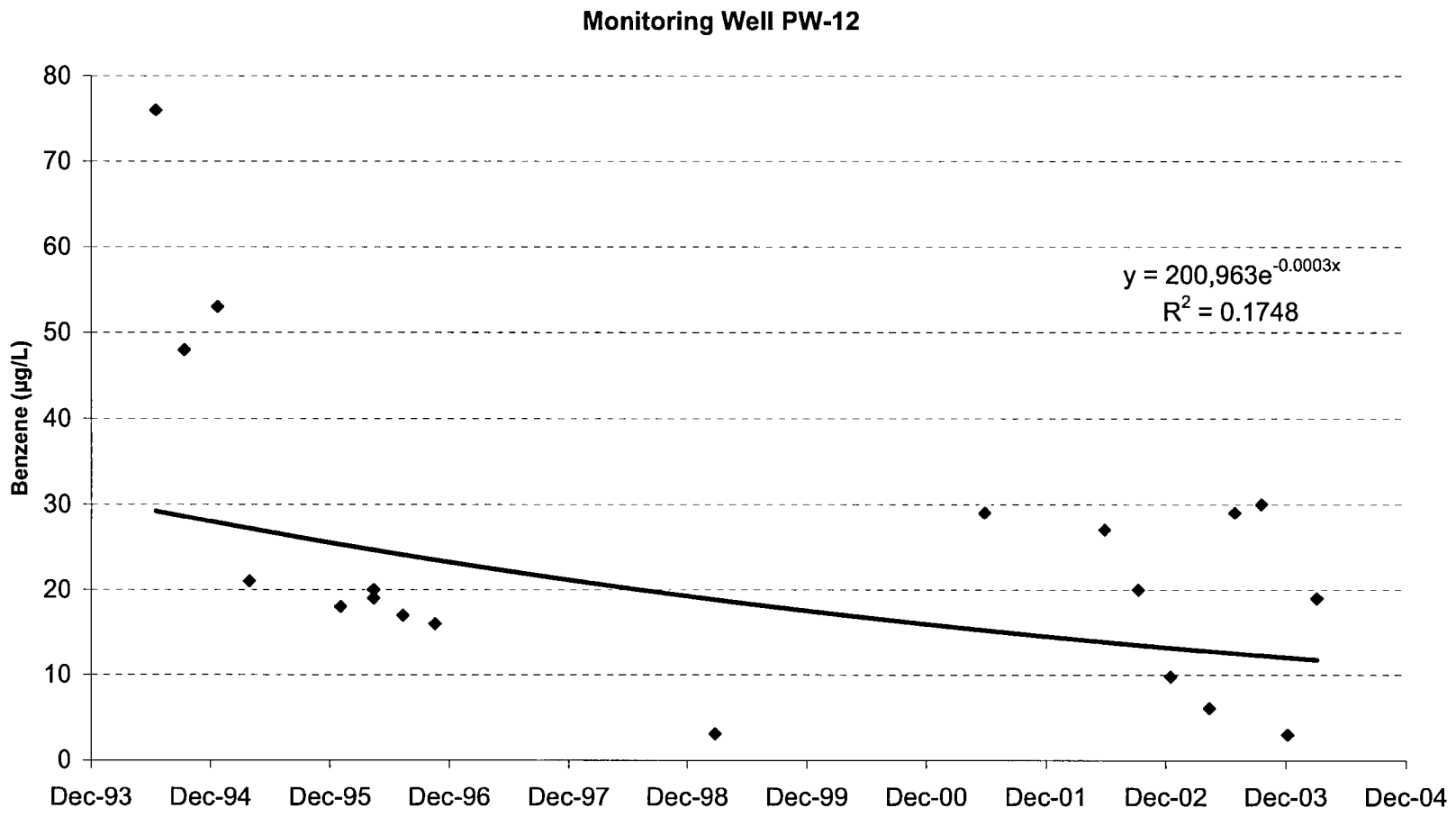


ERRG
Engineering/Remediation Resources Group, Inc.
185 Mason Circle, Suite A, Concord, CA 94520
Main: (925) 969-0750
Fax (925) 969-0751

First-Order Decay of Benzene in Monitoring Well P181-MW47
Alameda Point/Annex Groundwater RI/FS

CLIENT: UNITED STATES NAVY, SOUTHWEST DIVISION
NAVAL FACILITIES ENGINEERING COMMAND

SCALE:	DRAWING NO.:	LOCATION:			FIGURE:
not applicable	02-052_5-2	ALAMEDA POINT SITE 25/ ALAMEDA ANNEX IR-02			5-4
REFERENCE: I:\Projects\2002 Projects\22-052 RI FS Alameda Point\Figures\Figure 5-x time series plots		DESIGNED BY: RW	DRAWN BY: RW	RG/PE: CL	

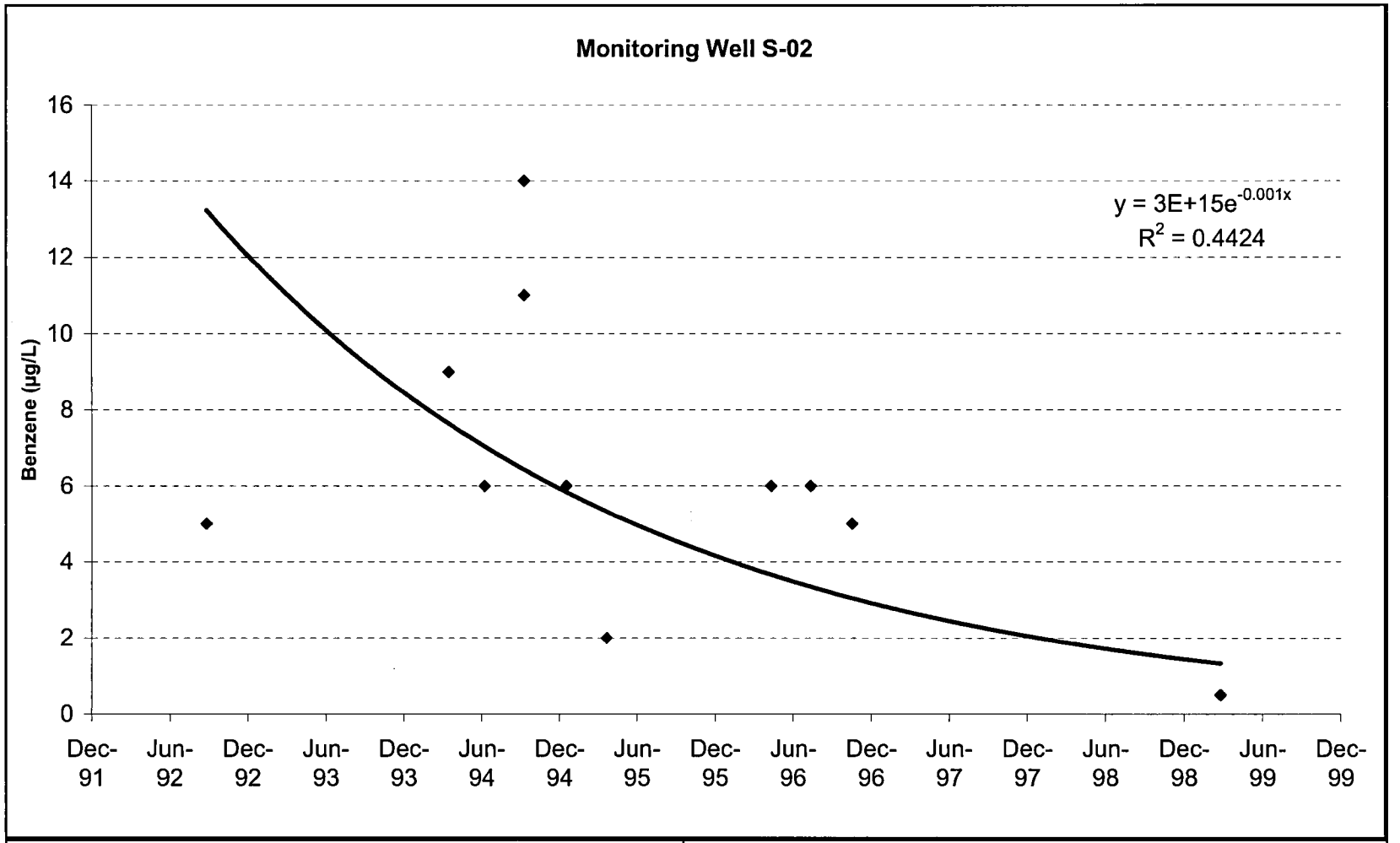


ERRG
Engineering/Remediation Resources Group, Inc.
185 Mason Circle, Suite A, Concord, CA 94520
Main: (925) 969-0750
Fax (925) 969-0751

First-Order Decay of Benzene in Monitoring Well PW-12
Alameda Point/Annex Groundwater RI/FS

CLIENT: UNITED STATES NAVY, SOUTHWEST DIVISION
NAVAL FACILITIES ENGINEERING COMMAND

SCALE:	DRAWING NO.:	LOCATION:			FIGURE:
not applicable	02-052_5-3	ALAMEDA POINT SITE 25/ ALAMEDA ANNEX IR-02			5-5
REFERENCE: I:\Projects\2002 Projects\22-052 RI FS Alameda Point\Figures\Figure 5-x time series plots		DESIGNED BY: RW	DRAWN BY: RW	RG/PE: CL	

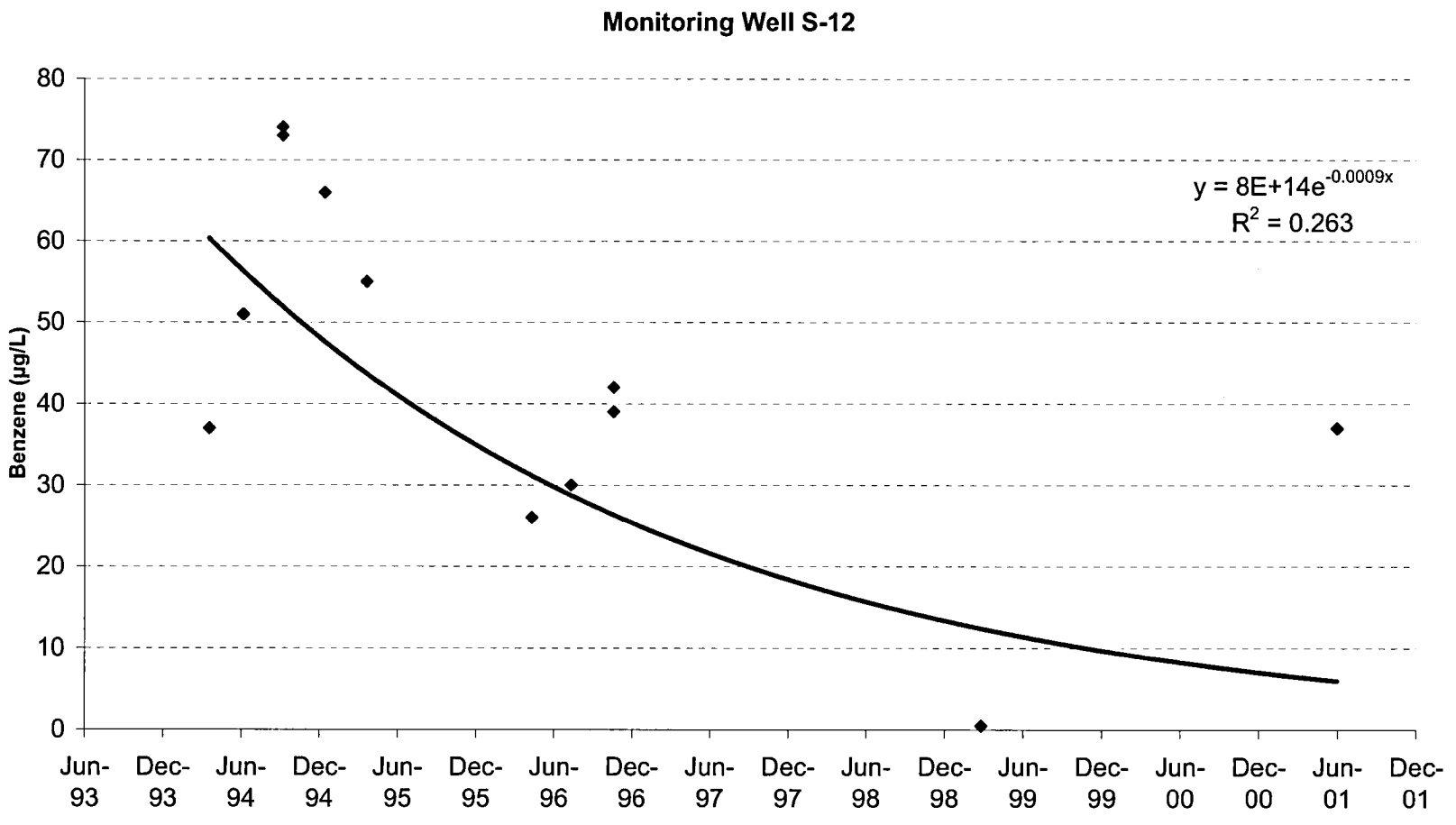


ERRG
Engineering/Remediation Resources Group, Inc.
185 Mason Circle, Suite A, Concord, CA 94520
Main: (925) 969-0750
Fax (925) 969-0751

First-Order Decay of Benzene in Monitoring Well S-02
Alameda Point/Annex Groundwater RI/FS

CLIENT: UNITED STATES NAVY, SOUTHWEST DIVISION
NAVAL FACILITIES ENGINEERING COMMAND

SCALE:	DRAWING NO.:	LOCATION:			FIGURE:
not applicable	02-052_5-4	ALAMEDA POINT SITE 25/ ALAMEDA ANNEX IR-02			5-6
REFERENCE: I:\Projects\2002 Projects\22-052 RI FS Alameda Point\Figures\Figure 5-x time series plots		DESIGNED BY: RW	DRAWN BY: RW	RG/PE: CL	

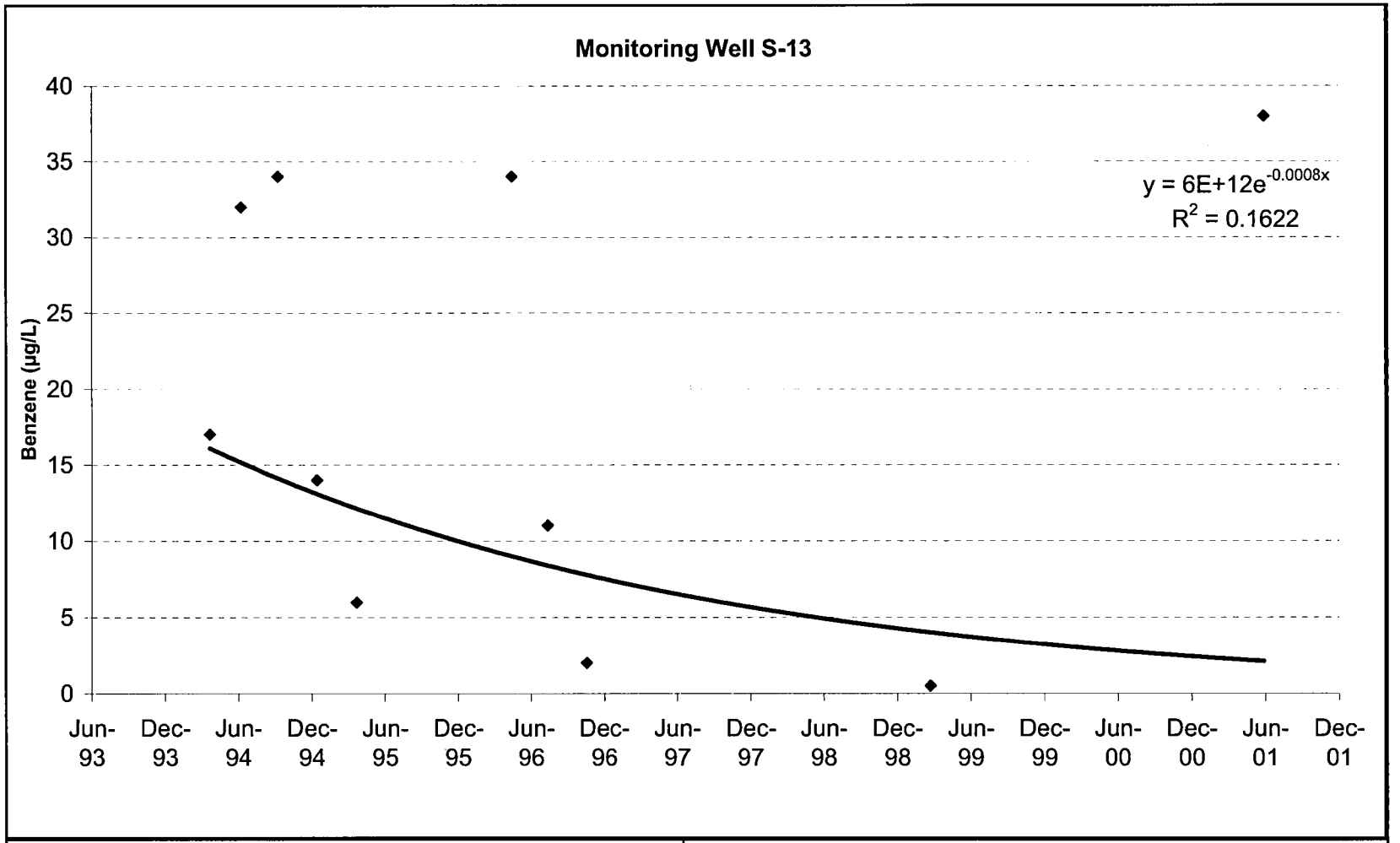


ERRG
Engineering/Remediation Resources Group, Inc.
185 Mason Circle, Suite A, Concord, CA 94520
Main: (925) 969-0750
Fax (925) 969-0751

First-Order Decay of Benzene in Monitoring Well S-12
Alameda Point/Annex Groundwater RI/FS

CLIENT: UNITED STATES NAVY, SOUTHWEST DIVISION
NAVAL FACILITIES ENGINEERING COMMAND

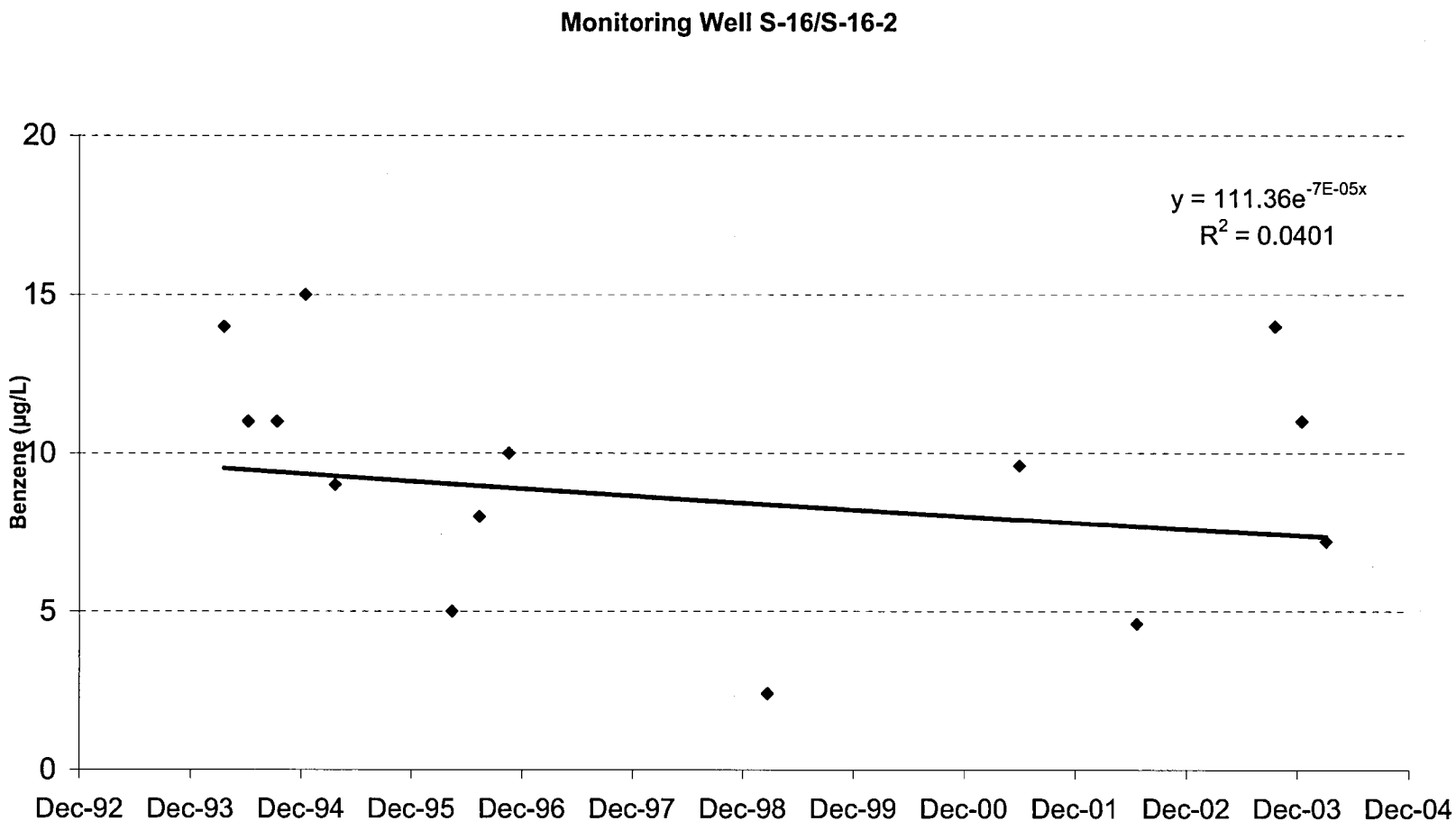
SCALE:	DRAWING NO.:	LOCATION:			FIGURE:
not applicable	02-052_5-5	ALAMEDA POINT SITE 25/ ALAMEDA ANNEX IR-02			5-7
REFERENCE: I:\Projects\2002 Projects\22-052 RI FS Alameda Point\Figures\Figure 5-x time series plots		DESIGNED BY: RW	DRAWN BY: RW	RG/PE: CL	



ERRG
Engineering/Remediation Resources Group, Inc.
185 Mason Circle, Suite A, Concord, CA 94520
Main: (925) 969-0750
Fax (925) 969-0751

First-Order Decay of Benzene in Monitoring Well S-13
Alameda Point/Annex Groundwater RI/FS

CLIENT:	UNITED STATES NAVY, SOUTHWEST DIVISION NAVAL FACILITIES ENGINEERING COMMAND
SCALE:	not applicable
DRAWING NO.:	02-052_5-6
LOCATION:	ALAMEDA POINT SITE 25/ ALAMEDA ANNEX IR-02
REFERENCE:	I:\Projects\2002 Projects\22-052 RI FS Alameda Point\Figures\Figure 5-x time series plots
DESIGNED BY:	RW
DRAWN BY:	RW
RG/PE:	CL
FIGURE:	5-8



ERRG
Engineering/Remediation Resources Group, Inc.
185 Mason Circle, Suite A, Concord, CA 94520
Main: (925) 969-0750
Fax (925) 969-0751

First-Order Decay of Benzene in Monitoring Well S-16/S-16-2[a]
Alameda Point/Annex Groundwater RI/FS

CLIENT: UNITED STATES NAVY, SOUTHWEST DIVISION
NAVAL FACILITIES ENGINEERING COMMAND

SCALE: not applicable

NOTE: [a] S-16 replaced by S-16-2 due to access problems

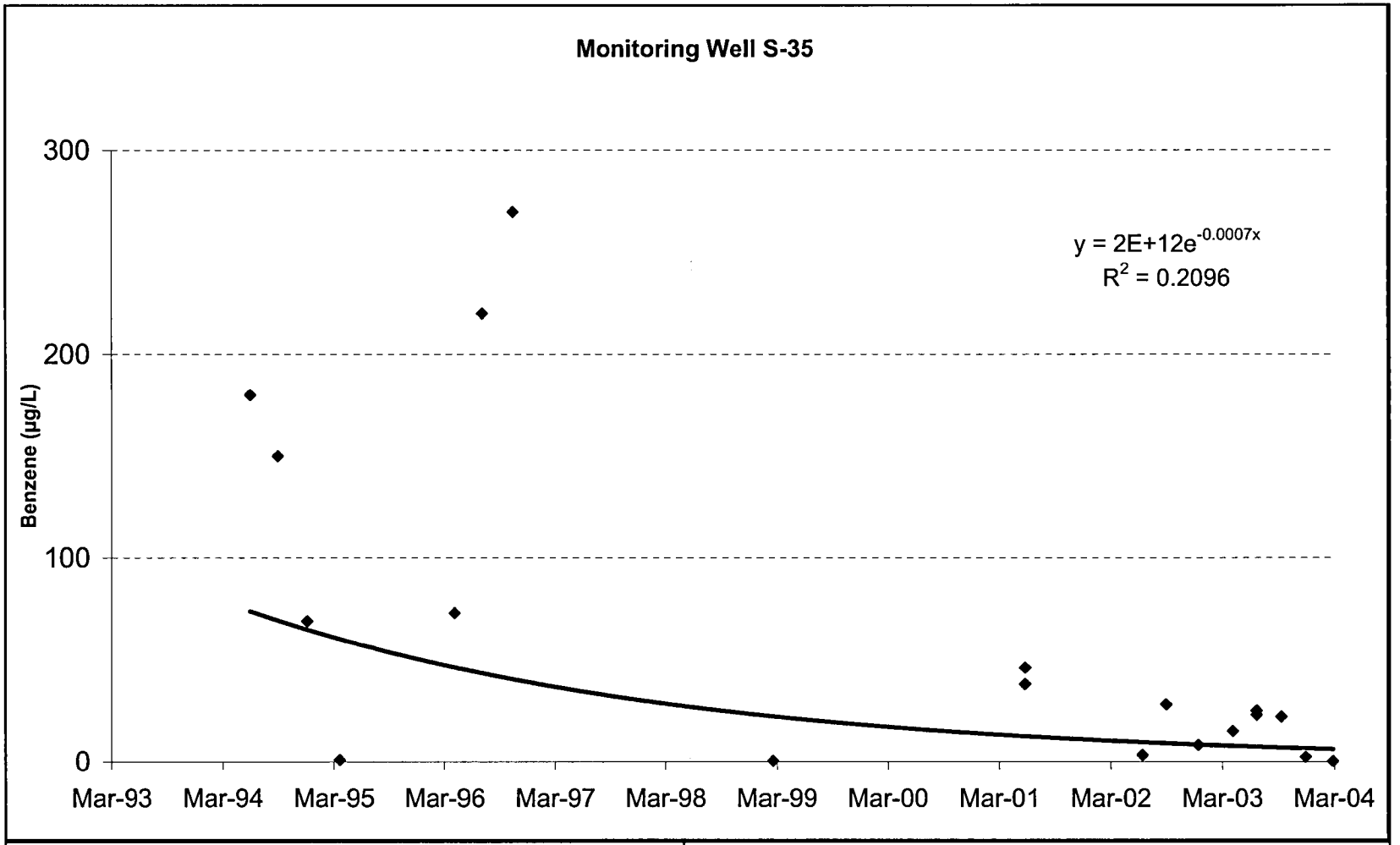
DRAWING NO.: 02-052_5-19

LOCATION: ALAMEDA POINT SITE 25/
ALAMEDA ANNEX IR-02

REFERENCE: I:\Projects\2002 Projects\22-052 RI FS Alameda Point\Figures\Figure 5 x time series plots

DESIGNED BY: RW | DRAWN BY: RW | RG/PE: CL | FIGURE:

5-9

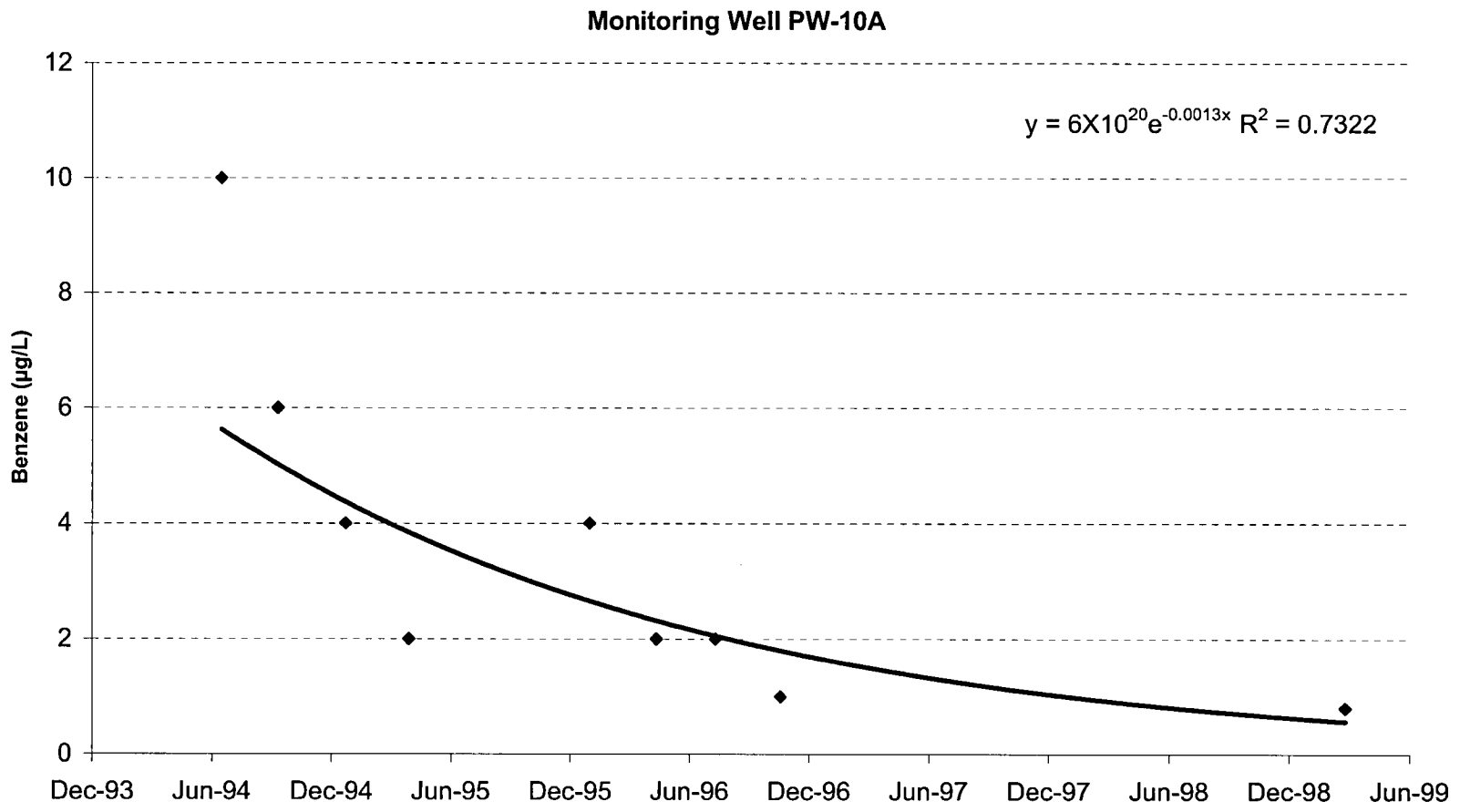


ERRG
Engineering/Remediation Resources Group, Inc.
185 Mason Circle, Suite A, Concord, CA 94520
Main: (925) 969-0750
Fax (925) 969-0751

First-Order Decay of Benzene in Monitoring Well S-35
Alameda Point/Annex Groundwater RI/FS

CLIENT: UNITED STATES NAVY, SOUTHWEST DIVISION
NAVAL FACILITIES ENGINEERING COMMAND

SCALE:	DRAWING NO.:	LOCATION:			
not applicable	02-052_5-18	ALAMEDA POINT SITE 25/ ALAMEDA ANNEX IR-02			5-10
REFERENCE: I:\Projects\2002 Projects\22-052 RI FS Alameda Point\Figures\Figure 5-x time series plots		DESIGNED BY: RW	DRAWN BY: RW	RG/PE: CL	FIGURE:

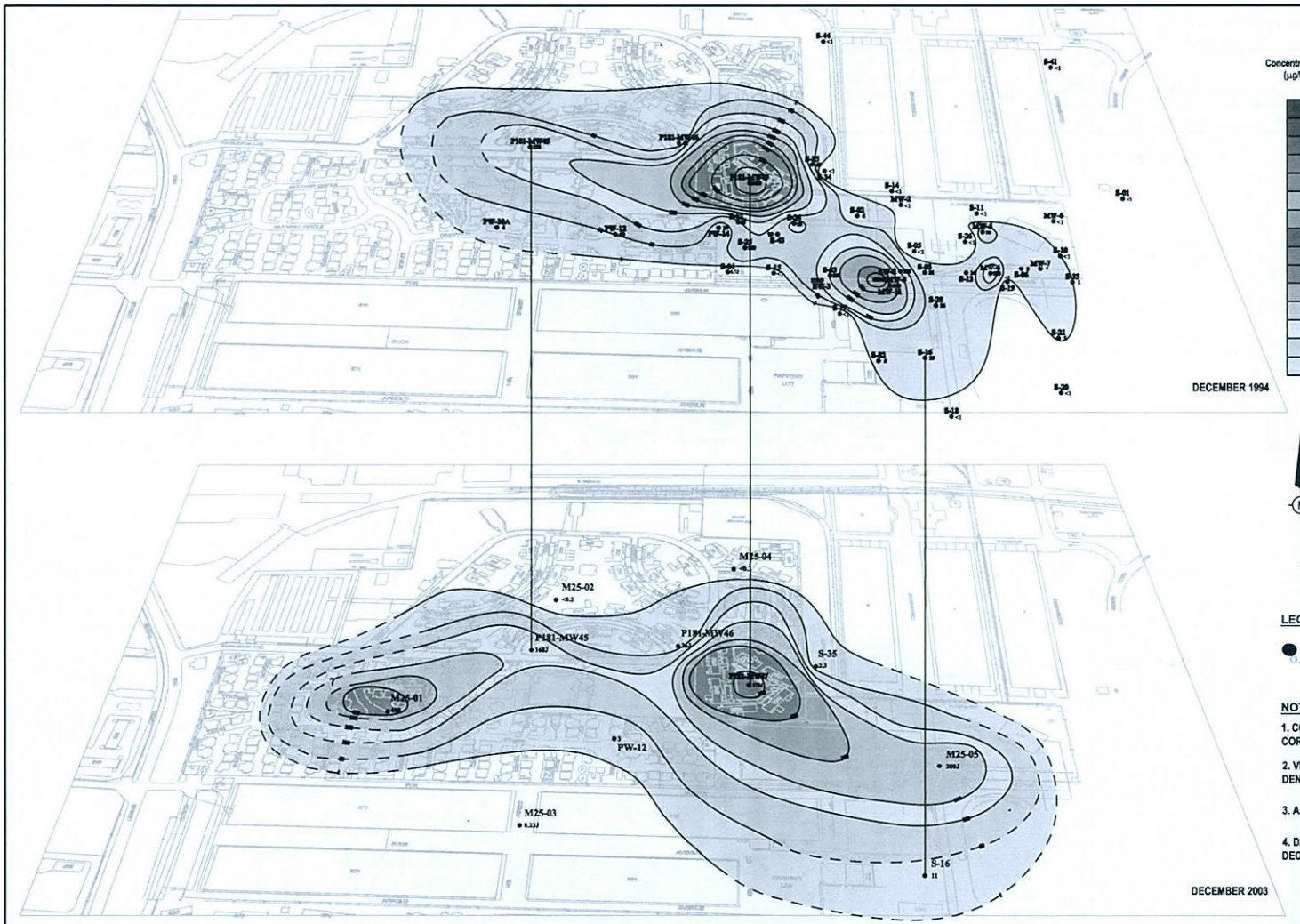


ERRG
Engineering/Remediation Resources Group, Inc.
185 Mason Circle, Suite A, Concord, CA 94520
Main: (925) 969-0750
Fax (925) 969-0751

First-Order Decay of Benzene in Monitoring Well PW10-A
Alameda Point/Annex Groundwater RI/FS

CLIENT: UNITED STATES NAVY, SOUTHWEST DIVISION
NAVAL FACILITIES ENGINEERING COMMAND

SCALE:	DRAWING NO.:	LOCATION:			FIGURE:
not applicable	02-052_5-7	ALAMEDA POINT SITE 25/ ALAMEDA ANNEX IR-02			5-11
REFERENCE: I:\Projects\2002 Projects\22-052 RI FS Alameda Point\Figures\Figure 5-x time series plots		DESIGNED BY: RW	DRAWN BY: RW	RG/PE: CL	



Concentrations (µg/L)

6000
5000
4000
3000
2000
1500
1000
750
500
400
300
200
100
50
0

N

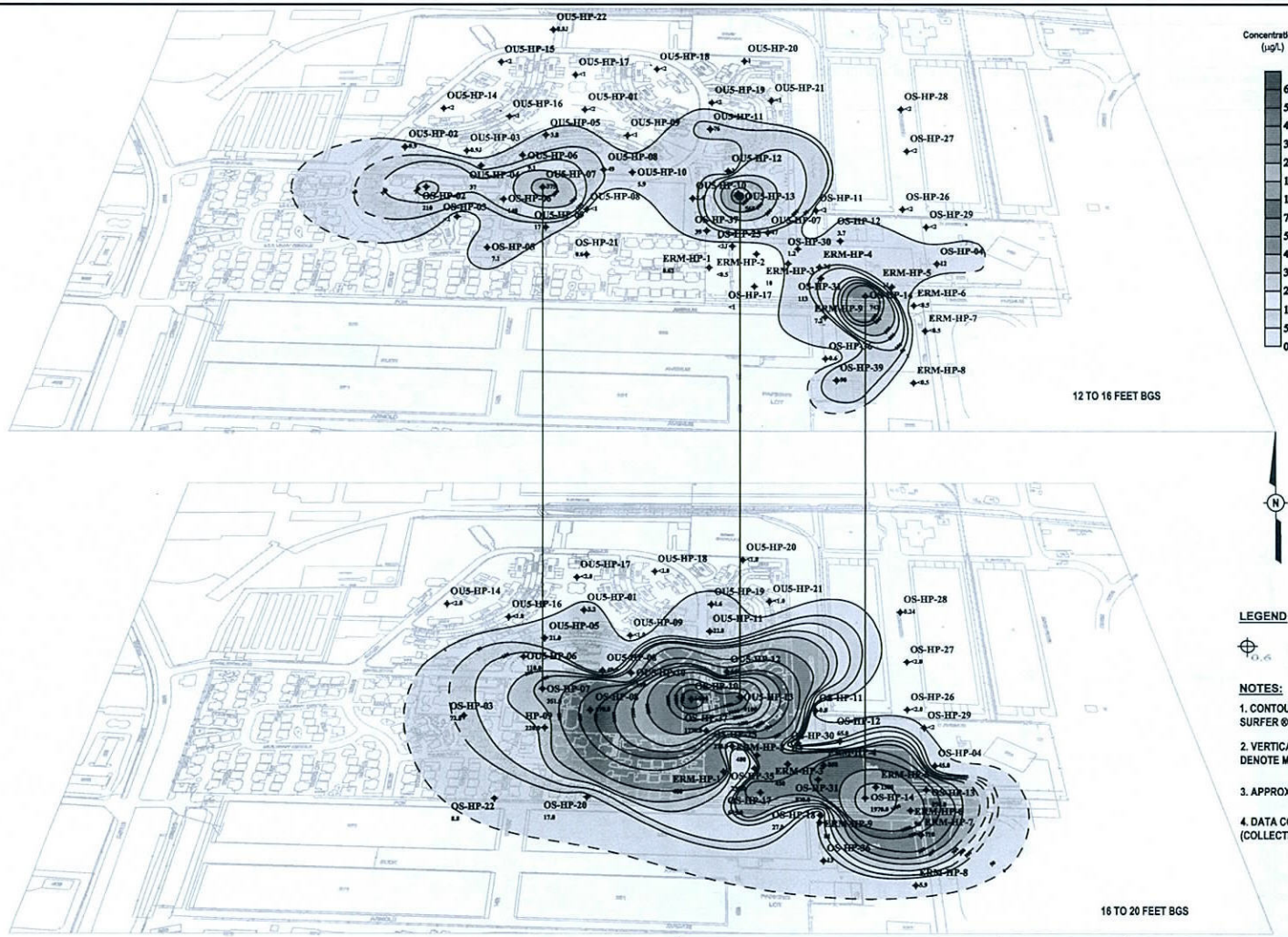
LEGEND

SHALLOW GROUNDWATER MONITORING WELL WITH BENZENE CONCENTRATION IN µg/L

NOTES:

1. CONTOURS WERE GENERATED IN SURFER® AND HAND CORRECTED.
2. VERTICAL LINES CONNECTING CONTOURS MAPS DENOTE MATCHING LOCATIONS.
3. APPROXIMATE CONTOURS SHOWN WITH DASHED LINES.
4. DATA COLLECTED IN DECEMBER 1994 (FIGURE 4-2) AND DECEMBER 2003 (FIGURE 4-8)

ERRG Engineering/Remediation Resources Group, Inc. 185 Mason Circle, Suite A Concord, California 94520 (925) 969-0750	DRAWN BY: L.H. 7/6/04	BENZENE GROUNDWATER CONTOUR MAP 1994 MONITORING WELL DATA VS. 2003 MONITORING WELL DATA	
	DESIGNED BY: C.L. 7/6/04	CLIENT: NAVY SWDIV	FIGURE: 5-12
	CHECKED BY: P.F. 7/6/04	DWG. NO. 22-052-FIGURE 5-12	



Concentrations (µg/L)

6000
5000
4000
3000
2000
1500
1000
750
500
400
300
200
100
50
0

N

LEGEND

0.6 - HYDROPUNCH SAMPLE LOCATIONS WITH BENZENE CONCENTRATION IN µg/L

NOTES:

1. CONTOURS WERE GENERATED IN GOLDEN SOFTWARE SURFER ® AND HAND CORRECTED.
2. VERTICAL LINES CONNECTING CONTOURS MAPS DENOTE MATCHING LOCATIONS.
3. APPROXIMATE CONTOURS SHOWN WITH DASHED LINES.
4. DATA COLLECTED IN JUNE 2001 EXCEPT "ERM-HP" DATA (COLLECTED IN MARCH 2001).

ERRG
Engineering/Remediation Resources Group, Inc.
185 Mason Circle, Suite A
Concord, California 94520
(925) 969-0750

DRAWN BY: R.W. 6/30/04	2001 BENZENE CONTOUR MAP 12'-16' bgs VS. 16'-20' bgs HYDROPUNCH DATA	
DESIGNED BY: C.L. 6/30/04	CLIENT: NAVY SWDIV	FIGURE: 5-13
CHECKED BY: P.F. 7/1/04	DWG. NO. 22-052-FIGURE 5-13	

6. RISK ASSESSMENT

As part of this RI/FS, a HHRA was conducted to evaluate potential risks to human health posed by chemical substances detected in groundwater at the Site. This HHRA is based on groundwater and soil gas data only. This section summarizes the findings of the HHRA. A complete copy of the assessment is provided in Appendix E. The risk assessment was performed in accordance with the USEPA's *Risk Assessment Guidance for Superfund: Volume I—Human Health Evaluation Manual* (USEPA, 1989), and California Department of Toxic Substances Control (DTSC) *Supplemental Guidance for Human Health Multimedia Risk Assessments of Hazardous Waste Sites and Permitted Facilities* (DTSC, 1992), and includes summary tables per these guidance documents. Total risk, including risk due to soil exposure for Alameda Point Site 25 (Parcels 181, 182, and 183) will be presented in the OU-5 Proposed Plan. Cumulative risk at Alameda Point Site 30 (Parcels 179 and 180) and Site 31 (Parcels 178 and 184) will be included in future documents associated with those IR sites.

The HHRA performed for this report used the latest available analytical data to evaluate all applicable exposure pathways for the Site, including the use of shallow groundwater as a potable drinking water supply. Specifically, higher benzene concentrations were used than in previous HHRAs performed for both Alameda Point OU-5 and the Alameda Annex. The higher concentrations of benzene were found during the Alameda Point OU-5 RI (IT et al., 2002) in Hydropunch™ samples collected at approximately 20 feet bgs. The Hydropunch™ samples contained higher concentrations than historically have been detected in site monitoring wells, because the wells' screened intervals often included shallower depths.

The following sections describe the HHRA results, exposure pathways, fate and transport assumptions, and exposure point concentration data. The subsequent sections describe ecological risk assessment (ERA) methodologies and results.

6.1. SUMMARY OF HHRA RESULTS

As shown in Table 6-1, carcinogenic and non-carcinogenic risks for non-potable uses were within USEPA's risk management range (10^{-4} to 10^{-6}). As expected, risks for scenarios including domestic potable water use exceeded USEPA's risk management range. The results of this HHRA are similar to those of the previous HHRA performed for the Alameda Annex, with risk levels within USEPA's risk management range for all non-ingestion pathways.

The findings of this HHRA indicate that, under current land use scenarios, risks to residents, students, and workers at the site are within the USEPA'a risk management range. If groundwater wells were installed, use of groundwater would not pose an unacceptable cancer risk to car wash and landscape workers if used as non-potable water. Under the non-potable water use scenarios, the non-carcinogenic HIs ranged from 0.29 to 0.99. Because the entire range is below the acceptable level of 1.0, adverse health effects to

workers are considered unlikely. Additionally, potential inhalation of VOCs in indoor air by residential and school receptors does not pose an unacceptable risk. Assuming no domestic potable water use, benzene contributed approximately 95 percent of the cancer risk, and benzene and naphthalene combined contributed approximately 98 percent of the non-cancer risks; the remainder of the risk was attributable to other contaminants. These calculations rely on multiple conservative assumptions and overestimate the actual risks posed by the Site.

Table 6-1
Summary of Tier 2 HHRA Results
Alameda Point Site 25/Alameda Annex IR-02 Groundwater RI/FS

Exposure Scenario	Non-Carcinogenic Hazard Index		Carcinogenic Risk	
	Average Exposure	Reasonable Maximum Exposure	Average Exposure	Reasonable Maximum Exposure
Assuming No Domestic Potable Water Use (500-foot radius Kriging)				
Car Wash Worker	0.38	0.99	2×10^{-6}	2×10^{-5}
Landscape Worker	0.66	0.98	3×10^{-6}	3×10^{-5}
Resident	0.29	0.29	1×10^{-5}	1×10^{-5}
School Worker	0.29	0.29	7×10^{-6}	7×10^{-6}
School Student	0.29	0.29	2×10^{-6}	2×10^{-6}
Assuming Domestic Potable Water Use (500-foot radius Kriging)				
Resident	88	145	5×10^{-3}	2×10^{-2}

The hypothetical ingestion of groundwater under any of the resident scenario would present unacceptable risks. Non-carcinogenic HIs ranged from 88 to 145, and carcinogenic risks ranged from 5×10^{-3} to 2×10^{-2}, due primarily to the benzene and naphthalene concentrations in groundwater. However, use of groundwater as a potable water supply is an unlikely scenario.

The following sections describe the methodology and parameters used in calculating the risks. Additional detail is presented in Appendix E.

6.2. EXPOSURE PATHWAYS

Risk assessments calculate risk only for complete source-pathway-receptor relationships. Four prerequisites are required for a source-pathway-receptor relationship to be considered complete:

1. A chemical source (such as dissolved-phase benzene in shallow groundwater);
2. A release mechanism and transport pathway to a point of contact (e.g., volatilization of benzene in groundwater and migration as soil gas);
3. An exposure medium (such as vapors or contact with groundwater); and
4. An exposure route (e.g., inhalation, dermal contact).

The exposure scenarios with the greatest potential for completion are:

- On-site residents, students, and school-workers theoretically exposed to vapor intrusion into indoor air.
- Workers theoretically exposed to contamination in groundwater during the operation of a commercial car wash.
- Maintenance/landscape workers theoretically exposed to contaminants in groundwater through irrigation activities.

Direct exposure to groundwater under a potable water supply was also considered based on input from stakeholders. Although the RWQCB concurred that groundwater beneath Alameda Annex IR-02 is exempted, groundwater ingestion has been included in the HHRA for completeness. Direct exposure pathways to groundwater as a potable water supply are:

- Ingestion of water by commercial workers and residential receptors.
- Inhalation of contaminants from water by residential receptors resulting from household use (showering, etc.).

It is important to note that groundwater at the site is currently not used as a potable water supply, and that any future development at the site will include connecting the developments to the existing municipal water supply.

6.3. FATE AND TRANSPORT ASSUMPTIONS

Under both the car wash and landscape worker scenarios, the theoretical inhalation of contamination was based on volatilization of water during operation of spray jets and sprinklers. The air concentrations resulting from these water use scenarios are based on activity-specific water use rates, chemical transfer efficiency from air to water, and ambient air dilution.

The estimated use of water during a car wash, as provided by two car wash manufacturers, averaged 0.14 liters per second, with a maximum of 0.22 liters per second. The portion of the day spent continuously spraying water was conservatively estimated at 3 to 5 hours per day. To estimate the amount of chemical that volatilizes during water spraying, the efficiency at which a chemical transfers from water to air was calculated using DTSC guidelines that have been developed for estimating chemical transfer during domestic showering (described in detail in Appendix E). Once the amount of chemical volatilized during an event was estimated, an air concentration was derived based on simple mixing and diffusion with ambient outdoor air.

Under the lawn irrigation/landscape worker scenario, the water use rate was based on the water needs for growing lawn in the Alameda area. This water use rate was estimated using methods developed by the Center for Irrigation Technology, California State University – Fresno, and the U.S. Bureau of Reclamation. Eight different turf crops were considered: Bentgrass, Bermuda, Bluegrass, Kikuyu,

Paspalm, Ryegrass, St. Augustine, and Tall Fescue. The average irrigation need per workday was determined to be 0.0033 cubic meters per square meters per day (m^3/m^2-d), with a maximum of 0.0076 m^3/m^2-d. An application rate was derived based on the irrigation rate, an 8-hour workday, and a 100-foot by 100-feet area (929 m^2). The chemical air emission rate was then based on the application rate, transfer efficiency, and groundwater concentration. Once the amount of chemical volatilized during an event was estimated, an air concentration was derived based on simple mixing and diffusion with ambient outdoor air.

For the residential exposure scenario, the volatilization of groundwater constituents into soil gas that migrates into indoor air was estimated using a heuristic model known as the Johnson and Ettinger model, which was also used for previous HHRAs. The Johnson and Ettinger model, as modified by DTSC to include California Environmental Protection Agency (Cal/EPA) toxicity criteria, was used for this HHRA to provide an output of predicted health risks associated with groundwater concentrations in indoor air. The default chemical properties provided in USEPA guidance were used where available. A slab-on-grade construction was assumed, and a default value of 15 centimeters was used for the depth below grade to the bottom of the enclosed space floor. The depth to groundwater was assumed to be 7.2 feet bgs based on observed depths to groundwater at Alameda Annex IR-02 (depths to groundwater within OU-5 are comparable). Soil properties taken from soil boring logs collected at the site identified the subsurface soil as a sandy loam. These parameters were the basis of the Johnson and Ettinger model as described in further detail in Appendix E.

To test the validity of the Johnson and Ettinger model, a second risk assessment was performed using actual soil gas data rather than modeled concentrations assumed to volatilize from contaminated groundwater. Benzene concentrations detected in soil gas are lower than concentrations predicted by the Johnson and Ettinger model. This may be due to areas of clay material in the vadose zone limiting vapor migration to the surface, or to the weathered nature of the groundwater contamination. In addition, benzene concentrations in soil gas were higher at Alameda Annex than at Alameda Point; thus, separate calculations were performed using the maximum detected concentration of benzene in each area to further refine estimated risks to human receptors. Table 6-2 summarizes the risks to residents, school workers, and school students modeled from exposure to soil gas in each area.

Actual concentrations of benzene in soil gas are lower than predicted by the Johnson and Ettinger model; therefore, the calculated risks were more than 1 order of magnitude lower, and the Tier 2 HHRA was overly conservative. The findings of this revised risk assessment indicate that soil gas exposure does not pose an unacceptable cancer or non-cancer risk to current or potential future residents, students, or school workers at Alameda Point or Alameda Annex. At Alameda Point, the non-carcinogenic HIs and carcinogenic risks for all three receptors were 0.0076 and 5×10^{-8}, respectively, well below the acceptable

Table 6-2
Summary of Tier 2 HHRA Results Modeled from Soil Gas Data
Alameda Point Site 25/Alameda Annex IR-02 Groundwater RI/FS

Exposure Scenario	Location	Non-Carcinogenic Hazard Index		Carcinogenic Risk	
		Average Exposure	Reasonable Maximum Exposure	Average Exposure	Reasonable Maximum Exposure
Assuming No Domestic Potable Water Use					
Resident	Alameda Annex	0.0092	0.0092	1×10^{-6}	1×10^{-6}
	Alameda Point	0.0076	0.0076	5×10^{-8}	5×10^{-8}
School Worker	Alameda Annex	0.0087	0.0087	8×10^{-7}	8×10^{-7}
	Alameda Point	0.0076	0.0076	5×10^{-8}	5×10^{-8}
School Student	Alameda Annex	0.0084	0.0084	2×10^{-7}	2×10^{-7}
	Alameda Point	0.0076	0.0076	5×10^{-8}	5×10^{-8}

levels of 1.0 and 1×10^{-6}. This indicates that, under current land use conditions at Alameda Point with no domestic potable water use, there are no unacceptable risks to current residents, students, or school workers.

Likewise, at Alameda Annex, the non-carcinogenic HI ranges from 0.0084 to 0.0092 for these receptors, well below the acceptable level. The carcinogenic risk at Alameda Annex to these receptors ranges from 2×10^{-7} to 1×10^{-6}, at or below the USEPA's risk management range. Therefore, as Alameda Annex is redeveloped, adverse health effects to current or future residents, students, or school workers are considered unlikely.

6.4. EXPOSURE POINT CONCENTRATION DATA

This HHRA is based on accumulated data from both Alameda Point and the Alameda Annex. The most recent groundwater data, which were collected during the field-sampling program in 2001 and quarterly sampling events through 2003, have been incorporated into the data used for this analysis.

The HHRA was completed in a two-tiered stepwise manner. The Tier 1 evaluation, based on maximum detected concentrations for each constituent, was performed prior to a more site-specific Tier 2 evaluation. Exposure point concentrations in the Tier 2 assessment were adjusted to account for the following factors:

- Sampling methodologies (Hydropunch™ samples were not filtered in the field; the highest benzene concentrations detected were from Hydropunch™ samples).

- Organic carbon content – PAHs tend to adsorb onto organic carbon; USEPA default values were used in the adjustment.
- Geospatial considerations utilizing block kriging was performed for both a 500-foot radius and a 725-foot radius. Rationale for selection of these kriging radii is provided in the following section.

In both tiers of the analysis, data were included from all depths of the FWBZ, and from both the Alameda Point OU-5 and the Alameda Annex areas. Tier 2 Exposure point concentrations are presented as Table 6-3.

Table 6-3
Summary of Tier 2 HHRA Exposure Point Concentrations
Alameda Point Site 25/Alameda Annex IR-02 Groundwater RI/FS

Exposure Point	Contaminant of Concern	Exposure Point Concentration		Units	Statistic[1]
		Average Exposure	Maximum Reasonable		
Groundwater	Benzene	322	322	µg/L	725 feet
		494	494	µg/L	500 feet
	Naphthalene	3,231	3,231	µg/L	725 feet
		4,171	4,171	µg/L	500 feet
Indoor Air	Benzene	0.59	0.59	µg/m³	Modeled – 725 feet
		0.91	0.91	µg/m³	Modeled – 500 feet
	Naphthalene	2.1	2.1	µg/m³	Modeled – maximum
Carwash Worker Air	Benzene	0.060	0.18	µg/m³	Modeled – 725 feet
		0.093	0.28	µg/m³	Modeled – 500 feet
	Naphthalene	0.48	1.5	µg/m³	Modeled – 725 feet
		0.62	1.9	µg/m³	Modeled – 500 feet
Landscape Workplace Air	Benzene	0.18	0.41	µg/m³	Modeled – 725 feet
		0.27	0.63	µg/m³	Modeled – 500 feet
	Naphthalene	1.4	3.3	µg/m³	Modeled – 725 feet
		1.9	4.2	µg/m³	Modeled – 500 feet

[1] *Groundwater concentration or calculated concentration in air based on a 95 percent upper confidence level calculated with the kriging radius shown.*

According to USEPA guidance, chemicals with a frequency of detection less than or equal to 5 percent may be considered for elimination (USEPA, 1989). The exception for this risk assessment was n-butylbenzene, because of the relative magnitude of one of the groundwater n-butylbenzene results. Therefore, n-butylbenzene was the only analyte with a detection frequency less than 5 percent that retained a COPC for this risk assessment. Detection limits were also examined, to identify if high detection limits were an issue in selecting COPCs. Detection limits for several compounds were elevated (2,000 µg/L) in a single sample; however, detection limits for the remaining samples are lower by an

order of magnitude or more. As discussed in Section 4.5.4, detection limits have typically been below their respective project required reporting limits.

6.5. SELECTION OF BLOCK KRIGING RADII

Because cancer risks and HIs for reasonably foreseeable complete exposure pathways were driven by the estimated exposures to benzene and naphthalene, respectively, Tier 2 concentrations were calculated for benzene and naphthalene in groundwater and benzene in soil gas. As described in further detail in Appendix E, Section 2.6.1, block kriging was used as a geostatistical method to calculate the exposure concentration over an area. If groundwater wells were installed and groundwater pumped for industrial or domestic potable water use, groundwater would be drawn down and a "cone of depression" would be created. The kriging radius selected for an HHRA is usually an approximation of the radius of this cone of depression.

Shallow aquifer, constant discharge pump testing was completed on wells S22 and S9 in August 1994. The results were reported in Volume I of the final Alameda Annex RI (PRC and Versar, 1996).

The shallow aquifer was capable of providing a sustained yield of 0.5 gallons per minute (gpm) during constant discharge pump testing at wells S22 and S9. Equilibrium appeared to be reached approximately 18 hours into the pump tests, with discharge durations of 74 and 68 hours for wells S22 and S9, respectively. The maximum radius of influence for the cone of depression is assumed to have extended approximately 100 feet beyond the pumping well in both instances (the S22 radius was between 90 and 110 feet, and the S9 radius was slightly greater than 90 feet).

To obtain a water supply in excess of 0.5 gpm from the shallow aquifer, a group of wells or a well field would be needed. The number of wells needed to supply the desired flow and optimal spacing for production is directly dependent on the required amount of groundwater discharge. For example, if a flow rate of 5 gpm is needed, a well field consisting of 10 wells installed on 200-foot centers would be needed; if a flow rate of 50 gpm is needed, the well field would contain 100 wells installed on 200-foot centers. The 50 gpm well field would draw groundwater from a minimum distance (radius) of 1,000 feet from the center of the well field, assuming the most efficient well placement. A well field designed to produce approximately 26 gpm would draw groundwater from a minimum radius of 725 feet. A well field designed to produce approximately 12 gpm would draw from a minimum radius of 500 feet. This analysis assumes that each well in the well field is 100 percent efficient, and no additional contingency wells are needed to provide a continuous water supply at the desired production rate.

Based on the water usage assumptions presented in Section 6.3, the flow rate required for landscape irrigation is 17 gpm per acre of lawn. Therefore, a well field with a radius of 725 feet would provide irrigation water for 1.5 acres of grass, and a well field with a radius of 500 feet would provide irrigation water for 0.75 acres of grass.

Based on this evaluation, although it may technically be possible to produce groundwater flows from the shallow aquifer adequate to meet or augment gray water requirements for the Site, it is neither practical nor feasible to install the large number of wells needed to achieve reasonable production rates. The kriging distances of 500 and 725 feet were chosen as conservative estimates.

6.6. ECOLOGICAL RISK ASSESSMENT

ERAs have been conducted quantitatively and qualitatively for Alameda Point and the Alameda Annex. Summaries of these assessments are provided in the following subsections.

6.6.1. Alameda Point ERA Summary

A screening level ERA was conducted for Alameda Point OU-5. The results were published as part of the draft RI report for Alameda Point OU-2, which included the parcels currently identified as OU-5 (TtEMI, 1999d). The ERA included identification of potentially complete exposure pathways, COPCs for soil based on a comparison to screening benchmarks, and refinement of the contaminants list through evaluation of risk to two upper-trophic level receptors likely to occur in the limited habitat in Alameda Point OU-5. After completing the screening process, no risk to small mammals was identified. Based on the results of this preliminary evaluation and the marginal nature of the ecological habitat at Alameda Point OU-5, no further ecological investigations of the terrestrial habitat have been conducted.

An assessment of the potential ecological risk to aquatic habitat (Section 5.8.2) concluded that receptors in the Oakland Inner Harbor are not being impacted by contaminated groundwater from the Site via either lateral groundwater movement or through the existing storm sewer system.

6.6.2. Alameda Annex ERA Summary

To date, the Navy has conducted a qualitative ERA of the Alameda Annex terrestrial habitat, and a quantitative ERA to evaluate the possible effects of stormwater discharge into the nearby Oakland Inner Harbor which were presented in the final Alameda Annex RI (PRC and Versar, 1996). The qualitative ERA did not find potential risks because:

- The Alameda Annex has a limited and unsuitable terrestrial habitat.
- No endangered species feed or nest on the facility.
- There is a scarcity of mammalian receptors.

The quantitative ERA concluded that storm drain discharges to sediments pose no ecological risk. Sediment bioassay results found no significant ecological effects above those found for the rest of the San Francisco Bay.

A groundwater fate and transport study was also conducted for the Alameda Annex and part of Alameda Point (TtEMI, 1998a) to evaluate potential migration of benzene contamination into the Bay. Benzene

was selected as the primary COPC because of its toxicity and mobility. Other contaminants, such as PAHs and SVOCs, are much less soluble and fairly immobile. The modeling concluded that benzene would not migrate beyond the boundaries of the Site, and ongoing groundwater monitoring has confirmed this conclusion. These findings further support the conclusion from Section 5.8.2, specifically that aquatic receptors in the Oakland Inner Harbor are not being impacted by contaminated groundwater from the Site via either lateral groundwater movement or through the existing storm sewer system.

6.6.3. ERA Summary

Results of the previous ERAs conducted for both Alameda Point and the Alameda Annex concluded that there is no significant risk to terrestrial ecological receptors, and there is no ecological risk to the Bay due to lateral groundwater movement or storm sewer system discharge. A large factor in the ERAs was the marginal quality of the general area with respect to terrestrial ecological receptors. Based on current reuse plans, this can be assumed to be true for future scenarios as well.

This page intentionally left blank

7. APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

7.1. INTRODUCTION

This section identifies and evaluates potential federal and State of California applicable or relevant and appropriate requirements (ARARs) from the universe of regulations, requirements, and guidance, and sets forth the Department of the Navy (DON) determinations regarding those potential ARARs for each remedial action alternative retained for detailed analysis in this RI/FS Report for Alameda Point Site 25 and Alameda Annex IR-02, Naval Facilities Engineering Command, Alameda, California.

This evaluation includes an initial determination of whether the potential ARARs actually qualify as ARARs, and a comparison for stringency between the federal and State regulations to identify the controlling ARARs. The identification of ARARs is an iterative process. The final determination of ARARs will be made by the DON in the record of decision (ROD) or action memorandum (AM), after public review, as part of the remedial action selection process.

7.1.1. Summary of CERCLA and National Contingency Plan Requirements

Section 121(d) of CERCLA (CERCLA, 42 *United States Code* [USC] Section [§] 9621[d]), as amended, states that remedial actions on CERCLA sites must attain (or the decision document must justify the waiver of) any federal or more stringent State environmental standards, requirements, criteria, or limitations that are determined to be legally applicable or relevant and appropriate.

Applicable requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or State law that specifically address the situation at a CERCLA site. The requirement is applicable if the jurisdictional prerequisites of the standard show a direct correspondence when objectively compared to the conditions at the site. An applicable federal requirement is an ARAR. An applicable State requirement is an ARAR only if it is more stringent than federal ARARs.

If the requirement is not legally applicable, the requirement is evaluated to determine whether it is relevant and appropriate. Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or State law that, while not applicable, address problems or situations similar to the circumstances of the proposed remedial action and are well suited to the conditions of the site (USEPA, 1988a). A requirement must be determined to be both relevant <u>and</u> appropriate to be considered an ARAR.

The criteria for determining relevance and appropriateness are listed in 40 Code of Federal Regulations [CFR] § 300.400(g)(2) and include the following:

- The purpose of the requirement and the purpose of the CERCLA action;
- The medium regulated or affected by the requirement and the medium contaminated or affected at the CERCLA site;
- The substances regulated by the requirement and the substances found at the CERCLA site;
- The actions or activities regulated by the requirement and the remedial action contemplated at the CERCLA site;
- Any variances, waivers, or exemptions of the requirement and their availability for the circumstances at the CERCLA site;
- The type of place regulated and the type of place affected by the release or CERCLA action;
- The type and size of structure or facility regulated and the type and size of structure or facility affected by the release or contemplated by the CERCLA action; and
- Any consideration of use or potential use of affected resources in the requirement and the use or potential use of the affected resources at the CERCLA site.

According to CERCLA ARARs guidance (USEPA, 1988a), a requirement may be "applicable" or "relevant and appropriate," but not both. Identification of ARARs must be done on a site-specific basis and involve a two-part analysis: first, a determination whether a given requirement is applicable; then, if it is not applicable, a determination whether it is nevertheless both relevant and appropriate. It is important to explain that some regulations may be applicable or, if not applicable, may still be relevant and appropriate. When the analysis determines that a requirement is both relevant and appropriate, such a requirement must be complied with to the same degree as if it were applicable (USEPA, 1988a).

Tables included in this section present each potential ARAR with an initial determination of ARAR status (i.e., applicable, relevant and appropriate, or not an ARAR). For the determination of relevance and appropriateness, the pertinent criteria were examined to determine whether the requirements addressed problems or situations sufficiently similar to the circumstances of the release or remedial action contemplated, and whether the requirement was well suited to the site. A negative determination of relevance and appropriateness indicates that the requirement did not meet the pertinent criteria. Negative determinations are discussed in the text only for specific cases.

To qualify as a State ARAR under CERCLA and the National Contingency Plan (NCP), a State requirement must be:

- A State law or regulation,
- An environmental or facility siting law or regulation,
- Promulgated (of general applicability and legally enforceable),
- Substantive (not procedural or administrative),
- More stringent than federal requirements,

- Identified in a timely manner, and
- Consistently applied.

To constitute an ARAR, a requirement must be substantive. Therefore, only the substantive provisions of requirements identified as ARARs in this analysis are considered to be ARARs. Permits are considered to be procedural or administrative requirements. Provisions of generally relevant federal and State statutes and regulations that were determined to be procedural or nonenvironmental, including permit requirements, are not considered to be ARARs. CERCLA Section 121(e)(1), 42 USC § 9621(e)(1), states that "No federal, State, or local permit shall be required for the portion of any removal or remedial action conducted entirely on-site, where such remedial action is selected and carried out in compliance with this section." The term *on-site* is defined for purposes of this ARARs discussion as "the areal extent of contamination and all suitable areas in very close proximity to the contamination necessary for implementation of the remedial action" (40 CFR § 300.5).

Nonpromulgated advisories or guidance issued by federal or state governments are not legally binding and do not have the status of ARARs. Such requirements may; however, be useful, and are "to be considered" (TBC). TBC (40 CFR § 300.400[g][3]) requirements complement ARARs, but do not override them. They are useful for guiding decisions regarding cleanup levels or methodologies when regulatory standards are not available.

Pursuant to USEPA guidance (USEPA, 1988a), ARARs are generally divided into three categories: chemical-specific, location-specific, and action-specific requirements. This classification was developed to aid in the identification of ARARs; some ARARs do not fall precisely into one group or another. ARARs are identified on a site basis for remedial actions where CERCLA authority is the basis for cleanup.

As the lead federal agency, the DON has primary responsibility for identifying federal ARARs at Alameda Point Site 25/Alameda Annex IR-02. Potential federal ARARs that have been identified for the Site 25/Annex IR-02 Groundwater RI/FS are discussed in Section 7.1.2.2. Pursuant to the definition of the term *on-site* in 40 CFR § 300.5, the extent of the dissolved phase benzene and naphthalene plumes extending from Alameda Annex IR-02 and into Alameda Point Site 25, is considered to be the on-site boundary for groundwater for the purposes of this ARARs analysis. Monitoring wells, injection wells, and soil vapor extraction (SVE) system installations proposed as a part of the response alternatives are defined as on-site actions. Hence, no federal, State, or local permit will be required for any of these on-site remedial actions. However, compliance with requirements identified as applicable or relevant and appropriate for these on-site remedial actions will be required.

Identification of potential State ARARs was initiated through DON requests that the DTSC identify potential State ARARs, an action described in more detail in Section 7.1.2.3. Potential State ARARs that have been identified for Alameda Point Site 25/Annex IR-02 are discussed below.

7.1.2. Methodology Description

The process of identifying and evaluating potential federal and State ARARs is described in this subsection.

7.1.2.1 General

As the lead federal agency, the DON has primary responsibility for identification of potential ARARs for Alameda Point Site 25/Annex IR-02. In preparing this ARARs analysis, the DON undertook the following measures, consistent with CERCLA and the NCP:

- Identified federal ARARs for each remedial action alternative addressed in the RI/FS, taking into account site-specific information for Alameda Point Site 25 and Alameda Annex IR-02;
- Reviewed potential State ARARs identified by the State to determine whether they satisfy CERCLA and NCP criteria that must be met in order to constitute State ARARs;
- Evaluated and compared federal ARARs and their state counterparts to determine whether State ARARs are more stringent than the federal ARARs or are in addition to the federally required actions; and
- Reached a conclusion as to which federal and State ARARs are the most stringent and/or "controlling" ARARs for each alternative.

As outlined in Section 8.1 of this RI/FS, the remedial action objectives for the site are to prevent exposure to benzene and naphthalene in site groundwater (for either a non-drinking water scenario or a potential drinking water scenario) and indoor air at concentrations that pose an unacceptable risk to human health. Remedial action alternatives retained for detailed analysis in this RI/FS are designed to accomplish these remedial action objectives. Removal of benzene and naphthalene in groundwater is achieved through a combination of monitored natural attenuation, enhanced contaminant biodegradation, contaminant extraction and treatment, and restrictions imposed through institutional controls.

The remedial action alternatives considered for detailed analysis, and for which an ARARs analysis is presented in this section, are as follows:

- **Alternative 1** – No action
- **Alternative 2** – MNA with Institutional Controls
- **Alternative 3** – Biosparging with MNA and Institutional Controls
- **Alternative 4** – Biosparging with Nutrient/Microorganism Enhancement, MNA, and Institutional Controls
- **Alternative 5** – Air Sparging with MNA and Institutional Controls
- **Alternative 6** – Groundwater Pump and Treat with MNA and Institutional Controls

7.1.2.2 Identifying and Evaluating Federal ARARs

The DON is responsible for identifying federal ARARs as the lead federal agency under CERCLA and the NCP. The final determination of federal ARARs will be made when the DON issues the ROD/AM. The federal government implements a number of federal environmental statutes that are the source of potential federal ARARs, either in the form of the statutes or regulations promulgated thereunder. Examples include the Resource Conservation and Recovery Act (RCRA), the Clean Water Act, the Safe Drinking Water Act (SDWA), the Toxic Substances Control Act, and their implementing regulations. See NCP preamble at 55 *Federal Register* (Fed. Reg.) 8764–8765 (1990) for a more complete listing.

The proposed remedial action and alternatives were reviewed against all potential federal ARARs, including but not limited to those set forth at 55 Fed. Reg. 8764–8765 (1990), to determine if they were applicable or relevant and appropriate utilizing the CERCLA and NCP criteria and procedures for ARARs identification by lead federal agencies.

7.1.2.3 Identifying and Evaluating State ARARs

The process of identifying and evaluating potential State ARARs by the State and the DON is described in this subsection.

Solicitation of State ARARS Under NCP

USEPA guidance (USEPA, 1988b) recommends that the lead federal agency consult with the State when identifying State ARARs for remedial actions. In essence, the CERCLA/NCP requirements at 40 CFR § 300.515 for remedial actions provide that the lead federal agency request the State to identify chemical- and location-specific State ARARs upon completion of site characterization. The requirements also provide that the lead federal agency request identification of all categories of State ARARs (chemical-, location-, and action-specific) upon completion of identification of remedial alternatives for detailed analysis. The State must respond within 30 days of receipt of the lead federal agency requests. The remainder of this subsection documents the DON's efforts to date to identify and evaluate State ARARs.

In accordance with the NCP (40 CFR 300.515[h][2]), the Navy solicited DTSC for timely identification of potential State chemical-, action- and location-specific ARARs for Alameda Point Site 25/Annex IR-02 in 1994, 1995, and 1996.

Chronology of Efforts to Identify State ARARs

The following chronology summarizes the DON's efforts to obtain State assistance in identifying State ARARs for the remedial action at Alameda Point Site 25/Annex IR-02. Key correspondence between the DON and the state agencies relating to this effort has been included in the Administrative Record (AR) for this RI/FS.

- The DON formally requested State chemical-, location-, and action-specific ARARs for Site 25 in 1994, 1995, and 1996. On November 13, 1996, DTSC responded by letter with a general list of laws they consider as ARARs.
- DON requested State agencies to provide relevant State ARARs for Alameda Annex. The Navy requested ARARs from DTSC in writing on July 6, 1994 and June 19, 1995.
- DTSC responded to the Navy in writing on August 29, 1995.
- On July 9, 1998, DTSC requested additional ARARs from several state agencies, and these agencies responded in late-July 1998.

This ARAR analysis addresses the potential State ARARs identified in the above correspondence from DTSC and other state agencies.

7.1.3. Other General Issues

General issues identified during the evaluation of ARARs for Alameda Point Site 25/Annex IR-02 are discussed in the following subsections.

7.1.3.1 General Approach to Requirements of the Federal Resource Conservation and Recovery Act

The RCRA is a federal statute passed in 1976 to meet four goals: the protection of human health and the environment; the reduction of waste; the conservation of energy and natural resources; and the elimination of the generation of hazardous waste as expeditiously as possible. The Hazardous and Solid Waste Amendments (HSWA) of 1984 significantly expanded the scope of RCRA by adding new corrective action requirements, land disposal restrictions, and technical requirements. RCRA, as amended, contains several provisions that are potential ARARs for CERCLA sites.

Substantive RCRA requirements are applicable to remedial actions on CERCLA sites if the waste is a RCRA hazardous waste, and either:

- The waste was initially treated, stored, or disposed after the effective date of the particular RCRA requirement; or
- The activity at the CERCLA site constitutes treatment, storage, or disposal, as defined by RCRA (USEPA, 1988a).

The preamble to the NCP indicates that State regulations that are components of a federally authorized or delegated State program are generally considered federal requirements and potential federal ARARs for the purposes of ARARs analysis (55 Fed. Reg. 8666, 8742 [1990]). The State of California received approval for its base RCRA hazardous waste management program on July 23, 1992 (57 Fed. Reg. 32726 [1992]). The State of California "Environmental Health Standards for the Management of Hazardous Waste," set forth in Title 22 *California Code of Regulations*, Division 4.5 (Cal. Code Regs. tit. 22, div. 4.5), was approved by USEPA as a component of the federally authorized State of California RCRA

program. On September 26, 2001, California received final authorization of its revised State Hazardous Waste Management Program by the USEPA (63 Fed. Reg. 49118 [2001]).

The regulations of Cal. Code Regs. tit. 22, div. 4.5 are, therefore, a source of potential federal ARARs for CERCLA remedial actions. The exception is when a state regulation is "broader in scope" than the corresponding federal RCRA regulations. In that case, such regulations are not considered part of the federally authorized program or potential federal ARARs. Instead, they are purely state law requirements and potential State ARARs.

The USEPA July 23, 1992 notice approving the State of California RCRA program (57 Fed. Reg. 32726 [1992]) specifically indicated that the State regulations addressed certain non-RCRA, state-regulated hazardous wastes that fell outside the scope of federal RCRA requirements. Cal. Code Regs. tit. 22, div. 4.5 requirements would be potential State ARARs for such non-RCRA, state-regulated wastes.

A key threshold question for the ARARs analysis is whether or not the contaminants at Alameda Point Site 25/Annex IR-02 constitute federal hazardous waste, as defined under RCRA and the state's authorized program, or qualify as non-RCRA, state-regulated hazardous waste. A discussion of waste characterization is included in Section 7.1.4.

7.1.4. Waste Characterization

Selection of ARARs involves the characterization of wastes as described below.

7.1.4.1 RCRA Hazardous Waste Determination

Federal RCRA hazardous waste determination is necessary to determine whether a waste is subject to RCRA requirements at Cal. Code Regs. tit. 22, div. 4.5 and other state requirements at Cal. Code Regs. tit. 23, div. 3, Chapter (ch.) 15. The first step in the RCRA hazardous waste characterization process is to evaluate contaminated media at the site(s) and determine whether the contaminant constitutes a "listed" RCRA waste. The preamble to the NCP states that "... it is often necessary to know the origin of the waste to determine whether it is a listed waste and that, if such documentation is lacking, the lead agency may assume it is not a listed waste" (55 Fed. Reg. 8666, 8758 [1990]).

This approach is confirmed in USEPA guidance for CERCLA compliance with other laws (USEPA 1988a), as follows:

"To determine whether a waste is a listed waste under RCRA, it is often necessary to know the source. However, at many Superfund sites, no information exists on the source of wastes. The lead agency should use available site information, manifests, storage records, and vouchers in an effort to ascertain the nature of these contaminants. When this documentation is not available, the lead agency may assume that the wastes are not listed RCRA hazardous wastes, unless further analysis or information becomes available that allows the lead agency to determine that the wastes are listed RCRA hazardous wastes."

RCRA hazardous wastes that have been assigned USEPA hazardous waste numbers (or codes) are listed in Cal. Code Regs. tit. 22, §§ 66261.30–66261.33. The lists include hazardous waste codes beginning with the letters "F," "K," "P," and "U."

Knowledge of the exact source of a waste is required for source-specific listed wastes ("K" waste codes). Some knowledge of the nature or source of the waste is required even for listed wastes from nonspecific sources, such as spent solvents ("F" waste codes) or commercial chemical products ("P" and "U" waste codes). These listed RCRA hazardous wastes are restricted to commercially pure chemicals used in particular processes such as degreasing.

P and U wastes cover only unused and unmixed commercial chemical products, particularly spilled or off-spec products (USEPA, 1991a). Not every waste containing a P or U chemical is a hazardous waste. To determine whether a CERCLA investigation-derived waste contains a P or U waste, there must be direct evidence of product use. In particular, all the following criteria must be met. The chemicals must be:

- Discarded (as described in 40 CFR § 261.2[a][2]);
- Either off-spec commercial products or a commercially sold grade;
- Not used (soil contaminated with spilled unused wastes is a P or U waste); and
- The sole active ingredient in a formulation.

The potential wastes at Alameda Point Site 25/Annex IR-02 consist of shallow soil and groundwater contaminated with dissolved phase benzene and PAHs to a depth of 20 feet bgs. The principal origin of the contamination at the site is material from historic dredge and fill operations used to create the Alameda Point and Alameda Annex land surface, or historic point source discharges. However, documentation of the definite source of the contamination or direct evidence of product use that caused the contamination is not available. Therefore, it is not expected that any wastes generated as a result of the remedial actions at the site will be considered RCRA-listed wastes.

The second step in the RCRA hazardous waste characterization process is to evaluate potential hazardous characteristics of the waste generated. The evaluation of characteristic waste is described in USEPA guidance as follows (USEPA, 1988a):

> Under certain circumstances, although no historical information exists about the waste, it may be possible to identify the waste as RCRA characteristic waste. This is important in the event that (1) remedial alternatives under consideration at the site involve on-site treatment, storage, or disposal, in which case RCRA may be triggered as discussed in this section; or (2) a remedial alternative involves off-site shipment. Since the generator (in this case, the agency or responsible party conducting the Superfund action) is responsible for determining whether the wastes exhibit any of these characteristics (defined in 40 CFR §§ 261.21–261.24), testing may be required. The lead agency must use best professional judgment to determine, on a site-specific basis, if testing for hazardous characteristics is necessary.

> In determining whether to test for the toxicity characteristic using the extraction procedures (EP) toxicity test, it may be possible to assume that certain low concentrations of waste are not toxic. For example, if the total waste concentration in soil is 20 times or less than the EP toxicity concentration, the waste cannot be characteristic hazardous waste. In such a case, RCRA requirements would not be applicable. In other instances, where it appears that the substances may be characteristic hazardous waste (ignitable, corrosive, reactive, or EP toxic), testing should be performed.

Hazardous waste characteristics, as defined in 40 CFR §§ 261.21–261.24, are commonly referred to as ignitability, corrosivity, reactivity, and toxicity. California environmental health standards for the management of hazardous waste set forth in Cal. Code Regs. tit. 22, div. 4.5 were approved by USEPA as a component of the federally authorized California RCRA program. Therefore, the characterization of RCRA waste is based on the State requirements.

The characteristics of ignitability, corrosivity, reactivity, and toxicity are defined in Cal. Code Regs. tit. 22, §§ 66261.21–66261.24. According to Cal. Code Regs. tit. 22, § 66261.24(a)(1)(A), "A waste that exhibits the characteristic of toxicity pursuant to subsection (a)(1) of this section has the USEPA Hazardous Waste Number specified in Table I of this section which corresponds to the toxic contaminant causing it to be hazardous." Table I assigns hazardous waste codes beginning with the letter "D" to wastes that exhibit the characteristic of toxicity; D waste codes are limited to "characteristic" hazardous wastes.

According to Cal. Code Regs. tit. 22, § 66261.10, waste characteristics can be measured by an available standardized test method or be reasonably classified by generators of waste based on their knowledge of the waste provided that the waste has already been reliably tested or if there is documentation of chemicals used. Soil contamination at the site is not ignitable, corrosive, or reactive, as defined in Cal. Code Regs. tit. 22, § 66261.21–66261.23. This determination was based on knowledge of the nature and concentrations of contaminants.

The requirements at Cal. Code Regs. tit. 22, § 66261.24 list the toxic contaminant concentrations that determine the characteristic of toxicity. The concentration limits are in mg/L. These units are directly comparable to total concentrations in waste groundwater and surface water. For waste soils, these concentrations apply to the extract or leachate produced by the toxicity characteristic leaching procedure (TCLP).

A waste is considered hazardous if the contaminants in the wastewater or in the soil TCLP extract equal or exceed the TCLP limits. TCLP testing is required only if total contaminant concentrations in soil equal or exceed 20 times the TCLP limits because TCLP uses a 20-to-1 dilution for the extract (USEPA, 1988a).

The alternatives proposed in this RI/FS are not designed to remove contaminated soil or groundwater from the site, but will generate some waste during remedial actions. Investigation-derived wastes such as

the soil drill cuttings, purge water from well development, and equipment decontamination water can be expected during installation activities. The RCRA hazardous toxicity characteristic will be determined by comparing waste concentrations to the TCLP limits at Cal. Code Regs. tit. 22, § 66261.24(a)(1) at the time waste is generated. The toxicity characteristic concentration for benzene is 500 micrograms per liter (µg/L). No TCLP limit has been established for naphthalene. Based on the data presented in this RI/FS report, the toxicity characteristic concentration for benzene has the potential to be exceeded at selected on-site wells. If groundwater is extracted from a monitoring well in a location where the groundwater benzene concentration exceeds the toxicity characteristic, that groundwater will be managed as a hazardous waste from the point of extraction to the point where it blends with other groundwater, thereby rendering the benzene concentration less than the toxicity characteristic concentration. Likewise, if waste soils are generated that may contain benzene concentrations exceeding the toxicity characteristic concentration, they will be treated as hazardous waste from the point of generation, to the point where they are characterized as non-hazardous (if possible).

7.1.4.2 California-Regulated, Non-RCRA Hazardous Waste

A waste determined not to be a RCRA hazardous waste may still be considered a State-regulated non-RCRA hazardous waste. The State is broader in scope in its RCRA program in determining hazardous waste. Cal. Code Regs. tit. 22, § 66261.24(a)(2) lists the total threshold limit concentrations (TTLCs) and the soluble threshold limit concentrations (STLCs) for non-RCRA hazardous waste. The State applies its own leaching procedure, Waste Extraction Test (WET), which uses a different acid reagent and has a different dilution factor (10-fold). Other State requirements may be broader in scope than federal ARARs for identifying non-RCRA wastes regulated by the State. These may be potential ARARs for wastes not covered under federal ARARs. See additional subsections of Cal. Code Regs. tit. 22, § 66261.24. A waste is considered hazardous if its total concentrations exceed the TTLCs or if the extract concentrations from the WET exceed the STLCs. A WET is required when the total concentrations exceed the STLC but are lower than the TTLCs (Cal. Code Regs. tit. 22, div. 4.5, ch. 11, Appendix [app.] II [b]). No STLC or TTLC concentrations have been established for the COPCs at the site; therefore, no wastes generated by the project are expected to be considered California-regulated, non-RCRA hazardous wastes.

7.1.4.3 Other California Waste Classifications

For waste discharged after July 18, 1997, solid waste classifications at Cal. Code Regs. tit. 27, §§ 20210, 20220, and 20230 are used to determine applicability of waste management requirements. These are summarized below.

A "designated waste" under Cal. Code Regs. tit. 27, § 20210 is defined at Cal. Water Code § 13173. Under Cal. Water Code § 13173, designated waste is hazardous waste that has been granted a variance from hazardous waste management requirements or non-hazardous waste that consists of or contains pollutants that, under ambient environmental conditions at a waste management unit, could be released in

concentrations exceeding applicable water quality objectives or that could reasonably be expected to affect beneficial uses of the waters of the State.

A nonhazardous solid waste under Cal. Code Regs. tit. 27, § 20220 is all putrescible and non-putrescible solid, semisolid, and liquid wastes, including garbage, trash, refuse, paper, rubbish, ashes, industrial wastes, demolition and construction wastes, abandoned vehicles and parts thereof, discarded home and industrial appliances, manure, vegetable or animal solid and semisolid wastes, and other discarded waste (whether of solid or semisolid consistency), provided that such wastes do not contain wastes that must be managed as hazardous wastes or wastes that contain soluble pollutants in concentrations that exceed applicable water quality objectives or could cause degradation of waters of the State.

Under Cal. Code Regs. tit. 27, § 20230, inert waste is that subset of solid waste that does not contain hazardous waste or soluble pollutants at concentrations in excess of applicable water quality objectives and does not contain significant quantities of decomposable waste.

7.2. CHEMICAL-SPECIFIC ARARS

Chemical-specific ARARs are generally health- or risk-based numerical values or methodologies applied to site-specific conditions that result in the establishment of a cleanup level. Many potential ARARs associated with particular response alternatives (such as closure or discharge) can be characterized as action-specific, but include numerical values or methodologies to establish them so they fit in both categories (chemical- and action-specific). To simplify the comparison of numerical values, most action-specific requirements that include numerical values are included in this chemical-specific section and, if repeated in the action-specific section, the discussion refers back to this section.

This section presents ARARs determination conclusions addressing numerical values for groundwater, a summary of the ARARs conclusions, and a more detailed discussion of the ARARs for groundwater. Potential federal and State chemical-specific ARARs are summarized in Table 7-1.

7.2.1. Summary of ARARs Conclusions by Medium

Groundwater and air are the environmental media potentially affected by the Alameda Point Site 25/Annex IR-02 remedial actions being considered in this report. The conclusions for ARARs pertaining to these media are presented in the following sections.

7.2.1.1 Groundwater ARARs Conclusions

Chemicals of concern in groundwater at Alameda Point Site 25/Annex IR-02 are benzene and naphthalene. Table 7-2 lists the groundwater chemicals of concern for this RI/FS.

Table 7-1
Proposed Federal and State Chemical-Specific[a] ARARs for Groundwater
Alameda Point Site 25/Annex IR-02 Groundwater RI/FS
Page 1 of 5

Requirement	Prerequisite	Citation[b]	ARAR Determination	Comments
Federal – Groundwater				
Safe Drinking Water Act (42 USC, ch. 6A, § 300[f]–300[j]-26)[c]				
National primary drinking water standards are health-based standards for public water systems (MCLs).	Public water system.	40 CFR § 141.61(a)	Relevant and Appropriate	The primary drinking water standards are not considered applicable because the point of compliance is the tap of a public water system; however, the MCLs are potentially relevant and appropriate for groundwater that is a potential source of drinking water. A discussion of site groundwater as a potential drinking water source is presented in Section 7.2.2.1.
MCLGs pertain to known or anticipated adverse health effects (also known as recommended MCLs).	Public water system.	40 C.F.R. § 141.50	Not an ARAR	There are no non-zero MCLGs for COPCs at the Site.
National secondary drinking water regulations are standards for the aesthetic qualities of public water systems (SMCLs).	Public water system.	40 C.F.R. § 143.3	Not an ARAR	SMCLs are federal contaminant levels intended as guidelines for the states. Because they are not enforceable, federal SMCLs are not ARARs.
Drinking Water Standards and Health Advisories				
National drinking water standards and health advisories for guidance on maximum permissible levels of contaminants for water delivered to users of public water systems	Public water system.	Drinking Water Standards and Health Advisories, USEPA 822-R-04-005 (2004 edition)	To Be Considered	The drinking water standards and health advisories provide information on contaminants that can cause human health effects and are known or anticipated to occur in drinking water. Health advisories are guidance values based on health effects for various durations of exposure (e.g., lifetime). For groundwater that is a potential source of drinking water the health advisories are to be considered.

Table 7-1
Potential Federal and State Chemical-Specific[a] ARARs for Groundwater
Alameda Point Site 25/Annex IR-02 Groundwater RI/FS
Page 2 of 5

Requirement	Prerequisite	Citation[b]	ARAR Determination	Comments
Federal – Groundwater				
Resource Conservation and Recovery Act (42 U.S.C., ch. 82, §§ 6901–6991[i])c				
Defines RCRA hazardous waste. A solid waste is characterized as toxic, based on the TCLP, if the waste exceeds the TCLP maximum concentrations.	Waste.	Cal. Code Regs. tit. 22, § 66261.21, 66261.22(a)(1), 66261.23, 66261.24(a)(1), and 66261.100	Applicable	Applicable for determining whether waste is hazardous.
Groundwater protection standards: Owners/operators of RCRA treatment, storage, or disposal facilities must comply with conditions in this section that are designed to ensure that hazardous constituents entering the groundwater from a regulated unit do not exceed the concentration limits for contaminants of concern set forth under Cal. Code Regs. tit. 22, § 66264.94 in the uppermost aquifer underlying the waste management area of concern at the POC.	A regulated unit that receives or has received hazardous waste before 26 July 1982 or regulated units that ceased receiving hazardous waste prior to 26 July 1982 where constituents in or derived from the waste may pose a threat to human health or the environment.	Cal. Code Regs. tit. 22, § 66264.94, except 66264.94(a)(2) and 66264.94(b)	Not an ARAR	While groundwater within the center of the plumes is similar or identical to RCRA hazardous waste, the site is not considered a discrete waste management unit, therefore, these regulations are potentially not ARARs.
The POC is a vertical surface located at the hydraulically downgradient limit of the waste management area that extends through the uppermost aquifer underlying the regulated unit.	Hazardous waste treatment or disposal.	Cal. Code Regs. tit. 22, § 66264.95	Not an ARAR	POC is not considered an ARAR because the alternatives considered will treat the entire plume.

Table 7-1
Potential Federal and State Chemical-Specific[a] ARARs for Groundwater
Alameda Point Site 25/Annex IR-02 Groundwater RI/FS
Page 3 of 5

Requirement	Prerequisite	Citation[b]	ARAR Determination	Comments
Federal – Groundwater				
Comprehensive Environmental Response, Compensation, and Liability Act (42 U.S.C., ch. 103, §§ 9601–9675)c				
ACLs using a point of exposure beyond the facility boundary.	Known or projected points of entry from groundwater to surface water.	CERCLA Section 121(d)(2)(B)(ii) 42 U.S.C., ch. 103, § 9621	Not an ARAR	Groundwater from the Site has not migrated to the Oakland inner harbor. There are no known or projected points of entry into surface water.
Clean Water Act of 1977, as Amended (33 USC § 1251-1387)				
National Ambient Water Quality Criteria.	Discharges to waters of the United States and groundwater.	33 U.S.C. § 1314(a) and 42 U.S.C. § 9621(d)(2) 64 Fed. Reg. 19,781 (22 April 1999)	Not An ARAR	Because it has been shown that site contaminants are not migrating and discharging to the Bay or surface waters, this is considered not an ARAR.
Water quality standards	Discharges to waters of the United States	40 CFR § 131.36(b) and 131.38	Not An ARAR	Because it has been shown that site contaminants are not migrating and discharging to the Bay or surface waters, this is considered not an ARAR.
Water quality standards	Discharges to the San Francisco Bay/ Sacramento–San Joaquin Delta Estuary	40 CFR § 131.37	Not An ARAR	Because it has been shown that site contaminants are not migrating and discharging to the Bay or surface waters, this is considered not an ARAR.

Table 7-1
Potential Federal and State Chemical-Specific[a] ARARs for Groundwater
Alameda Point Site 25/Annex IR-02 Groundwater RI/FS
Page 4 of 5

Requirement	Prerequisite	Citation[b]	ARAR Determination	Comments
State – Groundwater				
Cal/EPA Department of Toxic Substances Control[c]				
State MCL list.	Source of drinking water.	Cal. Code Regs. tit. 22, §§ 64431 and 64444	Relevant and Appropriate	The State MCLs are not considered applicable because the point of compliance is the tap of a public water system; however, the MCLs are potentially relevant and appropriate for groundwater that is a potential source of drinking water. A discussion of site groundwater as a potential drinking water source is presented in Section 7.2.2.1.
Federal – Air				
Clean Air Act (42 U.S.C., ch. 85, §§ 7401–7671)[c]				
NAAQS: Primary and secondary standards for ambient air quality to protect public health and welfare (including standards for particulate matter and lead).	Contamination of air affecting public health and welfare.	40 C.F.R. § 50.4–50.12	Not An ARAR	Not enforceable and therefore not applicable.

Table 7-1
Potential Federal and State Chemical-Specific[a] ARARs for Groundwater
Alameda Point Site 25/Annex IR-02 Groundwater RI/FS
Page 5 of 5

Requirement	Prerequisite	Citation[b]	ARAR Determination	Comments
Federal – Air				
Resource Conser ation and Reco er Act Air Emissions Requirements (42 U.S.C., ch. 82, §§ 6 01–6 1 i)c				
Air emission standards for process vents or equipment leaks.	Equipment that contains or contacts hazardous waste with organic concentrations of at least 10 percent by weight or process vents associated with specified operations that manage hazardous wastes with organic concentrations of at least 10 ppmw.	Cal. Code Regs. tit. 22, § 66264.1030–66264.1034, excluding .1030(c), .1033(j), .1034(c)(2), .1034(d)(2) Cal. Code Regs. tit. 22, § 66264.1050–66264.1063, excluding .1050(c), (d), .1057(g)(2), .1060, .1063(d)(3)	Not an ARAR	No hazardous wastes are present or will be generated through remedial activities at the site with organic concentrations of at least 10 percent by weight.

Notes:
[a] *Action-specific ARARs may contain chemical-specific limitations; if so, they are addressed in the action-specific ARAR tables.*
[b] *Only the substantive provisions of the requirements cited in this table are potential ARARs.*
[c] *Statutes and policies, and their citations, are provided as headings to identify general categories of proposed ARARs for the convenience of the reader; listing the statutes and policies does not indicate that the Navy accepts the entire statutes or policies as potential ARARs; specific proposed ARARs are addressed in the table below each general heading; only pertinent substantive requirements of the specific citations are considered proposed ARARs.*

Acronyms/Abbreviations:
ARAR – applicable or relevant and appropriate requirement
Cal. Code Regs. – California Code of Regulations
CFR – Code of Federal Regulations
ch. – chapter
CWA – Clean Water Act
USEPA – Environmental Protection Agency
MCL – maximum contaminant level
TBC – to be considered
USC – United States Code

The substantive provisions of the following requirements are the most stringent of the potential federal and State chemical-specific ARARs and TBCs for remediation of Alameda Point Site 25/Annex IR-02 groundwater:

- State primary MCLs for benzene in Cal. Code Regs. tit. 22, § 64444
- USEPA Health Advisory for naphthalene from USEPA 822-R-04-005

Numerical values of potential groundwater ARARs and identification of the controlling ARARs are presented in Table 7-2.

Table 7-2
Drinking Water Criteria and Standards for Chemicals of Concern in Groundwater
Alameda Point Site 25/Annex IR-02 Groundwater RI/FS

	Concentration (µg/L)			
Analyte	USEPA Maximum Contaminant Levels (40 CFR § 141.61)	USEPA Health Advisory (USEPA 822-R-04-005) [a,b]	California Maximum Contaminant Level (Cal. Code Regs. tit. 22, § 64444)	Controlling ARAR Contaminant Level
Benzene	5	100	1	1
Naphthalene	--	100	--	100[b]

Notes:
[a] 2004 Edition of the Drinking Water Standards and Health Advisories, Office of Water, Winter 2004 (USEPA, 2004).
[b] Specified contaminant level is a non-enforceable, health advisory being considered for evaluation purposes.

Acronyms/Abbreviations:
ARAR – Applicable or relevant and appropriate requirement
Cal. Code Regs. – California Code of Regulations
CFR – Code of Federal Regulations
-- – Not available
§ – Section
tit. – Title
USEPA – United States Environmental Protection Agency

7.2.1.2 Air ARARs Conclusions

A SVE system is a treatment technology being considered as part of Alternatives 2, 3, 4, and 5. Direct discharge of emissions from the SVE system to the atmosphere must comply with the Bay Area Air Quality Management District (BAAQMD) rules. BAAQMD rules are potential ARARs for remedial Alternatives 2, 3, 4, and 5 being considered under this action. The BAAQMD rules are federal ARARs because the U.S. EPA delegated them into the State Implementation Plan (SIP) under the Clean Air Act (CAA), 42 U.S. C. §§ 7401–7671. More specific information on these requirements is provided in the discussion of action-specific ARARs.

7.2.2. Detailed Discussion of ARARs by Medium

The following subsections provide a detailed discussion of federal and State ARARs by medium.

7.2.2.1 Groundwater ARARs

Groundwater beneath the Alameda Point Site 25/Annex IR-02 Site consists of the following water-bearing units in descending order:

- A shallow unconfined water-bearing zone, referred to as the FWBZ;
- The Merritt Sand aquifer, referred as the SWBZ; and
- The Alameda aquifer, referred to as the AFWBZ.

The groundwater flow in the FWBZ at Alameda Point Site 25/Annex IR-02 exhibits high local variability, but generally flows in a northwest direction, toward the Oakland Inner Harbor. Typical depths to water are 8 feet bgs in the FWBZ under the Site. The FWBZ is separated from the SWBZ by a layer of silts and clay known as the bay sediment unit. The bay sediment unit begins approximately at 20 feet bgs, and varies in depth from 20 to 100 feet thick. The San Antonio aquitard separates the SWBZ from the AFWBZ.

Groundwater investigations performed at the site showed contamination in the FWBZ. No contaminants were found above controlling ARAR contaminant levels in the SWBZ. In addition, water in the SWBZ was classified as a Class III aquifer (not a potential drinking water source and of limited beneficial use) due to high TDS concentrations (TtEMI, 2000b). The FWBZ contamination consists primarily of dissolved-phase benzene and naphthalene. Low concentrations of 1,2-dichloroethane, MTBE, and BaP were also detected.

Federal

One of the significant issues in identifying ARARs for groundwater under SDWA and RCRA is whether the groundwater at the site can be classified as a source of drinking water. USEPA groundwater policy is set forth in the preamble to the NCP (55 Fed. Reg. 8666, 8752–8756 [1990]). This policy uses the groundwater classification system set forth in the draft USEPA Guidelines for Groundwater Classification under the USEPA Groundwater Protection Strategy (USEPA, 1986). Under this policy, groundwater is classified in one of three categories (Class I, II, or III), based on ecological importance, replaceability, and vulnerability considerations. Irreplaceable groundwater that is currently used by a substantial population or groundwater that supports a vital habitat is considered to be Class I. Class II consists of groundwater that is currently being used or that might be used as a source of drinking water in the future. Groundwater that cannot be used for drinking water due to insufficient quality (e.g., high salinity or widespread, naturally-occurring contamination) or quantity is considered to be Class III. The USEPA guidelines define Class III groundwater as groundwater with TDS concentrations over 10,000 mg/L and a yield of less than 150 gallons per day (USEPA, 1986). Class III groundwater can also be classified based

on economic or technological treatability tests, as well as quality or quantity (both criteria are not needed, just one or the other). A site-specific evaluation may also include the following other site-specific factors (USEPA, 1998):

- Thickness
- Actual TDS level
- Actual groundwater well yield
- Proximity to saltwater
- Potential for saltwater intrusion
- Quality of underlying units
- Existence of existing institutional controls
- Current or historic use
- Cost of cleanup to drinking water standards

Underlying Alameda Point Site 25, the FWBZ is classified as a Class II aquifer (current or potential source of drinking water, or has other beneficial uses), and the SWBZ is classified as Class III aquifer based on USEPA criteria for TDS concentrations (TtEMI, 2000b). The groundwater beneath the Alameda Annex site meets the State exemption criteria for drinking water, and the RWQCB has concurred that groundwater in the FWBZ beneath Alameda Annex is not a potential source of drinking water (RWQCB, 1999). Because groundwater at Alameda Point Site 25 has been determined to be a potential source of drinking water, the evaluation of potential ARARs for Alameda Point Site 25/Annex IR-02 actions is based on the most conservative of these determinations. Cleanup goals will be based on potential ARARs evaluated herein for a drinking water scenario.

Safe Drinking Water Act

Federal MCLs and Maximum Contaminant Level Goals (MCLGs) developed by USEPA under the SDWA are potential relevant and appropriate requirements for aquifers with Class I and Class II characteristics, and therefore are potential federal ARARs. The point of compliance (POC) for MCLGs and MCLs under the SDWA is at the tap. Therefore, the MCLs and MCLGs are not "applicable" ARARs for DON sites. However, MCLs and MCLGs are generally considered relevant and appropriate as remediation goals for current or potential drinking water sources, and thus are commonly identified as potential ARARs for groundwater remedial actions under CERCLA.

MCLs for the COPCs for the action at Alameda Point Site 25/Annex IR-02 are found at 40 CFR § 141.61(a) and listed in Table 7-2. Although MCLs are developed using cost and technical considerations, USEPA considers them to be protective of human health as well.

USEPA has also developed MCLGs to serve as guidance for establishing MCLs. MCLGs for organic contaminants are promulgated at 40 CFR § 141.50. MCLGs for inorganic contaminants are promulgated at 40 CFR 141.51. An MCLG is set at a level at which no adverse health effects may arise, with a margin of safety. An MCL is required to be set as close as possible to its corresponding MCLG, taking into consideration the best technology, treatment techniques, and other factors, including cost. For noncarcinogens, MCLs generally are set equal to MCLGs. MCLGs for carcinogens are set at the zero level.

The NCP states that MCLGs set at levels above zero should be considered relevant and appropriate requirements for groundwaters that are potential sources of drinking water (40 CFR § 300.430(e)(2)(I)(B) and 55 Fed. Reg. 8666, 8750–8754 [1990]). The COPCs at Alameda Point Site 25/Annex IR-02 do not have nonzero MCLGs. Hence, MCLGs for these chemicals of concern are not considered to be relevant and appropriate requirements.

The FWBZ underlying Alameda Point Site 25 is classified as a Class II aquifer; therefore, MCLs are potentially relevant and appropriate ARARs for this portion of the Site. However, because groundwater in the FWBZ at Alameda Annex meets the State exemption criteria for drinking water and is not a potential source of drinking water (RWQCB, 1999), drinking water standards (MCLs, MCLGs, and secondary MCLs) are neither applicable nor relevant and appropriate for this portion of the Site; however, due to potential unapproved use of groundwater as a drinking water supply, these regulations will be considered.

RCRA Hazardous Waste

The federal RCRA requirements of 40 CFR pt. 261 do not apply in California because the State RCRA program is authorized. The authorized State RCRA requirements are therefore considered potential federal ARARs (see Section 7.1.3.1). The applicability of RCRA requirements depends on whether the waste is a RCRA hazardous waste; whether the waste was initially treated, stored, or disposed after the effective date of the particular RCRA requirement; and whether the activity at the site constitutes treatment, storage, or disposal as defined by RCRA. However, RCRA requirements may be relevant and appropriate even if they are not applicable. Examples include activities that are similar to the definition of RCRA treatment, storage, or disposal for waste that is similar to RCRA hazardous waste.

The determination of whether a waste is a RCRA hazardous waste can be made by comparing the site waste to the definition of RCRA hazardous waste. The RCRA requirements at Cal. Code Regs. tit. 22, § 66261.21, 66261.22(a)(1), 66261.23, 66261.24(a)(1), and 66261.100 are potential ARARs because they define RCRA hazardous waste. A waste can meet the definition of hazardous waste if it has the toxicity characteristic of hazardous waste. This determination is made by using the TCLP. The maximum concentrations allowable for the TCLP listed in § 66261.24(a)(1)(B) are potential federal ARARs for

determining whether the site has hazardous waste. If the site waste has concentrations exceeding these values, it is determined to be a characteristic RCRA hazardous waste (see Section 7.1.4.1).

RCRA Groundwater Protection Standards

Groundwater concentration limits for RCRA-regulated units are promulgated at Cal. Code Regs. tit. 22, § 66264.94. For corrective action programs, Cal. Code Regs. tit. 22, § 66264.94(c) states that the concentrations of compounds must not exceed the background level of that constituent in groundwater or, if achieving background is shown to be technologically or economically infeasible, some higher concentration limit that is set as part of the corrective action program. In no event shall a concentration limit greater than background exceed MCLs established under the federal SDWA (Cal. Code Regs. tit. 22, §§ 64431 and 64444).

These standards are not "applicable" because Alameda Point Site 25 and Alameda Annex IR-02 do not contain a RCRA waste management unit. The Site is not a discrete waste management unit, and the substantive provisions of Cal. Code Regs. tit. 22, § 66264.94(a)(1), (a)(3), (c), (d), and (e) are not potentially relevant or appropriate federal ARARs for groundwater at Alameda Point Site 25 and Alameda Annex IR-02

CERCLA Alternative Concentration Levels

Under CERCLA Section 121(d)(2)(B)(ii) (42 U.S.C. § 9621[d][2][B][ii]), an alternative concentration limit (ACL) using a point of exposure (akin to a POC) beyond the facility boundary can be used where:

- there are known and projected points of entry of such groundwater into surface water,
- there will be no statistically significant increase of hazardous constituents from groundwater in surface water at the point of entry or at any point where there is reason to believe accumulation of constituents may occur downstream, and
- there are enforceable institutional controls to preclude human exposure at any point between the facility boundary and the point of entry into surface water.

Groundwater at Alameda Point Site 25/Alameda Annex IR-02 ultimately flows to the Oakland Inner Harbor; however, available data indicate that groundwater contamination is stable or receding and has not reached the Oakland Inner Harbor. Therefore, exposure-based CERCLA ACLs is not a potential ARAR. Further discussion of consideration of the surface water pathway in developing potential ARARs for groundwater is discussed in Section 7.2.2.2.

National Ambient Water Quality Criteria

Section 304(a)(1) of the Clean Water Act (CWA) (33 USC § 1314[a][1]) directs USEPA to publish and periodically update the National Ambient Water Quality Criteria (NAWQC). These standards are intended to protect human health and aquatic life from contamination in surface water. The NAWQC are

updated in the *Federal Register*. The latest list of the NAWQC through June 2000 was published in the *Federal Register* on 10 December 1998, with amendments in 64 Fed. Reg. 19781 (1999). These criteria are to reflect the latest scientific knowledge on the identifiable effects of pollutants on public health and welfare, aquatic life, and recreation. These criteria serve as guidance to states in adopting water quality standards under Section 303(c) (33 USC § 1313[c]) of the CWA that protect aquatic life from acute and chronic effects.

The applicability of surface water criteria to groundwater is discussed in CERCLA Section 121(d)(2)(B)(i) (42 USC § 9621[d][2][B][i]), 40 CFR § 300.430(e), and the NCP preamble (55 Fed. Reg. 8666, 8754–8755 [1990]). Although the NAWQC are nonenforceable guidelines, they may be potentially relevant and appropriate for groundwater only in the absence of promulgated MCLs or MCLGs. In such cases, the NAWQC may be adjusted to reflect only drinking water use and may be used as cleanup goals for the remedial action.

MCLs and MCLGs exist for benzene; thus, the NAWQC is not relevant or appropriate for benzene. There is no MCL, MCLG, or NAWQC for naphthalene; thus, the NAWQC is not relevant or appropriate for naphthalene.

Drinking Water Standards and Health Advisories

The USEPA Office of Water has developed tables of Drinking Water Standards and Health Advisories. These tables are revised periodically by the USEPA on an "as needed" basis. The drinking water standards and health advisories provide information on contaminants that can cause human health effects and are known or anticipated to occur in drinking water. Health advisories are guidance values based on health effects for different durations of exposure (e.g., lifetime). Health advisories are not enforceable, but to be considered for remedial activities at the site. A compendium of the most current drinking water standards and health advisories is available in the USEPA publication USEPA 822-R-04-005. Health advisories for the COPCs are shown in Table 7-2.

State

The State has identified the following ARARs for groundwater cleanup at the site:

- State primary MCLs, Cal. Code Regs. tit. 22, §§ 64431, 64444, and 64449(a).

The chronology of efforts in requesting DTSC to identify the ARARs for Alameda Point Site 25/Annex IR-02 is presented in Section 7.1.2.3.

Primary and Secondary State MCLs

State MCLs are set forth in Cal. Code Regs. tit. 22:

- § 64431 (Maximum Contaminant Levels – Inorganic Chemicals),
- § 64444 (Maximum Contaminant Levels – Organic Chemicals), and
- § 64449(a) (Secondary Maximum Contaminant Levels).

The DON has determined that the substantive provisions of the standards in Cal. Code Regs. tit. 22, § 64444 constitute potential "relevant and appropriate" State ARARs for aquifers classified as a potential source of drinking water. The FWBZ underlying Alameda Point Site 25 is classified as a Class II aquifer; therefore, MCLs are potentially relevant and appropriate ARARs for this portion of the Site. However, because groundwater in the FWBZ at Alameda Annex meets the State exemption criteria for drinking water and is not a potential source of drinking water (RWQCB, 1999), drinking water standards (MCLs, MCLGs, and secondary MCLs) are neither applicable nor relevant and appropriate for this portion of the Site; however, due to potential unapproved use of groundwater as a drinking water supply, these regulations will be considered. State MCLs for chemicals of concern as listed in Table 7-2.

Secondary MCLs are applicable at the tap and are not potentially applicable ARARs for groundwater cleanup. They are potentially relevant and appropriate for cleanup of groundwater that is a potential source of drinking water. However, there are no Secondary MCLs for the COPCs at the site, so they are not potential ARARs.

7.2.2.2 Air ARARs

For this RI/FS the COPCs in groundwater are volatile or semi-volatile. Benzene and naphthalene have the potential to volatilize into soil gas and migrate to indoor or outdoor ambient air. Alternatives being considered as part of this plan may increase the rate at which contaminants are introduced into ambient air. SVE is being considered to treat fugitive vapors as part of Alternatives 2, 3, 4, and 5.

ARARs for air are discussed in greater detail under action-specific requirements.

Federal

The CAA and RCRA air emission requirements are discussed below.

Clean Air Act

The CAA establishes the National Ambient Air Quality Standards (NAAQS) in 40 C.F.R. § 50.4–50.12. NAAQS are not enforceable in and of themselves; they are translated into source-specific emissions

limitations by the state (U.S. EPA 1990). Substantive requirements of the AQMD rules that have been approved by U.S. EPA as part of the SIP under the CAA are potential federal ARARs for air emissions (CAA Section 110). The Bay Area AQMD has its regulations available at http://www.baaqmd.gov/regs/rulereg.htm. The SIP includes rules for emissions restrictions for particulates, organic compounds, and hazardous air pollutants, as well as standards of performance for new sources. More specific information on these requirements is provided in the discussion of action-specific ARARs in Section 7.4.

RCRA Air Emission Requirements

RCRA air emissions standards at Cal. Code Regs. tit. 22, § 66264.1030–66264.1034, excluding .1030(c), .1033(j), .1034(c)(2), and .1034(d)(2), and at Cal. Code Regs. tit. 22, § 66264.1050–66264.1063, excluding .1050(c) and (d), .1057(g)(2), .1060, .1063(d)(3), for vents or equipment leaks pertain to equipment that contains or contacts hazardous wastes with organic concentrations of at least 10 percent by weight. Because no hazardous wastes that will be generated at the site exceed concentrations of at least 10 percent by weight, these requirements are not potential ARARs.

7.3. LOCATION-SPECIFIC ARARS

Potential location-specific ARARs are identified and discussed in this section. The discussions are presented based on various attributes of the site location, such as whether it is within a floodplain. Additional surveys will be performed in connection with the remedial action design and remedial action to confirm location-specific ARARs where inadequate siting information currently exists, or in the event of changes to planned facility locations.

7.3.1. Summary of Location-Specific ARARs

Hydrologic resources, biological resources, and costal zone management are the resource categories relating to location-specific requirements potentially affected by the Alameda Point Site 25/Annex IR-02 remedial actions. The conclusions for ARARs pertaining to these resources are presented in the following sections. No potential cultural resources, wetlands protection, floodplain management, other natural resources, or geologic characteristics ARARs were identified for this Site.

The Site is located approximately 900 feet from the Oakland Inner Harbor; however, based on available groundwater monitoring data, the plumes of benzene and naphthalene have not reached the Oakland Inner Harbor and are stable to decreasing, as discussed in Section 4.1.5. Location-specific requirements pertaining to protection of the hydrologic or coastal resources are not considered to be potential ARARs, because contaminated groundwater is not migrating to the Bay and none of the remedial alternatives evaluated in this RI/FS involve discharges or other direct impacts to the Oakland Inner Harbor or other surface water bodies. Ongoing monitoring included as part of all remedies will verify plume stability or reduction.

7.3.1.1 Hydrologic Resources Conclusions

Contaminated groundwater is not migrating to surface water. Remedial activities considered for Alameda Point Site 25/Annex IR-02 do not involve any planned releases to any waters of the State, and are not expected to affect the water quality at the Oakland Inner Harbor, thereby causing harm to plant, fish, and bird life in the Oakland Inner Harbor. Therefore, no location-specific ARARs pertaining to hydrologic resources apply to remedial actions for the Site.

7.3.1.2 Biological Resources Conclusions

The Migratory Bird Treaty Act of 1972 protects almost all species of native migratory birds in the United States from unregulated "take," which can include poisoning at hazardous waste sites. Based on the available information presented, none of the IR sites were shown to contain threatened or endangered species. However, migratory bird species are located near Alameda Point Site 25/Annex IR-02, and the requirements of the Migratory Bird Treaty Act of 1972 are thus determined to be relevant and appropriate for this RI/FS. Proper waste control measures will be implemented to prevent the migratory bird species poisoning from the wastes generated during the remedial response.

7.3.1.3 Coastal Resources Conclusions

Alameda Point Site 25/Annex IR-02 is not located within or discharging contaminated groundwater to the coastal zone. Active remedial activities do not involve any planned impacts to coastal zones; hence, potential location-specific ARARs pertaining to coastal resources are not considered potential ARARs.

7.3.2. Detailed Discussion of ARARs

The following subsections provide a detailed discussion of federal and State ARARs by location-specific resources. Pertinent and substantive provisions of the potential ARARs listed and described below were reviewed to determine whether they are potential federal or State ARARs for the Alameda Point Site 25/Annex IR-02 groundwater RI/FS.

Requirements determined to be ARARs or TBCs are identified in Table 7-3 (federal) and Table 7-4 (State). Determinations of status for location-specific ARARs were generally based on consultation of maps or lists included in the regulation or prepared by the administering agency. References to the document or agency consulted are provided in the "Comments" column and also may be provided in the table footnotes. Specific issues concerning some of the requirements are discussed in the following sections.

Table 7-3
Proposed Federal Location-Specific ARARs
Alameda Point Site 25/Annex IR-02 Groundwater RI/FS
Page 1 of 8

Location	Requirement	Prerequisite	Citation[a]	ARAR Determination	Comments
CULTURAL RESOURCES					
National Historic Preservation Act of 1966, as Amended (16 U.S.C. § 470–470x-6)[b]					
Historic project owned or controlled by federal agency	Action to preserve historic properties; planning of action to minimize harm to properties listed on or eligible for listing on the National Register of Historic Places.	Property included in or eligible for the National Register of Historic Places.	16 U.S.C. § 470–470x-6 36 C.F.R. pt. 800 40 C.F.R. § 6.301(b)	Not an ARAR	Alameda Point Site 25 and Alameda Annex IR-02 are not listed on the National Register of Historical Places and have no other historical significance.
Archaeological and Historic Preservation Act (16 U.S.C. § 469–469c-1)[b]					
Within area where action may cause irreparable harm, loss, or destruction of significant artifacts	Construction on previously undisturbed land would require an archaeological survey of the area. Data recovery and preservation would be required if significant archaeological or historical data were found on-site. The responsible official or Secretary of the Interior is authorized to undertake data recovery and preservation.	Regulated alteration of terrain caused as a result of a federal construction project or federally licensed activity or program where action may cause irreparable harm, loss, or destruction of significant artifacts.	16 U.S.C. § 469–469c-1 40 C.F.R. § 6.301(c)	Not an ARAR	The affected groundwater at the Site is located predominantly in artificial fill. No archeological or historical resources are associated with the artificial fill.

Table 7-3
Proposed Federal Location-Specific ARARs
Alameda Point Site 25/Annex IR-02 Groundwater RI/FS
Page 2 of 8

Location	Requirement	Prerequisite	Citation[a]	ARAR Determination	Comments
CULTURAL RESOURCES					
Historic Sites, Buildings, and Antiquities Act of 1935 (16 U.S.C. §§ 461–467)[b]					
Historic sites	Avoid undesirable impacts on landmarks.	Areas designated as historic sites.	16 U.S.C. §§ 461–467 40 C.F.R. § 6.301(a)	Not an ARAR	The Site is not of potential historic significance.
Archaeological Resources Protection Act of 1979, as Amended (16 U.S.C. § 470aa–470mm)[b]					
Archaeological resources on federal land	Prohibits unauthorized excavation, removal, damage, alteration, or defacement of archaeological resources located on public lands unless such action is conducted pursuant to a permit.	Archaeological resources on federal land.	Pub. L. No. 96-95 16 U.S.C. § 470aa–470mm	Not an ARAR	There are no known archaeological resources at the Site.
WETLANDS PROTECTION AND FLOODPLAINS MANAGEMENT					
Exec. Order No. 11990, Protection of Wetlands[b]					
Wetland	Action to minimize the destruction, loss, or degradation of wetlands.	Wetland meeting definition of Section 7.	40 C.F.R. § 6.302(a)	Not an ARAR	There are no wetlands located at the Site.

Table 7-3
Proposed Federal Location-Specific ARARs
Alameda Point Site 25/Annex IR-02 Groundwater RI/FS
Page 3 of 8

Location	Requirement	Prerequisite	Citation[a]	ARAR Determination	Comments
WETLANDS PROTECTION AND FLOODPLAINS MANAGEMENT					
Exec. Order No. 11988, Floodplain Management[b]					
Within floodplain	Actions taken should avoid adverse effects, minimize potential harm, restore and preserve natural and beneficial values.	Action that will occur in a floodplain (i.e., lowlands) and relatively flat areas adjoining inland and coastal waters and other flood-prone areas.	40 C.F.R. § 6.302(b) 40 C.F.R. pt. 6, app. A, excluding § 6(a)(2), 6(a)(4), and 6(a)(6)	Not an ARAR	The Site is not located within a 100 year floodplain (ESRI and FEMA, 2004).
Clean Water Act of 1977, as Amended, Section 404 (33 U.S.C. § 1344)[b]					
Wetland	Action to prohibit discharge of dredged or fill material into wetland without permit.	Wetland as defined by Exec. Order No. 11990 Section 7.	33 U.S.C. § 1344	Not an ARAR	No discharge of dredged or fill material to a wetland is planned as part of this response action.
Resource Conservation and Recovery Act (42 U.S.C. §§ 6901–6991[i])[b]					
Within 100-year floodplain	Facility must be designed, constructed, operated, and maintained to avoid washout.	RCRA hazardous waste; treatment, storage, or disposal of hazardous waste.	Cal. Code Regs. tit. 22, § 66264.18(b)	Not an ARAR	The Site is not located within a 100-year floodplain (ESRI and FEMA, 2004).

Table 7-3
Proposed Federal Location-Specific ARARs
Alameda Point Site 25/Annex IR-02 Groundwater RI/FS
Page 4 of 8

Location	Requirement	Prerequisite	Citation[a]	ARAR Determination	Comments
			HYDROLOGIC RESOURCES		
Wild and Scenic Rivers Act (16 U.S.C. §§ 1271–1287)[b]					
Within area affecting national wild, scenic, or recreational river	Avoid taking or assisting in action that will have direct adverse effect on scenic river.	Activities that affect or may affect any of the rivers specified in 16 U.S.C. §1276(a).	16 U.S.C. §§ 1271–1287	Not an ARAR	No wild, scenic, or recreational rivers would be impacted by any remedial actions considered for this Site.
Fish and Wildlife Coordination Act (16 U.S.C. §§ 661–666c)[b]					
Area affecting San Francisco Bay and Oakland Inner Harbor	Action taken should protect fish or wildlife.	Diversion, channeling, or other activity that modifies a stream or other water body and affects fish or wildlife.	16 USC § 662	Not an ARAR	The remedial actions being considered for the Site do not involve diversion, channeling, or other modification to a stream or water body.
Rivers and Harbors Act of 1899 (33 U.S.C. §§ 401–413)[b]					
Navigable waters	Permits required for structures or work in or affecting navigable waters.	Activities affecting navigable waters.	33 U.S.C. § 403 33 C.F.R. § 322	Not an ARAR	The remedial alternatives planned for the Site are not planned to affect navigable waters.
The Clean Water Act of 1977 (40 CFR § 131.37,38)[b]					
Located near San Francisco Bay	Remedial actions should comply with the San Francisco Bay/ Sacramento - San Joaquin Delta Estuary water quality standards	Specifies water quality standards regarding discharges to the San Francisco Bay/ Sacramento - San Joaquin Delta Estuary	40 CFR § 131.37, 131.38	Not an ARAR	Contaminated groundwater is not migrating to surface water. The remedial actions being considered for the Site would not involve any impact to surface water.

Table 7-3
Proposed Federal Location-Specific ARARs
Alameda Point Site 25/Annex IR-02 Groundwater RI/FS
Page 5 of 8

Location	Requirement	Prerequisite	Citation[a]	ARAR Determination	Comments
HYDROLOGIC RESOURCES					
Endangered Species Act of 1973 (16 U.S.C. §§ 1531–1543)[b]					
Habitat upon which endangered species or threatened species depend	Federal agencies may not jeopardize the continued existence of any listed species or cause the destruction or adverse modification of critical habitat. The Endangered Species Committee may grant an exemption for agency action if reasonable mitigation and enhancement measures such as propagation, transplantation, and habitat acquisition and improvement are implemented.	Determination of effect upon endangered or threatened species or its habitat. Critical habitat upon which endangered species or threatened species depend.	16 U.S.C. § 1536(a), (h)(1)(B)	Not an ARAR	There are no endangered species present at the Site.

Table 7-3
Proposed Federal Location-Specific ARARs
Alameda Point Site 25/Annex IR-02 Groundwater RI/FS
Page 6 of 8

Location	Requirement	Prerequisite	Citation[a]	ARAR Determination	Comments
			BIOLOGICAL RESOURCES		
Migratory Bird Treaty Act of 1972 (16 USC §§ 703)[b]					
Migratory bird area	Protects almost all species of native migratory birds in the U.S. from unregulated "take," which can include poisoning at hazardous waste sites.	Presence of migratory birds.	16 USC § 703	Relevant and Appropriate	Migratory bird species are present near the Alameda Point/Alameda Annex, but do not use the site.
Marine Mammal Protection Act (16 U.S.C. §§ 1361–1421h)[b]					
Marine mammal area	Protects any marine mammal in the U.S. except as provided by international treaties from unregulated "take."	Presence of marine mammals.	16 U.S.C. § 1372(a)(2)	Not an ARAR	Contaminated groundwater is not migrating to surface water. The remedial actions being considered for the Site would not involve any impact to surface water
Magnuson-Stevens Fishery Conservation and Management Act of 1976, as Amended (16 U.S.C. §§ 1801–1882)[b]					
Fishery under management	Provides for conservation and management of specified fisheries within specified fishery conservation zones.	Presence of managed fisheries.	16 U.S.C. §§ 1801–1882	Not an ARAR	There are no managed fisheries at or near the Site.

Table 7-3
Proposed Federal Location-Specific ARARs
Alameda Point Site 25/Annex IR-02 Groundwater RI/FS
Page 7 of 8

Location	Requirement	Prerequisite	Citation[a]	ARAR Determination	Comments
BIOLOGICAL RESOURCES					
National Wildlife Refuge System Administration Act of 1996 (16 U.S.C. § 668dd–668ee)[b]					
Wildlife refuge	No person shall take any animal or plant on any national wildlife refuge, except as authorized under 50 C.F.R. § 27.51. The disposing or dumping of wastes is prohibited.	Area designated as part of National Wildlife Refuge System.	16 U.S.C § 668dd–668ee Substantive provisions of 50 C.F.R. § 27.11–27.97	Not an ARAR	The Site is not part of the National Wildlife Refuge System
Wilderness Act (16 U.S.C. §§ 1131–1136)[b]					
Wilderness area	Area must be administered in such a manner as will leave it unimpaired as wilderness and preserve its wilderness character.	Federally owned area designated as wilderness area.	16 U.S.C. §§ 1131–1136 50 C.F.R. §§ 35.1–35.14	Not an ARAR	The Site is not a federally owned wilderness area.
COASTAL RESOURCES					
Coastal Zone Management Act (16 USC §§ 1456, 15 CFR § 930)[b]					
Adjacent to coastal zone	Conduct activities in a manner consistent with approved State management programs.	Activities affecting the coastal zone, including lands thereunder and adjacent shore land.	16 USC § 1456(c) 15 CFR § 930	Not an ARAR	The site is not in a costal zone, contamination is not migrating to a costal zone, and remedial activities being considered for the Site would not impact a costal zone.

Table 7-3
Proposed Federal Location-Specific ARARs
Alameda Point Site 25/Annex IR-02 Groundwater RI/FS
Page 8 of 8

Location	Requirement	Prerequisite	Citation[a]	ARAR Determination	Comments
GEOLOGIC CHARACTERISTICS ARARS					
Resource Conservation and Recovery Act (42 U.S.C. §§ 6901–6991[i])[b]					
Within 61 meters (200 feet) of a fault displaced in Holocene time	New treatment, storage, or disposal of hazardous waste prohibited.	RCRA hazardous waste; treatment, storage, or disposal of hazardous waste.	Cal. Code Regs. tit. 22, § 66264.18(a)	Not an ARAR	The Site is located more than 61 meters from any fault (U.S. Geological Survey, 2004).

Notes:
[a] Only the substantive provisions of the requirements cited in this table are proposed ARARs.
[b] Statutes and policies, and their citations, are provided as headings to identify general categories of proposed ARARs for the convenience of the reader; listing the statutes and policies does not indicate that the Navy accepts the entire statutes or policies as proposed ARARs; specific proposed ARARs are addressed in the table below each general heading; only substantive requirements of the specific citations are considered proposed ARARs.

Acronyms/Abbreviations:
ARAR – Applicable or relevant and appropriate requirement
CFR – Code of Federal Regulations
§ – Section
U.S. – United States
USC – United States Code

Table 7-4
Proposed State Location-Specific ARARs
Alameda Point Site 25/Annex IR-02 Groundwater RI/FS

Location	Requirement	Prerequisite	Citation[a]	ARAR Determination	Comments
HYDROLOGIC RESOURCES					
California Water Pollution Prohibition Act					
Affects San Francisco Bay and Oakland Inner Harbor	The Act prohibits the deposition, directly or indirectly, into waters of the State of any substance or material that is deleterious to fish, plant, or bird life.	Any activity that could impact waters of the State.	Cal. Fish and Game Code Section 5650	Not an ARAR	Contaminated groundwater is not migrating to surface water. The remedial actions being considered for the Site would not involve any impact to surface water
COASTAL RESOURCES					
McAteer-Petris Act, 1965					
Adjacent to coastal zone	The State management program for San Francisco Bay is contained in the Bay Conservation and Development Commission Bay Plan, enacted pursuant to the McAteer-Petris Act of 1965; establishes requirements for prescribed activities affecting San Francisco Bay.	Any activity that could impact coastal waters and resources.	California Government Code Section 66600 and following sections	Not an ARAR	Contaminated groundwater is not migrating to surface water. The remedial actions being considered for the Site would not involve any impact to surface water

Notes:

[a] Only the substantive provisions of the requirements cited in this table are proposed ARARs.

7.3.2.1 Hydrologic Resources ARARs

Alameda Annex is bordered by the Oakland Inner Harbor to the north. The Oakland Inner Harbor drains into the San Francisco Bay approximately 6 miles west of the site. The harbor lies approximately 900 feet north of the site boundary. Three water-bearing zones underlie the site: a shallow groundwater aquifer at approximately 2 to 8 feet bgs; the Merritt Sand aquifer; and the deeper Alameda aquifer. The groundwater gradient in the shallow aquifer tends northwest toward the Oakland Harbor, and is subjected to tidal influence near the harbor. The deeper aquifers are not in direct connection with the Oakland Inner Harbor or the Bay. The San Francisco Bay and the Oakland Inner Harbor house nearly 82 benthic species and 130 fish species in a variety of aquatic habitats.

State

California Water Pollution Prohibition Act

The California Water Pollution Prohibition Act (California Fish and Game Code Section 5650) makes it illegal to deposit, permit, or place where it can pass into waters of the State any material that can harm animal or plant life. This includes, but is not limited to, any petroleum, acid, residuary product of petroleum, substance, or material deleterious to fish, plant, or bird life. It also prohibits the use of any vacuum or suction dredge equipment by any person in any river, stream, or lake unless authorized under a permit by the department in compliance with the regulations adopted pursuant to California Fish and Game Code Section 5653.9.

Contaminated groundwater is not migrating to surface water. In addition, no dredging operation or other actions that will impact surface water are planned as remedial actions in this RI/FS. Therefore, this is not considered a potential ARAR.

7.3.2.2 Biological Resources ARARs

Alameda Point Site 25/Annex IR-02 is currently a developed residential complex covering nearly 40 percent of the property. The terrestrial habitats at the facility are limited to paved corridors, residential buildings, railroad track corridors, and landscaped areas. Biological resources and sensitive habitats at the Alameda Point Site 25/Annex IR-02 were identified through various field reconnaissance surveys performed in 1984 through 1994. The site houses 3 species of small mammals and approximately 48 bird species, and does not support any endangered species listed in Cal. Code Regs. Tit.14, § 670.1. However, the site's location in close proximity to a sensitive habitat (Oakland Harbor and the San Francisco Bay) is considered in the analysis.

Federal

Migratory Bird Treaty Act of 1972

The Migratory Bird Treaty Act (16 USC §§ 703–712) prohibits at any time, using any means or manner, the pursuit, hunting, capturing, and killing or attempting to take, capture, or kill any migratory bird. This act also prohibits the possession, sale, export, and import of any migratory bird or any part of a migratory bird, as well as nests and eggs. A list of migratory birds for which this requirement applies is found at 50 CFR § 10.13. It is the DON's position that this Act is not legally applicable to DON actions; however, Executive Order No. 13186 (dated January 10, 2001) requires each federal agency taking actions that have or are likely to have a measurable effect on migratory bird populations to develop and implement, within 2 years, a memorandum of understanding (MOU) with the United States Fish and Wildlife Service (USFWS) to promote the conservation of such populations. The DON and the USFWS are in the process of negotiating this MOU. In the meantime, the Migratory Bird Treaty Act will continue to be evaluated as a potentially relevant and appropriate requirement for DON CERCLA remedial actions.

The San Francisco Bay is the staging area for migratory, native, and shoreline birds, including brown pelicans, double-crested cormorants, California brown pelicans, and several species of gulls. Several State- or federally-listed endangered species are known to inhabit the Bay. Considering the proximity of the Bay to the sites, the Migratory Bird Treaty Act is determined to be relevant and appropriate for the proposed Alternatives 2, 3, 4, 5, and 6. The remedial action will be designed to minimize potential effects on these migratory bird species.

7.3.2.3 Coastal Resources ARARs

The San Francisco Bay and the delta comprise the West Coast's largest estuary, encompassing approximately 1,600 square miles of waterways and draining over 40 percent of the fresh water in California. In the estuary, the Sacramento and San Joaquin Rivers flow from Northern California's inland valleys into the delta through a labyrinth of islands, sloughs, canals, and channels before emptying into the San Francisco Bay and the Pacific Ocean. Fresh water from the rivers mingles with salt water from ocean tides, creating a rich and diverse aquatic ecosystem. The San Francisco Bay is home to a diverse ecological community and hosts a wide variety of habitats and plant and animal species.

Federal

Coastal Zone Management Act

The CZMA (16. USC §§ 1451–1464) specifically excludes federal lands from the coastal zone (16 USC § 1453[1]). Therefore, the CZMA is not potentially applicable to Alameda Point OU-5/Alameda Annex IR-02. The CZMA is evaluated as a potentially relevant and appropriate requirement, if activities planned at the Site will directly affect the costal zone. Section 1456(a)(1)(A) requires each federal agency activity within or outside the coastal zone that affects any land or water use or natural resource to conduct its

activities in a manner consistent, to the maximum extent practicable, with enforceable policies of approved state management policies. A state coastal zone management program is developed under state law guided by the CZMA and its accompanying implementing regulations in 15 CFR § 930. A state program sets forth objectives, policies, and standards to guide public and private uses of lands and water in the coastal zone. See Section 7.3.2.3 for the state coastal zone management program.

The Act requires federal agencies to conduct activities affecting the coastal zone consistent, to the maximum extent practicable, with approved state management programs. A review of California Coastal Commission quad maps shows that Alameda Point Site 25 and Alameda Annex IR-02 are not located within the coastal zone, contamination is not migrating to a costal zone, and no remedial activities planned at the Site would involve any direct impacts to the costal zone; therefore, the CZMA is not an ARAR.

State

McAteer-Petris Act

The McAteer-Petris Act, Cal. Code Regs. Tit.7.2, § 66600-66661, the State management program for San Francisco Bay, is contained in the Bay Conservation and Development Commission Bay Plan, enacted pursuant to the McAteer-Petris Act of 1965. It establishes requirements for prescribed activities affecting San Francisco Bay. It also plans policies limiting Bay filling and maintaining marshes and mudflats to the fullest extent possible to conserve wildlife, abate pollution, and protect the beneficial uses of the Bay. As discussed previously, Alameda Point Site 25/Alameda Annex IR-02 is located near, but not within, the coastal zone; contamination is not migrating to the costal zone; and no remedial activities being considered for the Site would directly impact the San Francisco Bay or associated mashes and mudflats. Therefore, the McAteer-Petris Act is not a potential ARAR.

7.4. ACTION-SPECIFIC ARARS

The RI/FS report evaluates remedial action alternatives for Alameda Point Site 25/Alameda Annex IR-02. Action-specific ARARs analysis is based on the six alternatives for the Site, as presented in Section 9:

- **Alternative 1** – No Action; involves no remedial action conducted for the area of investigation.
- **Alternative 2** – MNA with Institutional Controls. Monitoring is used to assess changes in concentrations and locations of contaminants and parameters indicative of biological degradation at the Site. Institutional controls are used to ensure that groundwater at the Site is not used as potable water during implementation of the remedy.
- **Alternative 3** – Biosparging with Soil Vapor Extraction (SVE), MNA, and Institutional Controls. Biosparging is used to enhance the contamination degradation rate to allow use of the shallow groundwater as a potable water supply. Soil vapor extraction and treatment is used to ensure protection of site residents from possible fugitive emissions. MNA and institutional controls are used for similar purposes as for Alternative 2.

- **Alternative 4** – Biosparging with Nutrient/Microorganism Enhancement, SVE, MNA, and Institutional Controls. Alternative 4 is identical to Alternative 3, with the exception of introducing additional nutrients or microorganisms to the subsurface to accelerate the time for site cleanup. MNA and institutional controls are used for similar purposes as for Alternative 2.
- **Alternative 5** – Air Sparging, SVE, MNA, and Institutional Controls. Alternative 4 is similar to Alternative 3, with the exception that air sparging (air injection at higher pressure relative to biosparging) is used to both speed biodegradation and increase volatilization of dissolved contaminants. MNA and institutional controls are used for similar purposes as for Alternative 2.
- **Alternative 6** – Groundwater Pump and Treat, MNA, and Institutional Controls. Groundwater is extracted at the plume centers, to remove dissolved contamination for on-site treatment and subsequent discharge to the public-owned treatment works (POTW). MNA and institutional controls are used for similar purposes as for Alternative 2.

Detailed descriptions of the remedial alternatives are provided in Section 9. A discussion of the requirements determined to be pertinent to each alternative being evaluated, and how the alternative complies with the requirement, is presented in this section. The potential federal and State Action-Specific ARARs are presented in Tables 7-5 and 7-6, respectively.

7.4.1. Alternative 1 – No Action

There is no need to identify ARARs for the no action alternative because ARARs apply to "any removal or remedial action conducted entirely on-site," and "no action" is not a removal or remedial action (CERCLA Section 121(e), 42 USC § 9621[e]). CERCLA Section 121 (42 USC § 9621) cleanup standards for selection of a Superfund remedy, including the requirement to meet ARARs, are not triggered by the no action alternative (USEPA, 1991b). Therefore, a discussion of compliance with action-specific ARARs is not appropriate for this alternative.

7.4.2. Alternative 2 – Monitored Natural Attenuation with Institutional Controls

The overall approach within Alternative 2 would rely on MNA to remediate benzene and naphthalene in shallow groundwater. MNA involves periodic monitoring of contaminant concentrations and biologic indicator parameters such as DO to determine if the plume is stable or decreasing, and to determine if subsurface conditions are favorable for natural biodegradation of the contaminants. Institutional Controls would prevent the installation of private groundwater wells, resulting in unacceptable health risks from exposure to contaminants. Active response measures would not be implemented to collect, treat, or contain the site benzene and naphthalene plumes. The elements of Alternative 2 requiring the development of action-specific ARARs are:

- Monitoring of contaminant concentrations in the groundwater and vadose zone monitoring;
- Monitoring of natural attenuation parameters in the groundwater; and
- Implementation of institutional controls to ensure that groundwater at the Site is not used as potable water during implementation of the remedy.

Table 7-5
Proposed Federal Action-Specific ARARs
Alameda Point Site 25/Annex IR-02 Groundwater RI/FS
Page 1 of 16

Alternative 1 – No Action
Alternative 2 – MNA with Institutional Controls
Alternative 3 – Biosparging with SVE, MNA and Institutional Controls
Alternative 4 – Biosparging with Nutrient Enhancement, SVE, MNA, and Institutional Controls
Alternative 5 – Air Sparging with SVE, MNA, and Institutional Controls
Alternative 6 – Groundwater Pump and Treat with MNA and Institutional Controls

Action	Requirement	Prerequisite	Citation	ARAR Determination			Comments
				A	RA	TBC	
Resource Conservation and Recovery Act (42 U.S.C. §§ 6901–6991[i])*							
On-site waste generation	Person who generates waste shall determine if that waste is a hazardous waste.	Generator of waste.	Cal. Code Regs. tit. 22, § 66262.10(a), 66262.11	2 - 6			Applicable for any operation where hazardous waste is generated. There is a potential for groundwater from one or more on-site monitoring wells to be classified as RCRA hazardous waste due to localized concentrations of benzene. The determination of whether groundwater and/or other wastes generated during the remedial activities, such as excess soil cuttings from well installation and treatment residues, are hazardous will be made at the time the wastes are generated.
	Requirements for analyzing waste for determining whether waste is hazardous.	Generator of waste.	Cal. Code Regs. tit. 22, § 66264.13 (a) and (b)	2 - 6			Analytical results from generated wastes will be compared to the TCLP limits to determine if the wastes are RCRA hazardous wastes.

Table 7-5
Proposed Federal Action-Specific ARARs
Alameda Point Site 25/Annex IR-02 Groundwater RI/FS
Page 2 of 16

Alternative 1 – No Action

Alternative 2 – MNA with Institutional Controls

Alternative 3 – Biosparging with SVE, MNA and Institutional Controls

Alternative 4 – Biosparging with Nutrient Enhancement, SVE, MNA, and Institutional Controls

Alternative 5 – Air Sparging with SVE, MNA, and Institutional Controls

Alternative 6 – Groundwater Pump and Treat with MNA and Institutional Controls

Action	Requirement	Prerequisite	Citation	ARAR Determination			Comments
				A	RA	TBC	
Hazardous waste accumulation	On-site hazardous waste accumulation is allowed for up to 90 days as long as the waste is stored in containers in accordance with § 66262.171–178 or in tanks, on drip pads, inside buildings, is labeled and dated, etc.	Accumulate hazardous waste.	Cal. Code Regs. tit. 22, § 66262.34	2 - 6			All wastes generated such as purge water and soil cuttings will be characterized and disposed of appropriately within 90 days of generation at an off-site facility.
Site closure	Minimize the need for further maintenance controls and minimize or eliminate, to the extent necessary to protect human health and the environment, postclosure escape of hazardous waste, hazardous constituents, leachate, contaminated rainfall or runoff, or waste decomposition products to groundwater or surface water or to the atmosphere.	Hazardous waste management facility.	Cal. Code Regs. tit. 22, § 66264.111 (a) and (b)				Not an ARAR. No land-based disposal units are planned for waste management.
Clean closure	During the partial and final closure periods, all contaminated equipment, structures, and soils shall be properly disposed of or decontaminated by removing all hazardous waste and residues.	Hazardous waste management facility.	Cal. Code Regs. tit. 22, § 66264.114				Not an ARAR. The site is not a hazardous waste management facility.

Table 7-5
Proposed Federal Action-Specific ARARs
Alameda Point Site 25/Annex IR-02 Groundwater RI/FS
Page 3 of 16

Alternative 1 – No Action

Alternative 2 – MNA with Institutional Controls

Alternative 3 – Biosparging with SVE, MNA and Institutional Controls

Alternative 4 – Biosparging with Nutrient Enhancement, SVE, MNA, and Institutional Controls

Alternative 5 – Air Sparging with SVE, MNA, and Institutional Controls

Alternative 6 – Groundwater Pump and Treat with MNA and Institutional Controls

Action	Requirement	Prerequisite	Citation	ARAR Determination			Comments
				A	RA	TBC	
Container storage	Containers of RCRA hazardous waste must be: • maintained in good condition, • compatible with hazardous waste to be stored, and • closed during storage except to add or remove waste.	Storage of RCRA hazardous waste not meeting small-quantity generator criteria before treatment, disposal, or storage elsewhere, in a container.	Cal. Code Regs. tit. 22, § 66264.171, .172, .173	2 - 6			Appropriate containers will be used for wastes such as drill cuttings and purge water that may be temporarily stored on site pending characterization and appropriate transport and disposal.
	Inspect container storage areas weekly for deterioration.		Cal. Code Regs. tit. 22, § 66264.174	2 - 6			Containers of waste temporarily stored (for less than 90 days) on site will be inspected weekly.
	Place containers on a sloped, crack-free base, and protect from contact with accumulated liquid. Provide containment system with a capacity of 10 percent of the volume of containers of free liquids. Remove spilled or leaked waste in a timely manner to prevent overflow of the containment system.	Storage in a container of RCRA hazardous waste not meeting small-quantity generator criteria before treatment, disposal, or storage elsewhere.	Cal. Code Regs. tit. 22, § 66264.175 (a) and (b)	2 - 6			Appropriate secondary containment will be provided for all containers of waste temporarily stored on site.

Table 7-5
Proposed Federal Action-Specific ARARs
Alameda Point Site 25/Annex IR-02 Groundwater RI/FS
Page 4 of 16

Alternative 1 – No Action
Alternative 2 – MNA with Institutional Controls
Alternative 3 – Biosparging with SVE, MNA and Institutional Controls
Alternative 4 – Biosparging with Nutrient Enhancement, SVE, MNA, and Institutional Controls
Alternative 5 – Air Sparging with SVE, MNA, and Institutional Controls
Alternative 6 – Groundwater Pump and Treat with MNA and Institutional Controls

Action	Requirement	Prerequisite	Citation	ARAR Determination			Comments
				A	RA	TBC	
Container storage (continued)	Keep containers of ignitable or reactive waste at least 50 feet from the facility property line.	Ignitable or reactive waste.	Cal. Code Regs. tit. 22, § 66264.176				Not an ARAR. No ignitable or reactive wastes will be generated during any of the remedial alternatives considered for the Site.
	Keep incompatible materials separate. Separate incompatible materials stored near each other by a dike or other barrier.		Cal. Code Regs. tit. 22, § 66264.177				Not an ARAR. No incompatible wastes will be generated during any of the remedial alternatives considered for the Site.
	At closure, remove all hazardous waste and residues from the containment system, and decontaminate or remove all containers and liners.		Cal. Code Regs. tit. 22, § 66264.178	2 – 6			All wastes, containers, and liners will be removed from the Site at the completion of remedial activities.
Use of tank systems	Requirements for the design and installation of new tank systems, including strength, tightness testing, damage control, support, corrosion control, etc.	Tank systems for transferring, storing, or treating hazardous waste.	Cal. Code Regs. tit. 22, § 66264.192(a), (b), (c), (e), (f), and (g)	6			Groundwater from one or more of the wells may be classified as a characteristic RCRA hazardous waste; therefore, requirements of Cal. Code Regs. tit. 22, § 66264.193 for secondary containment of tanks and associated tank systems (i.e., pipes) would be potential ARARs for those portions of the extraction system.

Table 7-5
Proposed Federal Action-Specific ARARs
Alameda Point Site 25/Annex IR-02 Groundwater RI/FS
Page 5 of 16

Alternative 1 – No Action
Alternative 2 – MNA with Institutional Controls
Alternative 3 – Biosparging with SVE, MNA and Institutional Controls
Alternative 4 – Biosparging with Nutrient Enhancement, SVE, MNA, and Institutional Controls
Alternative 5 – Air Sparging with SVE, MNA, and Institutional Controls
Alternative 6 – Groundwater Pump and Treat with MNA and Institutional Controls

Action	Requirement	Prerequisite	Citation	ARAR Determination			Comments
				A	RA	TBC	
Use of tanks or piping	Requirements for secondary containment of tank systems.	Tank systems for transferring, storing, or treating hazardous waste.	Cal. Code Regs. tit. 22, § 66264.193(b), (c), (d), and (e)	6			Groundwater from one or more of the wells may be classified as a characteristic RCRA hazardous waste; therefore, requirements of Cal. Code Regs. tit. 22, § 66264.193 for secondary containment of tanks and associated tank systems (i.e., pipes) would be potential ARARs for those portions of the extraction system.
	Requirements for secondary containment of ancillary equipment.	Tank systems for transferring, storing, or treating hazardous waste.	Cal. Code Regs. tit. 22, § 66264.193(f)	6			Any ancillary equipment, such as piping from a well to a treatment system in a tank, that may convey RCRA hazardous waste will have appropriate secondary containment
Use of tank systems	Requirements for operation of tank systems, including spill prevention and prohibitions of material that could cause failure.	Tank systems for transferring, storing, or treating hazardous waste.	Cal. Code Regs. tit. 22, § 66264.194(a) and (b)	6			Groundwater from one or more of the wells may be classified as a characteristic RCRA hazardous waste; therefore, requirements of Cal. Code Regs. tit. 22, § 66264.194 (a) and (b) for would be potential ARARs for the groundwater extraction and treatment system.

Table 7-5
Proposed Federal Action-Specific ARARs
Alameda Point Site 25/Annex IR-02 Groundwater RI/FS
Page 6 of 16

Alternative 1 – No Action
Alternative 2 – MNA with Institutional Controls
Alternative 3 – Biosparging with SVE, MNA and Institutional Controls
Alternative 4 – Biosparging with Nutrient Enhancement, SVE, MNA, and Institutional Controls
Alternative 5 – Air Sparging with SVE, MNA, and Institutional Controls
Alternative 6 – Groundwater Pump and Treat with MNA and Institutional Controls

Action	Requirement	Prerequisite	Citation	ARAR Determination			Comments
				A	RA	TBC	
Use of tank systems (continued)	Requirements for inspection of tank systems, including inspection of overflow protection, corrosion, release, detection equipment, and cathodic protection.	Tank systems for transferring, storing, or treating hazardous waste.	Cal. Code Regs. tit. 22, § 66264.195(a), (b), and (c)	6			Groundwater from one or more of the wells may be classified as a characteristic RCRA hazardous waste; therefore, requirements of Cal. Code Regs. tit. 22, § 66264.195 (a), (b) and (c) for would be potential ARARs for the groundwater extraction and treatment system.
	Requirements for response to leaks and spills from tank systems, including removal of system from use if appropriate, containment, cleanup, emergency procedures, etc.	Tank systems for transferring, storing, or treating hazardous waste.	Cal. Code Regs. tit. 22, § 66264.196(b) except (b)(5) and (b)(7)	6			Groundwater from one or more of the wells may be classified as a characteristic RCRA hazardous waste; therefore, requirements of Cal. Code Regs. tit. 22, § 66264.196 would be potentially applicable for the groundwater extraction and treatment system.

Table 7-5
Proposed Federal Action-Specific ARARs
Alameda Point Site 25/Annex IR-02 Groundwater RI/FS
Page 7 of 16

Alternative 1 – No Action

Alternative 2 – MNA with Institutional Controls

Alternative 3 – Biosparging with SVE, MNA and Institutional Controls

Alternative 4 – Biosparging with Nutrient Enhancement, SVE, MNA, and Institutional Controls

Alternative 5 – Air Sparging with SVE, MNA, and Institutional Controls

Alternative 6 – Groundwater Pump and Treat with MNA and Institutional Controls

Action	Requirement	Prerequisite	Citation	ARAR Determination			Comments
				A	RA	TBC	
Use of tank systems (continued)	Requirements for closure and postclosure care of tank systems decontamination, clean closure, and leaving waste in place at closure.	Tank systems for transferring, storing, or treating hazardous waste.	Cal. Code Regs. tit. 22, § 66264.197(a) and (b)	6			Groundwater from one or more of the wells may be classified as a characteristic RCRA hazardous waste; therefore, requirements of Cal. Code Regs. tit. 22, § 66264.197 would be potentially applicable for the groundwater extraction and treatment system.
Monitoring	Requirements for monitoring groundwater, surface water, and the vadose zone.	Hazardous waste treatment, storage, or disposal facility.	Cal. Code Regs. tit. 22, § 66264.97(b) (1) (A), (b) (1) (D) (1) and (2), (b) (4-7), (e) (6), (12) (A) and (B), (13) and (15)				Not an ARAR. The Site is not a discrete waste management unit.

Table 7-5
Proposed Federal Action-Specific ARARs
Alameda Point Site 25/Annex IR-02 Groundwater RI/FS
Page 8 of 16

Alternative 1 – No Action
Alternative 2 – MNA with Institutional Controls
Alternative 3 – Biosparging with SVE, MNA and Institutional Controls
Alternative 4 – Biosparging with Nutrient Enhancement, SVE, MNA, and Institutional Controls
Alternative 5 – Air Sparging with SVE, MNA, and Institutional Controls
Alternative 6 – Groundwater Pump and Treat with MNA and Institutional Controls

Action	Requirement	Prerequisite	Citation	ARAR Determination			Comments
				A	RA	TBC	
Monitoring (continued)	Requirements for closure and postclosure care of tank systems decontamination, clean closure, and leaving waste in place at closure.	Tank systems for transferring, storing, or treating hazardous waste.	Cal. Code Regs. tit. 22, § 66264.197(a) and (b)	6			Groundwater from one or more of the wells may be classified as a characteristic RCRA hazardous waste; therefore, requirements of Cal. Code Regs. tit. 22, § 66264.197 for would be potentially applicable for the groundwater extraction and treatment system.
	Requirements for monitoring groundwater, surface water, and the vadose zone.	Hazardous waste treatment, storage, or disposal facility.	Cal. Code Regs. tit. 22, § 66264.97(b) (1) (A), (b) (1) (D) (1) and (2), (b) (4-7), (e) (6), (12) (A) and (B), (13) and (15)				Not an ARAR. The Site is not a discrete waste management unit.

Table 7-5
Proposed Federal Action-Specific ARARs
Alameda Point Site 25/Annex IR-02 Groundwater RI/FS
Page 9 of 16

Alternative 1 – No Action

Alternative 2 – MNA with Institutional Controls

Alternative 3 – Biosparging with SVE, MNA and Institutional Controls

Alternative 4 – Biosparging with Nutrient Enhancement, SVE, MNA, and Institutional Controls

Alternative 5 – Air Sparging with SVE, MNA, and Institutional Controls

Alternative 6 – Groundwater Pump and Treat with MNA and Institutional Controls

Action	Requirement	Prerequisite	Citation	ARAR Determination			Comments
				A	RA	TBC	
Monitoring	Requirements for a detection monitoring program.	Hazardous waste treatment, storage, or disposal facility.	Cal. Code Regs. tit. 22, § 66264.98(e) (1-5), (i), (j), (k)(1-3), (4)(A) and (D),(5), (7)(C) and (D), (n)(1), (2)(B), and (C)				Not an ARAR. The Site is not a discrete waste management unit.
	Requirements for an evaluation monitoring program.	Hazardous waste treatment, storage, or disposal facility.	Cal. Code Regs. tit. 22, § 66264.99(b), (e)(1)–(6), (f)(3), and (g)				Not an ARAR. The Site is not a discrete waste management unit.

Table 7-5
Proposed Federal Action-Specific ARARs
Alameda Point Site 25/Annex IR-02 Groundwater RI/FS
Page 10 of 16

Alternative 1 – No Action

Alternative 2 – MNA with Institutional Controls

Alternative 3 – Biosparging with SVE, MNA and Institutional Controls

Alternative 4 – Biosparging with Nutrient Enhancement, SVE, MNA, and Institutional Controls

Alternative 5 – Air Sparging with SVE, MNA, and Institutional Controls

Alternative 6 – Groundwater Pump and Treat with MNA and Institutional Controls

Action	Requirement	Prerequisite	Citation	ARAR Determination			Comments
				A	RA	TBC	
Safe Drinking Water Act (42 U.S.C. § 300[f]–300[j]-26)*							
Injection	The underground injection control (UIC) program prohibits injection activities that allow movement of contaminants into underground sources of drinking water that may result in violations of MCLs or adversely affect health.	An approved UIC program is required in states listed under SDWA Section 1422. Class I wells and Class IV wells are the relevant classifications for CERCLA sites. Class I wells are used to inject hazardous waste beneath the lowermost formation that contains a USDW within 0.25 mile of the well.	40 C.F.R. § 144.12, excluding the reporting requirements in § 144.12(b) and 144.12(c)(1)		3 - 5		Injection wells for Alternatives 2, 3, 5, and 6 would be designated as Class V wells per 40 C.F.R. § 144.6(e). There are currently no specific UIC program technical requirements for injection into Class V wells that apply to this remedial action. However, the general narrative provisions of the federal UIC rules are relevant and appropriate, in that injection of air through Class V wells must not cause the shallow aquifer at the Site to violate primary drinking water MCLs established by USEPA. This substantive requirement would be satisfied by using oil-less compressors to inject only clean ambient air.

Table 7-5
Proposed Federal Action-Specific ARARs
Alameda Point Site 25/Annex IR-02 Groundwater RI/FS
Page 11 of 16

Alternative 1 – No Action
Alternative 2 – MNA with Institutional Controls
Alternative 3 – Biosparging with SVE, MNA and Institutional Controls
Alternative 4 – Biosparging with Nutrient Enhancement, SVE, MNA, and Institutional Controls
Alternative 5 – Air Sparging with SVE, MNA, and Institutional Controls
Alternative 6 – Groundwater Pump and Treat with MNA and Institutional Controls

Action	Requirement	Prerequisite	Citation	ARAR Determination			Comments
				A	RA	TBC	
Injection (continued)	The UIC program regulates construction of new Class IV wells and operation and maintenance of existing wells.	Class IV wells are used to inject hazardous or radioactive waste into or above a formation that contains a USDW within 0.25 mile of the well.	40 C.F.R. § 144.13				Not an ARAR. There is no drinking water intake within 0.25 mile of the Site.
	Class IV wells are banned except for reinjection of treated groundwater into the same formation from which it was withdrawn, as part of a CERCLA cleanup or RCRA corrective action.		40 C.F.R. § 144.13(c)				Not an ARAR. Groundwater will not be reinjected as part of any remedial alternative considered for the Site.
	Prepare, maintain, and comply with plugging and abandonment plan.	Class I wells.	40 C.F.R. § 144.28(c), § 144.51(e)				Not an ARAR. There are no Class I wells at the Site, and none of the remedial alternatives considered for the site include installation of Class I wells.

Table 7-5
Proposed Federal Action-Specific ARARs
Alameda Point Site 25/Annex IR-02 Groundwater RI/FS
Page 12 of 16

Alternative 1 – No Action
Alternative 2 – MNA with Institutional Controls
Alternative 3 – Biosparging with SVE, MNA and Institutional Controls
Alternative 4 – Biosparging with Nutrient Enhancement, SVE, MNA, and Institutional Controls
Alternative 5 – Air Sparging with SVE, MNA, and Institutional Controls
Alternative 6 – Groundwater Pump and Treat with MNA and Institutional Controls

Action	Requirement	Prerequisite	Citation	ARAR Determination			Comments
				A	RA	TBC	
Injection (continued)	Conduct appropriate geologic drilling logs and other tests during construction.		40 C.F.R. § 146.12(d), excluding the reporting requirements		3 - 5		The general narrative provisions of the federal UIC rules are relevant and appropriate, in that injection of air through Class V wells must not cause the shallow aquifer at the Site to violate primary drinking water MCLs established by USEPA.
	Injection pressure may not exceed a maximum level designed to ensure that injection does not initiate new fractures or propagate existing ones and cause the movement of fluids into a USDW. Continuously monitor injection pressure, flow rate, and volume, and annual pressure if required. Demonstration of mechanical integrity is required every 5 years. Groundwater monitoring may also be required.		40 C.F.R. § 146.13(a), (b), (d)				Not an ARAR. Injection pressures are not anticipated to be of sufficient pressure to cause movement of fluids into a USDW.
	Comply with State underground injection requirements.		40 C.F.R. § 147				Not an ARAR. The State has not identified any underground injection requirements.

Table 7-5
Proposed Federal Action-Specific ARARs
Alameda Point Site 25/Annex IR-02 Groundwater RI/FS
Page 13 of 16

Alternative 1 – No Action
Alternative 2 – MNA with Institutional Controls
Alternative 3 – Biosparging with SVE, MNA and Institutional Controls
Alternative 4 – Biosparging with Nutrient Enhancement, SVE, MNA, and Institutional Controls
Alternative 5 – Air Sparging with SVE, MNA, and Institutional Controls
Alternative 6 – Groundwater Pump and Treat with MNA and Institutional Controls

Action	Requirement	Prerequisite	Citation	ARAR Determination			Comments
				A	RA	TBC	
Clean Air Act (42 USC §§ 7401–7671)*							
Discharge to air	Provisions of SIP approved by USEPA under Section 110 of CAA.	Major sources of air pollutants.	42 USC § 7410; portions of 40 CFR § 52.220		3 – 5		These rules are considered relevant and appropriate when the vapor extraction and treatment system is used as part the biosparging or air sparging alternatives.
	NAAQS – primary and secondary standards for ambient air quality to protect public health and welfare (including standards for particulate matter and lead).	Contamination of air affecting public health and welfare.	40 C.F.R. § 50.4–50.12				Not an ARAR. Federal NAAQS are non-enforceable standards.
BAAQMD Regulation Title 8							
Discharge to air	BACT shall be applied to any new source or modified source that results in an emission with the potential to emit 10.0 pounds or more per highest day of precursor organic compounds, nonprecursor organic compounds, nitrogen oxides, sulfur dioxide, PM_{10}, or carbon monoxide.	New source or modified source.	BAAQMD Regulation 2, Rule 2-301		3 – 5		Injection of air into the subsurface may cause increased emissions from soil gas at the Site. This will be mitigated by use of a vapor extraction system, and this ARAR would be considered applicable.

Table 7-5
Proposed Federal Action-Specific ARARs
Alameda Point Site 25/Annex IR-02 Groundwater RI/FS
Page 14 of 16

Alternative 1 – No Action

Alternative 2 – MNA with Institutional Controls

Alternative 3 – Biosparging with SVE, MNA and Institutional Controls

Alternative 4 – Biosparging with Nutrient Enhancement, SVE, MNA, and Institutional Controls

Alternative 5 – Air Sparging with SVE, MNA, and Institutional Controls

Alternative 6 – Groundwater Pump and Treat with MNA and Institutional Controls

Action	Requirement	Prerequisite	Citation	ARAR Determination			Comments
				A	RA	TBC	
Discharge to air (continued)	A person shall not emit from any source for a period or periods aggregating more than 3 minutes in any hour a visible emission which is as dark as or darker than No. 1 on the Ringelmann Chart or of such opacity as to obscure an observer's view to an equivalent or greater degree.		BAAQMD Regulation 6-301		3 – 5		When the vapor extraction and treatment system is operational, this ARAR would be considered applicable.
	A person shall not emit particulate matter from any source in excess of 343 mg/dscm of exhaust gas volume. For incineration operations, the actual measured concentration of particulate matter in the exhaust gas shall be corrected to the concentration that the same quantity of particulate matter would constitute in the exhaust gas minus water vapor corrected to standard conditions, containing 12 percent carbon dioxide by volume, and as if no auxiliary fuel had been used.		BAAQMD Regulation 6-310.1				Not an ARAR. No particulate matter will be released to air as part of any remedial activities proposed for the Site.

Table 7-5
Proposed Federal Action-Specific ARARs
Alameda Point Site 25/Annex IR-02 Groundwater RI/FS
Page 15 of 16

Alternative 1 – No Action
Alternative 2 – MNA with Institutional Controls
Alternative 3 – Biosparging with SVE, MNA and Institutional Controls
Alternative 4 – Biosparging with Nutrient Enhancement, SVE, MNA, and Institutional Controls
Alternative 5 – Air Sparging with SVE, MNA, and Institutional Controls
Alternative 6 – Groundwater Pump and Treat with MNA and Institutional Controls

Action	Requirement	Prerequisite	Citation	ARAR Determination			Comments
				A	RA	TBC	
Discharge to air (continued)	A person shall not discharge into the atmosphere from any miscellaneous operation an emission containing more than 6.8 kg/day and containing a concentration of more than 300 ppm total carbon on a dry basis.		BAAQMD Regulation 8-2-301				Not an ARAR. No carbon will be discharged to air as a result of any of the remedial activities planned for the Site.
Air stripping or SVE	Any air stripping and SVE operations that emit benzene, vinyl chloride, perchloroethylene, methylene chloride, and/or trichloroethylene shall be vented to a control device that reduces emissions to the atmosphere by at least 90 percent by weight.		BAAQMD Regulation 8-47-301		3 – 5		When the vapor extraction and treatment system is operational, this requirement would be potentially relevant and appropriate.
	Any air stripping and SVE operations with a total organic compound emission greater than 15 pounds per day shall be vented to a control device that reduces the total organic compound emission to the atmosphere by at least 90 percent by weight.		BAAQMD Regulation 8-47-302		3 – 5		When the vapor extraction and treatment system is operational, this requirement would be potentially relevant and appropriate.

Table 7-5
Proposed Federal Action-Specific ARARs
Alameda Point Site 25/Annex IR-02 Groundwater RI/FS
Page 16 of 16

Alternative 1 – No Action
Alternative 2 – MNA with Institutional Controls
Alternative 3 – Biosparging with SVE, MNA and Institutional Controls
Alternative 4 – Biosparging with Nutrient Enhancement, SVE, MNA, and Institutional Controls
Alternative 5 – Air Sparging with SVE, MNA, and Institutional Controls
Alternative 6 – Groundwater Pump and Treat with MNA and Institutional Controls

Action	Requirement	Prerequisite	Citation	ARAR Determination			Comments
				A	RA	TBC	
Air stripping or SVE	A person shall not aerate contaminated soil, except as provided in Regulations 8-40-304 through 306.	More than 1 cubic yard of soil contaminated with 50 ppm_w organic content from other than a known chemical with less than 302 °F initial boiling point. More than 8 cubic yards if less than 500 ppm_w. Does not apply to accidental spills of 5 gallons or less.	BAAQMD Regulation 8-40-301				Not an ARAR. Concentrations of volatile organic compounds, as methane, measured no more than 3 inches from the surface of the soil do not exceed 50 ppmw. Therefore, the soil at the Site is not considered contaminated according to this regulation.
	Any air stripping or SVE operation shall meet the monitoring and record keeping requirements.		BAAQMD Regulation 8-47-500		3 – 5		When the vapor extraction and treatment system is operational, this ARAR would be considered applicable.
	Any air stripping or SVE operation shall follow the manual of procedures for sampling, analysis, and emissions.		BAAQMD Regulation 8-47-600		3 – 5		When the vapor extraction and treatment system is operational, this ARAR would be considered applicable.

Table 7-6
Proposed State Action-Specific ARARs
Alameda Point Site 25/Annex IR-02 Groundwater RI/FS
Page 1 of 4

Action	Requirement	Prerequisite	Citation	ARAR Determination	Comments
			INSTITUTIONAL CONTROLS		
Cal/EPA Department of Toxic Substances Control*					
Land Use Covenants	A land use covenant imposing appropriate limitations on land use shall be executed and recorded when remedial or removal action or other response actions are undertaken, and hazardous wastes or substances will remain at the property at levels which are not suitable for unrestricted use of the land.	Property transfer by federal government to non-federal entity.	Cal. Code Regs. tit. 22, § 67391.1(a) and (e)(1)	Relevant and appropriate	Cal. Code Regs. tit. 22 § 67391.1 provides for a land-use covenant to be executed and recorded when remedial actions are taken, and hazardous substances will remain at the property at concentrations that are unsuitable for unrestricted use of the land. The substantive provisions of this regulation have been determined to be "relevant and appropriate" state ARARs by the DON.
California Civil Code*					
Land-use controls	Provides conditions under which land-use restrictions will apply to successive owners of land.	Transfer property from the DON to a nonfederal agency.	Cal. Civ. Code § 1471	Relevant and Appropriate	Generally, Cal. Civ. Code § 1471 allows an owner of land to make a covenant to restrict the use of land for the benefit of a covenantee. The covenant runs with the land to bind successive owners, and the restrictions must be reasonably necessary to protect present or future human health or safety or the environment as a result of the presence on the land of hazardous materials, as defined in Cal. Health & Safety Code § 25260. Substantive provisions are the

Table 7-6
Proposed State Action-Specific ARARs
Alameda Point Site 25/Annex IR-02 Groundwater RI/FS
Page 2 of 4

Action	Requirement	Prerequisite	Citation	ARAR Determination	Comments
Land-use controls (continued)					following general narrative standard: "to do or refrain from doing some act on his or her own land . . . where (c) Each such act relates to the use of land and each such act is reasonably necessary to protect present or future human health or safety or the environment as a result of the presence of hazardous materials, as defined in Section 25260 of the California Health and Safety Code." This narrative standard would be implemented through incorporation of restrictive covenants in the deed and Environmental Restriction and Covenant Agreement at the time of transfer.
California Health and Safety Code*					
Land-use controls	Allows DTSC to enter into an agreement with the owner of a hazardous waste facility to restrict present and future land uses.	Transfer property from the DON to a nonfederal agency.	Cal. Health & Safety Code § 25202.5	Relevant and Appropriate	The substantive provisions of Cal. Health & Safety Code § 25202.5 are the general narrative standards to restrict "present and future uses of all or part of the land on which the . . . facility . . . is located . . ."

Table 7-6
Proposed State Action-Specific ARARs
Alameda Point Site 25/Annex IR-02 Groundwater RI/FS
Page 3 of 4

Action	Requirement	Prerequisite	Citation	ARAR Determination	Comments
Land-use controls (continued)	Provides a streamlined process to be used to enter into an agreement to restrict specific use of property in order to implement the substantive use restrictions of Cal. Health & Safety Code § 25232(b)(1)(A)–(E).	Transfer property from the DON to a nonfederal agency.	Cal. Health & Safety Code §§ 25222.1 and 25355.5(a)(1)(C)	Relevant and Appropriate	Generally, Cal. Health & Safety Code §§ 25222.1 and 25355.5(a)(1)(C) provide the authority for the DTSC to enter into voluntary agreements with land owners to restrict the use of property. The agreements run with the land restricting present and future uses of the land. The substantive requirements of the following Cal. Health & Safety Code § 25222.1 provisions are "relevant and appropriate": (1) the general narrative standard: "restricting specified uses of the property..." and (2) "...the agreement is irrevocable, and shall be recorded by the owner, ...as a hazardous waste easement, covenant, restriction or servitude, or any combination thereof, as appropriate, upon the present and future uses of the land." The substantive requirements of the following Cal. Health & Safety Code § 25355.5(a)(1)(C) provisions are "relevant and appropriate": "...execution and recording of a written instrument that imposes an easement, covenant, restriction, or servitude, or combination thereof , as appropriate, upon the present and future uses of the land."
	Prohibits certain uses of land containing hazardous waste without a specific variance.	Hazardous waste property.	Cal. Health & Safety Code § 25232(b)(1)(A)–(E)	Relevant and Appropriate	Land-use restrictions will be used to prohibit the following activities at the Site: installation of groundwater extraction wells for potable water uses.

Table 7-6
Proposed State Action-Specific ARARs
Alameda Point Site 25/Annex IR-02 Groundwater RI/FS
Page 4 of 4

Action	Requirement	Prerequisite	Citation	ARAR Determination	Comments
Land-use controls (continued)	Provides processes and criteria for obtaining written variances from a land-use restriction and for removal of the land use restrictions.	Transfer property from the DON to a nonfederal agency.	Cal. Health & Safety Code §§ 25233(c) and 25234	Relevant and Appropriate	Cal. Health & Safety Code § 25233(c) sets forth "relevant and appropriate" substantive criteria for granting variances based upon specified environmental and health criteria. Cal. Health & Safety Code § 25234 sets forth the following "relevant and appropriate" substantive criteria for the removal of a land-use restriction on the grounds that "...the waste no longer creates a significant existing or potential hazard to present or future public health or safety."

Note:

* Statutes and policies, and their citations, are provided as headings to identify general categories of proposed ARARs for the convenience of the reader. Listing the statutes and policies does not indicate that the Navy accepts the entire statutes or policies as proposed ARARs; specific proposed ARARs are addressed in the table below each general heading; only substantive requirements of specific citations are considered proposed ARARs.

Acronyms/Abbreviations:

ARAR – applicable or relevant and appropriate requirement
BAAQMD – Bay Area Air Quality Management District
BACT – Best Available Control Technology
CAA – Clean Air Act
Cal. Code Regs. – California Code of Regulations
Cal. Fish & Game Code – California Fish and Game Code
CFR – Code of Federal Regulations
CWA – Clean Water Act
NPDES – National Pollution Discharge Elimination System
ppm – parts per million
ppm_w – parts per million by weight
RCRA – Resource Conservation and Recovery Act
SIP – State Implementation Plan
SVE – Soil Vapor Extraction
TCLP – toxicity characteristic leaching procedure
USC – United States Code
USEPA – United States Environmental Protection Agency

These actions are also included in Alternatives 3, 4, 5, and 6; therefore, the federal and State requirements described in the following sections pertain to Alternatives 2, 3, 4, 5, and 6.

7.4.2.1 Groundwater Monitoring ARARs

Alternatives 2, 3, 4, 5, and 6 include a groundwater monitoring component. Federal and State requirements that pertain to groundwater monitoring for corrective action programs are described in the following sections.

Federal

Resource Conservation and Recovery Act

Portions of the RCRA groundwater protection standards contained in Cal. Code Regs. tit. 22 are not considered to be relevant and appropriate for the Site. Although the hazardous constituents being addressed by this action are similar or identical to those found in RCRA hazardous wastes, the Site is not considered a discrete waste management unit.

RCRA requirements for identification and management of solid and hazardous wastes are also potential federal action-specific ARARs identified for Alternative 2. Soil cuttings and wastewater generated in the course of installing and developing monitoring wells would be subject to RCRA requirements at Cal. Code Regs. tit. 22, § 66262.10(a) and § 66262.11 to determine whether such wastes should be classified as hazardous.

The DON has determined that soil cuttings, decontamination water, and well purge water from the Alameda Point Site 25/Annex IR-02 site would not be classified as RCRA-listed hazardous wastes. However, testing will be required to classify these materials with respect to the RCRA hazardous waste characteristics. This determination would be made at the time the waste is generated. The appropriate requirements outlined in Table 7-5 for storing, manifesting, and transporting this material for final disposal will be followed if soil cuttings and well purge water are classified as RCRA characteristic hazardous wastes. As discussed in Section 7.1.4.1, groundwater from some wells at the center of the plume has the potential to be classified as a RCRA hazardous waste.

The soil cuttings and well development water generated under Alternative 2 would also be subject to State action-specific requirements to determine if these materials are non-RCRA hazardous waste. The appropriate management requirements of Cal. Code Regs. tit. 22, § 66264 would be evaluated as potential ARARs should testing unexpectedly classify these materials as non-RCRA hazardous waste.

7.4.2.2 Institutional Controls ARARs

The objective of institutional controls is to restrict current or future occupants from withdrawing or reusing shallow groundwater during implementation of the remedy. The primary land use controls used to meet this objective will likely consist of:

- Land use restrictions issued by the DON in the deed for the property and a land use control covenant agreement with DTSC restricting future occupants from drinking or discharging the shallow groundwater would be implemented.
- The transferee would be required to submit a groundwater management plan to the DON addressing sampling and analysis requirements and appropriate disposal of contaminated groundwater along with its request for approval. The transferee would then be required to abide by the approved groundwater management plan and any other conditions of approval.
- A periodic review of the institutional controls would be performed at a frequency to be determined during the remedial design to ensure long-term compliance with institutional controls and the monitoring program. Institutional controls would also be evaluated as part of the comprehensive 5-year review.

State

State statutes that have been accepted by the DON as ARARs for implementing institutional controls and entering into an Environmental Restriction Covenant and Agreement with DTSC include substantive provisions of the Cal. Civ. Code § 1471 and Cal. Health & Safety Code §§ 25202.5, 25222.1, 25233(c), 25234, and 25355.5. DTSC promulgated a regulation on April 19, 2003 regarding "Requirements for Land Use Covenants" at Cal. Code Regs. tit. 22, § 67391.1. The substantive provisions of this regulation have been determined to be "relevant and appropriate" state ARARs by the DON.

The substantive provisions of Cal. Civ. Code § 1471 are the following general narrative standard: "... to do or refrain from doing some act on his or her own land ... where ... (c) Each such act relates to the use of land and each such act is reasonably necessary to protect present or future human health or safety or the environment as a result of the presence on the land of hazardous materials, as defined in Section 25260 of the Health and Safety Code." This narrative standard would be implemented through incorporation of restrictive environmental covenants in the deed at the time of transfer. These covenants would be recorded with the environmental restriction covenant and agreement and run with the land.

The substantive provisions of Cal. Health & Safety Code § 25202.5 are the general narrative standard to restrict "present and future uses of all or part of the land on which the ... facility ... is located . . . ." These substantive provisions will be implemented by incorporation of restrictive environmental covenants in the Environmental Restriction Covenant and Agreement at the time of transfer for purposes of protecting present and future public health and safety.

Cal. Health & Safety Code §§ 25222.1 and 25355.5(a)(1)(C) provide the authority for the state to enter into voluntary agreements to establish land-use covenants with the owner of property. The substantive

requirements of the following Cal. Health & Safety Code § 25222.1 provisions are "relevant and appropriate": (1) the general narrative standard: "restricting specified uses of the property,..." and (2) "...the agreement is irrevocable, and shall be recorded by the owner, ...as a hazardous waste easement, covenant, restriction or servitude, or any combination thereof, as appropriate, upon the present and future uses of the land." The substantive requirements of the following Cal. Health & Safety Code § 25355.5(a)(1)(C) provisions are "relevant and appropriate": "...execution and recording of a written instrument that imposes an easement, covenant, restriction, or servitude, or combination thereof, as appropriate, upon the present and future uses of the land." The DON will comply with the substantive requirements of Cal. Health & Safety Code §§ 25222.1 and 25355.5(a)(1)(C) by incorporating the CERCLA use restrictions (Section 8.2.2.2 of this ROD) into the DON's deed of conveyance in the form of restrictive covenants under the authority of Cal. Civ. Code § 1471 and into the environmental restriction covenant and agreement. The substantive provisions of Cal. Health & Safety Code §§ 25222.1 and 25355.5(a)(1)(C) may be interpreted in a manner that is consistent with the substantive provisions of Cal. Civ. Code § 1471. The covenants shall be recorded with the deed and run with the land.

Cal. Health & Safety Code § 25233(c) sets forth "relevant and appropriate" substantive criteria for granting variances from prohibited uses based upon specified environmental and health criteria. Cal. Health & Safety Code § 25234 sets forth the following "relevant and appropriate" substantive criteria for the removal of a land-use restriction on the grounds that "...the waste no longer creates a significant existing or potential hazard to present or future public health or safety."

In addition to being implemented through the Environmental Restriction Covenant and Agreement between the DON and DTSC, the appropriate and relevant portions of Cal. Health & Safety Code §§ 25202.5, 25222.1, 25233(c), 25234, and 25355.5(a)(1)(C) and Cal. Civ. Code § 1471 shall also be implemented through the deed between the DON and the transferee.

U.S. EPA does not agree with the DON and DTSC that the sections of the Cal. Civ. Code and Cal. Health & Safety Code cited above are ARARs because they fail to meet the criteria for ARARs pursuant to U.S. EPA guidance (i.e., they are administrative, not substantive, requirements that establish a discretionary way to implement land-use restrictions). However, USEPA agrees that the substantive provisions of the recently promulgated regulation (Cal. Code Regs. tit. 22, § 67391.1) providing for the execution of a land-use covenant between DON and DTSC is a "relevant and appropriate" state ARAR.

7.4.2.3 Conclusion

Alternative 2 being evaluated for Alameda Point Site 25/Annex IR-02 includes MNA and Institutional Controls to monitor biological activity and contaminant degradation and to prevent unacceptable risk from groundwater well installation. Applicability of RCRA requirements for identification and management of hazardous wastes will be determined during the course of remedial action. No State requirements that pertain to action-specific ARARs were identified by the DTSC for this component; however, potential state ARARs pertaining to institutional controls are recognized by DON.

7.4.3. Alternative 3 – Biosparging, with Soil Vapor Extraction, Monitored Natural Attenuation, and Institutional Controls

Alternative 3 utilizes biosparging to increase biological activity, and incorporates MNA and institutional controls. To mitigate the potential effect of fugitive vapor emissions, a SVE system will be required during the course of the remedial action. Because Alternative 3 incorporates all of the components of Alternative 2, the ARARs listed in the previous section for Alternative 2 will also apply to Alternative 3. Additional ARARs for Alternative 3 are presented below.

The SVE system will be used only to control fugitive emissions, and is not intended as a primary treatment system. The SVE system will be run during startup of the biosparging system until baseline conditions and the level of increased volatilization of contaminants from groundwater to soil gas is understood. After system startup, the SVE system will be turned off when soil gas concentrations in shallow soil gas monitoring probes are consistently below health-based criteria such as USEPA vapor intrusion risk-based screening values for shallow soil gas. Soil gas will be monitored on a bi-weekly basis. If concentrations exceed the health-based criteria, the SVE system will be turned on until concentrations have been reduced below the health-based criteria. If Alternative 3 is selected in the ROD, specific protocol and action levels will be developed in the remedial design.

7.4.3.1 Sparging and SVE ARARs

Federal

Clean Air Act

During operation of the SVE system, air monitoring for VOCs emitting from the SVE system will be required, along with monitoring the effectiveness of the biosparging system. Off-gassing from the biosparging system operation would be required to comply with the air emissions requirements of the BAAQMD. Requirements that have been incorporated into the SIP and are therefore considered to be federal ARARs include Rules 2-301, 6-301, 8-47-301, 8-47-302, 8-47-500, and 8-47-600. These requirements and their applicability to Alternative 3 are discussed below.

40 CFR § 52.220 lists USEPA-approved State Implementation Plans (SIPs) for achieving National Ambient Air Quality Standards (NAAQS) for certain critical air pollutants. NAAQS sets primary and secondary standards for ambient air quality to protect public health and welfare. These are non-enforceable standards, and thus are determined to be relevant and appropriate requirements if a SVE system is installed.

Rule 8-47-301, 302 restricts emissions of specific compounds. It requires that any air stripping and SVE operations that emit benzene, vinyl chloride, perchoroethylene, methylene chloride, and/or trichloroethylene or any other total organic compounds with emissions greater than 15 pounds be vented to a control device that reduces emissions to the atmosphere by at least 90 percent by weight.

Rule 8-47-500 sets the protocols for monitoring and record keeping requirements, and 8-47-600 details the manual of procedures for sampling, analysis, and emissions determination. The off-gassing from the biosparging system is required to comply with BAAQMD requirements for air emissions. These regulations are considered to be potentially relevant and appropriate State requirements.

Safe Drinking Water Act Underground Injection Control Regulations

Underground injection control (UIC) regulations established pursuant to the SDWA also constitute potential federal action-specific ARARs for Alternative 3. The biosparge injection wells would be designated as Class V wells per 40 C.F.R. § 144.6(e). There are currently no specific UIC program technical requirements for injection into Class V wells that apply to this remedial action. However, the general narrative provisions of the federal UIC rules are relevant and appropriate, in that injection of air through Class V wells must not cause the shallow aquifer at the Site to violate primary drinking water MCLs established by USEPA. This substantive requirement would be satisfied by using oil-less compressors to inject only clean ambient air.

7.4.3.2 Conclusions

Biosparging technology presented in Alternative 3 will be designed to minimize the release of volatiles to the atmosphere. In addition to the ARARs identified for Alternative 2, the Clean Air Act (CAA) and BAAQMD regulations discussed above are relevant and appropriate for the operation of a SVE system, which will be included as part of Alternative 3.

7.4.4. Alternative 4 – Biosparging with Nutrient/Microorganism Enhancement, SVE, MNA, and Institutional Controls

Alternative 4 is identical to Alternative 3, with the exception of introducing additional nutrients or microorganisms to the subsurface to accelerate the time for site cleanup. Because Alternative 4 incorporates all of the components of Alternatives 2 and 3, the ARARs listed in the previous sections for Alternatives 2 and 3 will also apply to Alternative 4. There are no additional ARARs for Alternative 4.

7.4.5. Alternative 5 – Air Sparging with SVE, MNA, and Institutional Controls

Alternative 5 is identical to Alternative 3, with the exception that air sparging (air injection at higher pressure relative to biosparging) is used to both speed biodegradation and increase volatilization of dissolved contaminants. Because Alternative 5 incorporates all of the components of Alternative 3, the ARARs listed in the previous sections for Alternatives 2 and 3 will also apply to Alternative 5. There are no additional ARARs for Alternative 5.

7.4.6. Alternative 6 – Pump and Treat with MNA and Institutional Controls

Alternative 6 involves extracting groundwater from the plume centers to remove dissolved contamination for on-site treatment and subsequent discharge to the POTW. Because Alternative 6 incorporates all of

the components of Alternative 2, the ARARs listed in the previous section for Alternative 2 will also apply to Alternative 6.

Waste streams generated in the course of implementing Alternative 6 (such as extracted groundwater and spent granulated activated carbon) would be subject to RCRA requirements for identification and management of solid and hazardous waste, as discussed for Alternative 2. In addition, groundwater from one or more of the extraction wells may be classified as a characteristic RCRA hazardous waste; therefore, substantive requirements of Cal. Code of Regs. Tit. 22 § 66264 would be potentially applicable for any tanks, piping, or other ancilliary equipment that would transfer, store, or treat groundwater that would be classified as RCRA hazardous waste.

7.5. SUMMARY

Controlling ARARs have been identified in the text of this section for each medium, location, and proposed remedial action. Alternatives identified as remedial actions for this RI/FS do not involve any significant discharge to surface water, groundwater, or air. The substantive provisions of the following requirements were identified as potential relevant and appropriate, or to be considered, requirements that affected the development of RAOs for this action.

- RCRA (Cal. Code Regs. tit. 22, div. 4.5 and tit. 23, div. 3, Chapter (ch.) 15)
- SDWA (40 CFR § 141.61)
- USEPA Water Quality Requirements and Health Advisories (USEPA 822-R-04-005)
- The Migratory Bird Treaty Act (16 USC §§ 703)
- CAA (42 USC §7410)
- BAAQMD (Regulations 8-47-301,302,500,600)
- Cal/EPA Department of Toxic Substances Control Land Use Covenant regulations (Cal Code Regs. Tit. 22, §67391.1 (a) and (e)(1)
- California Civil Code §1471
- California Health and Safety Code §25202.5, 25222.1, 25355.5(a)(1)(C), 25232(b)(1)(A)-(E), 25233(c), and 25234
- Portions of the shallow groundwater at Alameda Point Site 25/Annex IR-02 have been classified as potentially suitable for drinking water purposes. Cleanup goals will be based on the most conservative of potential ARARs evaluated herein for a drinking water scenario.

The Migratory Bird Treaty Act section 703 is considered relevant and appropriate because the site is located near a sensitive migratory habitat. The Fish and Wild Life section 662 (USC § 403) and the Harbor Act 33 (33 CFR § 322) were identified under the biological resources as potential ARARs because of Alternatives 2 and 3.

Actions evaluated as part of remedial Alternatives 2, 3, 4, 5, and 6 include installation and sampling of groundwater wells. RCRA regulations may be applicable if any of the wastes generated exceed the criteria for toxicity under Cal. Code Regs. tit. 22, § 66261.24(a)(1). RCRA regulations may also be applicable to additional waste streams generated under Alternative 6.

Remedial Alternatives 3, 4, and 5 will involve the installation of a SVE system. The CAA (40 CFR § 52.220) is relevant and appropriate during the operation of SVE as a remedial alternative. BAAQMD requirements to be met for emissions from the SVE system at the on-station treatment facilities include potentially applicable federal ARARs in Rule 8. Air emissions from the SVE treatment system are expected to be minimal. Control of fugitive emissions during the construction operation will be performed by undertaking proper BACT measures.

Alternatives 2, 3, 4, 5, and 6 include institutional controls to limit use of groundwater as a potable water supply in the short term. DTSC regulations in Cal Code Regs. Tit. 22, §67391.1 (a) and (e)(1), California Civil Code §1471, and California Health and Safety Code §25202.5, 25222.1, 25355.5(a)(1)(C), 25232(b)(1)(A)-(E), 25233(c), and 25234 are potential ARARs for the development and enforcement of institutional controls.

This page intentionally left blank

8. IDENTIFICATION AND SCREENING OF TECHNOLOGIES

This report was prepared in accordance with the USEPA's *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (USEPA, 1988c), and requests from stakeholders to evaluate both passive and active remedial technologies and/or processes to address Site contamination.

Because risk assessments performed prior to 2002 assumed that groundwater would not be used as a potable water supply, these studies did not find risk levels greater than USEPA's risk management range. As a result, the original scope of this report was to evaluate passive alternatives to remediate the Site under the assumption that groundwater would not be used as a potable water supply. However, based on stakeholder concern, the cleanup goals for this report were adjusted to consider the possible future use of Site groundwater as a potable water supply.

The sections that follow detail:

- Remedial Action Objectives: Medium-specific and/or Site-specific goals for protecting human health.
- General Response Actions (GRAs): Broad-based classes of actions that will satisfy Site RAOs.
- Identification and screening of technology types and processes: Conducted for each of the GRAs to develop remedial alternatives for groundwater at the Site.

8.1. REMEDIAL ACTION OBJECTIVES

RAOs are either medium-specific and/or site-specific goals for protecting human health and the environment. Where possible, each RAO should specify: (1) each COPC; (2) the exposure route and each receptor; and (3) an acceptable contaminant concentration or range of concentrations for each exposure pathway and media.

The RAO developed for the project Site is based on previous investigations, with a primary emphasis on the RIs for both Alameda Point OU-5 and the Alameda Annex. The previous ERAs performed for the Site, based primarily on the lack of terrestrial receptors (Section 6.6), and subsequent comparison of groundwater data against aquatic criteria (Section 5.8.2), concluded that no risks were posed to the environment. Therefore, the RAOs in this report are designed to protect human health.

The groundwater RAO developed for the Site is to prevent exposure to groundwater contaminants in the FWBZ at concentrations that pose an unacceptable risk to human health.

Groundwater RAO specifications include:

- COPCs: benzene and naphthalene
- Exposure routes and receptors: shallow well pumping from the FWBZ and subsequent use by a resident, student, construction worker, landscape worker, or school worker. Based on previous evaluations of groundwater beneficial uses (as discussed in Section 2), this exposure route has a low probability of being completed; however, the exposure route is being retained for the RAO to address the possibility of unapproved use of Site groundwater from the FWBZ as a potable water supply.
- Acceptable chemical concentrations, or range of concentrations, for each exposure pathway and media: State MCL for benzene (1 μg/L), and the USEPA Health Advisory for naphthalene (100 μg/L). These threshold concentrations address risk associated with the potential unapproved use of Site groundwater from the FWBZ as a potable water supply.

The RAO developed for indoor air at the Site is to prevent exposure to vapors volatilized from groundwater at the Site at concentrations that pose an unacceptable risk to human health. As discussed in Section 6, current risk to human health from the vapor intrusion pathway is within the USEPA's risk management range (10^{-4} to 10^{-6}); however, increased volatilization of contaminants from the groundwater may occur during implementation of an active remediation technology. The indoor air RAO is being established to ensure protection of human health during implementation of the selected groundwater remedy.

Indoor Air RAO specifications include:

- COPCs: benzene and naphthalene
- Exposure routes and receptors: volatilization of COPCs from the groundwater and migration through the vadose zone and into buildings where residents, students, and workers can be exposed.
- Acceptable contamination concentrations or range of concentrations for each pathway and media: indoor air concentrations of benzene and naphthalene must be within USEPA's risk management range (10^{-4} to 10^{-6}), as modeled from measured soil gas concentrations using current regulatory agency guidance. Site-specific trigger levels for soil gas will be developed in the proposed plan and selected in the ROD. Remedial action monitoring will be performed at soil gas probes. Soil gas concentrations in excess of the trigger levels will prompt a contingency action to prevent exposure to volatilized contaminants from the groundwater during implementation of an active remediation technology.

8.2. GENERAL RESPONSE ACTIONS

The following GRAs were identified for the Site:

- No Action: The NCP requires inclusion of the no action response among the alternatives evaluated in every FS (40 CFR Subsection 300.430[e][6]). The no action response provides a baseline for comparison to the other remedial response actions.
- Institutional Actions: Land use controls (consisting of either institutional or engineering controls) that limit exposure to contaminated groundwater, and Site monitoring of groundwater contaminant concentrations.
- Groundwater Containment and/or Removal, Treatment, and Disposal: The physical restriction of contaminated groundwater to its present location. This GRA may also include groundwater extraction that contains groundwater contamination and involves its removal, treatment (if required), and disposal. The treatment and disposal could be performed either on- or off-site.
- Saturated Soil Removal, Treatment, and Disposal: The physical removal of saturated soil, and the associated treatment (if required) and disposal of the waste. The treatment and disposal could be performed either on- or off-site.
- In situ Treatment: The "in place" treatment of contaminated groundwater and/or saturated zone soil using a variety of physical, chemical, and biological methods.

For each of the GRAs listed above, specific remedial technologies or processes have been selected for evaluation, as presented in Table 8-1. The technologies and/or processes determined to be viable for the project Site will be used to form the remedial alternatives presented in Section 9.

8.3. IDENTIFICATION AND SCREENING OF TECHNOLOGY TYPES AND PROCESSES

A brief description of the technologies and/or processes selected for evaluation is provided below. The technologies and/or processes were evaluated on the criteria of general effectiveness, cost, and implementability.

8.3.1. No-Action

As discussed above, evaluation of the no action response is required by the NCP to provide a baseline for comparison to other response actions. Under the no action response, no actions would be conducted to contain, remove, or treat groundwater contamination at the Site, no additional institutional controls would be established, and no monitoring would be required at the Site.

"No-Action" General Screening

Effectiveness:	Low
Cost:	Low
Implementability:	High
Retained for Further Analysis:	Yes (to provide a baseline for comparison to other response actions)

8.3.2. Institutional Actions

Actions taken to limit exposure to the hazardous substances in the Site groundwater can be achieved by land use controls, consisting of either institutional controls or engineering controls. In addition, site monitoring is used to track the effectiveness of the remedy alternative or to ensure that hazardous substances in the Site groundwater do not migrate and impact human or ecological receptors. The institutional actions are discussed in more detail below.

8.3.2.1 Institutional Controls

Institutional controls, as defined by the U.S. Department of Defense (DoD, 2001), are non-engineering measures limiting potential exposures to a site or media of concern, or ensure that engineering measures designed to remediate a site, or limit access to a site, remain in place. Similarly, the USEPA defines institutional controls as "non-engineering measures designed to prevent or limit exposure to hazardous substances left in place at a site, or assure effectiveness of a selected remedy."

Examples of institutional controls include easements, covenants (enforced by law with allowance for recovery of damages), equitable servitudes (only enforceable in equity; remedy may be an injunction or requirement for compliance), notices (in the deed or in local newspapers), zoning, educational materials, permits (such as construction, well drilling, and excavation permits), and agreements with regulators.

Advising the public of the presence of groundwater contamination at the Site (specifically benzene and naphthalene), and restricting excavation, construction, and installation of irrigation, industrial, and drinking water wells through deed restrictions and land-use covenants, would effectively reduce the risks associated with exposure to contaminated groundwater. The risk associated with the off-Site flow of contaminants (e.g., migration to the Oakland Inner Harbor) would not be reduced by deed restrictions. However, groundwater contamination does not appear to be migrating (see Section 4). Deed restrictions can be an effective tool when exposure pathways are not complete and are not predicted to be complete in the future.

Examples of deed restrictions that would prohibit shallow groundwater use include:

- Restrictions on construction of extraction wells screened in the FWBZ area of contamination.
- Restrictions on extraction (except for required construction dewatering), use, or consumption of water from the FWBZ.
- Restrictions on the disposal of extracted groundwater from construction site dewatering into the waters of the State, except in compliance with the California Water Code and the NPDES of the USEPA.
- Restrictions on engaging in any excavation below the water table without an excavation permit.

Because deed restrictions can be an effective tool, they are retained for further analysis. However, because deed restrictions alone will not provide a long-term remedy, they will be considered for use with other technologies or processes.

"Institutional Controls" General Screening

Effectiveness:	High in situations with low risk to humans and the environment
Cost:	Low compared to other more aggressive remedial technologies
Implementability:	High
Retained for Further Analysis:	Yes

8.3.2.2 Engineering Controls

Engineering controls, such as vapor barriers or passive gas collection systems, may serve to mitigate vapor intrusion from the subsurface into indoor air. Retrofitting existing structures with such systems would be labor-intensive and costly; however, installation of such systems during the construction of new structures would be, in comparison, easier to implement and less costly. Because current conditions do not pose an unacceptable risk to human health via the vapor intrusion pathway, implementation of these type of engineering controls would not be required as a stand-alone remedy. Any active remedial technology that could increase volatilization of groundwater contamination in excess of acceptable levels would require a contingency action to mitigate these risks. Such contingency actions will be evaluated in conjunction with the remedial technology prompting the action. Therefore, engineering controls designed to mitigate vapor intrusion from the subsurface into indoor air are eliminated from further analysis.

Additional engineering controls include access restrictions, such as fencing and other physical barriers, that can be effective in limiting access to contaminated media. Because the Site involves groundwater contamination and there are no surface discharges, access restrictions would not be effective in preventing exposure to groundwater contamination. Fencing and other physical barriers will be incorporated as part of any active remedial technology that involves intrusive Site activities, consistent with standard health and safety practices, in order to limit access to contaminated media.

Because access restrictions would not be effective as a stand-alone remedy, although they are economical and easy to implement, they are eliminated from further analysis.

"Engineering Controls" General Screening

Effectiveness:	High in situations with low risk to humans and the environment
Cost:	Moderate; dependent on type of control and Site-specific conditions
Implementability:	Moderate to High
Retained for Further Analysis:	No

8.3.2.3 Site Monitoring

Under CERCLA, site monitoring is a required component for any site remedy. Short-term monitoring is conducted to ensure that potential risks to human health and the environment are controlled while a site remedy is being implemented. Long-term monitoring can be used to track site contaminants after an active remedial technology has been used.

Monitoring would evaluate the potential phases of a completed groundwater-to-human inhalation/ ingestion pathway that includes groundwater and soil gas migration. Soil gas concentrations would be monitored through properly located and constructed soil gas wells to evaluate the possible volatilization of groundwater contaminants. Groundwater contaminant concentrations would be monitored through properly located and constructed wells.

Because groundwater and/or soil gas site monitoring can be effective, is easy to implement, and is cost effective, it is retained for further analysis. However, because site monitoring alone will not provide a long term remedy, it will be considered for use with other technologies or processes.

Monitoring for the Site has already begun under the Alameda Point Basewide Groundwater Monitoring Program, and will continue through implementation of the remedial alternative selected in this report.

"Site Monitoring" General Screening

Effectiveness:	Highly effective in situations with low risk to humans and the environment
Cost:	Moderate; dependent on timeframe for and extent of required monitoring
Implementability:	High
Retained for Further Analysis:	Yes

8.3.3. Groundwater Containment and/or Removal, Treatment, and Disposal

Groundwater containment options include passive physical barriers (such as slurry walls or sheet piling) and the active extraction methods (such as extraction wells and phytoremediation) to control groundwater flow. Because of the relative stability of the plume, containment responses alone would not serve to address the groundwater RAO, and passive physical barriers were eliminated during the initial screening process. However, active extraction methods that can also remove contaminated groundwater from the subsurface are discussed in more detail in the following subsections.

8.3.3.1 Groundwater Pump and Treat Systems

Historically, pump and treat systems have been the most common method for containment and removal of contaminants in groundwater. Pump and treat systems are designed to extract groundwater containing dissolved contaminants from the subsurface and deliver water to the surface for treatment. In general, electric submersible pumps are used for high-flow conditions, and reciprocating electric or pneumatic pumps are used for low-flow conditions. Extraction of groundwater creates an inward gradient of the water table, reducing the potential for contaminant migration. Extracted groundwater can be treated on-site using granular activated carbon (GAC) filtration or air-stripping, or in some cases can be pumped to an off-site wastewater treatment facility. The goal of a pump and treat system designed primarily to remove groundwater contamination, as compared to systems designed primarily for containment, is to maximize the rate of contaminant removal and minimize the volume of groundwater requiring treatment

(Air Force Center for Environmental Excellence [AFCEE] and the Defense Logistics Agency [DLA], 2001).

Extensive performance data have shown pump and treat systems to be most effective at removing floating free product and dissolved contaminants from porous soils. While pump and treat systems are effective in removing dissolved contaminant mass from permeable soil layers, the dissolution of contaminants from less permeable soil layers is limited by much slower diffusion processes. As a pump and treat system continues to operate, the efficiency diminishes as less contaminant mass is removed for the same volume of extracted groundwater. For this reason, pump and treat systems have, in many cases, resulted in greater costs over the entire implementation timeframe compared to more aggressive in situ treatment methods. Further, pump and treat systems intended for removal of contaminant mass have not typically been successful as stand-alone remedies (AFCEE and DLA, 2001).

The effectiveness of pump and treat systems may be limited at the Site, considering the existing heterogeneous and low-permeability soils producing low groundwater yields, the absence of floating free product or significant contaminant migration, the inefficiencies of pump and treat systems in removing low concentrations of dissolved contaminants from groundwater, and the additional time and resulting higher costs to achieve cleanup goals. However, pump and treat systems would minimize the potential for fugitive emissions into nearby residences and would not require the use of vapor extraction and treatment systems (as are typically used for sparging systems). Considering the current Site use and the need to effectively control potential fugitive emissions, pump and treat systems are being retained for further analysis, primarily to be compared with sparging technologies.

"Pump and Treat" General Screening

Effectiveness:	Moderate due to asymptotic approach to cleanup goals
Cost:	High given the longer timeframe to achieve cleanup goals
Implementability:	Moderate
Retained for Further Analysis:	Yes (to compare with sparging technologies)

8.3.3.2 Phytoremediation

Phytoremediation uses vegetation and its associated microbiota, soil amendments, and agronomic techniques to remove, contain, and/or reduce the toxicity of contaminants. At this Site, phytoremediation would provide hydraulic control via root structure water extraction. Removal of contaminant mass through phytotransformation is theoretically possible. However, it would be limited at the Site due to the depth of contamination and the shallow penetration of root structures (USEPA, 2001a).

Implementing phytoremediation requires identifying plants that have a high evapotranspiration rate and are suitable for the project area. Hybrid poplar trees are commonly used for remediation of groundwater, but other trees such as eucalyptus have also been studied. Depending on factors such as growth stage and climate, one hybrid poplar tree, with roots located in groundwater, can have a transpiration rate of

approximately 26 gpd, thus altering the water table and creating a hydraulic containment zone (USEPA, 2000). The plants, trees, or shrubs used in phytoremediation remove water primarily during the growing season. The range of plants and area and density of planting must be designed to ensure that the water table is drawn down sufficiently during the growing season to prevent contaminated groundwater from escaping into the planting zone during the winter.

Although removal of contaminant mass is possible with phytoremediation, the root zone depth can be a limiting factor. Tree root structures may only extend 3 to 6 feet bgs, with 90 percent of the roots only extending 2 feet bgs (USEPA, 2000). Hybrid poplar trees have deeper root structures and may extend 15 feet bgs (USEPA, 2001a), but the contaminant mass at the Site is concentrated near 20 feet bgs.

Though phytoremediation is possible for hydraulic containment and would improve the aesthetic appearance of the area, it would not substantially contribute to containment of contaminants (contaminants are relatively stable to begin with), and would not remove significant contaminant mass from the subsurface. In addition, both the current and future Site use (residential housing) would limit the amount of open space available to plant trees over a large portion of the Site.

While implementation costs for phytoremediation are lower than for other technologies, the Site-specific conditions (most notably, the depth of groundwater contamination and space limitations) would render it ineffective and difficult to implement. Phytoremediation is therefore not retained for further analysis.

"Phytoremediation" General Screening

Effectiveness:	Low
Cost:	Low
Implementability:	Moderate in areas with surface obstructions (e.g., residential housing)
Retained for Further Analysis:	No

8.3.4. Saturated Soil Removal, Treatment, and Disposal

Removal of soil within the saturated zone is applicable primarily to sites where soil source areas are contributing to groundwater contamination. Excavation of the affected soils would eliminate ongoing sources, and dewatering would remove groundwater that infiltrates into the excavation.

If Site soils do not retain their integrity during excavation, shoring or sheet piling would be placed around the perimeter of the excavation to stabilize the opening and reach the final depth of excavation. All excavated materials would likely require transportation and disposal to an off-site treatment and disposal facility, or might be considered for on-site treatment and/or disposal, if an acceptable option could be found within Alameda Point. Off-site treatment of soils typically involves thermal desorption or aeration to remove volatile contaminants, which can then be destroyed through various combustion methods. This alternative requires significant transportation and processing costs, and is most applicable to heavily contaminated soils. Extracted groundwater removed during excavation dewatering can be treated on site

using GAC filtration or air-stripping, or in some cases can be pumped to an off-site wastewater treatment facility.

Excavation of saturated soil is typically performed for source or "hot spot" areas that continue to leach contaminants into groundwater. As presented in Section 4.3, a comparison of naphthalene concentrations in soil and groundwater indicates that the majority of naphthalene contamination is dissolved in groundwater, and not adsorbed onto soil. This finding is consistent with the conceptual site model of an aging plume with no significant ongoing soil sources. In addition, the depth of contamination within the saturated zone (at 20 feet bgs), coupled with the current Site use, would make excavation of saturated soils difficult to implement. Therefore, excavation of saturated soils is not retained for further analysis.

"Saturated Soil Removal, Treatment, and Disposal" General Screening

Effectiveness:	Low for the Site
Cost:	High given the Site conditions (depth of contamination, Site use)
Implementability:	Moderate for small excavations; more difficult for larger areas
Retained for Further Analysis:	No

8.3.5. In Situ Treatment

In situ technologies and/or processes can be applied without removing contaminants or contaminated media from their on-Site locations. Some in situ technologies can achieve a considerable cost savings by eliminating the need for physical removal, transport, and off-site destruction of contaminated media. Also, as more sites are remediated using in situ technologies, more data become available regarding the efficiency of such methods.

There is favorable evidence to support the viability of in situ biological treatment, particularly in remediating petroleum hydrocarbons and BTEX compounds. Furthermore, USEPA's "Treatment Technologies for Site Cleanup Annual Status Report" documented an increase in the use of in situ treatment (USEPA, 2001b).

A 5-year moving average of the percentage of in situ treatment technologies being employed showed a generally steady increase from 28 percent (Fiscal Year 1985-1988) to 51 percent (Fiscal Year 1995-1999). During this period, BTEX compounds were the second most common contaminant treated at Superfund sites (USEPA, 2001b). The most common form of in situ biological treatment involves injection of air into the subsurface to convert conditions from anaerobic (generally less than 0.5 mg/L DO) to aerobic, and/or physically volatilize contaminants. Biological treatment technologies are proven to be less disruptive to Site activities and less expensive for less time-critical remedial actions.

8.3.5.1 Monitored Natural Attenuation

MNA involves the careful tracking of natural in situ processes that degrade and/or contain groundwater contamination. These processes are commonly referred to as natural attenuation, and act without human

intervention in soil and groundwater to reduce the mass, toxicity, mobility, volume, or concentration of contaminants. Contaminants have varying tendencies toward natural attenuation; the more difficult contaminants are considered recalcitrant.

In situ natural attenuation processes include biodegradation, dispersion, dilution, adsorption, volatilization, and chemical or biological stabilization or destruction. Chemical or biological destruction involves microorganisms that consume and degrade contaminants either aerobically or anaerobically. In the case of petroleum contamination, constituents are transformed into harmless by-products such as carbon dioxide and water.

Natural attenuation has been shown to be a dominant process at petroleum-contaminated sites. During the past 10 years, remediation of petroleum-contaminated sites has shifted from physical removal techniques for affected media to the removal of "source areas" and the use of MNA to address residual contamination (Lawrence Livermore National Laboratory [LLNL], 1999). The RWQCB, in an effort to facilitate petroleum site closures and reduce costs, has published guidance for establishing low-risk soil and groundwater sites. If low-risk groundwater criteria are met, the guidance promotes MNA.

MNA is retained for consideration as a remedial alternative; however, it may not be able to fully address certain anaerobic areas at the Site, such as zones near 20 feet bgs.

"MNA" General Screening

Effectiveness:	Moderate
Cost:	Low
Implementability:	High
Retained for Further Analysis:	Yes

8.3.5.2 Air Sparging with Soil Vapor Extraction

Air sparging involves the use of injection wells to introduce clean air into the saturated zone, primarily to volatilize contamination for collection via SVE, and secondarily to promote aerobic biodegradation. If sparging is performed at lower pressures to enhance aerobic biodegradation with a lower potential for volatilizing contaminants, it is referred to as biosparging (see Section 8.3.8.3). Air sparging injects air vertically or horizontally into the aquifer at a pressure above the local hydrostatic head. The air travels from the injection point through the aquifer and moves to the hydrostatic surface.

Air sparging typically requires a soil vapor extraction/recovery system to capture and treat contaminants transferred to the vapor phase. This would consist of vapor extraction wells positioned within and around the treatment area, and post-extraction vapor treatment, such as catalytic oxidation or GAC filtration. If air sparging were used at the Site, vapor extraction/recovery and treatment would be needed to protect the nearby residents from fugitive benzene emissions.

Removal mechanisms associated with in situ air sparging have been investigated both in the laboratory and in field applications, and have been found to be effective (Fields et al., 2002). Air sparging, like many in situ remediation technologies is limited by subsurface heterogeneities, particularly low-permeability soil. Low-permeability and heterogeneous subsurface conditions inhibit efficient flow of air and result in areas of discontinuous remediation.

Typical factors to consider for an air sparging system are:

- Plume size
- Vadose zone permeability
- Depth of contamination and Site-specific geology/hydrogeology
- Contaminant volatility and solubility
- Injection well design (radius of influence of sparging wells)
- Soil heterogeneity (may cause certain zones to be relatively unaffected)
- Presence of dense non-aqueous phase liquids (DNAPLs), which are difficult to sparge because they are usually concentrated above less permeable subsurface zones
- Air-saturation data from the saturated zone, collected during an air sparging test, using a neutron probe

Because of the relatively high air injection pressure and the resulting increased fugitive emissions at the Site, air sparging poses increased risks to Site occupants relative to other technologies. However, air sparging may reduce overall cleanup time relative to other technologies, and could be feasible in areas at the Site that are currently unoccupied. Therefore, air sparging is retained for further analysis, primarily to be used in comparison with the biosparging technology.

"Air Sparging" General Screening

Effectiveness:	Highly effective for volatile contaminants (Henrys constant greater than 100 atmospheres)
Cost:	Moderate; size of the Site influences cost
Implementability:	Moderately implementable in areas where fugitive emissions are less of a concern; low to moderate implementability in areas with sensitive receptors (such as residents)
Retained for Further Analysis:	Yes (to compare with biosparging technology)

8.3.5.3 Biosparging with Soil Vapor Extraction

Biosparging involves injection of air into the saturated zone, similar to air sparging, but at lower pressures to minimize the possibility of volatized contaminants passing through the vadose zone. Biosparging enhances in situ biodegradation by increasing DO in the saturated zone, and increasing volatilization of contaminants into the vapor phase where they rise into the vadose zone and undergo further biodegradation. Whereas air sparging is designed to push volatilized contaminants through the vadose

zone for subsequent collection and treatment, biosparging is designed to push air (oxygen) into the saturated zone to promote treatment via biodegradation. Injection pressure is optimized to overcome hydraulic head, and radius of influence is driven by oxygen diffusion into the formation. Because air injection rates are optimized to promote biodegradation in the saturated zone, fugitive emissions are minimized. However, due to the proximity to Site residents, vapor extraction/recovery and treatment would be needed if biosparging were used at the Site to ensure protection of the nearby residents from potential fugitive emissions. Due to the lower potential for fugitive emissions, the vapor extraction system associated with the biosparging remedy may not require continuous operation during sparging (which is necessary for air sparging systems). A reduction in operation time for the vapor extraction system, if deemed appropriate based on acceptable soil gas monitoring results, would result in a potentially significant cost reduction relative to air sparging systems.

The effectiveness of biosparging generally depends on several primary factors:

- Plume size
- Soil permeability, which determines the rate at which oxygen can be supplied to the subsurface microorganisms.
- The biodegradability of contaminants, which determines both the rate and degree to which constituents will be degraded by microorganisms.
- The biodegradation capacity of vadose-zone soils.

As described in the previous subsection (Air Sparging), if soils are not permeable enough, biosparging will only address localized areas, leaving pockets of residual contamination. Previous investigations at the Site have found that soils are moderately permeable (IT et al., 2002b; TtEMI, 1998a), which would be sufficient to support a biosparging system. Even soils with low permeability have been shown to support sparging systems (Fields et al., 2002).

In addition, the biodegradability of Site contaminants is very high, which would support a biosparging system. The two primary COPCs at the Site (benzene and naphthalene) are petroleum hydrocarbon constituents, which have been shown to be readily biodegradable given oxygen sources and subsurface microbes and nutrients.

The biodegradation capacity of a vadose zone is usually dependent on the type and number of indigenous soil microbes, the type and concentration of contaminants, and the physical characteristics of the soils (depth, porosity, specific surface area, heterogeneity, and anisotropy). The biodegradation capacity of the Site vadose zone appears to be sufficient to support biosparging. To date, benzene has had a low frequency of detection in the vadose zone (frequency of detection less than 10 percent, see Section 4.2) indicating not only weathered contaminants, but also that vadose zone biodegradation may have assisted in breaking down contaminants.

Although biosparging is designed to minimize fugitive emissions and Site conditions appear beneficial to vadose zone degradation, engineering controls to monitor vapor-phase contamination, and if necessary collect and treat it, are equally as important. As previously discussed, vapor extraction wells will be installed for contingency use, as soil gas monitoring probes in the shallow vadose zone and in deeper vadose zone near the groundwater table. Should contaminant concentrations be shown to exceed risk-based trigger levels, active extraction and treatment will be initiated and the biosparging program will be modified as needed. Groundwater monitoring wells are also a fundamental component of a biosparging system. For the project Site, it also may be necessary to perform Hydropunch™ sampling throughout a biosparging implementation to monitor contaminant concentrations near the 20-foot-bgs depth, where contaminants appear to be concentrated in an anaerobic zone. Alternatively, more permanent groundwater monitoring wells, screened across the deeper portion of the FWBZ could be installed to monitor contamination.

The design of a biosparging system typically requires an on-site pilot test. However, design methods are now sufficiently well established to allow for the implementation of a biosparging system in phases, and for refining system parameters as field test results are evaluated.

Biosparging is most often used at sites with mid-weight petroleum products (i.e., diesel fuel and jet fuel), which do not readily volatilize but biodegrade more efficiently in aerobic environments. Biosparging is ineffective at sites containing free product, or that contain confined aquifers where injected air can be trapped.

Based on the preceding discussion, biosparging is retained for further evaluation.

"Biosparging" General Screening

Effectiveness:	Highly effective for anaerobic environments where additional oxygen would stimulate biodegradation; works well with petroleum hydrocarbon constituents
Cost:	Moderate
Implementability:	Moderate to high
Retained for Further Analysis:	Yes

8.3.5.4 Bioventing

Bioventing is similar in concept to air sparging and biosparging, with the primary difference that it supplies additional oxygen to the vadose zone rather than the saturated zone. Because Site contamination is present in the saturated zone, bioventing is not directly applicable, and therefore is not retained for further analysis.

"Bioventing" General Screening

Effectiveness:	Low effectiveness for the Site; bioventing addresses vadose-zone contamination whereas Site contamination is present in the saturated zone
Cost:	Low
Implementability:	High
Retained for Further Analysis:	No

8.3.5.5 Nutrient/Microorganism Enhancement

Nutrient/microorganism enhancement introduces microorganisms and/or nutrients into contaminated areas to stimulate and accelerate natural biodegradation processes that degrade (metabolize) subsurface contaminants. The addition of inoculated microorganisms and nutrients can be conducted on an as-needed basis by injecting a liquid base. The liquid can be injected through specially-designed wells or with direct-push technology. Other amendments may be added to the liquid base to enhance bioremediation and contaminant desorption from subsurface materials.

Nutrient/microorganism enhancement has been successfully used to remediate soils, sludges, and groundwater contaminated with petroleum hydrocarbons and BTEX compounds. The technology does not require heating; requires relatively inexpensive inputs, such as nutrients; and does not generate residuals requiring additional treatment or disposal. The length of time required for treatment is highly dependent on Site-specific factors, and can range from 6 months to 5 years (Fields et al., 2002). The key to successful implementation is the definition of contaminant characteristics such as chemical reactivity and biodegradability. Generally, petroleum hydrocarbons can be readily bioremediated, at relatively low cost, by stimulating indigenous microorganisms.

However, in general, the limiting factor in all natural biodegradation processes is the amount of oxygen (electron acceptors) available to microorganisms. Previous studies have found that the microorganisms and nutrients typically needed for in situ biological treatment are usually present in subsurface soils, and that oxygen deficiency acts as the process "bottle-neck." Once conditions convert to anaerobic, degradation efficiencies decrease.

Though nutrient/microorganism enhancement is implementable and can be cost-effective, it may not be technically effective for environments that are anaerobic, or close to anaerobic. However, nutrient/ microorganism enhancement performed in conjunction with a technology that increases DO concentrations in the groundwater may be effective at decreasing cleanup timeframes. Because of its cost-effectiveness and potential for accelerating cleanup, nutrient/microorganism enhancement is retained for further analysis.

"Nutrient/Microorganism Enhancement" General Screening

Effectiveness:	Moderate
Cost:	Low to moderate
Implementability:	High
Retained for Further Analysis:	Yes

8.3.5.6 Aerobic Degradation with Oxygen Release Compound

Oxygen releasing compound (ORC®) is a proprietary formulation of magnesium peroxide mixed with food-grade phosphate (http://www.regenesis.com/ORC). The mixture provides a time-release property that allows for longer effective treatment periods than compounds that react immediately upon contact with substrata. The ORC® solution can be injected into groundwater to release oxygen, increasing DO content and promoting biological degradation of aerobically degradable organic compounds.

A concentrated application of ORC® could be used to promote biodegradation of contamination at the Site. However, due to the high cost of repeated applications, and the large treatment area at the Site (three plume centers), it is not considered cost-effective or practical.

ORC® can be injected into groundwater by one of the three following methods:

- Placing porous bags filled with ORC® slurry into conventional drilled wells
- Pumping ORC® into direct push locations or drilled wells
- Injecting ORC® slurry as an infiltration grout

Injection using closely-spaced pushed points (i.e., 5-foot centers) is the generally favored method because it ensures more uniform oxygenation compared to placing porous bags into widely-spaced existing wells. However, the installation of closely-spaced push point may not be possible in developed areas.

The proprietary formulation of ORC® is insoluble in water, but slowly reacts to release oxygen into groundwater where it is distributed by natural groundwater flow. An oxygen-release reaction can be illustrated as:

$$MgO_2 + H_2O = Mg(OH)_2 + \frac{1}{2} O_2$$

The elevated DO content in the groundwater promotes biodegradation of aerobically-degradable compounds. The ORC® reaction produces pure oxygen, so the DO concentration can be 5 times higher than the saturation limit in a case where air is used to oxygenate the groundwater (i.e., 40 mg/L rather than 8 mg/L).

ORC® typically needs to be replenished approximately every 6 months until remediation is complete, and the reaction rate increases with increasing salt concentration. Therefore, replenishment frequencies at sites with brackish groundwater are typically higher.

Because of the high costs of implementation at the Site (due to the size of the affected area), and because the high salinity of Site groundwater would require frequent replenishment, ORC® injection is eliminated from further evaluation.

"ORC®" General Screening

Effectiveness:	Moderate
Cost:	Moderate to high, depending on the size of the area to be treated
Implementability:	Low implementability for heavily developed areas
Retained for Further Analysis:	No

8.3.5.7 Aerobic Degradation using Chemical Oxidation

In situ chemical oxidation (ChemOx) is based on the delivery of chemical oxidants to convert contaminants to innocuous compounds, commonly found in nature, through the process of aerobic degradation. The introduction of oxidants assumes that subsurface conditions are already anaerobic, or will become anaerobic as natural attenuation depletes the available oxygen sources.

The methods for delivery of the chemical oxidant solutions may include injection through a well or injector head directly into the subsurface, mixing with a catalyst and then injecting, or combining with extracted groundwater from the Site and re-injecting (re-circulation).

The volume and chemical composition of the oxidant solution varies, based on contaminant types and concentrations, subsurface characteristics, and pre-application laboratory test results. The oxidants applied are typically hydrogen peroxide (including Fentons reagent which also utilizes iron as a catalyst), potassium permanganate, ozone, and, to a lesser extent, DO.

Two pilot studies have already been performed at Alameda Point, both involving the application of a potassium permanganate solution. One study was performed at Parcel 182 in Alameda Point Site 25. The study was focused primarily on the treatment of PAHs in shallow soils located north of the benzene and naphthalene plumes. Certain limitations were observed during the Site 25 pilot study. One limitation was the presence of clays and other subsurface heterogeneities, which hampered uniform application of the solution. Several different mixing techniques were used to overcome the shallow soil heterogeneity. However, these techniques would not apply to a groundwater application. An additional limitation was the high total organic carbon content of on-site soils, which tended to scavenge the injection solution. A third limitation was the USEPA PRG for manganese in soils, which was used to calculate an acceptable injection solution concentration. Because potassium permanganate degrades into manganese, which has an associated PRG limitation, it was necessary to calculate an acceptable concentration of injection solution that would not introduce manganese into the subsurface at concentrations exceeding the USEPA

PRG. The resulting diluted solution was found to be less effective at breaking down on-site PAHs (IT, 2001l).

The second pilot study at Alameda Point was performed at Sites 9, 11, 16, and 21 to evaluate ChemOx effectiveness in treating groundwater contamination (DNAPLs and VOCs). The subsurface geology is somewhat different at Sites 9, 11, 16, and 21, and the contaminants in question were also different. However, destruction efficiencies as high as 90 percent were observed during the study. Shaw published the results of the second pilot study in July 2003 (Shaw, 2003).

Some general limitations are involved in the use of ChemOx as a remedial technology. The ability to inject solution into the subsurface is one of the primary site-specific factors, which may limit the applicability of the technology. If the subsurface geology does not allow for sufficient distribution of the oxidant, results can be limited. Site-specific chemical reactions may also limit effectiveness. In the case of the Site 25 pilot study, high organic carbon levels hampered the effectiveness of ChemOx. In addition, ChemOx solutions may pose some practical handling issues. Potassium permanganate is a stable and easily-handled oxidant, both in solid and solution form. However, hydrogen peroxide can be costly and, because of its volatility, require protective measures. A final limitation is the potential for subsurface explosions when the technology is used to treat high-level petroleum contaminant (due to the exothermic oxidation reactions that can ignite combustible gases and materials).

Because of the following limitations, ChemOx is not retained for further evaluation:

- Site soils have high organic carbon content, especially near the Marsh Crust
- The Site has subsurface heterogeneity due to filling techniques and previous tidal channels which would inhibit subsurface injection of ChemOx
- The cost to provide adequate coverage at the Site would be prohibitive
- The potential for subsurface explosions exists

"ChemOx" General Screening

Effectiveness:	Moderate
Cost:	High
Implementability:	Low to moderate
Retained for Further Analysis:	No

8.3.5.8 Steam Enhanced Extraction

Steam enhanced extraction involves injecting pressurized steam into subsurface soils and/or groundwater, coupled with extraction, to remove site contaminants. The advantage of using this technology is that it aggressively and rapidly removes contaminants through in situ stripping. There are limitations, however, such as heterogeneous subsurface geology, recalcitrant contaminants, and size of the treatment area (large areas are more difficult to address).

A pilot study was conducted (LLNL, 1999) at Alameda Point Site 5 to evaluate the technology's potential to address a site with groundwater TCE and floating free product contamination.

The remediation strategy used in the study involved encircling the affected area with steam injection wells; injecting steam through six wells (using two depth intervals in each well); and extracting groundwater, soil vapor, steam, and volatilized contaminants from the center.

The system was run continuously for 50 days and pressure cycled for 20 days. The results indicated removal efficiencies as high as 99 percent for TCE, with a lower efficiency for petroleum products.

While the results of the pilot study were favorable, certain limitations would preclude its use at the Site. Because the technology is aggressive, it would readily volatilize benzene into the vadose zone, posing a potential risk to nearby residents. This would require a rather large field of, not only steam injection wells, but also vapor extraction wells to remove volatilized benzene. Also, the removal efficiency for mid- to heavy-weight petroleum hydrocarbons was less efficient than for volatile contaminants. In addition, the use of steam injection in a residential area introduces a higher level of physical hazards, with large equipment required to produce and convey high temperature steam into the subsurface, that would make the technology difficult to implement. Lastly, steam injection can be detrimental to existing microbial processes, which would be needed later for ongoing natural attenuation at the Site. Therefore, steam-enhanced extraction is not retained for further analysis.

"Steam-Enhanced Extraction" General Screening

Effectiveness:	Moderate to High
Cost:	High
Implementability:	Low implementability due to increased physical hazards
Retained for Further Analysis:	No

8.3.5.9 Electrical Resistance Heating

Electrical resistance heating uses electrical current to vaporize water and contaminants trapped in the saturated zone of a conductive soil, typically clay or fine-grained sediment. Vaporized contaminants are recovered through SVE wells, and then treated on site by combustion or GAC. A typical arrangement, known as six-phase heating (SPH), delivers low-frequency electrical current to a circular array of six electrodes to heat the soil. SPH increases the temperature of the soil and contaminant, thereby increasing the contaminant's vapor pressure and its removal rate.

While pilot studies have shown greatly accelerated rates of removal using SPH, this method has limitations similar to steam injection, primarily the volatilization of benzene into the vadose zone, posing a potential risk to nearby residents and requiring vapor extraction and treatment. In addition, SPH treats only a limited area, which would require numerous electrode arrays and SVE wells to encircle the area of contamination, and is detrimental to existing microbial processes, which would be needed later for

ongoing natural attenuation at the Site. Finally, SPH would present similar physical hazards to existing Site residents as steam-enhanced extraction, with large high-voltage equipment required to produce and convey electrical current into the subsurface, that would make the technology difficult to implement. Therefore, electrical resistance heating is not retained for further analysis.

"Electrical Resistance Heating" General Screening

Effectiveness:	Moderate to high
Cost:	Moderate to high, depending on the size of the area requiring treatment
Implementability:	Low implementability due to increased physical hazards
Retained for Further Analysis:	No

8.4. SUMMARY OF RETAINED TECHNOLOGIES AND PROCESS OPTIONS

The remedial technologies and processes evaluated in the previous subsections are listed in Table 8-1. Included in the table are brief descriptions of the evaluated technologies, a summary of their evaluation with respect to the criteria, and whether or not they have been retained for consideration as a remedial alternative.

In summary, the following technologies and/or processes are retained for the creation and evaluation of remedial alternatives (see Section 9):

- No Action
- Institutional Actions – Institutional Controls and Site Monitoring
- Groundwater Removal, Treatment, and Disposal – Pump and Treat Systems
- In situ Treatment – MNA
- In situ Treatment – Air Sparging with Soil Vapor Extraction
- In situ Treatment – Biosparging with Soil Vapor Extraction
- In situ Treatment – Nutrient/microorganism Enhancement

This page intentionally left blank

Table 8-1
Remedial Technology Screening Table and Evaluative Criteria Results
Alameda Point Site 25/Alameda Annex IR-02 Groundwater RI/FS

General Response Action	Remedial Technology	Report Section	Effectiveness	Cost	Implementability	General Evaluation (based on effectiveness, cost, and implementability)	Retained for Analysis?
No Action	No Action	8.3.1	Low	Low	High	Required by NCP to be retained for analysis.	Yes
Institutional Actions	Institutional Controls (deed restrictions)	8.3.2.1	High	Low	High	Retained for inclusion with another technology and/or process.	Yes
	Engineering Controls (passive vapor control, access restrictions)	8.3.2.2	High	Moderate	Moderate to High	Not retained due to inapplicability to current Site conditions; mitigative measures for vapor control evaluated under appropriate in situ technologies.	No
	Site Monitoring	8.3.2.3	High	Moderate	High	Retained for inclusion with another technology and/or process.	Yes
Groundwater Containment and/or Removal, Treatment, and Disposal	Groundwater Pump and Treat Systems	8.3.3.1	Moderate	High	Moderate	Retained because it would provide treatment without increasing the potential for fugitive emissions into nearby residences.	Yes
	Phytoremediation	8.3.3.2	Low	Low	Moderate	Not retained due to low effectiveness and Site constraints (existing housing and time to achieve cleanup).	No
Saturated Soil Removal, Treatment, and Disposal	Excavation and Dewatering	8.3.4	Low	High	Moderate	Not retained due to the depth of soil contamination and evidence indicating it is not an ongoing source of groundwater contamination.	No
In situ treatment	Monitored Natural Attenuation	8.3.5.1	Moderate	Low	High	Retained because contaminants are already naturally degrading, and it is a low cost, easy-to-implement solution. Also retained for use with another technology and/or process.	Yes
	Air Sparging with SVE	8.3.5.2	High	Moderate	Moderate	Retained to be evaluated in comparison with the biosparging technology. Reductions in overall cleanup timeframe may balance increased risks from fugitive emissions.	Yes
	Biosparging with SVE	8.3.5.3	High	Moderate	Moderate/High	Retained because it accelerates already-occurring natural degradation processes, and minimizes fugitive emissions; to include a vapor extraction and treatment contingency.	Yes
	Bioventing	8.3.5.4	Low	Low	High	Not retained because it only addresses contamination in the vadose zone.	No
	Nutrient/Microorganism Enhancement	8.3.5.5	Moderate	Low/Moderate	High	Retained because it is a low-cost, easy-to-implement solution that could accelerate the cleanup; to be used with another technology and/or process.	Yes
	Aerobic degradation with Oxygen Release Compounds (ORC®)	8.3.5.6	Moderate	Moderate/High	Low	Not retained due to the large size of the Site and high salinity groundwater, which would result in high implementation costs.	No
	Aerobic degradation using chemical oxidation (ChemOx)	8.3.5.7	Moderate	High	Low/Moderate	Not retained due to the large size of the Site, which would result in high implementation costs. Subsurface heterogeneity would also inhibit performance.	No
	Steam-Enhanced Extraction	8.3.5.8	Moderate/High	High	Low	Not retained due to the large size of the Site (resulting in high costs), increased physical hazards to Site residents, and the resulting impairment of microbial processes required for ongoing biodegradation.	No
	Electrical Resistance Heating	8.3.5.9	Moderate/High	Moderate/High	Low	Not retained due to the large size of the Site (resulting in high costs), increased physical hazards to Site residents, and the resulting impairment of microbial processes required for ongoing biodegradation.	No

9. DEVELOPMENT AND SCREENING OF REMEDIAL ALTERNATIVES

Based on the screening process detailed in Section 8, the following technologies and processes have been considered for use in remedial alternatives:

- No Action
- Institutional Actions – Institutional Controls and Site Monitoring
- Groundwater Removal, Treatment, and Disposal – Pump and Treat Systems
- In situ Treatment – MNA (see Appendix F for a general technology description)
- In situ Treatment – Air Sparging with SVE
- In situ Treatment – Biosparging with SVE (see Appendix G for a general technology description)
- In situ Treatment – Nutrient/Microorganism Enhancement

Relying on the preceding technologies and processes, the following remedial alternatives have been formulated for the project:

- **Alternative 1**: No Action
- **Alternative 2:** MNA with Institutional Controls
- **Alternative 3:** Biosparging with SVE, MNA, and Institutional Controls
- **Alternative 4:** Biosparging with SVE, Nutrient/Microorganism Enhancement, MNA, and Institutional Controls
- **Alternative 5:** Air Sparging with SVE, MNA, and Institutional Controls
- **Alternative 6:** Pump and Treat with MNA and Institutional Controls

The reasoning behind the formulation of each of the alternatives is as follows:

- **Alternative 1** – The No Action alternative is included to comply with the NCP.
- **Alternative 2** – As described in Section 6, the risks calculated for groundwater contamination are within the USEPA's risk management range provided that shallow groundwater is not used as a potable water supply. Therefore, Alternative 2, which is a passive remedial technology involving MNA, also includes institutional controls to ensure that groundwater is not used as a potable water supply. Alternative 2 also includes a comprehensive groundwater monitoring program that would track concentrations of both contaminants and natural attenuation parameters.
- **Alternative 3** – Biosparging has been included to evaluate an active remedial technology, which could reduce risk levels to allow use of the shallow groundwater as a potable water supply. Alternative 3 includes:
  - Biosparging to add oxygen to the subsurface environment and speed biodegradation

- Vapor extraction/treatment, to ensure protection of site residents from possible fugitive emissions
- Institutional controls, to ensure that groundwater is not used as a potable water supply during implementation of the remedy
- MNA, to track the natural degradation processes, which will continue to address any contamination not remediated by biosparging

- **Alternative 4** – This alternative adds nutrient enhancement to Alternative 3, to potentially accelerate the timeframe for cleanup. Alternative 4 includes:
  - Biosparging to add oxygen to the subsurface environment and speed biodegradation
  - Vapor extraction/treatment, to ensure protection of site residents from possible fugitive emissions
  - Nutrient/microorganism enhancement, to accelerate the timeframe for cleanup
  - Institutional controls, to ensure that groundwater is not used as a potable water supply during implementation of the remedy
  - MNA, to track the natural degradation processes, which will continue to address any contamination not remediated by biosparging

- **Alternative 5** – Air sparging involves injecting air into the saturated zone at high pressure (compared to biosparging), thereby potentially accelerating cleanup time but increasing fugitive gas emissions from the groundwater. This alternative has been included to compare with Alternatives 3 and 4. Alternative 5 includes:
  - Air sparging to add oxygen to the subsurface environment, speeding biodegradation and increasing volatilization of dissolved contaminants
  - Vapor extraction/treatment, to capture and treat contaminants volatilized from the groundwater
  - Institutional controls, to ensure that groundwater is not used as a potable water supply during implementation of the remedy
  - MNA, to track the natural degradation processes, which will continue to address any contamination not remediated by air sparging

- **Alternative 6** – Pump and treat is a conventional remediation technology that involves extracting and treating contaminated groundwater. This alternative has been included to compare conventional technology with more innovative, in situ technologies such as biosparging and air sparging. Alternative 6 includes:
  - Extraction of groundwater at the plume centers, to remove contamination dissolved in groundwater
  - Institutional controls, to ensure that groundwater is not used as a potable water supply during implementation of the remedy
  - MNA, to track the natural degradation processes, which will continue to address any contamination not remediated by pump and treat

The six preceding alternatives were compared and evaluated in detail to facilitate CERCLA remedy selection requirements in a ROD.

9.1. EVALUATION CRITERIA

The detailed evaluation performed in this section is based on the nine evaluation criteria specified by the NCP (40 CFR section 300.430(e)(a)(iii)) and the guidance for conducting RI/FS activities under CERCLA (USEPA, 1988c). The nine evaluation criteria are:

1. **Overall protection of human health and the environment:** Describes how each alternative as a whole protects human health and the environment. The criterion focuses on a specific alternative's ability to achieve adequate protection and describes the manner in which site risks passing through each pathway are eliminated, reduced, or controlled through treatment, engineering, or institutional controls. This evaluation also allows for the consideration of any unacceptable short-term or cross-media impacts associated with each alternative.
2. **Compliance with ARARs:** Evaluates each alternative's compliance with federal and State ARARs and TBC requirements. If an ARAR waiver is required, this criterion evaluates the approach taken to justify the waiver. ARARs address location-specific, chemical-specific, and action-specific concerns. A detailed discussion of ARARs is included as Section 7.
3. **Long-term effectiveness and permanence:** Addresses the risk remaining at the Site after RAOs have been met. The primary focus is the extent and effectiveness of the controls that may be required to manage the risk posed by treatment residuals and untreated wastes. Factors considered include the magnitude of residual risks and the adequacy and reliability of release controls.
4. **Reduction of toxicity, mobility, or volume through treatment:** Addresses the statutory preference for remedial alternatives that employ treatment technologies for the permanent and significant reduction of toxicity, mobility, and volume. This criterion focuses on: (1) treatment processes and materials treated; (2) amount of hazardous materials that will be destroyed or treated; (3) degree of expected reduction in toxicity, mobility, or volume measured as a percentage of reduction (or order of magnitude); (4) degree to which the treatment will be irreversible; (5) type and quantity of treatment residuals that will remain following treatment; and (6) ability of the alternative to satisfy the statutory preference for treatment as a principal element.
5. **Short-term effectiveness:** Examines the effectiveness of each alternative in protecting human health and the environment during the construction and implementation period until the RAOs are met. Four factors are considered when assessing the short-term effectiveness of an alternative: (1) protection of the community during remedial actions; (2) protection of workers during remedial actions; (3) environmental impacts of remedial actions; and (4) time required to complete the remedial action to achieve the RAOs.
6. **Implementability:** Evaluates the technical and administrative feasibility of each alternative and the availability of various services and materials required during its implementation.
7. **Cost:** Addresses capital costs (both direct and indirect), annual operation and maintenance (O&M) costs, accuracy of the cost estimate, present worth analysis, and cost-sensitivity analysis of alternatives. Cost estimates for alternatives in this FS are provided in Appendix H, and are based largely on industry standard costs for remedial actions taken at other sites similar to the investigation area. Capital and O&M cost estimates are order-of-magnitude level estimates, and have an expected accuracy of minus 30 to plus 50 percent.

8. **State acceptance:** Evaluates technical and administrative issues and potential concerns of the State regarding each of the alternatives. A preliminary discussion of these potential concerns is provided in this report; however, this criterion will be assessed in the ROD following comment on the RI/FS and the proposed plan.
9. **Community acceptance:** Evaluates technical and administrative issues and potential concerns of the public regarding each of the alternatives. A preliminary discussion of these potential concerns is provided in this report, but this criterion will be assessed in the ROD following comment on the RI/FS and the proposed plan.

The first two criteria are categorized as threshold criteria; they relate directly to statutory requirements that each remedial alternative must meet. If a given alternative does not satisfy both of these criteria, it is not retained for further consideration beyond the individual analysis of alternatives. The next five criteria are the primary balancing criteria upon which the selection of a remedy is based. Together, these first seven criteria are considered the evaluation criteria. The final two are modifying criteria, and are only discussed, but not assessed, in this report.

The following sections describe each of the remedial alternatives and discuss the assessment of each remedial alternative with respect to the evaluation criteria. This information will be used to compare the remedial alternatives in this report and support selection of a remedy in the ROD.

9.2. ALTERNATIVE 1 – NO ACTION

Under Alternative 1, no remedial action would be taken; physical conditions would remain unchanged and contaminants found in groundwater would be left in place. No institutional controls, containment, removal, or treatment would be implemented, and no other mitigating actions would be taken. Alternative 1 is retained throughout the FS process, as required by the NCP, to provide a comparative baseline against which other alternatives can be evaluated.

9.2.1. Overall Protection of Human Health and the Environment

Shallow groundwater does not pose a human health risk, so long as it is not used as a potable water supply. There is no likely beneficial reuse for shallow groundwater (e.g., drinking water, commercial use, or irrigation) because of high TDS concentrations and questionable well yield. However, this alternative would not prevent exposure to hazardous substances through improper use (i.e., unapproved use for potable water supply) of shallow groundwater in the future because it does not incorporate any institutional controls. Furthermore, this alternative does not provide any mechanisms for monitoring contaminant degradation or potential groundwater contaminant migration.

Alternative 1 does not meet this threshold criterion, and will therefore not be retained for comparative analysis in Section 9.8.

9.2.2. Compliance with ARARs

Compliance with identified ARARs is not required for this alternative because ARARs apply to "any removal or remedial action conducted entirely on-site." The no action alternative is not considered a removal or remedial action (CERCLA Section 121(e), 42 U.S.C. § 9621[e]). An analysis of ARARs is presented in Section 7.

Because Alternative 1 does not meet the first threshold criterion as discussed in Section 9.2.1, it will not be retained for comparative analysis in Section 9.8.

9.2.3. Long-Term Effectiveness and Permanence

No remedial action would be conducted under Alternative 1. However, long-term natural degradation processes would slowly reduce contamination at the Site. This would only be marginally effective in the long-term because, as discussed in Section 5, the lateral extent of benzene contamination at the Site is generally stable or decreasing, with the exception of the southeast plume center of the Site. While the plume is naturally attenuating, subsurface conditions have become strongly anaerobic, and biodegradation is proceeding under predominantly sulfate-reducing conditions. Based on the current decay rate of benzene, the cleanup timeframe for the no-action alternative may be longer than 50 years.

Because Alternative 1 does not meet the first threshold criterion as discussed in Section 9.2.1, it will not be retained for comparative analysis in Section 9.8.

9.2.4. Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative 1 would only reduce the toxicity, mobility, or volume of contaminants through natural ongoing biodegradation processes and is considered a passive remedial technology.

Because Alternative 1 does not meet the first threshold criterion as discussed in Section 9.2.1, it will not be retained for comparative analysis in Section 9.8.

9.2.5. Short-Term Effectiveness

Because Alternative 1 would involve no remedial action, it would not pose risks to the community, current occupants, workers, or the environment as long as shallow groundwater continues not to be used as a potable water supply.

Because Alternative 1 does not meet the first threshold criterion as discussed in Section 9.2.1, it will not be retained for comparative analysis in Section 9.8.

9.2.6. Implementability

No resources are required to implement this alternative, and no known administrative considerations would impact its overall implementability.

Because Alternative 1 does not meet the first threshold criterion as discussed in Section 9.2.1, it will not be retained for comparative analysis in Section 9.8.

9.2.7. Cost

No known capital or O&M costs are associated with the no action alternative.

Because Alternative 1 does not meet the first threshold criterion as discussed in Section 9.2.1, it will not be retained for comparative analysis in Section 9.8. However, as required by the NCP, it will be used as a comparative baseline against which other alternatives can be evaluated.

9.2.8. State/Community Acceptance

While the groundwater-to-human ingestion/inhalation pathway is not complete at the Site, this pathway could be completed if groundwater is brought to the surface for use. And although groundwater contamination has not been found to be volatilizing into soil gas or indoor air, this alternative would not provide for ongoing monitoring to ensure protection of site occupants. Due to these concerns, this alternative would likely be unacceptable to State and community stakeholders.

The State and community acceptance criteria will be assessed in the ROD following comment on the RI/FS and the proposed plan.

9.3. ALTERNATIVE 2 – MONITORED NATURAL ATTENUATION WITH INSTITUTIONAL CONTROLS

Alternative 2 consists of implementing a comprehensive MNA program, along with institutional controls, to allow natural degradation to address site contaminants. For the purposes of this report, site monitoring has been replaced by the more comprehensive MNA program, which is considered a separate remedial technology/process. MNA is more comprehensive than simple site monitoring because it:

- Generally requires a more extensive monitoring well network to track contaminant degradation throughout the various plume locations
- Requires collection of biological indicator data to evaluate degradation progresses
- Incorporates a more thorough evaluation of contaminant concentrations and plume migration over time (stability analysis)

In addition, for the present alternative, MNA would include soil gas monitoring to ensure the protection of on-site residents.

One of the key differences between an MNA program and a standard site monitoring program is that biological indicator data, as well as chemical data, are collected to evaluate the effectiveness of ongoing natural degradation processes. Standard site-monitoring programs typically collect only chemical analytical data to evaluate contaminant concentrations in groundwater. However, the ongoing Alameda

Point Basewide Groundwater Monitoring Program is collecting data on MNA parameters, in addition to soil gas concentrations and contaminant concentrations.

A more detailed description of MNA and its in situ processes is included in Appendix F. The following sections present a more site-specific evaluation of MNA than the initial screening performed in Section 8.

Applicability of MNA

Several guidance documents present criteria to consider when using MNA (American Society for Testing and Materials [ASTM], 1998; LLNL, 1995; Parsons, 1999; Sutherson, 1999; USEPA, 1999; Weidemeier et al., 1998; Weidemeier et al., 1995).

ASTM Guide #E1942, *Standard Guide for Remediation of Groundwater by Natural Attenuation at Petroleum Release Sites* (ASTM, 1998) presents the following:

> *4.2 In general, remediation by natural attenuation may be used in the following instances:*
>
> *4.2.1 As the sole remedial action at sites where immediate threats to human health, safety, and the environment do not exist or have been mitigated, and constituents of concern are unlikely to impact a receptor;*
>
> *4.2.2 As a subsequent phase of remediation after another remedial action has sufficiently reduced concentrations/mass in the source area so that plume impacts on receptors are unlikely;*
>
> *4.2.3 As part of a multi-component remediation plan.*

The USEPA guidance (USEPA, 2001c) also suggests demonstrating that MNA is appropriate when site-specific information documents a cause-and-effect relationship between contaminant loss and the destruction and immobilization process. Lines of evidence that can be used to document the relationship are:

a) historical chemical and/or biological data for the COPCs that demonstrate a clear and convincing trend of decreasing contaminant mass, concentration, and/or toxicity over time at appropriate monitoring or sampling points;

b) hydrologic, geochemical, biological, or mineralogical data that can be used to demonstrate indirectly that specific types of natural attenuation processes are active at the site and the rate at which such processes will reduce contaminant concentrations to desired levels; and

c) data from field or laboratory microcosm studies conducted with actual contaminated site media which directly demonstrate the occurrence of a particular natural process at the site and its ability to degrade or otherwise reduce the risk of exposure from the COPCs.

Because the COPCs are benzene and naphthalene, which are constituents of petroleum hydrocarbons, the ASTM guidance is particularly relevant.

The Navy has also published natural attenuation guidelines (Weidemeier et al., 1998) in *Technical Guidelines for Evaluating Monitored Natural Attenuation at Naval and Marine Corps Facilities*. The supporting lines of evidence structure is also presented in this document and consists of:

1. Historical groundwater chemistry data showing plume stabilization and/or loss of contaminant mass over time
2. Groundwater chemistry data showing that: a) geochemical conditions are suitable for biodegradation; and b) active biodegradation has occurred as indicated by the consumption of electron acceptors and/or the production of final products

In addition, the RWQCB has published guidance for the use of natural attenuation at low-risk petroleum hydrocarbon sites (RWQCB, 1995). The RWQCB guidance recommends the removal of all source areas (soils or saturated materials that continue to act as a source for groundwater contamination), and an assessment of risk associated with the site. If associated risks are low, and source areas do not cause the plume to expand (natural degradation exceeds contaminant source generation), natural attenuation may be applied as a site remedial action.

The USEPA Office of Solid Waste and Emergency Response (OSWER) has published the following directive (USEPA, 1999) regarding the use of MNA: *Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites*. The directive contains guidance similar to that found in the preceding documents, and states that the cleanup timeframe associated with an MNA program should be comparable to what could be achieved through active restoration.

Additional documents pertaining to MNA also contain similar guidance on its use whenever source areas have been removed and associated risk levels are low.

To perform a site-specific evaluation of MNA at the investigation area, the following subjects will be discussed in detail:

- The nature and extent of contamination (the primary line of evidence): Are contaminant plumes stable or receding?
- Geochemical data/MNA parameters (secondary line of evidence): pH, temperature, DO, ORP, nitrate, sulfate, methane, iron, and others
- Potential receptors and preferential pathways
- Hydrogeologic data
- Potential groundwater beneficial reuse
- Risk assessment results (and site reuse plans)
- Performance criteria (cleanup time-frame and degradation rates)

The NCP criteria will be examined following evaluation of these subjects.

Nature and Extent of Contamination

As detailed in Section 4.0, the nature and extent of groundwater contamination in the investigation area has been defined by numerous characterization efforts. As detailed in Section 5.6, the existing benzene plume in the FWBZ has been found to be relatively stable and is not migrating or expanding. The naphthalene plume shown in Figures 4-9 and 4-10 is co-located with benzene contamination.

The majority of the characterization work done prior to 2001 used monitoring wells to gather chemical contaminant data from the FWBZ. However, in 2001, Hydropunch™ sampling was used, which allowed for a more accurate understanding of groundwater contamination in the FWBZ.

The Hydropunch™ sampling effort was particularly useful because samples collected from multiple depths revealed a stratified distribution of, not only chemical contaminants, but also MNA parameters such as DO and ORP.

At present, there are adequate data to characterize the nature and extent of contamination at the Site, and to support MNA as a remedial alternative. The delineation of site contamination could be improved by the addition of monitoring wells on the northwestern and southeastern sides of the Site. However, sufficient data have been generated to conclude that contaminant plumes are stable or receding.

Geochemical Data

Geochemical data from the investigation area have been collected as part of the Alameda Point OU-5 RI (IT et al., 2002), and also continue to be collected as part of the ongoing Alameda Point Basewide Groundwater Monitoring Program (Shaw, 2004b and c). To date, samples collected during the OU-5 RI have produced data to vertically and laterally delineate trends in geochemical data, while the sampling conducted as part of the Basewide Groundwater Monitoring Program allow analysis of geochemical data over time.

During the OU-5 RI, samples from 9 monitoring wells and 13 Hydropunch™ locations were collected and analyzed for MNA parameters (see Table 4-2). These data showed that DO decreased with depth, indicating a correlation between depth and contaminant biodegradation. As discussed in Section 5.2, trends in electron receptors observed during the Basewide Groundwater Monitoring Program indicate that MNA processes are already occurring under sulfate-reducing and methanogenic conditions.

The MNA parameters evaluated during the OU-5 RI included:

- Cations (calcium, sodium, potassium, magnesium, and iron), by USEPA Method 6010B
- Chloride, nitrate, nitrite, and sulfate, by USEPA Method 9056
- Sulfide, by USEPA Method 376.1
- Alkalinity, by USEPA Method 310.1

- Methane, ethane, and ethene, by R.S. Kerr Standard Operating Procedure 175
- Field measurements for pH, conductivity, temperature, DO, and ORP

The data collected during the OU-5 RI also indicate that there are anaerobic areas at the Site. The data generated during the Quarterly Basewide Groundwater Monitoring Program indicate that oxygen continues to be consumed, and that subsurface conditions at the site are now predominantly anaerobic. While biodegradation is continuing under anaerobic conditions through sulfate reduction and methanogenesis, these processes are less efficient and proceed more slowly than anaerobic degradation. This does not rule out MNA entirely as a remedial alternative, but does indicate that cleanup timeframes for the Site may be too prolonged when compared with other remedial alternatives, as referenced in the OSWER Directive on the matter (USEPA, 1999).

Potential Receptors and Exposure Pathways

Currently, no receptors are subject to unacceptable risks due to site groundwater contamination. Ongoing groundwater monitoring shows that utility lines are not acting as preferential pathways, there are no surface discharge locations for groundwater, the Oakland Inner Harbor is located approximately 900 feet from the leading edge of the benzene plume, and risk to human health from vapor inhalation is within the USEPA's risk management range. In addition, there are no significant terrestrial ecological receptors on the Site; the majority of the area is developed or is in the process of being redeveloped for residential/mixed use.

As discussed in Section 6, the HHRA evaluated the following exposure scenarios:

- Contamination will migrate from groundwater into indoor air, resulting in exposure to residents, students, and workers.
- Groundwater extraction wells are constructed in the FWBZ at the Site and used for applications such as landscaping and a car wash.
- Groundwater extraction wells are constructed in the FWBZ at the Site and used for domestic potable water by residents or workers.

These pathways were evaluated in the risk assessment (Section 6), and risks were found to be within the USEPA's risk management range (10^{-4} to 10^{-6}), except when shallow groundwater is used as a potable water supply. The risk management range is intended to allow site decision makers flexibility in determining how best to manage the risks. Therefore, ensuring that risks remain within the risk management range would require that MNA be accompanied by institutional controls during the cleanup timeframe to prevent use of contaminated groundwater as a potable water supply.

Hydrogeologic Data

Hydrogeologic data have been collected and analyzed for the Site during multiple investigations, and were summarized in Section 2. MNA is a viable alternative based on the hydrogeologic data, because the contaminant plume appears to be stable or decreasing.

Potential Groundwater Beneficial Reuse

As detailed in Section 2.4, groundwater beneficial reuse is not predicted for the Site because the Alameda Annex site has been exempted as a drinking water source, groundwater has high TDS concentrations, well yields would be low, and potable water is available from the municipal water supply. However, the possibility exists that contaminated groundwater could be used as a potable water supply. Therefore, MNA would require sufficient time to achieve potable water cleanup criteria. Due to the concentrations present, the existence of subsurface anaerobic environments, and the timeframe estimated to achieve drinking water goals, MNA may not be viable as a stand-alone alternative to achieve potable water cleanup criteria. As stated in the OSWER Directive (USEPA, 1999), the cleanup timeframe for MNA should be consistent with the timeframe for other active remedial alternatives considered.

Risk Assessment Results and Site Reuse

As detailed in Section 6, the HHRA results indicate that future Site reuse can be unrestricted, with the exception of human ingestion of groundwater. The risks to residents and school and landscape workers, and commercial carwash use, were all evaluated as part of the HHRA.

Risk assessment results therefore support the use of MNA as a remedial alternative, provided that shallow groundwater is protected from use as a potable water supply until MNA has reduced contaminants to acceptable concentrations.

Performance Criteria

The time required to achieve site-specific goals is an integral criterion for selecting a remedial alternative. Several different techniques, varying from empirical to computer modeling, can be used to evaluate the rate of contaminant degradation at a site. In Section 5, empirical methods were used to estimate timeframes for a cleanup based on first-order exponential decay curves derived from monitoring well data. Benzene data from monitoring well P181-MW47 indicated that benzene concentrations would continue to decrease and reach the State MCL for benzene (1 μg/L) in approximately 2060. The exponential decay curves do not account for subsurface mechanisms such as stalling due to anaerobic environments, and may underestimate contaminant degradation rates. A longer timeframe to achieve potable water cleanup criteria may render MNA infeasible as a stand-alone alternative.

Therefore, the empirical data indicate continued plume degradation until only the deeper portions and plume centers remain in anaerobic states. The remaining contamination would then require longer timeframes to achieve potable water cleanup criteria.

In 1998, TtEMI presented the results of site-specific fate and transport modeling, which used benzene monitoring well data to predict plume size over time (TtEMI, 1998a). The model indicated that the benzene plume would remain stable and then decrease over time until 2020, when only the plume centers would remain. However, the model did not use the higher benzene concentrations detected in 2001 Hydropunch™ samples, and did not extrapolate out to determine when all plume centers would be degraded below the State MCL for benzene.

Therefore, both empirical and computer methods predict the same outcome: that benzene and naphthalene will continue to undergo biodegradation until only plume centers and deeper portions are left above potable water use cleanup levels. If conditions within those areas remain anaerobic over time, the final time required to achieve potable water cleanup criteria could extend beyond the cleanup timeframe associated with the other alternatives. While not designated as a potable water supply, for alternative comparison purposes and cost estimation, the exposure scenario at the Site is the domestic use of groundwater by residents and workers.

Acceptable performance will be marked by:

- Continued declining contaminant concentrations in on-site monitoring wells, meeting cleanup goals within a reasonable timeframe
- Continued stable or receding contaminant plumes.
- Documented contaminant degradation, even when contamination has been reduced to the plume centers and deeper portions

Non-acceptable performance will be marked by:

- Expanding contaminant plumes
- A trend of increasing contaminant concentrations in monitoring wells at the plume centers
- A stalling of biodegradation processes when only plume centers and deeper contamination remains, indicating that a reasonable cleanup timeframe will not be achieved

As previously detailed, application of MNA at a project site usually involves several lines of evidence. The primary evidence is plume stability. As described in Sections 4 and 5, the benzene plume has been shown to be relatively stable and appears not to be migrating or expanding across the Site, with the exception of the southeast plume center and the west side of the site.

Supporting evidence includes the MNA parameter data (geochemical), and laboratory or microcosm studies. MNA parameter monitoring has been performed under previous investigations and continues under the Basewide Groundwater Monitoring Program. However, laboratory or microcosm studies have

not been performed because there are ample contaminant concentration data over time. Sufficient MNA parameter data also have been collected to conclude that biodegradation is occurring at the Site under predominantly sulfate-reducing and methanogenic conditions.

The timeframe estimated to achieve cleanup goals is also a key factor. If MNA cannot remediate the Site within a timeframe comparable to other remedial alternatives, it may not be suitable as a stand-alone alternative for the Site. For alternative comparison purposes and cost estimation, the exposure scenario at the site is the domestic use of groundwater by residents and workers.

MNA Components and Institutional Control Objectives

The conceptual design of the MNA alternative would include the following components:

- Installation of 9 additional monitoring wells to create a 20-well monitoring network (11 wells currently included in the Basewide Groundwater Monitoring Program plus 9 additional wells to provide plume bounding in the eastern and western portions of the site)
- 1 year of sampling and analysis using the 20-well network to establish a MNA baseline (some cost savings may be achieved by using data already collected as part of the ongoing Alameda Point Basewide Groundwater Monitoring Program)
- Continued quarterly monitoring of soil gas for 5 years, with its continuation evaluated during the first 5-year review
- For the domestic use of groundwater by residents and workers, 50 years of MNA monitoring (based on observed rates of decay presented in Section 5.5): quarterly for 5 years at the 20-well network, semi-annually for the next 5 years at the 20-well network, and semi-annually for the remaining 40 years (with the size monitoring well network to be reduced to 10 wells), with comprehensive annual reviews
- Quarterly reporting, annual evaluations, and comprehensive 5-year reviews to monitor progress

Additional information on the conceptual MNA system is provided in Appendix F. The details of the conceptual design for all alternatives are provided as guidelines and estimated quantities used for costing purposes.

The objective of institutional controls associated with the MNA alternative is to restrict current or future occupants from withdrawing or reusing shallow groundwater during implementation of the remedy. The primary land use controls used to meet this objective would likely be land use restrictions issued by the DON in the deed and a land use control covenant agreement with DTSC. The transferee would be required to submit a groundwater management plan to the DON addressing sampling and analysis requirements and appropriate disposal of contaminated groundwater along with its request for approval. The transferee would then be required to abide by the approved groundwater management plan and any other conditions of approval. A periodic review of the institutional controls would be performed at a frequency to be specified in the remedial design to ensure long-term compliance with institutional controls and the monitoring program. Institutional controls would also be evaluated as part of the

comprehensive five-year review. Costs for development and enforcement of institutional controls were included in Appendix H.

9.3.1. Overall Protection of Human Health and the Environment

Alternative 2 would protect human health and the environment under current and anticipated future uses, including the domestic use of groundwater by residents and workers, by requiring long-term monitoring to track contaminant degradation and institutional controls to prevent exposure to contaminated groundwater at concentrations that pose a risk to human health. Alternative 2 would remediate site contaminants to below potable water cleanup criteria within an estimated 50-year timeframe. Alternative 2 is considered to be protective of human health and the environment, and will be compared against the other alternatives relative to the NCP criteria. The lengthy estimated timeframe for Site cleanup to potable water criteria relative to the other alternatives will be assessed in the comparative analysis.

Alternative 2 meets this threshold criterion.

9.3.2. Compliance with ARARs

Alternative 2 has several potential action specific ARARs:

- **Resource Conservation and Recovery Act** – Requirements of this act regarding proper characterization and disposal of investigation-derived wastes such as purge water or drill cuttings are considered potentially applicable.
- **DTSC Requirements for Land Use Covenants** – The substantive provisions of this regulation, which provide for a land use covenant to be executed and recorded when remedial actions are taken and when hazardous substances will remain at the property at concentrations unsuitable for unrestricted use of the land, are considered potentially relevant and appropriate.
- **California Civil Code** – The substantive provisions of this requirement are potentially applicable and allow an owner of land to make a covenant to restrict the use of land to protect present or future human health or safety or the environment as a result of the presence of hazardous materials.
- **California Health and Safety Code** –The substantive provisions of this regulation are potentially applicable and allow DTSC to enter into an agreement with the owner of a hazardous waste facility to restrict present and future land uses.

For a listing of chemical- and location-specific ARARs, and an analysis of ARARs, refer to Section 7.

Alternative 2 meets the ARARs identified, and therefore meets this threshold criterion.

9.3.3. Long-Term Effectiveness and Permanence

As stated previously, because of anaerobic conditions at the Site, the rate of natural attenuation will continue to decrease over time due to lack of oxygen and other electron acceptors, and therefore may not have good long-term effectiveness and permanence. Although biodegradation is occurring and will likely continue to occur, it may not fully address contamination within the plume centers or at depth within an acceptable timeframe for the domestic use of groundwater by residents and workers. Institutional controls under this alternative will require a commitment to long-term monitoring and enforcement which may not be feasible. Therefore, Alternative 2 has low long-term effectiveness.

9.3.4. Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative 2 only relies on natural processes (considered a passive treatment technology) to reduce the toxicity, mobility, and volume of contaminants, and does not directly employ an active treatment technology. Although natural attenuation processes are currently addressing contamination, they have slowed due to anaerobic conditions. Under anaerobic conditions, MNA processes may be unable to continue at a rate that reduces contaminant mass within a reasonable timeframe.

9.3.5. Short-Term Effectiveness

Alternative 2 would involve minimal remedial action construction activities. Additional wells would be required to perform Site monitoring. However, there is a low risk associated with the construction of a groundwater monitoring well or a soil gas well. As a result, this alternative would be moderately effective in minimizing short-term risks to the community, current occupants, or workers.

9.3.6. Implementability

Alternative 2 would be technically implementable because groundwater monitoring wells and soil gas probes are relatively easy to install. MNA is also administratively implementable, unless the timeframe for cleanup for the domestic use of groundwater by residents and workers becomes too excessive, due to anaerobic biodegradation of plume centers and deeper areas.

9.3.7. Cost

The costs associated with the MNA alternative are as follows (see Appendix H for a detailed cost estimate):

- Capital equipment costs at the onset of the project: $247,416
- O&M costs converted into Net Present Value (NPV) 2004 dollars: $1,978,898
- Total estimated cost for the MNA alternative: $2,226,314

Note that these costs include a 10 percent contingency. Additionally, the cost estimate for Alternative 2 assumes an exposure scenario at the Site of domestic use of groundwater by residents and workers

9.3.8. State/Community Acceptance

MNA programs have been widely used and are a commonly accepted remedial tool. Some skepticism generally is associated with leaving contaminants in place for natural attenuation processes. The present case is no exception, given the shallow depth to groundwater, benzene as one of the COPCs, and the potential for improper use of groundwater. Stakeholders have indicated reservations regarding Alternative 2, and have expressed a desire for a more aggressive cleanup process (see Alternative 3, 4, 5, or 6).

The State and community acceptance criteria will be assessed in the ROD following comment on the RI/FS and the proposed plan.

9.4. ALTERNATIVE 3 – BIOSPARGING WITH SOIL VAPOR EXTRACTION, MONITORED NATURAL ATTENUATION, AND INSTITUTIONAL CONTROLS

As described in Section 8, biosparging involves injecting air into the saturated zone at a flow rate designed to maximize biodegradation in the saturated and unsaturated zones while minimizing the release of volatiles to the atmosphere. Figure 9-1 depicts a conceptual drawing of a biosparging system; Figure 9-2 shows the areas requiring biosparging at the Site; Figure 9-3 shows the conceptual layout of a biosparging system; and Figure 9-4 shows the typical construction of an air injection or sparging well.

Given the sensitive receptors at the Site, a vapor extraction and treatment contingency is included in Alternative 3 to mitigate potential human health risk from possible fugitive emissions during biosparging.

The injected air would assist the indigenous soil bacteria that aerobically respire, using oxygen as an electron acceptor and hydrocarbons as an energy and carbon source. Oxygen is a much more efficient electron acceptor than sulfate and carbon dioxide, which are the primary electron receptors remaining at the site. Therefore, the addition of oxygen will speed the rate of natural biodegradation.

This alternative also incorporates MNA and institutional controls (as discussed in Section 9.3) because biosparging will be implemented to address plume centers and/or deeper areas that may not be amenable to the use of MNA alone. MNA would remediate residual contamination left after biosparging, and institutional controls would ensure that contaminated groundwater is not used as a potable water supply prior to achieving cleanup goals. The details of the MNA and institutional controls alternative are not repeated in this section for brevity (see Section 9.3).

Biosparging typically is used to address medium-weight petroleum hydrocarbons such as naphthalene, which are resistant to air stripping, while air sparging is generally used to treat more volatile contaminants such as benzene. Because there are residents within close proximity to the Site, biosparging would be used to address both benzene and naphthalene contamination. In situ biodegradation rates for benzene have been shown to be higher than those for naphthalene.

The biosparging portion of this alternative would focus on the removal of contaminant mass from three "biosparge zones," including approximately 2 acres centered around monitoring well P181-MW47; 1 acre centered around monitoring well EW-2; and 1 acre centered around monitoring well P181-MW45 or M25-01. The biosparge zones are shown as roughly circular clusters of biosparge and SVE wells in Figure 9-2, because that formation of wells has been shown to be the most efficient (Fields et al., 2002). The exact configuration and radius of influence of the biosparge and SVE wells will be determined at the remedial design stage.

Some of the physical differences between the three areas will have a direct influence on implementation:

- Biosparge Zone 1 (centered around monitoring well P181-MW47): Zone 1 is located within a residential area; the central grass courtyard could be used for a treatment system with little disturbance to the community; underground utilities are present.
- Biosparge Zone 2 (centered around monitoring well EW-2): Zone 2 is located in Alameda Annex IR-02, which was an open, unused paved area; however, residential development is currently underway at Zone 2, and has removed all paving and asphalt.
- Biosparge Zone 3 (centered either around monitoring well P181-MW45 or M25-01): Zone 3 is located in a residential area similar to Zone 1.

Because all of the biosparge zones are within current or planned residential areas, engineering controls for vapor extraction/recovery and treatment are recommended to accompany biosparging.

Prior to the remedial design, additional soil and groundwater investigation will be performed to refine the contaminant delineation within the treatment zones, and to provide additional data (such as soil porosity and hydraulic conductivity) to refine estimates of cleanup times.

Given the site characteristics and other case studies, the estimated time required for biosparging the three zones is 6 months to 2 years. Two years has been assumed for cost estimation purposes, which would allow for the maximum degradation of naphthalene. Based on empirical data from already occurring biodegradation, the MNA phase that follows biosparging has been estimated at 7 years.

Performance Criteria

The performance criteria used for biosparging is directly linked to the cleanup goals stated in the Site RAO. The cleanup goals for the Site have been determined to be drinking water standards (MCL and USEPA Health Advisory level), although Site groundwater has not been used as a potable water supply and is not likely to be used as such in the future. If it were conclusively determined that Site groundwater would not be used as a potable water supply, alternative, risk-based criteria protective of human health via the inhalation pathway could be used to establish cleanup goals. The resulting cleanup goals would be considerably higher, and less biosparging, SVE, and MNA would be required to remediate the Site.

The performance criteria for biosparging are listed below.

Acceptable performance will be marked by:

- Continued declining contaminant concentrations in on-site monitoring wells, meeting cleanup goals within the predicted cleanup timeframe
- Receding contaminant plumes
- Documented degradation of contamination left after biosparging to below cleanup goals

Non-acceptable performance will be marked by:

- Stable contaminant concentrations within biosparging zones throughout the treatment period
- Expanding contaminant plumes
- A trend of increasing contaminant concentrations in monitoring wells at the plume centers

Biosparging System Design

The biosparging system conceptually designed for Alternative 3 would consist of the following (see Appendix H for a detailed itemization of system components and costs):

- Installation of 50 2-inch-diameter sparge wells for treatment in Biosparge Zones 1, 2, and 3; the number of wells was estimated using an assumed radius of influence of 40 feet.
- Installation of 15 4-inch-diameter SVE wells for recovery of any fugitive contaminants resulting from biosparging in Zones 1, 2 and 3; the number of recovery wells was estimated using an assumed radius of influence of 80 feet, which exceeds the cumulative radius of influence of the biosparging wells. Soil gas concentrations will be monitored at least biweekly.
- Overlapping injection well radii of influence for the center of the biosparging zones.
- Sparge wells screened from 16 and 20 feet bgs, and SVE wells screened from 5 to 10 feet bgs.
- Three continuously-operated 10-hp compressors for air injection, and three stand-by 15 hp vacuum blowers, within Zones 1, 2, and 3.
- Adequate manifolding, piping, control valves, etc., at each zone to operate clusters of injection wells separately, allowing for pulsing and cycling of the system and injection of liquid or gas phase nutrient or microorganism amendments.
- Adequate maintenance of the system to allow for optimization and continual operation; installation of 13 soil gas monitoring probes to monitor cleanup progress.
- Two years of biosparging, followed by seven years of MNA and institutional controls.
- Simultaneous implementation at all biosparge zones.

The goal of the above design is to provide an adaptable system, which can deliver oxygen to anaerobic areas at the plume centers for a period of 2 years. The assumed radius of influence for the injection wells was selected by balancing several factors. Typical air sparging systems located in sand can achieve a radius of influence of 40 feet or more. However, field studies have shown that optimal biosparge system performance can be achieved with a 15- to 20-foot radius of influence (Fields et al., 2002). The larger radius of influence was used for cost estimation purposes to account for surface obstructions; however,

smaller radii of influence can be used in areas with no surface obstructions. The presence of surface structures does not effect the radius of influence of a biosparging well; however, such obstructions may result in gaps in the system coverage.

Some variations may also be used in the biosparging design:

- Higher air injection (air sparging) rates may be used in areas with no sensitive receptors (residents) and/or areas in which sufficient engineering controls can control vapors.
- Horizontal biosparge wells may be used if worker safety and site physical constraints can be addressed; some cost savings can be achieved through the use of horizontal biosparge injection wells and horizontal SVE wells.

9.4.1. Overall Protection of Human Health and the Environment

Alternative 3 would protect human health and the environment under current and likely future land uses because contaminants would be destroyed through accelerated biodegradation. After initial treatment with biosparging and a short period of MNA, Alternative 3 would permanently eliminate risks associated with groundwater contamination. Institutional controls and site monitoring, as in Alternative 2, would remain a critical element to protect short-term exposure during treatment of the plume.

Alternative 3 meets this threshold criterion.

9.4.2. Compliance with ARARs

Alternative 3 has several potential action-specific ARARs:

- **Resource Conservation and Recovery Act** – Requirements of this act regarding proper characterization and disposal of investigation-derived wastes such as purge water or drill cuttings are considered potentially applicable.
- **DTSC Requirements for Land Use Covenants** – The substantive provisions of this regulation, which provide for a land use covenant to be executed and recorded when remedial actions are taken and when hazardous substances will remain at the property at concentrations unsuitable for unrestricted use of the land, are considered potentially relevant and appropriate.
- **California Civil Code** – The substantive provisions of this requirement are potentially applicable and allow an owner of land to make a covenant to restrict the use of land to protect present or future human health or safety or the environment as a result of the presence of hazardous materials.
- **California Health and Safety Code** –The substantive provisions of this regulation are potentially applicable and allow DTSC to enter into an agreement with the owner of a hazardous waste facility to restrict present and future land uses.
- **Clean Air Act** – This law is considered potentially applicable for operation of the vapor extraction and treatment system.

- **Bay Area Air Quality Management District Regulation Title 8** – This regulation, covering discharge to air and air stripping operations, is relevant and appropriate due to use of a vapor extraction system as part of the remedial alternative.

For a listing of chemical- and location-specific ARARs, and an analysis of ARARs, refer to Section 7.

Alternative 3 can meet the ARARs specified, and therefore meets this threshold criterion.

9.4.3. Long-Term Effectiveness and Permanence

Alternative 3 would reduce site contamination to below cleanup goals within an estimated 9 years, allowing for unrestricted use of groundwater after the cleanup has been completed. Therefore, Alternative 3 would have high, long-term effectiveness because, even if the groundwater-to-human receptor pathway were completed in the future, there would be no significant contamination that posed an unacceptable risk.

9.4.4. Reduction of Toxicity, Mobility, or Volume through Treatment

Based on the site-specific details and other case studies involving biosparging and MNA, Alternative 3 would be effective for the Site. Alternative 3 meets the RAO for groundwater and would accelerate the natural biodegradadation at the site to reduce contaminant concentrations. Biosparging is considered innovative, but has had a number of successful applications for remediation of groundwater contamination, especially VOCs and petroleum hydrocarbons. Some of the case studies documenting the successful application of the technology are listed below.

- Within 4 to 6 months of system operation at a USCG site in Traverse City, Michigan, biosparging was found to decrease BTEX concentrations in groundwater from approximately 100 µg/L to 10 µg/L (Kambell et al., 1993). Groundwater sampling indicated that DO concentrations increased from 2 mg/L to more than 6 mg/L during the biosparging effort.
- A pump and treat system was replaced by biosparging to enhance aerobic biodegradation of BTEX compounds and prevent further migration of the plume. Biosparging was selected because the pump and treat system failed to achieve cost-effective removal rates for BTEX compounds. Following a 7-month operational period of the biosparging system, BTEX concentrations at the site decreased to <1 µg/L at most sampling locations. This decrease was attributed primarily to biodegradation rates enhanced through biosparging. Treating the plume with biosparging costs approximately half as much as treating with the pump and treat system (Gallagher et al., 1996).
- In an additional study (Javanmardian, et al., 1995), a biosparging pilot test was conducted at an Amoco Oil petroleum products storage terminal in Michigan to investigate its effectiveness in oxygenating soil and groundwater. The results of benzene and total BTEX concentrations were analyzed before biosparging and 1 month later. The results showed a decrease of benzene concentrations in all monitoring wells within the study area. The highest benzene concentration in the test area decreased from approximately 250 mg/L to 90 mg/L following the initial trial.
- In five case studies examined by Battelle (Fields, et al., 2002), biosparging was shown to be effective in all; treated initial BTEX concentrations ranged from 690 µg/L to free product. Given the benzene concentrations at Alameda Point OU-5/Annex IR-02, there is no reason to believe that biosparging would not be as effective.

- In a project performed by the U.S. Army Corps of Engineers (USACE, 2000), BTEX and VOCs were remediated in shallow groundwater using a biosparging system. The 35,000-square foot site was located near a shoreline, had an average depth to groundwater of 10 to 12 feet bgs, and had an initial maximum benzene concentration of 640 µg/L. After an initial pilot test, a full-scale system consisting of 22 injection wells was implemented. The majority of the plume was reduced to non-detectable concentrations within 1 year. The area with the highest initial concentration of benzene was finally remediated at the end of the second year, with over 98 percent mass removal.
- Air sparging/biosparging systems have also been evaluated and recently selected for active remediation at sites in Camp Pendleton (Battelle, 2002a) and Hamilton Army Airfield (Battelle, 2002b). Air sparging was selected for a plume approximately 1,000 feet in length at Camp Pendleton, which contained petroleum hydrocarbon concentrations nearing free product. Biosparging with contingency SVE wells was selected for the Hamilton site, where a biosparging cutoff wall was designed to intercept off-site contaminant flow in shallow groundwater, and biosparging injection wells were installed to address high concentration areas. For both sites, the timeframes to complete the cleanup were estimated at less than 2 years.

9.4.5. Short-Term Effectiveness

Alternative 3 would involve some short-term risks associated with well installation and vapor emissions, to be controlled using an extraction and treatment system, as the system is pilot tested and taken to full implementation. If horizontal wells are used, excavation may directly expose contaminated groundwater, completing the groundwater-to-human exposure pathway.

9.4.6. Implementability

Alternative 3 would be technically and administratively implementable. Sparging well placement is flexible, and underground as well as aboveground obstructions could be avoided. The presence of surface structures such as residential buildings would affect the radius of influence of the biosparging system. However, SVE well placement and soil gas monitoring would require special attention.

The components of a biosparging system are not overly complicated; however, potential fugitive benzene vapor emissions would require monitoring and control.

9.4.7. Cost

The costs associated with Alternative 3 (see Appendix H for the detailed cost estimate) are:

- Capital equipment costs at the onset of the project: $1,020,832
- O&M costs converted into NPV 2004 dollars: $1,215,531
- Total estimated cost for Alternative 3: $2,236,363

Note that these costs include a 10 percent contingency.

9.4.8. State/Community Acceptance

Stakeholders have indicated a preference for more aggressive cleanup technologies, provided they are not cost-prohibitive or impracticable. Stakeholders, including regulatory agencies and community representatives, have expressed a preference for a Site cleanup technology that is more aggressive than MNA.

The State and community acceptance criteria will be assessed in the ROD following comment on the RI/FS and the proposed plan.

9.5. ALTERNATIVE 4 – BIOSPARGING WITH SOIL VAPOR EXTRACTION, NUTRIENT/MICROORGANISM ENHANCEMENT, MONITORED NATURAL ATTENUATION, AND INSTITUTIONAL CONTROLS

Alternative 4 involves the same components of Alternative 3, with the addition of nutrient and/or microorganism enhancement to accelerate the cleanup timeframe. The details of Alternative 3 are not repeated in this section for brevity (see Section 9.4).

Generally, oxygen availability is the limiting factor in biodegradation of petroleum compounds, and appears to be the limiting factor at the Site. Generally, the availability of nitrogen and phosphorous is not a limiting factor, and supplying oxygen to the subsurface is sufficient to promote in situ aerobic biodegradation of petroleum compounds. However, at some sites, essential nutrients such as nitrogen and phosphorous may not be present in sufficient concentrations to sustain the growth of the microorganism. At such sites, the addition of essential nutrients may increase biodegradation rates.

Because nitrate and nitrite concentrations at the site have generally been below the detection limit, (IT et al., 2002 and Shaw, 2004b), nitrogen may be limiting the biodegradation rate at the Site. Existing data indicate that biodegradation is already occurring on the site; however, the enhancement of the naturally-occurring microbial population may also increase the degradation rate at the Site. Therefore, nutrient/ microorganism enhancement is included as part of Alternative 3.

During the remedial design process, the enhancement of biodegradation by addition of nutrients or microbial substrates will be evaluated by conducting laboratory treatability studies. The addition of nitrogen and phosphorous is quantified by conducting respirometer tests using diammonium phosphate (DAP) as a nutrient source. If the addition of essential nutrients is determined to substantially promote biodegradation rates, the biosparging system may be optimized to provide these nutrients to the subsurface. Nitrogen concentration can be increased by the addition of gaseous ammonia, nitrous oxide, or liquid nitrate solution to the injection stream. If phosphorous is also determined to be a limiting factor, a low concentration liquid phosphate solution may be added to the injection process.

Alternative 4 is assumed, for cost estimating purposes, to shorten the required cleanup time by 1 year relative to Alternative 3; however, without laboratory treatability studies (to be performed during the

remedial design), it is difficult to accurately assess the reduced cleanup time for biosparging with nutrient enhancement. Two years of biosparging with nutrient enhancement followed by six years of MNA are assumed for cost estimating purposes.

9.5.1. Performance Criteria

The performance criteria for Alternative 4 are identical to those for Alternative 3 (see Section 9.4), with the addition of non-acceptable performance being marked by potential biofouling of the biosparge wells (such as that caused by excessive algae growth) that could limit injection efficiency.

9.5.2. Biosparging System Design

The biosparging system conceptually designed for Alternative 3 would be similar to the system for Alternative 4, with the addition of nutrients (in either gas or liquid form) during the injection process. Technical specifications of the system remain unchanged from Alternative 3, but the duration for implementation is changed to 2 years of biosparging followed by 6 years of MNA.

9.5.3. Overall Protection of Human Health and the Environment

Alternative 4 would protect human health and the environment under current and likely future land uses because contaminants would be destroyed through accelerated biodegradation. After initial treatment with biosparging and a short period of MNA, Alternative 4 would permanently eliminate risks associated with groundwater contamination. Institutional controls and site monitoring, as in Alternative 2, would remain a critical element to protect short-term exposure during treatment of the plume.

Alternative 4 meets this threshold criterion.

9.5.4. Compliance with ARARs

Alternative 4 has several potential action-specific ARARs:

- **RCRA** – Requirements of this act regarding proper characterization and disposal of investigation-derived wastes such as purge water or drill cuttings are considered potentially applicable.
- **DTSC Requirements for Land Use Covenants** - The substantive provisions of this regulation, which provide for a land use covenant to be executed and recorded when remedial actions are taken and when hazardous substances will remain at the property at concentrations unsuitable for unrestricted use of the land, are considered potentially relevant and appropriate.
- **California Civil Code** – The substantive provisions of this requirement are potentially applicable and allow an owner of land to make a covenant to restrict the use of land to protect present or future human health or safety or the environment as a result of the presence of hazardous materials.
- **California Health and Safety Code** –The substantive provisions of this regulation are potentially applicable and allow DTSC to enter into an agreement with the owner of a hazardous waste facility to restrict present and future land uses.

- **Clean Air Act** – This law is considered potentially applicable for operation of the vapor extraction and treatment system.
- **BAAQMD Regulation Title 8** – This regulation, covering discharge to air and air stripping operations, is relevant and appropriate due to use of a vapor extraction system as part of the remedial alternative.

For a listing of chemical- and location-specific ARARs, and an analysis of ARARs, refer to Section 7.

Alternative 4 can meet the ARARs specified, and therefore meets this threshold criterion.

9.5.5. Long-Term Effectiveness and Permanence

Alternative 4 would reduce site contamination to below cleanup goals within an estimated 8 years, allowing for unrestricted use of groundwater after the cleanup has been completed. Therefore, Alternative 4 would have high, long-term effectiveness because, even if the groundwater-to-human receptor pathway were completed in the future, there would be no significant contamination that posed an unacceptable risk.

9.5.6. Reduction of Toxicity, Mobility, or Volume through Treatment

Based on the site-specific details and other case studies involving biosparging and MNA, Alternative 4 would be effective for the Site. Alternative 4 meets the RAO for groundwater and would accelerate the natural biodegradadation at the site to reduce contaminant concentrations. Biosparging is considered innovative, but has had a number of successful applications for remediation groundwater contamination, especially VOCs and petroleum hydrocarbons (see Section 9.4.4).

9.5.7. Short-Term Effectiveness

Alternative 4 would involve some short-term risks associated with well installation and vapor emissions, to be controlled using an extraction and treatment system, as the system is pilot tested and taken to full implementation. If horizontal wells are used, excavation may directly expose contaminated groundwater, completing the groundwater-to-human exposure pathway.

9.5.8. Implementability

Alternative 4 would be technically and administratively implementable. Sparging well placement is flexible, and underground as well as aboveground obstructions can be avoided. The presence of surface structures such as residential buildings will affect the radius of influence of the biosparging system. However, SVE well placement and soil gas monitoring would require special attention.

The components of a biosparging system are not overly complicated; however, potential fugitive benzene vapor emissions would require monitoring and control. The addition of nutrients or microorganisms to the subsurface would require additional operation and maintenance effort to ensure that potential biofouling of the biosparge wells is effectively controlled as not to inhibit injection efficiency.

9.5.9. Cost

The costs associated with Alternative 4 (see Appendix H for the detailed cost estimate) are:

- Capital equipment costs at the onset of the project: $1,020,832
- O&M costs converted into NPV 2004 dollars: $1,296,136
- Total estimated cost for Alternative 3: $2,316,968

Note that these costs include a 10 percent contingency.

9.5.10. State/Community Acceptance

Stakeholders have indicated a preference for more aggressive cleanup technologies, provided they are not cost-prohibitive or impracticable. Stakeholders, including regulatory agencies and community representatives, have expressed a preference for a Site cleanup technology that is more aggressive than MNA.

The State and community acceptance criteria will be assessed in the ROD following comment on the RI/FS and the proposed plan.

9.6. ALTERNATIVE 5 – AIR SPARGING WITH SOIL VAPOR EXTRACTION, MONITORED NATURAL ATTENUATION, AND INSTITUTIONAL CONTROLS

As described in Section 8, air sparging involves injecting air into the saturated zone at a flow rate designed primarily to volatilize contamination for collection via SVE wells, and secondarily to promote aerobic biodegradation. An air sparging system would be constructed similar to the biosparging system described in Section 9.5, with the exception of larger-capacity compressors to deliver air into the subsurface at higher flow rates relative to biosparging. Because of the similarities to Alternative 3, the details of Alternative 5 are not repeated in this section for brevity (see Section 9.4).

A vapor extraction and treatment contingency is an essential component of Alternative 5, to collect volatilized contamination in the unsaturated zone prior to reaching the surface. Given the sensitive receptors at the site, the increased potential human health risk from possible fugitive emissions during air sparging should be balanced with the potential benefit of an accelerated cleanup timeframe.

As with Alternatives 3 and 4, this alternative also incorporates MNA and institutional controls because air sparging will be implemented to address plume centers and/or deeper areas that may not be amenable to the use of MNA alone. MNA would remediate residual contamination left after air sparging, and institutional controls would ensure that contaminated groundwater is not used as a potable water supply prior to achieving cleanup goals. The details of the MNA and institutional controls alternative are not repeated in this section for brevity (see Section 9.3).

Alternative 5 is assumed, for cost estimating purposes, to shorten the required cleanup time by 1 year relative to Alternative 3. One year of air sparging followed by seven years of MNA are assumed for cost estimating purposes.

9.6.1. Performance Criteria

The performance criteria for Alternative 5 are identical to those for Alternative 3 (see Section 9.4).

9.6.2. Air Sparging System Design

The biosparging system conceptually designed for Alternative 3 would be similar to the air sparging system for Alternative 5, with the addition of larger-capacity compressors at each treatment zone. Technical specifications of the system remain unchanged from Alternative 3, with the following exceptions (see Appendix H for a detailed itemization of system components and costs):

- Three continuously-operated 20-hp compressors for air injection, and three stand-by 30 hp vacuum blowers, within Zones 1, 2, and 3
- One year of air sparging, followed by seven years of MNA and institutional controls

9.6.3. Overall Protection of Human Health and the Environment

Alternative 5 would protect human health and the environment under current and likely future land uses because contaminants would be destroyed through accelerated biodegradation. After initial treatment with air sparging and a short period of MNA, Alternative 5 would permanently eliminate risks associated with groundwater contamination. Institutional controls and site monitoring, as in Alternative 2, would remain a critical element to protect short-term exposure during treatment of the plume.

Alternative 5 meets this threshold criterion.

9.6.4. Compliance with ARARs

Alternative 5 has several potential action-specific ARARs:

- **RCRA** – Requirements of this act regarding proper characterization and disposal of investigation-derived wastes such as purge water or drill cuttings are considered potentially applicable.
- **DTSC Requirements for Land Use Covenants** – The substantive provisions of this regulation, which provide for a land use covenant to be executed and recorded when remedial actions are taken and when hazardous substances will remain at the property at concentrations unsuitable for unrestricted use of the land, are considered potentially relevant and appropriate.
- **California Civil Code** – The substantive provisions of this requirement are potentially applicable and allow an owner of land to make a covenant to restrict the use of land to protect present or future human health or safety or the environment as a result of the presence of hazardous materials.

- **California Health and Safety Code** –The substantive provisions of this regulation are potentially applicable and allow DTSC to enter into an agreement with the owner of a hazardous waste facility to restrict present and future land uses.
- **Clean Air Act** – This law is considered potentially applicable for operation of the vapor extraction and treatment system.
- **BAAQMD Regulation Title 8** – This regulation, covering discharge to air and air stripping operations, is relevant and appropriate due to use of a vapor extraction system as part of the remedial alternative.

For a listing of chemical- and location-specific ARARs, and an analysis of ARARs, refer to Section 7.

Alternative 5 can meet the ARARs specified, and therefore meets this threshold criterion.

9.6.5. Long-Term Effectiveness and Permanence

Alternative 5 would reduce site contamination to below cleanup goals within an estimated 8 years, allowing for unrestricted use of groundwater after the cleanup has been completed. Therefore, Alternative 5 would have high, long-term effectiveness because, even if the groundwater-to-human receptor pathway were completed in the future, there would be no significant contamination that posed an unacceptable risk.

9.6.6. Reduction of Toxicity, Mobility, or Volume through Treatment

Based on the site-specific details and other case studies involving biosparging and MNA, Alternative 5 would be effective for the Site. Alternative 5 meets the RAO for groundwater and would actively volatilize contaminants from the saturated zone for extraction and treatment, as well as accelerate the natural biodegradation in the saturated zone. Air sparging has been successfully demonstrated both in the laboratory and in field applications, and has been found to be effective (Fields et al., 2002).

9.6.7. Short-Term Effectiveness

Alternative 5 would involve some short-term risks associated with well installation and vapor emissions (to be controlled using an extraction and treatment system) as the system is pilot tested and taken to full implementation. The increased fugitive emissions could pose increased risk to site occupants, if not adequately controlled with the vapor extraction and treatment system. If horizontal wells are used, excavation may directly expose contaminated groundwater, completing the groundwater-to-human exposure pathway.

9.6.8. Implementability

Alternative 5 would be technically and administratively implementable. Sparging well placement is flexible, and underground as well as aboveground obstructions can be avoided. The presence of surface structures such as residential buildings will affect the radius of influence of the biosparging system.

The components of an air sparging system are not overly complicated; however, fugitive benzene vapor emissions would require monitoring and control, particularly given the increased fugitive emissions and nearby site occupants.

9.6.9. Cost

The costs associated with Alternative 5 (see Appendix H for the detailed cost estimate) are:

- Capital equipment costs at the onset of the project: $1,087,822
- O&M costs converted into NPV 2004 dollars: $1,131,629
- Total estimated cost for Alternative 3: $2,219,451

Note that these costs include a 10 percent contingency.

9.6.10. State/Community Acceptance

Stakeholders have indicated a preference for more aggressive cleanup technologies, provided they are not cost-prohibitive or impracticable. Given the sensitive receptors in the area, the increased fugitive emissions from an air sparging system may be less preferable compared to other alternatives.

The State and community acceptance criteria will be assessed in the ROD following comment on the RI/FS and the proposed plan.

9.7. ALTERNATIVE 6 – PUMP AND TREAT WITH MONITORED NATURAL ATTENUATION AND INSTITUTIONAL CONTROLS

As described in Section 8, pump and treat systems involve extracting groundwater containing dissolved contaminants from the subsurface and delivering water to the surface for either on-site or off-site treatment. Pump and treat systems are typically effective in containing groundwater contamination, and are sometimes effective in removing contaminant mass from the saturated zone, particularly in areas with free floating product and in permeable aquifers. The benzene and naphthalene plume at the Site is stable, as discussed in Section 4 and 5; therefore, the purpose of a pump and treat system at the Site would be to remove contaminant mass, primarily from the plume centers.

The effectiveness of a pump and treat system in removing contaminant mass at the plume centers will be constrained by the heterogeneity of the Site soils, particularly low-permeability materials present within the FWBZ. This limitation of pump and treat is not unique compared with the other alternatives, as most in situ technologies are also limited by subsurface heterogeneity. The determination of whether pump and treat could be a viable remediation technology for the Site will depend largely on the cost evaluation developed for Alternative 6.

The pump and treat system conceptually designed for Alternative 6 involves treatment at zones identical to those in Alternatives 3, 4, and 5, the details of which are not repeated for brevity. Treatment

equipment would be contained near the treatment zones in enclosures similar to those described for Alternatives 3, 4, and 5; the enclosures would be designed to house the treatment vessels required for on-site treatment, as appropriate, and to contain an appropriate volume of groundwater in the event of an accidental spill. Because fugitive emissions from the groundwater extraction are not expected to be significant, no vapor extraction and treatment systems would be required for Alternative 6.

This alternative also incorporates MNA and institutional controls because pump and treat will be implemented to address plume centers and/or deeper areas that may not be amenable to the use of MNA alone. MNA would remediate residual contamination left after pump and treat, and institutional controls would ensure that contaminated groundwater is not used as a potable water supply prior to achieving cleanup goals. The details of the MNA and institutional controls alternative are not repeated in this section for brevity (see Section 9.3).

Given the site characteristics and other case studies, the estimated time required for pump and treat of the three zones is 6 to 10 years. Eight years has been assumed for cost estimation purposes, with an MNA phase to follow pump and treat for an estimated seven years.

9.7.1. Performance Criteria

The performance criteria used for pump and treat are directly linked to the cleanup goals stated in the Site RAO, and are listed below.

Acceptable performance will be marked by:

- Continued declining contaminant concentrations in on-site monitoring wells, meeting cleanup goals within the predicted cleanup timeframe
- Receding contaminant plumes
- Documented degradation of contamination left after pump and treat to below cleanup goals

Non-acceptable performance will be marked by:

- Stable contaminant concentrations within pump and treat zones throughout the treatment period
- Expanding contaminant plumes
  - A trend of increasing contaminant concentrations in monitoring wells at the plume centers

9.7.2. Pump and Treat System Design

The pump and treat system conceptually designed for Alternative 6 would consist of the following (see Appendix H for a detailed itemization of system components and costs):

- Installation of 16 4-inch-diameter groundwater extraction wells in Zones 1, 2, and 3; the number of wells was estimated using an assumed radius of influence of 100 feet (based on previous aquifer testing performed at the Site).

- Overlapping extraction well radii of influence for the center of the treatment zones
- Extraction wells screened from 10 to 25 feet bgs
- 16 controller-less pneumatic displacement pumps supplied by three 15-hp air compressors, within Zones 1, 2, and 3
- Adequate manifolding, piping, control valves, etc., at each zone to operate clusters of extraction wells separately, allowing for pulsing and cycling of the system
- Treatment pads at each treatment zone, designed to hold two 200-gallon steel vessels containing granulated activated carbon, and of an adequate capacity to contain accidental spills and stormwater
- Adequate maintenance of the system to allow for optimization and continual operation; installation of nine additional groundwater monitoring wells to monitor cleanup progress
- Eight years of pump and treat, followed by seven years of MNA and institutional controls
- Simultaneous implementation at all pump and treat zones

9.7.3. Overall Protection of Human Health and the Environment

Alternative 6 would protect human health and the environment under current and likely future land uses because contaminants would be destroyed following extraction and treatment. After initial treatment and a short period of MNA, Alternative 6 would permanently eliminate risks associated with groundwater contamination. Institutional controls and site monitoring, as in Alternative 2, would remain a critical element to protect short-term exposure during treatment of the plume.

Alternative 6 meets this threshold criterion.

9.7.4. Compliance with ARARs

Alternative 6 has several potential action-specific ARARs:

- **RCRA** – Requirements of this act regarding proper characterization and disposal of investigation-derived wastes such as purge water or drill cuttings are considered potentially applicable.
- **DTSC Requirements for Land Use Covenants** – The substantive provisions of this regulation, which provide for a land use covenant to be executed and recorded when remedial actions are taken and when hazardous substances will remain at the property at concentrations unsuitable for unrestricted use of the land, are considered potentially relevant and appropriate.
- **California Civil Code** – The substantive provisions of this requirement are potentially applicable and allow an owner of land to make a covenant to restrict the use of land to protect present or future human health or safety or the environment as a result of the presence of hazardous materials.
- **California Health and Safety Code** – The substantive provisions of this regulation are potentially applicable and allow DTSC to enter into an agreement with the owner of a hazardous waste facility to restrict present and future land uses.

For a listing of chemical- and location-specific ARARs, and an analysis of ARARs, refer to Section 7.

Alternative 6 can meet the ARARs specified, and therefore meets this threshold criterion.

9.7.5. Long-Term Effectiveness and Permanence

Alternative 6 would reduce site contamination to below cleanup goals within an estimated 15 years, allowing for unrestricted use of groundwater after the cleanup has been completed. Therefore, Alternative 6 would have high, long-term effectiveness because, even if the groundwater-to-human receptor pathway were completed in the future, there would be no significant contamination that posed an unacceptable risk.

9.7.6. Reduction of Toxicity, Mobility, or Volume through Treatment

Based on the site-specific details and other case studies involving pump and treat with MNA, Alternative 6 would be effective for the Site. Alternative 6 meets the RAO for groundwater and would remove groundwater contaminants from the subsurface through pump and treat, followed by MNA to further reduce contaminant concentrations.

9.7.7. Short-Term Effectiveness

Alternative 6 would involve some short-term risks associated with well installation and groundwater extraction and treatment. The extraction of large volumes of contaminated groundwater poses potential risks to site occupants that would require control through frequent system maintenance and spill prevention procedures to prevent exposure to contaminated groundwater.

9.7.8. Implementability

Alternative 3 would be technically and administratively implementable. Extraction well placement is flexible, and underground as well as aboveground obstructions can be avoided. The operation and maintenance of the treatment systems would require special attention because the site is currently occupied.

9.7.9. Cost

The costs associated with Alternative 6 (see Appendix H for the detailed cost estimate) are:

- Capital equipment costs at the onset of the project: $809,868
- O&M costs converted into NPV 2004 dollars: $2,365,271
- Total estimated cost for Alternative 6: $3,175,139

Note that these costs include a 10 percent contingency.

9.7.10. State/Community Acceptance

Stakeholders have indicated a preference for more aggressive cleanup technologies, provided they are not cost-prohibitive or impracticable. Community representatives have expressed a preference for a site

cleanup technology that is more aggressive than MNA, and have specifically discussed pump and treat as a potential treatment technology that should be fully evaluated in this report.

The State and community acceptance criteria will be assessed in the ROD following comment on the RI/FS and the proposed plan.

9.8. COMPARATIVE EVALUATION OF REMEDIAL ALTERNATIVES

The comparative evaluation of remedial alternatives included in this section includes the relative performance of each alternative (that has met the first two threshold criteria) with respect to the five balancing criteria, as outlined in the NCP and presented in Section 9.1. The NCP states: "The national goal of the remedy selection process is to select remedies that are protective of human health and the environment, that maintain protection over time, and that minimize untreated waste." As discussed in Section 9.2.1, Alternative 1 does not meet the first threshold criterion, overall protection of human health and the environment, and is therefore excluded from this comparative evaluation, except as required by the NCP. All of the remaining alternatives can meet the second threshold criterion, compliance with ARARs.

The following evaluation compares Alternatives 2, 3, 4, 5, and 6, each of which meets the two threshold criteria, against the five balancing criteria: (1) long-term effectiveness and permanence; (2) reduction of toxicity, mobility, and volume through treatment; (3) short-term effectiveness; (4) implementability; and (5) cost. This evaluation serves to identify and assess the relative performance of each alternative with respect to these five criteria to assist the decision-making process. As previously discussed, the last two criteria, State and community acceptance, will be assessed in the ROD following comment on the RI/FS and the proposed plan. Figure 9-5 summarizes the comparative analysis and presents each remedial alternative in order of its relative performance to each of the five balancing criteria.

9.8.1. Long-Term Effectiveness and Permanence

Alternatives 2, 3, 4, 5, and 6 would each be effective in the long-term. Alternatives 3, 4, 5, and 6 would actively reduce concentrations in the most contaminated areas. Then, all five alternatives would allow MNA to reduce residual concentrations to below cleanup goals for the domestic use of groundwater by residents and workers. Alternatives 4 and 5 would achieve the long-term effectiveness and permanence goals within the shortest estimated timeframe (8 years), and would perform highly relative to this criterion. Alternative 3, projected to achieve the cleanup goals within an estimated 9 years, would perform moderately well relative to this criterion. Alternative 6, projected to achieve the cleanup goals within an estimated 15 years, would perform at a moderate low level relative to this criterion. Alternative 2, projected to achieve the cleanup goals within an estimated 50 years, would perform at a low level relative to this criterion.

9.8.2. Reduction of Toxicity, Mobility, or Volume through Treatment

Alternatives 2, 3, 4, 5, and 6 would each be effective in reducing the toxicity, mobility, or volume of groundwater contamination through treatment. Alternative 2 would rely completely on natural degradation processes, and Alternatives 3 and 4 would accelerate the natural degradation processes occurring at the site, and would produce harmless end products (carbon dioxide and water) that are ubiquitous in the environment. Alternative 5 and, to a lesser extent, Alternative 6 would also accelerate the natural degradation processes by increasing oxygen concentrations in the saturated zone; however, both alternatives would rely on the extraction and treatment of contaminated waste streams.

Alternatives 4 and 5 would reduce the contaminant volume within the shortest estimated timeframe (8 years), and would perform highly relative to this criterion. Alternative 3, projected to reduce contamination to the cleanup goals within an estimated 9 years, would perform moderately well relative to this criterion. Alternative 6, projected to achieve the cleanup goals within an estimated 15 years, would leave a residual volume for a longer timeframe and would perform at a moderately low level relative to this criterion. Alternative 2 utilizes passive treatment technologies, requiring the longest timeframe to provide reduction of toxicity, mobility, and volume of contaminants, and therefore performs at a low level relative to this criterion.

9.8.3. Short-Term Effectiveness

Short-term effectiveness is a measure of the benefits seen by implementation of a remedial alternative and the risks associated with its implementation. Alternatives 2, 3, 4, 5, and 6 each would involve some short-term risks associated with construction or operation of the remediation system; however, these risks could be mitigated through proper engineering design and controls. Possible vapor emissions from the subsurface is a potential risk associated with sparging operations specified in Alternatives 3, 4, and 5. These risks would be mitigated by the use of vapor extraction and treatment systems over the sparging zone, although the potential risk among these alternatives would be greatest for Alternative 5 because air sparging involves injecting air at higher pressures relative to biosparging. Alternative 6 is not anticipated to cause any significant vapor emissions or other exposure to groundwater contamination, assuming that the treatment system operates properly. However, an accidental release of contaminated groundwater from a pump and treat system could pose a risk to site occupants and ecological receptors in Oakland Inner Harbor.

Alternative 4 would perform highly relative to this criterion because of its lower potential risk to site occupants via fugitive emissions compared with Alternative 5, and would provide the greater benefit in the short term, achieving contaminant mass reduction within an estimated 8 years. Alternative 3 would perform at a moderately high level relative to this criterion for the same reasons as Alternative 4, albeit achieving contaminant reduction within a slightly longer timeframe (9 years). Alterative 6 would perform moderately well relative to this criterion because, although its implementation will not result in significant vapor emissions, the treatment of a contaminated water stream poses a potential risk to human and

ecological receptors, and contaminant reduction would involve a longer timeframe (15 years). Alternative 2 would also perform moderately well because it involves minimal additional risks during installation of new groundwater wells and monitoring activities; however, it would require the longest timeframe (50 years) to reduce contamination to potable water cleanup criteria. Alternative 5 would perform at a low level relative to this criterion because the increased volatilization could pose increased risk to site occupants that would not be outweighed by a significant reduction in cleanup time.

9.8.4. Implementability

Alternatives 2, 3, 4, 5, and 6 all consist of remediation technologies that are readily implementable, and each would involve subsurface construction in an active residential community. Alternative 2 would require only additional monitoring wells, and would have the least impact on Site residents. Alternatives 3, 4, and 5 would each involve a similar number of sparge wells and vapor extraction wells within each treatment zone, while Alternative 5 would require larger equipment to accommodate the higher injection pressures of air sparging. Alternative 4 would involve the addition of nutrients to the subsurface, which would increase biological activity and potentially foul the biosparge wells (via algal growth) unless controlled. Alternative 6 would require fewer extraction wells to treat each zone, but a separate water discharge point would need to be established for each treatment zone. Because of the space limitation caused by the current site use, it may be difficult to identify an appropriate discharge point for each treatment zone.

Alternatives 2, 3, and 5 would perform highly relative to this criterion. Alternatives 4 and 6 would perform moderately well relative to this criterion, considering the increased level of effort likely required to control potential fouling of the biosparge wells (Alternative 4) and to identify discharge points for treated groundwater (Alternative 6).

9.8.5. Cost

The costs for the six alternatives are as follows:

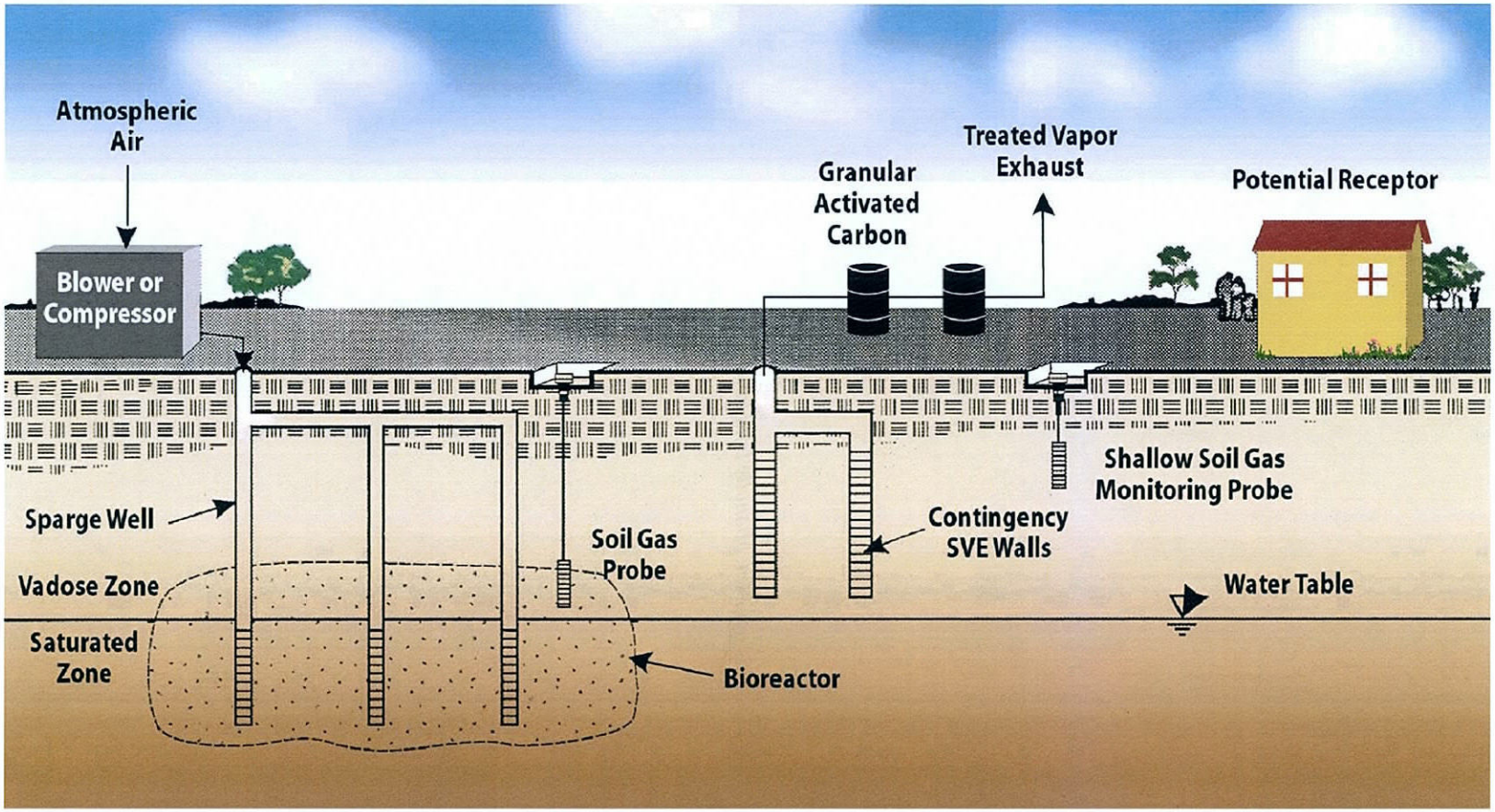
Remedial Alternative Cost Comparison

Remedial Alternative	Estimated Cost
Alternative 1 – No Action	$0
Alternative 2 – MNA and Institutional Controls	$2,226,314
Alternative 3 – Biosparging with MNA and Institutional Controls	$2,236,363
Alternative 4 – Biosparging with Nutrient Enhancement, MNA, and Institutional Controls	$2,316,968
Alternative 5 – Air Sparging with MNA and Institutional Controls	$2,219,451
Alternative 6 – Pump and Treat with MNA and Institutional Controls	$3,175,139

9.8.6. State/Community Acceptance

As previously discussed, the State and community acceptance criteria will be assessed in the ROD following comment on the RI/FS and the proposed plan.

This page intentionally left blank



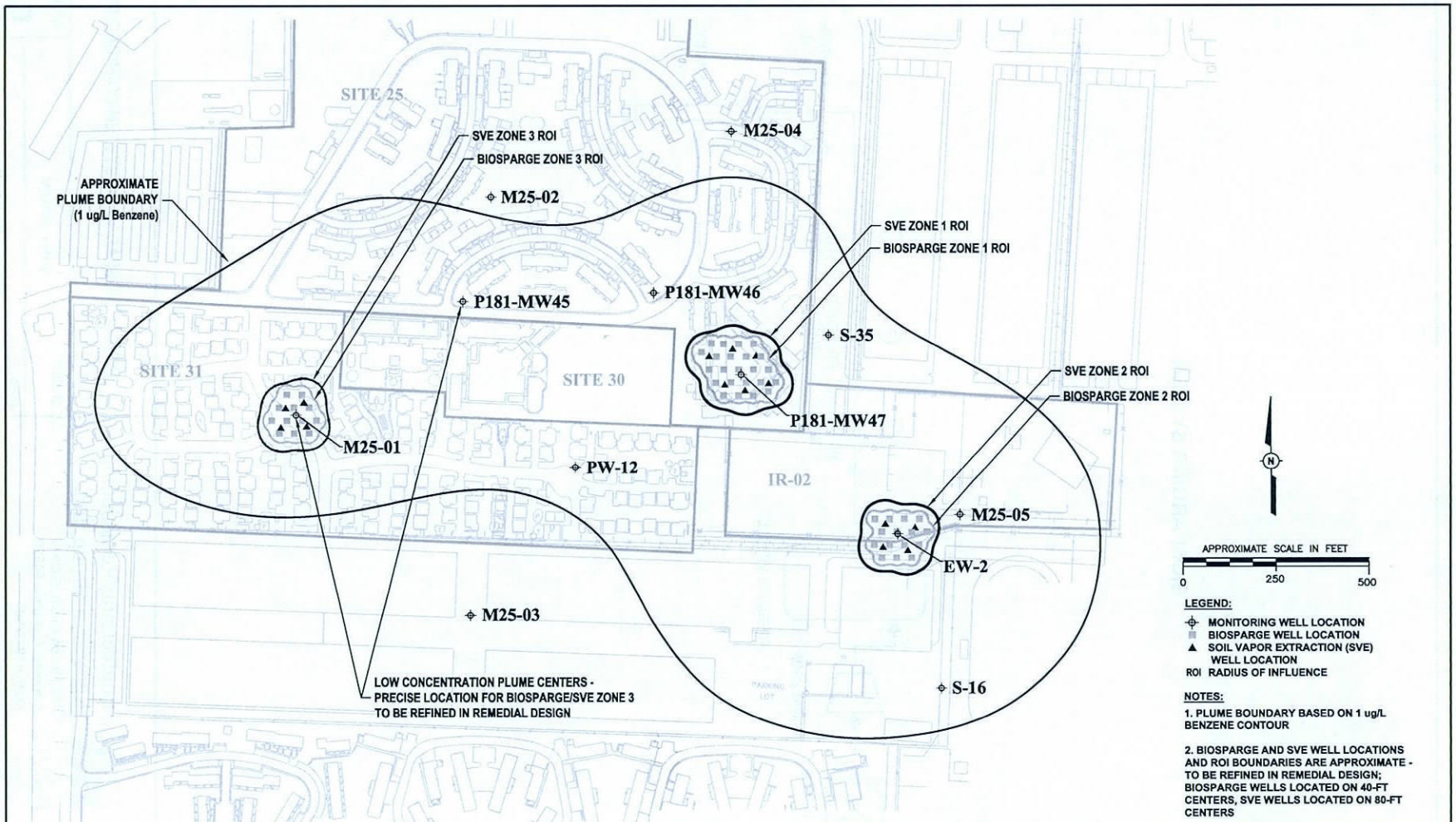
ERRG

Engineering/Remediation Resources Group, Inc.
185 Mason Circle, Suite A
Concord, California 94520
(925) 969-0750

BIOSPARGING SYSTEM CONCEPTUAL DRAWING

CLIENT:	NAVY SWDIV	FIGURE: 9-1
DWG. NO.	22-052-FIGURE 9-1	

XREF:
FILE: P:\2002 Projects\22-052 RI FS Alameda Point\Figures\Draft version\8 Oct 03\22-052_FIG_9-1.dwg USER: mrong Jul 09, 2004 3:17pm



LEGEND:

- MONITORING WELL LOCATION
- BIOSPARGE WELL LOCATION
- SOIL VAPOR EXTRACTION (SVE) WELL LOCATION
- ROI RADIUS OF INFLUENCE

NOTES:

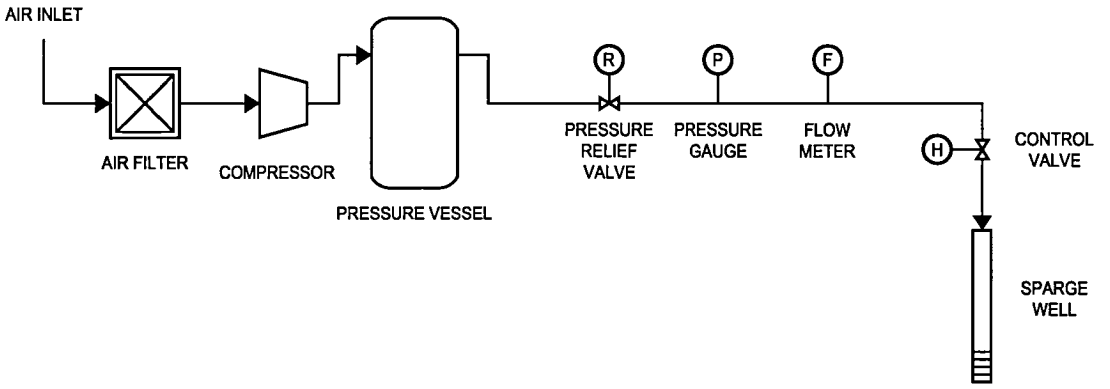
1. PLUME BOUNDARY BASED ON 1 ug/L BENZENE CONTOUR

2. BIOSPARGE AND SVE WELL LOCATIONS AND ROI BOUNDARIES ARE APPROXIMATE - TO BE REFINED IN REMEDIAL DESIGN; BIOSPARGE WELLS LOCATED ON 40-FT CENTERS, SVE WELLS LOCATED ON 80-FT CENTERS

ERRG Engineering/Remediation Resources Group, Inc. 185 Mason Circle, Suite A Concord, California 94520 (925) 969-0750	DRAWN BY: J.M. 7/12/04	ALTERNATIVE 3 BIOSPARGE ZONES	
	DESIGNED BY: J.M. 7/12/04	CLIENT: NAVY SWDIV	FIGURE: 9-2
	CHECKED BY: D.B. 7/12/04	DWG. NO. 22-052-FIGURE 9-2	

FILE: P:\2002 Projects\22-052 RI FS Alameda Point\Figures\Draft version\Jun 04\FIG 9-2 A3 Concept.dwg USER: mwong Aug 23, 2004 1:42pm

BIOSPARGING SYSTEM



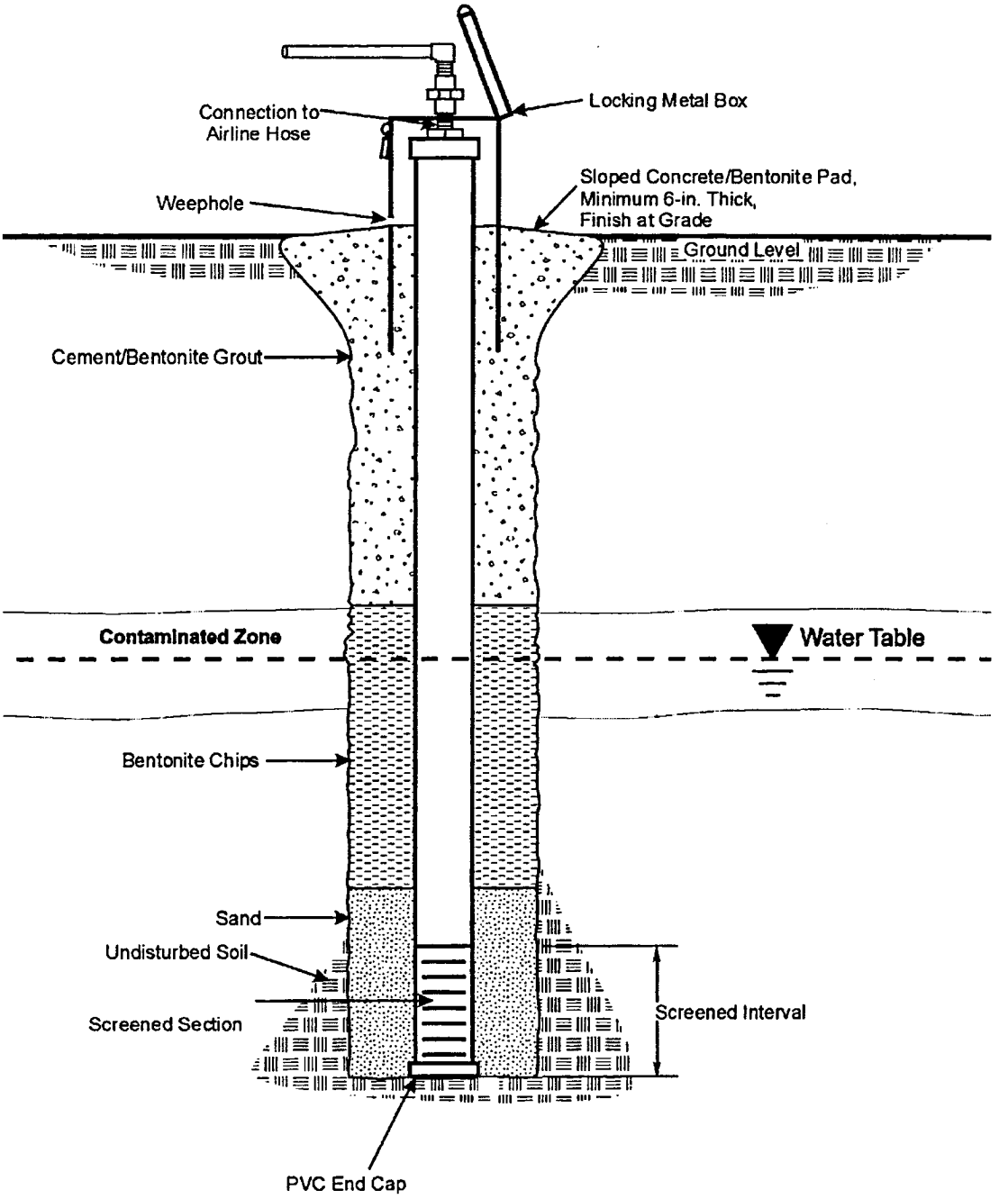
ERRG

Engineering/Remediation Resources Group, Inc.
185 Mason Circle, Suite A
Concord, California 94520
(925) 969-0750

TYPICAL BIOSPARAGING SYSTEM COMPONENTS

CLIENT:	NAVY SWDIV
DWG. NO.:	22-052-FIGURE 9-3
FIGURE:	9-3

FILE: P:\2002 Projects\22-052 RI FS Alameda Point\Figures\Draft version\8 Oct 03\22-052 FIG 9-2.dwg USER: rwong Aug 11, 2004 9:34am



NOT TO SCALE

*** REPRINTED FROM AIR SPARGING A PROJECT MANAGER'S GUIDE**

ERRG
Engineering/Remediation Resources Group, Inc.
185 Mason Circle, Suite A
Concord, California 94520
(925) 969-0750

TYPICAL SPARGING WELL CONSTRUCTION

CLIENT:	NAVY SWDIV
DWG. NO.:	22-052-FIGURE 9-4
FIGURE:	9-4

FILE: P:\2002 Projects\22-052 RI FS Alameda Point\Figures\Draft version\8 Oct 03\22-052 FIG 9-3.dwg USER: rwong Aug 11, 2004 9:37am

Figure 9-5
Comparative Analysis of Remedial Alternatives
Alameda Point Site 25/Alameda Annex IR-02 Groundwater RI/FS

Remedial Alternatives:	Threshold Criteria (Yes or No): Overall Protection of Human Health and the Environment	Threshold Criteria (Yes or No): Compliance with ARARs	Balancing Criteria (Alternatives are listed in order of relative performance, highest to lowest): Long Term Effectiveness and Permanence	Balancing Criteria: Reduction through Treatment	Balancing Criteria: Short Term Effectiveness	Balancing Criteria: Implementability	Balancing Criteria: Cost
Alternative 1 - No Action No active or passive remediation, no institutional or engineering controls Included for comparison to other alternatives (per NCP)	**Alternative 1 - No** Would not prevent exposure to hazardous substances through improper use of shallow groundwater Does not include a mechanism for monitoring contaminant degradation or migration through groundwater	**Alternative 2 - Yes** **Can meet all ARARs including:** RCRA regulations regarding proper characterization and disposal of wastes	**Alternative 4** Provides permanent reduction of contamination to acceptable concentrations in an estimated 2 years of active treatment and 6 years of monitored natural attenuation ***Performance: High***	**Alternative 4** Accelerates natural degradation processes Minimal extraction and treatment of contaminated vapor stream Projected to reduce contamination to cleanup goals within 8 years ***Performance: High***	**Alternative 4** Limited short term risks during well installation Risks of fugitive vapors low, mitigated by SVE system Reduction of contamination in shortest timeframe (8 years) ***Performance: High***	**Alternative 2** Technically and administratively implementable Least impact to residents at the Site ***Performance: High***	**Alternative 5** Capital equipment cost: $1,087,822 O&M costs: $1,131,629 ***Total costs: $2,219,451***
Alternative 2 - MNA with Institutional Controls Comprehensive groundwater monitoring program to track concentrations of both contaminants and natural attenuation parameters Institutional controls to ensure that groundwater is not used as a potable water supply (during implementation of remedy)	**Alternative 2 - Yes** Permanent reduction of contamination to potable water cleanup criteria in 50 year timeframe Institutional controls to prevent short term exposure (during remedial implementation)	**Alternative 3 - Yes** **Can meet all ARARs including:** RCRA regulations regarding proper characterization and disposal of wastes Air quality regulations covering the discharge from the vapor extraction treatment system	**Alternative 5** Provides permanent reduction of contamination to acceptable concentrations in an estimated 1 year of active treatment and 7 years of monitored natural attenuation ***Performance: High***	**Alternative 5** Accelerates natural degradation processes Relies on extraction and treatment of contaminated vapor stream Projected to reduce contamination to cleanup goals within 8 years ***Performance: High***	**Alternative 3** Limited short term risks during well installation Risks of fugitive vapors low, mitigated by SVE system Reduction of contamination in slightly longer timeframe (9 years) ***Performance: Moderately High***	**Alternative 3** Technically and administratively implementable Well placement is flexible, but care should be taken around residential buildings ***Performance: High***	**Alternative 2** Capital equipment cost: $247,416 O&M costs: $1,978,898 ***Total costs: $2,226,314***
Alternative 3 - Biosparging with SVE, MNA, and Institutional Controls Biosparging to add oxygen to the subsurface and speed biodegradation SVE to ensure protection of site residents from possible fugitive emissions MNA and institutional controls (as outlined in Alternative 2)	**Alternative 3 - Yes** Permanent reduction of contamination to potable water cleanup criteria in 9 year timeframe Institutional controls to prevent short term exposure (during remedial implementation)	**Alternative 4 - Yes** **Can meet all ARARs including:** RCRA regulations regarding proper characterization and disposal of wastes Air quality regulations covering the discharge from the vapor extraction treatment system	**Alternative 3** Provides permanent reduction of contamination to acceptable concentrations in an estimated 2 years of active treatment and 7 years of monitored natural attenuation ***Performance: Moderate***	**Alternative 3** Accelerates natural degradation processes Minimal extraction and treatment of contaminated vapor stream Projected to reduce contamination to cleanup goals within 9 years ***Performance: Moderate***	**Alternative 6** Limited short term risks during well installation Accidental release of contaminated groundwater could pose risks to site occupants or ecological receptors in Oakland Inner Harbor Longer cleanup timeframe (15 years) ***Performance: Moderate***	**Alternative 5** Technically and administratively implementable Well placement is flexible, but care should be taken around residential buildings ***Performance: High***	**Alternative 3** Capital equipment cost: $1,020,832 O&M costs: $1,215,531 ***Total costs: $2,236,363***
Alternative 4 - Biosparging with SVE, Nutrient/ Microorganism Enhancement, MNA, and Institutional Controls Biosparging and SVE (as outlined in Alternative 3) with the addition of nutrients and/or microorganisms to accelerate cleanup MNA and institutional controls (as outlined in Alternative 2)	**Alternative 4 - Yes** Permanent reduction of contamination to potable water cleanup criteria in 8 year timeframe Institutional controls to prevent short term exposure (during remedial implementation)	**Alternative 5 - Yes** **Can meet all ARARs including:** RCRA regulations regarding proper characterization and disposal of wastes Air quality regulations covering the discharge from the vapor extraction treatment system	**Alternative 6** Provides permanent reduction of contamination to acceptable concentrations with an estimated 8 years of active treatment and 7 years of monitored natural attenuation ***Performance: Moderately Low***	**Alternative 6** Accelerates natural degradation processes to lesser extent Extraction and treatment of contaminated groundwater Projected to reduce contamination to cleanup goals within 15 years ***Performance: Moderately Low***	**Alternative 2** Limited short term risks during well installation Reduction of contamination in longest timeframe (50 years) ***Performance: Moderate***	**Alternative 4** Technically and administratively implementable Well placement is flexible, but care should be taken around residential buildings Requires increased level of effort to control biofouling of biosparge wells ***Performance: Moderate***	**Alternative 4** Capital equipment cost: $1,020,832 O&M costs: $1,296,136 ***Total costs: $2,316,968***
Alternative 5 - Air Sparging with SVE, MNA, and Institutional Controls Air sparging to add oxygen to the subsurface speeding biodegradation and volatilizing contaminants for capture and treatment using SVE MNA and institutional controls (as outlined in Alternative 2)	**Alternative 5 - Yes** Permanent reduction of contamination to potable water cleanup criteria in 8 year timeframe Institutional controls to prevent short term exposure (during remedial implementation)	**Alternative 6 - Yes** Can meet all ARARs including: RCRA regulations regarding proper characterization and disposal of wastes	**Alternative 2** Provides permanent reduction of contamination to acceptable concentrations with an estimated 50 years of monitored natural attenuation ***Performance: Low***	**Alternative 2** Utilizes natural degradation processes Projected to reduce contamination to cleanup goals within 50 years ***Performance: Low***	**Alternative 5** Limited short term risks during well installation Increased risks of fugitive vapors due to increased injection pressures, mitigated by SVE system Increased risks to site occupants are not outweighed by a significant reduction in cleanup timeframe (8 years) ***Performance: Low***	**Alternative 6** Technically and administratively implementable Fewer wells would be required; however, separate connections to POTW at each treatment zone would be required ***Performance: Moderate***	**Alternative 6** Capital equipment cost: $809,868 O&M costs: $2,365,271 ***Total costs: $3,175,139***
Alternative 6 - Pump and Treat with MNA, and Institutional Controls Extraction of groundwater at the plume centers to remove and treat contamination dissolved in groundwater MNA and institutional controls (as outlined in Alternative 2)	**Alternative 6 - Yes** Permanent reduction of contamination to potable water cleanup criteria in 15 year timeframe Institutional controls to prevent short term exposure (during remedial implementation)						

Abbreviations:

ARARs	Applicable or Relevant and Appropriate Requirements
MNA	Monitored Natural Attenuation
NCP	National Contingency Plan
O&M	Operation and maintenance
POTW	Public-owned treatment works
RCRA	Resource Conservation and Recovery Act
RI/FS	Remedial Investigation / Feasibility Study
ROD	Record of Decision
SVE	Soil vapor extraction

Modifying Criteria
State and Community Acceptance
(Evaluated in the ROD after comment on the RI/FS and proposed plan)

Notes:
Refer to the Comparative Evaluation of Alternatives in Section 9.8 for more information.
Colors in each cell correspond to individual remedial alternatives.
In cases where relative performance is identical, alternatives are listed in numerical order.

10. CONCLUSIONS

This Remedial Investigation/Feasibility Study was conducted to address dissolved-phase benzene and naphthalene contamination in shallow groundwater beneath Alameda Point Sites 25, 30, and 31, and Alameda Annex Installation Restoration Site-02 in Alameda, California. The groundwater contamination underlies approximately 42 acres of residential and industrial areas. To date, characterization data indicate that benzene and naphthalene contamination is not migrating and that natural degradation has been occurring; however, the rate of natural degradation has slowed as dissolved oxygen has been consumed and site conditions have become predominantly anaerobic. In addition, additional monitoring data are needed to better understand benzene and naphthalene concentrations at the west and east edges of the contaminant plume.

A human health risk assessment was performed as part of this report, and risks were found to be acceptable for all groundwater use scenarios, except for use as a potable water supply. There are currently no drinking water wells installed at the Site. However, there is concern that wells may be installed in the future, which would complete the groundwater ingestion pathway. Therefore, drinking water standards were used as cleanup goals to address the concern that contaminated groundwater could be used as a potable water supply.

A variety of remedial technologies were screened and evaluated in this report to formulate six remedial alternatives:

- **Alternative 1** – No Action: This alternative would not adequately address the potential for unacceptable risks to human health if the drinking water pathway were completed.
- **Alternative 2** – Monitored Natural Attenuation (MNA) with Institutional Controls: In the short term, this alternative would prevent the drinking water pathway from being completed through the use of institutional controls to prohibit installation of drinking water wells at the Site. Alternative 2 would rely on MNA to degrade the existing contaminant plumes over an estimated 50-year period. While MNA is a useful tool for addressing residual contamination, it is dependent on the electron acceptors available in the natural environment. Dissolved oxygen, the preferred electron acceptor, has been largely consumed throughout the Site, creating predominantly anaerobic subsurface conditions. The remaining electron acceptors are less efficient and the rate of biodegradation has slowed. The remaining electron acceptors will not be sufficient to degrade remaining contamination present within plume centers and at depth within a practical time frame.
- **Alternative 3** – Biosparging with a Soil Vapor Extraction (SVE), MNA, and Institutional Controls: This alternative introduces air as an oxygen source for aerobic degradation into the subsurface, thereby converting anaerobic environments to aerobic environments and accelerating the naturally occurring biodegradation processes. Biosparging could also volatilize a certain amount of benzene into the vadose zone. Although benzene vapors would likely be degraded in the aerobic vadose zone, a vapor extraction contingency is included as part of the biosparging alternative to capture and treat fugitive benzene vapors in the vadose zone. Initiation of the vapor

extraction contingency would be triggered if soil gas monitoring indicates a potential risk to site occupants. It is estimated that approximately 2 years of biosparging would be required, followed by 7 years of MNA to reduce contaminant concentrations to below cleanup goals. During the 9-year period, institutional controls would be used to ensure that groundwater wells are not installed in the first water bearing zone.

- **Alternative 4** – Biosparging with SVE, Nutrient/Microorganism Enhancement, MNA, and Institutional Controls: This alternative is identical to Alternative 3, with the addition microbes or essential nutrients to further increase the degradation rate. It is estimated that approximately 2 years of biosparging with nutrient/microorganism enhancement would be required, followed by 6 years of MNA to reduce contaminant concentrations to below cleanup goals. During the 8-year period, institutional controls would be used to ensure that groundwater wells are not installed in the first water bearing zone.
- **Alternative 5** – Air Sparging with SVE, MNA, and Institutional Controls: This alternative is similar to Alternative 3; the primary difference involves the injection of air at higher pressure to volatilize contaminants for extraction and treatment. It is estimated that approximately 1 year of air sparging would be required, followed by 7 years of MNA to reduce contaminant concentrations to below cleanup goals. During the 8-year period, institutional controls would be used to ensure that groundwater wells are not installed in the first water bearing zone.
- **Alternative 6** – Pump and Treat with MNA, and Institutional Controls: This alternative involves extracting and treating contaminated groundwater. It is estimated that approximately 8 years of pump and treat would be required, followed by 7 years of MNA to reduce contaminant concentrations to below cleanup goals. During the 15-year period, institutional controls would be used to ensure that groundwater wells are not installed in the first water bearing zone.

Alternative 1 was not considered to be protective of human health and the environment if the drinking water pathway were completed, and was therefore eliminated from further consideration. A comparative analysis of Alternatives 2, 3, 4, 5, and 6 concluded that each alternative was technically and administratively implementable and, with the exception of Alternative 6, the estimated cost of each alternative was comparable. The primary distinguishing factor in the comparative analysis was the performance of each alternative relative to the long-term effectiveness criteria, Alternatives 4 and 5 would reduce groundwater contamination to below drinking water standards in an estimated 8 years. Alternative 3 would require an estimated 9 years, Alternative 6 would require an estimated 15 years, and Alternative 2 would require an estimated 50 years. The short-term effectiveness of each alternative was judged to be generally comparable, with the exception of Alternative 5 (air sparging). The increased air injection pressure associated with Alternative 5 will increase the volatilization of groundwater contaminants into the vadose zone. The volatilization will be controlled with soil vapor extraction and treatment; however, given the sensitive receptors at the Site, the increased fugitive emissions from an air sparging system may be less preferable compared to other alternatives.

11. REFERENCES

Air Force Center for Environmental Excellence (AFCEE) and Defense Logistics Agency (DLA), 2001. Final Remedial Process Optimization Handbook. June.

American Society of Testing and Materials (ASTM), 1998. Standard Guide for Remediation of Groundwater by Natural Attenuation at Petroleum Release Sites. Guide # E1943. August.

Battelle, 2002a. Final Interim Remedial Action Plan for Site 62507. January.

Battelle, 2002b. Final, Revision 2, Corrective Action Plan for Groundwater for Underground Storage Tank Site 957/970. March 1.

Bennett, Kathleen, 1999. "In Situ Treatment of Soil Contaminated with Benzene (A BTEX Compound)" (http://www.hort.agri.umn.edu/h5015/99fpapers/bennett.htm).

California, State of, Department of Toxic Substances Control (DTSC), 1992. Supplemental Guidance for Human Health Multimedia Risk Assessments of Hazardous Waste Sites and Permitted Facilities.

CDM Federal, 2003. Draft Soil Feasibility Study, Operable Unit (OU) 5, Alameda Point. August 15.

ERM and Cattellus Development Corporation, 2004. Draft Technical Memorandum, Storm Water Conveyance and Associated Infrastructure Development, Fleet Industrial Supply Center Oakland, Alameda Facility/ Alameda Annex. June 22.

ESRI and FEMA, 2004. Flood Hazard Map. http://www.esri.com/hazards. Accessed August 25.

Federal Register, 1990. 55 Fed. Reg. 8666, 8742, 8750, 8751, 8752, 8753, 8754, 8755, 8756, 8758, 8764, 8765.

Federal Register, 1992. 57 Fed. Reg. 32726, 60848.

Federal Register, 1995. 60 Fed. Reg. 22228.

Federal Register, 1999. 64 Fed. Reg. 19781.

Federal Register, 2001. 63 Fed. Reg. 49118.

Fields, Keith, James Gibbs, Wendy Condit, Andrea Leeson, and Godage Wickramanayake, 2002. Air Sparging: A Project Managers Guide. Battelle Press.

Foster Wheeler Environmental Corporation (FWENC), 2002. Draft Project Closeout Report, Comprehensive Environmental Response, Compensation, and Liability Act Time-Critical Removal Action at IR Site 25. November.

Gallagher, M.N., R.E. Payne, and M.N. Nainan (Gallagher, et al), 1996. Replacing a Pump and Treat System With a Biosparging Cut-Off Wall In Gallagher et al. (Eds.), Proceedings of Petroleum Hydrocarbon Remediation Conference, pp. 123-133. Groundwater Publishing.

Gilbert, Richard O., 1987. Statistical Methods for Environmental Pollution Monitoring. Van Nostrand Reinhold Company.

Hickenbottom, Kelvin and Kenneth Muir, 1988. Geohydrology and Groundwater Data Quality Overview of the East Bay Plain Area, Alameda County, California. Prepared for Alameda County Flood Control and Water Conservation District.

International Technology Corporation (IT), 1998. Environmental Baseline Survey, Draft Evaluation Summaries, Volumes I – XIV, NAS Alameda, California.

IT, 2001a. Zone Evaluation Data Summary, Zone 16: Housing Zone, Alameda Point, Alameda, California. January.

IT, 2001b. Parcel Evaluation Data Summary, Phase 2A Sampling, Zone 16: Housing Zone, Parcel 178: Family Housing, Alameda Point, Alameda, California. January.

IT, 2001c. Parcel Evaluation Data Summary, Phase 2A Sampling, Zone 16: Housing Zone, Parcel 179: George P. Miller Elementary School, Alameda Point, Alameda, California. January.

IT, 2001d. Parcel Evaluation Data Summary, Phase 2A Sampling, Zone 16: Housing Zone, Parcel 180: NAS Alameda Child Day Care, Alameda Point, Alameda, California. January.

IT, 2001e. Parcel Evaluation Data Summary, Phase 2A Sampling, Zone 16: Housing Zone, Parcel 181: Multiple Unit Housing, Alameda Point, Alameda, California. January.

IT, 2001f. Parcel Evaluation Data Summary, Phase 2A Sampling, Zone 16: Housing Zone, Parcel 182: Open Space, Alameda Point, Alameda, California. January.

IT, 2001g. Parcel Evaluation Data Summary, Phase 2B Sampling, Zone 16: Housing Zone, Parcel 182: Open Space, Alameda Point, Alameda, California. January.

IT, 2001h. Parcel Evaluation Data Summary, Phase 2A Sampling, Zone 16: Housing Zone, Parcel 183: Building 545, Alameda Point, Alameda, California. January.

IT, 2001i. Parcel Evaluation Data Summary, Phase 2A Sampling, Zone 16: Housing Zone, Parcel 184: Building 172 - Demolished, Alameda Point, Alameda, California. January.

IT, 2001j. Final Comprehensive Guide to the Environmental Baseline Survey. June 29.

IT, 2001k. Draft Field Summary Report for Operable Unit 5 Addendum Activities. July 23.

IT, 2001l. Final Work Plan Chemical Oxidation Treatability Study Installation Restoration Site 25 Alameda Point Alameda, California. August 3.

IT, Neptune and Company, Inc., and Environ (IT et al.), 2002. Draft Final Remedial Investigation, Alameda Point OU-5. July 12.

Javanmardian, M., J. S. Huber, C. B. Olson, W. P. Schwartz, C. A. Masin, and V. J. Kremesec, Jr., 1995. In Situ Biosparging at an Amoco Site: Subsurface Air Distribution and Biostimulation.

Lawrence Livermore National Laboratory (LLNL), 1995. Recommendations to Improve the Cleanup Process for California's Leaking Underground Fuel Tanks. October.

Kampbell, Don H., John T. Wilson, and Christopher J. Griffin, 1993. In-Situ Bioremediation of an Aviation Gasoline Spill by Subsurface Aeration. Air & Waste Management Association 86th Annual Meeting & Exhibition, Denver, Colorado. June.

LLNL, 1999. Draft Treatability Study Report, Steam Enhanced Extraction, Site 5, Alameda Point. March 9.

Neptune and Company, Inc., IT, and Environ (Neptune et al.), 2001. Draft Final Remedial Investigation Work Plan for Operable Unit (OU) 5, Alameda Point. May 9.

Newell, Charles J., Hanadi S. Rifai, John T. Wilson, John A. Connor, Julia A. Aziz, and Monica P. Suarez, 2002. Groundwater Issue, Calculation and Use of First-Order Rate Constants for Monitored Natural Attenuation Studies. USEPA, EPA/540/S-2/500. November.

NewFields, 2000. Baseline Human Health Risk Assessment, FISCA. January 14.

Oakland, City of, Public Works Department, 2000. Guidance Document: Urban Land Redevelopment Program. January 1.

Parsons Engineering Science, 1999. Natural Attenuation of Fuel Hydrocarbons Performance and Cost Results from Multiple Air Force Demonstration Sites. October.

PRC Environmental Management, Inc. (PRC), 1989. Shallow Soil Gas Investigation: Parcels 178/179/180 and Alameda Annex Warehouse Area. November 27.

PRC, 1990. Risk Assessment Report, Military Housing Site; Naval Supply Center Oakland, Alameda Annex. October 2.

PRC, 1993. Alameda Annex and Screening Lot and Scrap Yard, Sampling Results Technical Memorandum. February.

PRC, 1995. Remedial Investigation/Feasibility Study, Data Transmittal Memorandum Sites 1, 2, 3, Runway Area 6, 7B, 7C, 910B, 11, 13, 15, 16, and 19, Naval Air Station Alameda. July.

PRC and Versar, Inc. (Versar), 1996. Final Remedial Investigation, Fleet Industrial Supply Center, Alameda Annex. January.

Regional Water Quality Control Board (RWQCB), 1995. Interim Guidance on Low-Risk Petroleum Hydrocarbon Cleanups. December 8.

RWQCB, 1999. Letter from Gregory W. Bartow to Antonio Tactay, Navy Engineering Facility Activity. Re: Concurrence that Groundwater Meets the Exemption Criteria in the SWRCB Sources of Drinking Water Policy Resolution 88-63 at Fleet and Industrial Supply Center Oakland, Alameda Facility/Annex, Alameda County. June 9.

Shaw Environment and Infrastructure (Shaw), 2003. Field Summary Report for In Situ ChemOx Pilot Test at Sites 9, 11, 16, and 21. July 4.

Shaw, 2004a. Final Work Plan for the Basewide Groundwater Monitoring Plan, Alameda Point. February 6.

Shaw, 2004b. Groundwater Monitoring Report for Installation Restoration Site 25 Group, Summer 2002 to Spring 2003, Alameda Point. February 27.

Shaw, 2004c. Groundwater Monitoring Report for Installation Restoration Site 25 Group, Summer 2003 to Spring 2004, Alameda Point. April 16.

Sims, J.L., J.M. Suflita, and H.H. Russel, 1996. "In Situ Bioremediation of Contaminated Ground Water." In ed. J.R. Boulding, USEPA Environmental Engineering Sourcebook. Ann Arbor Press, Chelsea, MN.

Suthersan, S.S., 1999. "In-Situ Bioremediation." In Remediation Engineering: Design Concepts. CRC Press, Boca Raton.

Tetra Tech, Inc., 2002. Residential Risk Evaluation for U.S. Coast Guard Housing, Alameda. August.

Tetra Tech EM, Inc. (TtEMI), 1998a. Final Technical Memorandum, Groundwater Contaminant Fate and Transport Modeling, FISCA. October 2.

TtEMI, 1998b. Draft Basewide Focused FS for Soil and Groundwater, Alameda Facility/Alameda Annex. November 24.

TtEMI, 1999a. Data Summary Report, Site 25 Remedial Investigation, Alameda Point. January 29.

TtEMI, 1999b. Updated Alameda Point/Alameda Annex Benzene Soil-Gas Investigation and Summary of Crawl Space Benzene Air Sampling at Parcel 179. October 20.

TtEMI, 1999c. Groundwater Beneficial Uses Evaluation, Alameda Annex. November 2.

TtEMI, 1999d. Draft OU-2 Remedial Investigation Report, Alameda Point.

TtEMI, 2000a. Final Feasibility Study for the Marsh Crust and Groundwater at FISCA, and Feasibility Study for the Marsh Crust and Former Subtidal Area, Alameda Point. March 31.

TtEMI, 2000b. Final Determination of Beneficial Uses of Groundwater, Alameda Point. July 1.

TtEMI, 2001a. Storm Sewer Study Tech Memo Addendum and RTCs on the Draft Final Storm Sewer Study Report. August 30.

TtEMI, 2001b. Summary of Background Concentrations in Soil and Groundwater, Alameda Point, Alameda, California. November.

TtEMI, 2001c. Final Technical Memorandum on the Groundwater and Benzene Soil Gas Investigation at Installation Restoration Site 02 Fleet and Industrial Supply Center Oakland Alameda Facility/Alameda Annex, Alameda, California. December 27.

TtEMI, 2002. Data Summary Report, Supplementary Remedial Investigation, Data Gap Sampling for OU-1 and 2. July 25.

U.S. Army Corps of Engineers (USACE), 2000. Cost and Performance Report, Biosparging Contaminated Groundwater, T-Dock Site, South Prudence Bay Island Park, Portsmouth, Rhode Island. June 5.

U.S. Department of Defense (DoD), 2001. Memorandum from Sherri W. Goodman, Deputy Under Secretary of Defense (Environmental Security) regarding "Policy on Land Use Controls Associated with Environmental Restoration Activities." January 17.

U.S. Geological Survey, 2004. National Seismic Hazard Maps – 1996. http://eqmaps.cr.usgs.gov/website/nshmp/viewer.htm Accessed August 25.

DoD, 2004. Memorandum from Alex A. Beehler, Assistant Under Secretary of Defense (Environment, Safety, and Occupational Health) regarding "Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Record of Decision (ROD) and Post-ROD Policy." January 16.

U.S. Department of Navy (Navy), 1998. Technical Guidelines For Evaluating Monitoring Natural Attenuation At Naval and Marine Corps Facilities. September.

U.S. Department of Navy (Navy), 1999. Letter from Antonio F. Tactay to James Ricks, USEPA. Re: Groundwater Beneficial Uses Evaluation – Fleet and Industrial Supply Center, Oakland (FISCO), Alameda Facility/Alameda Annex. November 2.

U.S. Department of Navy (Navy), 2004. Minutes for July 13, 2004 Meeting Re: Groundwater Remedial Investigation/Feasibility Study – Alameda Point Site 25/Alameda Annex IR-02. July 27.

U.S. Environmental Protection Agency (USEPA), 1986. Guidelines for Groundwater Classification Under the EPA Groundwater Protection Strategy.

USEPA. 1988a. CERCLA Compliance With Other Laws Manual, Draft Guidance. EPA/540/G 89/006, Office of Emergency and Remedial Response, Washington, DC. August.

USEPA, 1988b. Guidance on Remedial Actions for Contaminated Groundwater at Superfund Sites. OSWER Directive 9283.1-2. EPA/540/G-88/003. December.

USEPA, 1988c. Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA.

USEPA, 1989. Risk Assessment Guidance for Superfund: Volume I – Human Health Evaluation Manual.

USEPA, 1991a. Management of Investigation-Derived Wastes During Site Inspections. EPA/540/G-91/009. May.

USEPA, 1991b. ARARs Q's and A's: General Policy, RCRA, CWA, SDWA, Post-ROD Information, and Contingent Waivers. OSWER Directive No. 9234.2-01/FS-A, Washington, DC. June.

USEPA, 1995. How to Evaluate Alternative Cleanup Technologies for Underground Storage Tank Sites: A Guide for Corrective Action Plan Reviewers. Chapter VIII, EPA Document #510-B-95-007.

USEPA, 1998. Letter from Tom Huetteman Region IX to Henry Gee, Department of the Navy, regarding groundwater classification as a potential drinking water source. June 30.

USEPA, 1999. Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action and Underground Storage Tank Sites. OSWER Directive 9200.4-17P.

USEPA, 2000. Introduction to Phytoremediation. EPA/600/R-99/107. February.

USEPA, 2001a. Brownfields Technology Primer: Selecting and Using Phytoremediation for Site Cleanup. EPA 542-R-01-006. July.

USEPA, 2001b. Treatment Technologies for Site Cleanup: Annual Status Report, Tenth Edition. EPA #542-R-01-004.

USEPA, 2001c. Monitored Natural Attenuation: USEPA Research Program – An EPA Science Advisory Board Review. EPA-SAB-EEC-01-004. May.

USEPA, 2002. Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway From Groundwater and Soils.

USEPA, 2004. 2004 Edition of the Drinking Water Standards and Health Advisories. EPA-822-R-04-005. (http://www.epa.gov/waterscience/drinking/standards/dwstandards.pdf) Winter.

Weidemeier, Todd and Francis H. Chapelle, 1998. Technical Guidelines for Evaluating Monitored Natural Attenuation of Petroleum Hydrocarbons and Chlorinated Solvents in Groundwater at Naval and Marine Corps Facilities. Department of the Navy. September.

Weidemeier, Todd, John T. Wislon, Donald Kampbell, Ross N. Miller, and Jerry E. Hansen, 1995. Technical Protocol for Implementing Intrinsic Remediation with Long-Term Monitoring for Natural Attenuation of Fuel Contamination Dissolved in Groundwater. Air Force Center for Environmental Excellence. November 11.

Willard, Ruth, 1988. Alameda County, California Crossroads. Windsor Publications, Inc.

Appendix A
Groundwater Analytical Data Set

Table A-1
Benzene Analytical Results for Site Monitoring Wells
Alameda Point/Annex Groundwater RI/FS
(Results in µg/L)

P181- MW45			P181-MW46			P181-MW47			EW-2			PW-12			PW-10A		
Result	Date	Company	Result	Date	Company	Result	Date	Company	Result	Date	Company	Result	Date	Company	Result	Date	Company
170	12/28/1994	TtEMI	73	9/16/1994	TtEMI	1400 J	12/28/1994	TtEMI	560	6/15/1994	TtEMI	76	6/22/1994	TtEMI	10	6/22/1994	TtEMI
180	4/3/1995	TtEMI	43	12/28/1994	TtEMI	1000 U	4/3/1995	TtEMI	660	12/20/1994	TtEMI	48	9/16/1994	TtEMI	6	9/16/1994	TtEMI
170	4/17/1996	TtEMI	38	4/3/1995	TtEMI	1400	4/3/1995	TtEMI	410	3/31/1995	TtEMI	53	12/28/1994	TtEMI	4 J	12/28/1994	TtEMI
170	7/15/1996	TtEMI	32	4/16/1996	TtEMI	920 J	4/15/1996	TtEMI	580	4/16/1996	TtEMI	21	4/4/1995	TtEMI	2	4/4/1995	TtEMI
100	10/23/1996	TtEMI	37	7/16/1996	TtEMI	1200	7/16/1996	TtEMI	500	7/17/1996	TtEMI	18	1/8/1996	TtEMI	4	1/5/1996	TtEMI
80.7	2/23/1999	TtEMI	26	10/23/1996	TtEMI	1200	10/23/1996	TtEMI	450	7/17/1996	TtEMI	20	4/17/1996	TtEMI	2 J	4/17/1996	TtEMI
149	5/31/2001	IT	14 J	2/23/1999	TtEMI	1100	10/23/1996	TtEMI	470	10/23/1996	TtEMI	19	4/17/1996	TtEMI	2	7/16/1996	TtEMI
134	5/31/2001	IT	5 J	12/13/1999	IT	251 J	2/23/1999	TtEMI	730	2/26/1999	TtEMI	17	7/16/1996	TtEMI	10	10/23/1996	TtEMI
150	6/24/2002	Shaw	5.2	12/13/1999	IT	300	12/13/1999	IT	673	6/1/2001	IT	16 J	10/23/1996	TtEMI	0.8	3/1/1999	TtEMI
150	6/24/2002	Shaw	1 U	6/1/2001	IT	358	12/13/1999	IT				3.1	3/1/1999	TtEMI			
140	9/11/2002	Shaw	49	6/1/2002	Shaw	1620	5/31/2001	IT				29	6/1/2001	IT			
160	12/19/2002	Shaw	64	9/11/2002	Shaw	580	6/24/2002	Shaw				27	6/24/2002	Shaw			
150	12/19/2002	Shaw	120	12/19/2002	Shaw	480	12/19/2002	Shaw				20	9/12/2002	Shaw			
150	4/17/2003	Shaw	52	4/17/2003	Shaw	480 J	7/3/2003	Shaw				9.8	12/20/2002	Shaw			
140 J	7/3/2003	Shaw	18 J	7/3/2003	Shaw	570 J	12/11/2003	Shaw				6.1	4/16/2003	Shaw			
120	9/19/2003	Shaw	25	9/19/2003	Shaw							29 J	7/3/2003	Shaw			
160 J	12/11/2003	Shaw	26 J	12/11/2003	Shaw							30	9/22/2003	Shaw			
77	3/8/2004	Shaw	26	3/8/2004	Shaw							3	12/11/2003	Shaw			
												19	3/8/2004	Shaw			

S-35			S-12			S-13			S-16/S-16-2[1]			S-02			D-02		
Result	Date	Company	Result	Date	Company	Result	Date	Company	Result	Date	Company	Result	Date	Company	Result	Date	Company
180	6/14/1994	TtEMI	37	3/25/1994	TtEMI	17	3/29/1994	TtEMI	14	3/29/1994	TtEMI	5 UJ	9/2/1992	TtEMI	0.5 U	7/16/2002	IT
150	9/13/1994	TtEMI	51	6/13/1994	TtEMI	32	6/14/1994	TtEMI	11 J	6/16/1994	TtEMI	9	3/22/1994	TtEMI	0.32 U	7/16/2002	Shaw
69	12/19/1994	TtEMI	74	9/13/1994	TtEMI	34	9/14/1994	TtEMI	11	9/20/1994	TtEMI	6	6/14/1994	TtEMI	0.08 U	9/11/2002	Shaw
73	4/17/1996	TtEMI	73	9/13/1994	TtEMI	14	12/20/1994	TtEMI	15	12/23/1994	TtEMI	11	9/15/1994	TtEMI	0.2 U	12/27/2002	Shaw
220	7/16/1996	TtEMI	66	12/20/1994	TtEMI	6	3/29/1995	TtEMI	9	3/30/1995	TtEMI	14	9/15/1994	TtEMI	0.1 U	4/16/2003	Shaw
270	10/25/1996	TtEMI	55 J	3/28/1995	TtEMI	34	4/19/1996	TtEMI	5	4/19/1996	TtEMI	6	12/23/1994	TtEMI	0.2 U	7/2/2003	Shaw
0.5	3/1/1999	TtEMI	26	4/16/1996	TtEMI	11	7/17/1996	TtEMI	8	7/18/1996	TtEMI	2 J	3/28/1995	TtEMI	0.2 U	9/22/2003	Shaw
38	6/6/2001	IT	30	7/17/1996	TtEMI	2	10/23/1996	TtEMI	10	10/23/1996	TtEMI	6	4/16/1996	TtEMI	0.2 U	12/8/2003	Shaw
46	6/6/2001	IT	39	10/24/1996	TtEMI	0.5 U	2/26/1999	TtEMI	2.4	2/26/1999	TtEMI	6	7/18/1996	TtEMI	0.2 U	3/8/2004	Shaw
3.3	6/25/2002	Shaw	42	10/24/1996	TtEMI	38	6/1/2001	IT	9.6	6/5/2001	IT	5	10/23/1996	TtEMI	0.2 U	3/8/2004	Shaw
28	9/11/2002	Shaw	0.5 U	3/1/1999	TtEMI				4.6	6/25/2002	Shaw	0.5 U	3/1/1999	TtEMI			
8.2	12/26/2002	Shaw	37	6/4/2001	IT				14	9/23/2003	Shaw						
15	4/17/2003	Shaw							11	12/19/2003	Shaw						
23	7/3/2003	Shaw							7.2	3/8/2004	Shaw						
25	7/3/2003	Shaw															
22	9/22/2003	Shaw															
2.3	12/11/2003	Shaw															
0.2 U	3/8/2004	Shaw															

Table A-1
Benzene Analytical Results for Site Monitoring Wells
Alameda Point/Annex Groundwater RI/FS
(Results in µg/L)

M25-01			M25-02			M25-03			M25-04			M25-05		
Result	Date	Company	Result	Date	Company	Result	Date	Company	Result	Date	Company	Result	Date	Company
510	9/11/2002	Shaw	36 U	9/12/2002	Shaw	0.2 J	9/11/2002	Shaw	0.1 J	9/11/2002	Shaw	150	9/11/2002	Shaw
190	12/30/2002	Shaw	0.2 J	12/26/2002	Shaw	1	12/18/2002	Shaw	0.3 U	12/19/2002	Shaw	170	12/20/2002	Shaw
460	4/16/2003	Shaw	0.1 J	4/16/2003	Shaw	0.1 U	4/16/2003	Shaw	0.1 U	4/16/2003	Shaw	140 J	4/21/2003	Shaw
330 J	7/3/2003	Shaw	0.2 U	7/7/2003	Shaw	0.1 U	4/16/2003	Shaw	0.2 U	7/3/2003	Shaw	180	7/3/2003	Shaw
350 J	7/3/2003	Shaw	0.2 U	9/19/2003	Shaw	0.3 J	7/3/2003	Shaw	0.2 U	9/19/2003	Shaw	190	9/23/2003	Shaw
520	9/22/2003	Shaw	0.2 U	12/8/2003	Shaw	0.37 J	9/22/2003	Shaw	0.2 U	9/19/2003	Shaw	200 J	12/11/2003	Shaw
400	12/8/2003	Shaw	0.2 U	12/8/2003	Shaw	0.23 J	12/8/2003	Shaw	0.2 U	12/12/2003	Shaw	140	3/9/2004	Shaw
650 J	3/9/2004	Shaw	0.2 U	3/8/2004	Shaw	0.2 U	3/9/2004	Shaw	0.2 U	3/8/2004	Shaw			

IT = IT Corporation
J = Concentration approximated because data quality criteria were not met or because the concentration of the analyte was below the reporting limit.
TtEMI = Tetra Tech EMI
Shaw = Shaw Environment and Infrastructure
U = The analyte was analyzed for, but was not detected at or above the detection limit shown.
UJ = The analyte was not detected at or above the adjusted reporting level shown. However, the adjusted reporting level is approximate and may be inaccurate or imprecise.
µg/L = micrograms per liter
[1] = Monitoring well S-16 was replaced by well S-16-2 due to access problems
Note : Only monitoring wells used to track plume stability are shown.

Table A-2
Benzene Analytical Results for Hydropunch Samples
(1 of 4)

Hydropunch Sample	Result (µg/L)	Top Depth(ft bgs)	Bottom Depth(ft bgs)	Date
S25-SB01	0.5 J	8	10	10/23/1998
S25-SB04	0.5 U	8	10	10/23/1998
S25-SB10	0.5 U	8	10	10/23/1998
S25-SB14	0.5 U	8	10	10/23/1998
S25-SB16	0.5 U	8	10	10/23/1998
S25-SB22	28.1	7.5	9.5	10/26/1998
S25-SB24	0.5 U	7.5	9.5	10/26/1998
S25-SB28	0.5 U	7.5	9.5	10/26/1998
S25-SB30	0.5 U	7.5	9.5	10/26/1998
S25-SB30	0.5 U	7.5	9.5	10/26/1998
S25-SB34	0.5 U	10	12	10/26/1998
P181-01	0.5 U	7	9	2/25/1999
P181-03	0.5 U	5	7	2/25/1999
P181-06	0.5 U	5	7	2/25/1999
P181-09	0.5 U	5	7	2/25/1999
P181-09	0.5 U	5	7	2/25/1999
P181-10	0.5 U	5	7	2/25/1999
P181-14	0.5 U	5	7	2/25/1999
RA-1-5	0.5 U	5	5	2/14/2000
RA-1-9	0.5 U	9	9	2/14/2000
RA-1-18	0.5 U	18	18	2/14/2000
RA-2-8	0.5 U	8	8	2/14/2000
RA-2-10	0.5 U	10	10	2/14/2000
RA-2-17	27.1	17	17	2/14/2000
RA-3-17	43.9	17	17	2/15/2000
RA-3-21	1100	21	21	2/15/2000
RA-4-14	7.35	14	14	2/15/2000
RA-4-19	28.5	19	19	2/15/2000
W-11-10	0.5 U	10	10	2/14/2000
W-12-8	0.5 U	8	8	2/15/2000
W-17-7	0.5 U	7	7	2/15/2000
W-18-6	0.5 U	6	6	2/16/2000
HP-1-8	0.5 U	8	8	3/27/2001
HP-1-13	0.62	13	13	3/27/2001
HP-1-18	480	18	18	3/27/2001
HP-2-10	0.5 U	10	10	3/28/2001
HP-2-15	0.5 U	15	15	3/28/2001
HP-2-20	480	20	20	3/28/2001
HP-3-10	0.5 U	10	10	3/28/2001
HP-3-15	10	15	15	3/28/2001
HP-3-20	450	20	20	3/28/2001
HP-4-9	0.5 U	9	9	3/28/2001
HP-4D-9	0.5 U	9	9	3/28/2001
HP-4-14	26	14	14	3/28/2001
HP-4-19	860	19	19	3/28/2001
HP-5-8	0.5 U	8	8	3/27/2001
HP-5-13	11	13	13	3/27/2001
HP-5-18	1500	18	18	3/27/2001

Table A-2
Benzene Analytical Results for Hydropunch Samples
(2 of 4)

Hydropunch Sample	Result (µg/L)	Top Depth(ft bgs)	Bottom Depth(ft bgs)	Date
HP-6-8	0.5 U	8	8	3/26/2001
HP-6-13	0.5 U	13	13	3/26/2001
HP-6-18	96	18	18	3/26/2001
HP-7-8	0.5 U	8	8	3/26/2001
HP-7-13	0.5 U	13	13	3/26/2001
HP-7-18	710	18	18	3/26/2001
HP-8-9	2.5 U	9	9	3/26/2001
HP-8-13	0.5 U	13	13	3/27/2001
HP-8-18	5.9	18	18	3/27/2001
HP-9-8	0.5 U	8	8	3/27/2001
HP-9-13	7.2	13	13	3/27/2001
HP-9-18	81	18	18	3/27/2001
OS-HP-02	41	8	12	6/16/2001
OS-HP-02	210	12	16	6/16/2001
OS-HP-03	2 U	12	16	6/19/2001
OS-HP-03	72	16	20	6/19/2001
OS-HP-04	12	12	16	6/11/2001
OS-HP-04	45	16	20	6/11/2001
OS-HP-05	7.1	12	16	6/15/2001
OS-HP-06	1 U	6	10	6/16/2001
OS-HP-06	148	10	14	6/16/2001
OS-HP-07	375	10	14	6/16/2001
OS-HP-07	351	14	18	6/16/2001
OS-HP-08	1 U	6	10	6/16/2001
OS-HP-08	1 U	11	15	6/16/2001
OS-HP-08	670	15	19	6/16/2001
OS-HP-09	1 U	8	12	6/16/2001
OS-HP-09	17	12	16	6/16/2001
OS-HP-09	220	16	20	6/16/2001
OS-HP-10	4.2 J	6	10	6/12/2001
OS-HP-10	2.4	9	13	6/12/2001
OS-HP-10	6000 J	14	18	6/12/2001
OS-HP-11	0.49 J	8	12	6/12/2001
OS-HP-11	2 UJ	12	16	6/12/2001
OS-HP-11	0.76 J	16	20	6/12/2001
OS-HP-11	2 U	20	24	6/12/2001
OS-HP-12	2 UJ	5.5	9.5	6/8/2001
OS-HP-12	3.7	10	14	6/8/2001
OS-HP-12	65 J	16	20	6/8/2001
OS-HP-13	850 J	16	20	6/7/2001
OS-HP-14	742	12	16	6/11/2001
OS-HP-14	1970	16	19	6/11/2001
OS-HP-17	1 U	8	12	6/11/2001
OS-HP-17	1 U	12	16	6/11/2001
OS-HP-17	645	16	20	6/11/2001
OS-HP-18	27	17.5	20	6/7/2001
OS-HP-20	17	16	20	6/14/2001
OS-HP-21	0.6 J	12	16	6/15/2001

Table A-2
Benzene Analytical Results for Hydropunch Samples
(3 of 4)

Hydropunch Sample	Result (µg/L)	Top Depth(ft bgs)	Bottom Depth(ft bgs)	Date
OS-HP-22	8.8	16	20	6/15/2001
OS-HP-25	2 UJ	12	16	6/8/2001
OS-HP-25	270 J	16	20	6/8/2001
OS-HP-26	2 U	12	16	6/12/2001
OS-HP-26	2 U	16	20	6/12/2001
OS-HP-26	2 U	20	24	6/12/2001
OS-HP-27	2 U	12	16	6/12/2001
OS-HP-27	2 U	16	20	6/12/2001
OS-HP-28	2 U	8	12	6/12/2001
OS-HP-28	2 U	12	16	6/12/2001
OS-HP-28	0.24 J	16	20	6/12/2001
OS-HP-28	2 U	20	24	6/12/2001
OS-HP-29	2 U	12	16	6/7/2001
OS-HP-29	2 U	17	21	6/7/2001
OS-HP-30	1.2 J	12	16	6/8/2001
OS-HP-30	21	17	21	6/8/2001
OS-HP-31	113	12	16	6/11/2001
OS-HP-31	920	16	20	6/11/2001
OS-HP-35	230 J	16	20	6/8/2001
OS-HP-36	1 U	8	12	6/11/2001
OS-HP-36	0.6 J	12	16	6/11/2001
OS-HP-36	13	16	19	6/11/2001
OS-HP-37	1 U	6	10	6/13/2001
OS-HP-37	39	10	14	6/13/2001
OS-HP-37	1770	14	18	6/13/2001
OS-HP-39	90 J	12	16	6/12/2001
OU5-HP01	2 U	10	14	6/13/2001
OU5-HP01	3.2	14	18	6/13/2001
OU5-HP-02	2.2	8	12	6/14/2001
OU5-HP-02	9.9	12	16	6/14/2001
OU5-HP-03	1 U	8	12	6/14/2001
OU5-HP-03	0.9 J	12	16	6/14/2001
OU5-HP-04	1 U	8	12	6/14/2001
OU5-HP-04	37	12	16	6/14/2001
OU5-HP-05	3.8	12	16	6/14/2001
OU5-HP-05	21	16	20	6/14/2001
OU5-HP06	2 U	6	10	6/14/2001
OU5-HP06	9.1	10	14	6/14/2001
OU5-HP06	110 J	14	18	6/14/2001
OU5-HP-07	2 U	6	10	6/19/2001
OU5-HP-07	47 J	10	14	6/19/2001
OU5-HP08	2 U	8	12	6/13/2001
OU5-HP08	49	12	16	6/13/2001
OU5-HP08	49	16	20	6/13/2001
OU5-HP-09	1 U	8	12	6/14/2001
OU5-HP-09	1 U	12	16	6/14/2001
OU5-HP-09	1 U	16	20	6/14/2001
OU5-HP10	2 U	8	10	6/14/2001

Table A-2
Benzene Analytical Results for Hydropunch Samples
(4 of 4)

Hydropunch Sample	Result (µg/L)	Top Depth(ft bgs)	Bottom Depth(ft bgs)	Date
OU5-HP10	5.9	10	14	6/14/2001
OU5-HP10	180 J	14	18	6/14/2001
OU5-HP-11	1 U	8	12	6/13/2001
OU5-HP-11	76	12	16	6/13/2001
OU5-HP-11	22	16	20	6/13/2001
OU5-HP-12	1 U	8	12	6/13/2001
OU5-HP-12	1	12	16	6/13/2001
OU5-HP-12	640	16	20	6/13/2001
OU5-HP-13	2 U	8	12	6/12/2001
OU5-HP-13	560 J	12	15	6/12/2001
OU5-HP-13	4100 J	15	17.5	6/12/2001
OU5-HP14	2 U	6	10	6/14/2001
OU5-HP14	2 U	10	14	6/14/2001
OU5-HP14	2 U	14	18	6/14/2001
OU5-HP15	2 U	7	11	6/13/2001
OU5-HP15	2 U	12	16	6/13/2001
OU5-HP-16	1 U	8	12	6/15/2001
OU5-HP-16	1 U	12	16	6/15/2001
OU5-HP-16	1 U	16	20	6/15/2001
OU5-HP-17	1 U	6	10	6/13/2001
OU5-HP-17	1 U	10	14	6/13/2001
OU5-HP-17	2	14	18	6/13/2001
OU5-HP18	2 U	8	12	6/13/2001
OU5-HP18	2 U	12	16	6/13/2001
OU5-HP18	2 U	16	20	6/13/2001
OU5-HP18	0.38 J	20	24	6/13/2001
OU5-HP-19	2 U	8	12	6/12/2001
OU5-HP-19	2 U	12	16	6/12/2001
OU5-HP-19	1.6 J	16	20	6/12/2001
OU5-HP-20	0.4 J	6	10	6/13/2001
OU5-HP-20	1 U	10	14	6/13/2001
OU5-HP-20	1 U	15	19	6/13/2001
OU5-HP-21	1 U	8	12	6/13/2001
OU5-HP-21	1 U	12	16	6/13/2001
OU5-HP-21	1 U	16	20	6/13/2001
OU5-HP-22	1 U	8	12	6/15/2001
OU5-HP-22	0.8 J	12	16	6/15/2001

bgs = below ground surface
ft = feet
J = Concentration approximated because data quality criteria were not met or because the concentration of the analyte was below the reporting limit.
U = The analyte was analyzed for, but was not detected at or above the reporting limit shown.
UJ = The analyte was not detected at or above the adjusted reporting level shown. However, the adjusted reporting level is approximate and may be inaccurate or imprecise.
µg/L = micrograms per liter

Table A-3
Naphthalene Analytical Reults for Site Monitoring Wells
Alameda Point Site 25/Annex IR-02 Groundwater RI/FS
(Results in µg/L)

P181-MW45			P181-MW46			P181-MW47			EW-2			PW-12			PW-10A		
Result	Date	Company	Result	Date	Company	Result	Date	Company	Result	Date	Company	Result	Date	Company	Result	Date	Company
3400 J	12/28/1994	TtEMI	1100	9/16/1994	TtEMI	8400 J	12/28/1994	TtEMI	2100 J	6/15/1994	TtEMI	10 U	6/22/1994	TtEMI	10 U	6/22/1994	TtEMI
500 J	4/3/1995	TtEMI	910 J	12/28/1994	TtEMI	6800	4/3/1995	TtEMI	1800	12/20/1994	TtEMI	280	9/16/1994	TtEMI	12 J	1/5/1996	TtEMI
4000	4/3/1995	TtEMI	720	4/3/1995	TtEMI	6000	4/3/1995	TtEMI	2200	3/31/1995	TtEMI	580	12/28/1994	TtEMI	16	4/17/1996	TtEMI
2500	4/17/1996	TtEMI	590	4/16/1996	TtEMI	10 U	4/3/1995	TtEMI	2600	4/16/1996	TtEMI	320	4/4/1995	TtEMI	2 NJ	4/17/1996	TtEMI
2200	7/15/1996	TtEMI	88 NJ	4/16/1996	TtEMI	4100	4/15/1996	TtEMI	1500	7/17/1996	TtEMI	140	1/8/1996	TtEMI	10 U	4/17/1996	TtEMI
2200	10/23/1996	TtEMI	1200	7/16/1996	TtEMI	6000	7/16/1996	TtEMI	1300	7/17/1996	TtEMI	76 J	1/8/1996	TtEMI	14	7/16/1996	TtEMI
5 U	5/31/2001	IT	450	10/23/1996	TtEMI	4000	10/23/1996	TtEMI	10 U	7/17/1996	TtEMI	260	4/17/1996	TtEMI	8 J	10/24/1996	TtEMI
980	5/31/2001	IT	71 J	2/23/1999	IT	190 NJ	10/23/1996	TtEMI	1000	10/23/1996	TtEMI	34 NJ	4/17/1996	TtEMI			
860	5/31/2001	IT	0.4 UJ	5/31/2001	IT	4100	10/23/1996	TtEMI	69 NJ	10/23/1996	TtEMI	250	4/17/1996	TtEMI			
2700	6/24/2002	IT	400	5/31/2001	IT	63 NJ	10/23/1996	TtEMI	2400	6/1/2001	IT	170	7/16/1996	TtEMI			
2100	6/24/2002	IT	1100	6/24/2002	IT	10 U	10/23/1996	TtEMI	566	6/1/2001	IT	80	10/23/1996	TtEMI			
2400	6/24/2002	IT	910	6/24/2002	IT	617 J	2/23/1999	IT				210 NJ	10/23/1996	TtEMI			
2200	6/24/2002	IT	1200	9/11/2002	Shaw	10	5/31/2001	IT				130	6/24/2002	IT			
1000	9/11/2002	Shaw	1300	9/11/2002	Shaw	2500	6/24/2002	IT				45	6/24/2002	IT			
1200	9/11/2002	Shaw	2600	12/19/2002	Shaw	2200	6/24/2002	Shaw				12	9/12/2002	Shaw			
950	9/11/2002	Shaw	1900	12/19/2002	Shaw	1800	9/11/2002	Shaw				38	9/12/2002	Shaw			
1300	9/11/2002	Shaw	1400	4/17/2003	Shaw	2200	12/19/2002	Shaw				24	12/20/2002	Shaw			
2700	12/19/2002	Shaw	1400	4/17/2003	Shaw	1600	12/19/2002	Shaw				24	12/20/2002	Shaw			
1500	12/19/2002	Shaw	490 J	7/3/2003	Shaw	1500	4/17/2003	Shaw				27	4/16/2003	Shaw			
2300 J	12/19/2002	Shaw	480	7/3/2003	Shaw	1900 J	7/3/2003	Shaw				23	4/16/2003	Shaw			
1500	12/19/2002	Shaw	380	9/19/2003	Shaw	2000	7/3/2003	Shaw				84 J	7/3/2003	Shaw			
2300	4/17/2003	Shaw	340 J	9/19/2003	Shaw	1600 J	9/19/2003	Shaw				91	7/3/2003	Shaw			
2400	4/17/2003	Shaw	710 J	12/11/2003	Shaw	3100 J	12/11/2003	Shaw				43	9/22/2003	Shaw			
1900 J	7/3/2003	Shaw	510	12/11/2003	Shaw	1100	12/11/2003	Shaw				40 J	9/22/2003	Shaw			
2200	7/3/2003	Shaw	540	03/08/2004	Shaw	1500	03/08/2004	Shaw				29	12/11/2003	Shaw			
1200	9/19/2003	Shaw	390	03/08/2004	Shaw							28	12/11/2003	Shaw			
1700 J	9/19/2003	Shaw										160	03/08/2004	Shaw			
3000 J	12/11/2003	Shaw										170	03/08/2004	Shaw			
1900	12/11/2003	Shaw															
1900	03/08/2004	Shaw															
1400	03/08/2004	Shaw															

Table A-3
Naphthalene Analytical Reults for Site Monitoring Wells
Alameda Point Site 25/Annex IR-02 Groundwater RI/FS
(Results in µg/L)

S-35			S-12			S-13			S-16/S-16-2[1]			S-02			D-02		
Result	Date	Company	Result	Date	Company	Result	Date	Company	Result	Date	Company	Result	Date	Company	Result	Date	Company
10 U	6/14/1994	TtEMI	10 U	3/25/1994	TtEMI	42 J	3/29/1994	TtEMI	5 J	3/29/1994	TtEMI	10 U	9/2/1992	TtEMI	0.12 U	7/16/2002	Shaw
150	9/13/1994	TtEMI	690	6/13/1994	TtEMI	7 J	6/14/1994	TtEMI	19 J	6/16/1994	TtEMI	260	3/22/1994	TtEMI	0.25 U	7/16/2002	Shaw
250	12/19/1994	TtEMI	15	9/13/1994	TtEMI	8 J	9/14/1994	TtEMI	15	9/20/1994	TtEMI	320	6/14/1994	TtEMI	0.06 U	9/11/2002	Shaw
100 J	12/19/1994	TtEMI	10 U	9/13/1994	TtEMI	4 J	12/20/1994	TtEMI	10 J	12/23/1994	TtEMI	620	9/15/1994	TtEMI	0.25 U	9/11/2002	Shaw
10 U	4/4/1995	TtEMI	920	12/20/1994	TtEMI	1 J	12/20/1994	TtEMI	21	12/23/1994	TtEMI	600	9/15/1994	TtEMI	1 J	12/27/2002	Shaw
100	4/17/1996	TtEMI	670	3/28/1995	TtEMI	10 U	3/29/1995	TtEMI	10 J	3/30/1995	TtEMI	400	12/23/1994	TtEMI	0.25 U	12/27/2002	Shaw
20 NJ	4/17/1996	TtEMI	410	4/16/1996	TtEMI	10 U	4/19/1996	TtEMI	10 U	4/19/1996	TtEMI	550	3/28/1995	TtEMI	0.1 UJ	4/16/2003	Shaw
330	7/16/1996	TtEMI	63	7/17/1996	TtEMI	10 U	7/17/1996	TtEMI	10 U	7/18/1996	TtEMI	100 J	3/28/1995	TtEMI	0.31 U	4/16/2003	Shaw
180 NJ	7/16/1996	TtEMI	80 NJ	7/17/1996	TtEMI	32	10/22/1996	TtEMI	10 U	10/23/1996	TtEMI	2 J	3/28/1995	TtEMI	0.3 U	7/2/2003	Shaw
370	10/25/1996	TtEMI	110	10/24/1996	TtEMI	140 NJ	10/23/1996	TtEMI	160 NJ	10/23/1996	TtEMI	20 J	3/28/1995	TtEMI	0.48 U	7/2/2003	Shaw
59 NJ	10/25/1996	TtEMI	68 NJ	10/24/1996	TtEMI	111	6/1/2001	IT	7.9 U	6/5/2001	IT	480	4/16/1996	TtEMI	0.3 U	9/22/2003	Shaw
116	6/6/2001	IT	120	10/24/1996	TtEMI	19	6/1/2001	IT	5 U	6/5/2001	IT	450	7/18/1996	TtEMI	3.7 UJ	9/22/2003	Shaw
10	6/6/2001	IT	10 U	10/24/1996	TtEMI				28	6/25/2002	IT	280	10/23/1996	TtEMI	0.3 U	12/8/2003	Shaw
131	6/6/2001	IT	1 U	6/4/2001	IT				27	6/25/2002	IT	4 UJ	10/23/1996	TtEMI	2	12/8/2003	Shaw
11	6/6/2001	IT	5 U	6/4/2001	IT				30	9/23/2003	Shaw				0.95 J	03/08/2004	Shaw
47	6/25/2002	IT							29 J	9/23/2003	Shaw				0.3 U	03/08/2004	Shaw
2.6	6/25/2002	IT							24	12/19/2003	Shaw				0.47 U	03/08/2004	Shaw
230	9/11/2002	Shaw							8.4	3/8/2004	Shaw				0.3 U	03/08/2004	Shaw
240	9/11/2002	Shaw							5.3	3/8/2004	Shaw						
110	12/26/2002	Shaw															
0.95 U	12/26/2002	Shaw															
220	4/17/2003	Shaw															
210	4/17/2003	Shaw															
330	7/3/2003	Shaw															
350	7/3/2003	Shaw															
280	7/3/2003	Shaw															
210	7/3/2003	Shaw															
320	9/22/2003	Shaw															
330 J	9/22/2003	Shaw															
55	12/11/2003	Shaw															
47	12/11/2003	Shaw															
2.2	3/8/2004	Shaw															
2.4	3/8/2004	Shaw															

Table A-3
Naphthalene Analytical Reults for Site Monitoring Wells
Alameda Point Site 25/Annex IR-02 Groundwater RI/FS
(Results in µg/L)

M25-01			M25-02			M25-03			M25-04			M25-05		
Result	Date	Company	Result	Date	Company	Result	Date	Company	Result	Date	Company	Result	Date	Company
3200	9/11/2002	Shaw	4.5 U	9/12/2002	Shaw	0.06 U	9/11/2002	Shaw	0.06 U	9/11/2002	Shaw	1500	9/11/2002	Shaw
3600	9/11/2002	Shaw	2.8	9/12/2002	Shaw	0.25 U	9/11/2002	Shaw	0.77 J	9/11/2002	Shaw	1500	9/11/2002	Shaw
5000	12/30/2002	Shaw	3.5	12/26/2002	Shaw	0.2 U	12/18/2002	Shaw	1.2 UJ	12/19/2002	Shaw	2500	12/20/2002	Shaw
4400	12/30/2002	Shaw	4.3	12/26/2002	Shaw	0.25 U	12/18/2002	Shaw	0.26	12/19/2002	Shaw	2200	12/20/2002	Shaw
4600 J	4/16/2003	Shaw	0.9	4/16/2003	Shaw	0.1 UJ	4/16/2003	Shaw	0.2 J	4/16/2003	Shaw	1800	4/21/2003	Shaw
4200 J	7/3/2003	Shaw	4.5	7/7/2003	Shaw	0.1 UJ	4/16/2003	Shaw	0.3 U	7/3/2003	Shaw	1900	4/21/2003	Shaw
4100	7/3/2003	Shaw	5.1	7/7/2003	Shaw	1.4 J	7/3/2003	Shaw	17	7/3/2003	Shaw	2000	7/3/2003	Shaw
4200 J	7/3/2003	Shaw	2.1	9/19/2003	Shaw	14	7/3/2003	Shaw	0.3 U	9/19/2003	Shaw	1900	7/3/2003	Shaw
4300	7/3/2003	Shaw	3.8	12/8/2003	Shaw	0.3 U	9/22/2003	Shaw	0.3 U	9/19/2003	Shaw	2600	9/23/2003	Shaw
4300	9/22/2003	Shaw	3.2	12/8/2003	Shaw	0.3 U	12/8/2003	Shaw	0.3 U	12/12/2003	Shaw	1700	9/23/2003	Shaw
4900 J	12/8/2003	Shaw	3.4	12/8/2003	Shaw	9.2	12/8/2003	Shaw	0.5 U	12/12/2003	Shaw	2200	12/11/2003	Shaw
4300	12/8/2003	Shaw	3.7	12/8/2003	Shaw	0.3 U	3/9/2004	Shaw	0.3 U	3/8/2004	Shaw	1900	12/11/2003	Shaw
6100	3/9/2004	Shaw	0.74 J	3/8/2004	Shaw							2000	3/9/2004	Shaw
												1300	3/9/2004	Shaw

IT = IT Corporation
J = Concentration approximated because data quality
NJ = The analysis indicates the presence of an analyte that has been "tentatively identified" and the associated numerical value represents its approximate concentration.
Shaw = Shaw Environment and Infrastructure
TtEMI = Tetra Tech EMI
U = The analyte was analyzed for, but was not detected at or above the detection limit shown.
UJ = The analyte was not detected at or above the
µg/L = micrograms per liter
[1] = Monitoring well S-16 was replaced by well S-16-2 due to access problems
Note: Only monitoring wells included in the ongoing groundwater monitoring program have been shown.

Table A-4
Naphthalene Analytical Results from Hydropunch Samples
Alameda Point Site 25/Annex IR-02 Groundwater RI/FS
(1 of 6)

Hydropunch Sample	Result (µg/L)	Top Depth(ft bgs)	Bottom Depth(ft bgs)	Date
182-Z16-011	1 J	9	10	10/19/1995
182-Z16-012	10 U	7.5	9	10/19/1995
S25-SB01	5 U	8	10	10/23/1998
S25-SB04	5 U	8	10	10/23/1998
S25-SB10	5 U	8	10	10/23/1998
S25-SB14	5 U	8	10	10/23/1998
S25-SB16	5 U	8	10	10/23/1998
S25-SB22	10 J	7.5	9.5	10/26/1998
S25-SB24	0.7 J	7.5	9.5	10/26/1998
S25-SB28	4 J	7.5	9.5	10/26/1998
S25-SB30	1 U	7.5	9.5	10/26/1998
S25-SB30	0.3 J	7.5	9.5	10/26/1998
S25-SB34	1 U	10	12	10/26/1998
P181-01	0.4 U	7	9	2/25/1999
P181-03	0.1 U	5	7	2/25/1999
P181-06	0.1 U	5	7	2/25/1999
P181-09	0.1 U	5	7	2/25/1999
P181-09	0.1 U	5	7	2/25/1999
P181-14	0.1 U	5	7	2/25/1999
OS-HP-02	270	8	12	6/16/2001
OS-HP-02	77	8	12	6/16/2001
OS-HP-02	3040	12	16	6/16/2001
OS-HP-02	880	12	16	6/16/2001
OS-HP-03	1.9 U	12	16	6/19/2001
OS-HP-03	0.6 J	12	16	6/19/2001
OS-HP-03	970 J	16	20	6/19/2001
OS-HP-03	370 J	16	20	6/19/2001
OS-HP-04	839	12	16	6/11/2001
OS-HP-04	40	12	16	6/11/2001
OS-HP-04	821	16	20	6/11/2001
OS-HP-04	430	16	20	6/11/2001
OS-HP-05	89 J	12	16	6/15/2001
OS-HP-05	220 J	12	16	6/15/2001
OS-HP-06	5 U	6	10	6/16/2001
OS-HP-06	2.6	6	10	6/16/2001
OS-HP-06	1350	10	14	6/16/2001
OS-HP-06	740	10	14	6/16/2001
OS-HP-07	3180	10	14	6/16/2001
OS-HP-07	2100	10	14	6/16/2001
OS-HP-07	4530	14	18	6/16/2001
OS-HP-07	1400	14	18	6/16/2001
OS-HP-08	8	6	10	6/16/2001
OS-HP-08	4.4	6	10	6/16/2001
OS-HP-08	2.7	11	15	6/16/2001
OS-HP-08	5 U	11	15	6/16/2001
OS-HP-08	1800	15	19	6/16/2001
OS-HP-08	6130	15	19	6/16/2001

Table A-4
Naphthalene Analytical Results from Hydropunch Samples
Alameda Point Site 25/Annex IR-02 Groundwater RI/FS
(2 of 6)

Hydropunch Sample	Result (µg/L)	Top Depth(ft bgs)	Bottom Depth(ft bgs)	Date
OS-HP-09	30	8	12	6/16/2001
OS-HP-09	7	8	12	6/16/2001
OS-HP-09	129	12	16	6/16/2001
OS-HP-09	53	12	16	6/16/2001
OS-HP-09	1770	16	20	6/16/2001
OS-HP-10	49	6	10	6/12/2001
OS-HP-10	19	6	10	6/12/2001
OS-HP-10	15	9	13	6/12/2001
OS-HP-10	14	9	13	6/12/2001
OS-HP-10	12000 J	14	18	6/12/2001
OS-HP-10	5800 J	14	18	6/12/2001
OS-HP-11	0.48 J	8	12	6/12/2001
OS-HP-11	0.89 J	8	12	6/12/2001
OS-HP-11	110	12	16	6/12/2001
OS-HP-11	220 J	12	16	6/12/2001
OS-HP-11	67 J	16	20	6/12/2001
OS-HP-11	79	16	20	6/12/2001
OS-HP-11	0.44 J	20	24	6/12/2001
OS-HP-11	5.1	20	24	6/12/2001
OS-HP-12	13 J	5.5	9.5	6/8/2001
OS-HP-12	2.5	5.5	9.5	6/8/2001
OS-HP-12	330	10	14	6/8/2001
OS-HP-12	250 J	10	14	6/8/2001
OS-HP-12	3600 J	16	20	6/8/2001
OS-HP-12	2400 J	16	20	6/8/2001
OS-HP-13	19000 J	16	20	6/7/2001
OS-HP-13	4500 J	16	20	6/7/2001
OS-HP-14	3710	12	16	6/11/2001
OS-HP-14	5400	12	16	6/11/2001
OS-HP-14	5320	16	19	6/11/2001
OS-HP-17	1 U	8	12	6/11/2001
OS-HP-17	23	12	16	6/11/2001
OS-HP-17	3970	16	20	6/11/2001
OS-HP-17	61	16	20	6/11/2001
OS-HP-18	2400 J	17.5	20	6/7/2001
OS-HP-18	1400 J	17.5	20	6/7/2001
OS-HP-20	210 J	16	20	6/14/2001
OS-HP-20	510 J	16	20	6/14/2001
OS-HP-21	0.7 J	12	16	6/15/2001
OS-HP-21	0.3 J	12	16	6/15/2001
OS-HP-22	74	16	20	6/15/2001
OS-HP-22	370 J	16	20	6/15/2001
OS-HP-25	6.6 J	12	16	6/8/2001
OS-HP-25	7.2	12	16	6/8/2001
OS-HP-25	6700 J	16	20	6/8/2001
OS-HP-25	2300 J	16	20	6/8/2001
OS-HP-26	2 U	12	16	6/12/2001

Table A-4
Naphthalene Analytical Results from Hydropunch Samples
Alameda Point Site 25/Annex IR-02 Groundwater RI/FS
(3 of 6)

Hydropunch Sample	Result (µg/L)	Top Depth(ft bgs)	Bottom Depth(ft bgs)	Date
OS-HP-26	1.1 J	12	16	6/12/2001
OS-HP-26	0.81 J	16	20	6/12/2001
OS-HP-26	2.8	16	20	6/12/2001
OS-HP-26	0.69 J	20	24	6/12/2001
OS-HP-26	1.9 U	20	24	6/12/2001
OS-HP-27	1.3 J	12	16	6/12/2001
OS-HP-27	1.9 UJ	12	16	6/12/2001
OS-HP-27	0.69 J	16	20	6/12/2001
OS-HP-27	1.9 UJ	16	20	6/12/2001
OS-HP-28	0.47 J	8	12	6/12/2001
OS-HP-28	2 U	8	12	6/12/2001
OS-HP-28	0.71 J	12	16	6/12/2001
OS-HP-28	1.1 J	12	16	6/12/2001
OS-HP-28	5	16	20	6/12/2001
OS-HP-28	14 J	16	20	6/12/2001
OS-HP-28	1.9 J	20	24	6/12/2001
OS-HP-28	3.9	20	24	6/12/2001
OS-HP-29	2 U	12	16	6/7/2001
OS-HP-29	4.2	12	16	6/7/2001
OS-HP-29	1.9 J	17	21	6/7/2001
OS-HP-29	6.6	17	21	6/7/2001
OS-HP-30	240	12	16	6/8/2001
OS-HP-30	390	12	16	6/8/2001
OS-HP-30	5 U	17	21	6/8/2001
OS-HP-30	1100 J	17	21	6/8/2001
OS-HP-31	235	12	16	6/11/2001
OS-HP-31	73	12	16	6/11/2001
OS-HP-31	6260	16	20	6/11/2001
OS-HP-31	100	16	20	6/11/2001
OS-HP-35	2300	16	20	6/8/2001
OS-HP-35	3400 J	16	20	6/8/2001
OS-HP-36	9.2	8	12	6/11/2001
OS-HP-36	5 U	8	12	6/11/2001
OS-HP-36	6	12	16	6/11/2001
OS-HP-36	9	12	16	6/11/2001
OS-HP-36	472	16	19	6/11/2001
OS-HP-37	4.9	6	10	6/13/2001
OS-HP-37	5 U	6	10	6/13/2001
OS-HP-37	21 J	10	14	6/13/2001
OS-HP-37	212	10	14	6/13/2001
OS-HP-37	1240	14	18	6/13/2001
OS-HP-37	8040	14	18	6/13/2001
OS-HP-39	1200 J	12	16	6/12/2001
OU5-HP01	19 UJ	10	14	6/13/2001
OU5-HP01	1.2 J	10	14	6/13/2001
OU5-HP01	20	14	18	6/13/2001
OU5-HP01	91 J	14	18	6/13/2001

Table A-4
Naphthalene Analytical Results from Hydropunch Samples
Alameda Point Site 25/Annex IR-02 Groundwater RI/FS
(4 of 6)

Hydropunch Sample	Result (µg/L)	Top Depth(ft bgs)	Bottom Depth(ft bgs)	Date
OU5-HP-02	2 J	8	12	6/14/2001
OU5-HP-02	34	8	12	6/14/2001
OU5-HP-02	11 J	12	16	6/14/2001
OU5-HP-02	512	12	16	6/14/2001
OU5-HP-03	1 U	8	12	6/14/2001
OU5-HP-03	2 J	8	12	6/14/2001
OU5-HP-03	37	12	16	6/14/2001
OU5-HP-03	40 J	12	16	6/14/2001
OU5-HP-04	1 J	8	12	6/14/2001
OU5-HP-04	1 U	8	12	6/14/2001
OU5-HP-04	2530	12	16	6/14/2001
OU5-HP-04	300 J	12	16	6/14/2001
OU5-HP-05	26	12	16	6/14/2001
OU5-HP-05	4 J	12	16	6/14/2001
OU5-HP-05	7 J	16	20	6/14/2001
OU5-HP-05	159	16	20	6/14/2001
OU5-HP06	0.67 J	6	10	6/14/2001
OU5-HP06	2 U	6	10	6/14/2001
OU5-HP06	91	10	14	6/14/2001
OU5-HP06	81	10	14	6/14/2001
OU5-HP06	1300 J	14	18	6/14/2001
OU5-HP06	1600 J	14	18	6/14/2001
OU5-HP-07	2 UJ	6	10	6/19/2001
OU5-HP-07	1.2 J	6	10	6/19/2001
OU5-HP-07	2400 J	10	14	6/19/2001
OU5-HP-07	1600 J	10	14	6/19/2001
OU5-HP08	1.9 J	8	12	6/13/2001
OU5-HP08	2 U	8	12	6/13/2001
OU5-HP08	770 J	12	16	6/13/2001
OU5-HP08	1200 J	12	16	6/13/2001
OU5-HP08	750	16	20	6/13/2001
OU5-HP-09	1 U	8	12	6/14/2001
OU5-HP-09	5 J	8	12	6/14/2001
OU5-HP-09	1 U	12	16	6/14/2001
OU5-HP-09	10 J	12	16	6/14/2001
OU5-HP-09	2 J	16	20	6/14/2001
OU5-HP-09	3.6 U	16	20	6/14/2001
OU5-HP10	0.78 J	8	10	6/14/2001
OU5-HP10	2 UJ	8	10	6/14/2001
OU5-HP10	48 J	10	14	6/14/2001
OU5-HP10	52	10	14	6/14/2001
OU5-HP10	5100 J	14	18	6/14/2001
OU5-HP10	8500 J	14	18	6/14/2001
OU5-HP-11	5	8	12	6/13/2001
OU5-HP-11	5 U	8	12	6/13/2001
OU5-HP-11	5660	12	16	6/13/2001
OU5-HP-11	70 J	12	16	6/13/2001

Table A-4
Naphthalene Analytical Results from Hydropunch Samples
Alameda Point Site 25/Annex IR-02 Groundwater RI/FS
(5 of 6)

Hydropunch Sample	Result (µg/L)	Top Depth(ft bgs)	Bottom Depth(ft bgs)	Date
OU5-HP-11	1070	16	20	6/13/2001
OU5-HP-11	61 J	16	20	6/13/2001
OU5-HP-12	14	8	12	6/13/2001
OU5-HP-12	5 U	8	12	6/13/2001
OU5-HP-12	21	12	16	6/13/2001
OU5-HP-12	50 U	12	16	6/13/2001
OU5-HP-12	320 J	16	20	6/13/2001
OU5-HP-12	6220	16	20	6/13/2001
OU5-HP-13	2.3	8	12	6/12/2001
OU5-HP-13	9.8 J	8	12	6/12/2001
OU5-HP-13	3700 J	12	15	6/12/2001
OU5-HP-13	2200 J	12	15	6/12/2001
OU5-HP-13	13000	15	17.5	6/12/2001
OU5-HP-13	6000 J	15	17.5	6/12/2001
OU5-HP14	2 UJ	6	10	6/14/2001
OU5-HP14	1.1 J	6	10	6/14/2001
OU5-HP14	1.6 J	10	14	6/14/2001
OU5-HP14	1.5 J	10	14	6/14/2001
OU5-HP14	1.2 J	14	18	6/14/2001
OU5-HP15	2 UJ	7	11	6/13/2001
OU5-HP15	1.8 J	7	11	6/13/2001
OU5-HP15	1.7 J	12	16	6/13/2001
OU5-HP15	0.83 J	12	16	6/13/2001
OU5-HP-16	1 U	8	12	6/15/2001
OU5-HP-16	5 U	8	12	6/15/2001
OU5-HP-16	5 U	12	16	6/15/2001
OU5-HP-16	2 U	12	16	6/15/2001
OU5-HP-16	5 U	16	20	6/15/2001
OU5-HP-16	0.4 J	16	20	6/15/2001
OU5-HP-17	2.2	6	10	6/13/2001
OU5-HP-17	5 U	6	10	6/13/2001
OU5-HP-17	50 U	10	14	6/13/2001
OU5-HP-17	2	10	14	6/13/2001
OU5-HP-17	29	14	18	6/13/2001
OU5-HP-17	5 U	14	18	6/13/2001
OU5-HP18	0.79 J	8	12	6/13/2001
OU5-HP18	19 U	8	12	6/13/2001
OU5-HP18	2 U	12	16	6/13/2001
OU5-HP18	1.8 J	12	16	6/13/2001
OU5-HP18	2 U	16	20	6/13/2001
OU5-HP18	3.3	16	20	6/13/2001
OU5-HP18	29	20	24	6/13/2001
OU5-HP18	29	20	24	6/13/2001
OU5-HP-19	4.7 J	8	12	6/12/2001
OU5-HP-19	9.1	8	12	6/12/2001
OU5-HP-19	5.2	12	16	6/12/2001
OU5-HP-19	3 J	12	16	6/12/2001
OU5-HP-19	26	16	20	6/12/2001

Table A-4
Naphthalene Analytical Results from Hydropunch Samples
Alameda Point Site 25/Annex IR-02 Groundwater RI/FS
(6 of 6)

Hydropunch Sample	Result (µg/L)	Top Depth(ft bgs)	Bottom Depth(ft bgs)	Date
OU5-HP-19	34 J	16	20	6/12/2001
OU5-HP-20	27	6	10	6/13/2001
OU5-HP-20	9	6	10	6/13/2001
OU5-HP-20	5.7	10	14	6/13/2001
OU5-HP-20	5 U	10	14	6/13/2001
OU5-HP-20	10	15	19	6/13/2001
OU5-HP-20	7 J	15	19	6/13/2001
OU5-HP-21	5 U	8	12	6/13/2001
OU5-HP-21	21	8	12	6/13/2001
OU5-HP-21	5 U	12	16	6/13/2001
OU5-HP-21	7.3	12	16	6/13/2001
OU5-HP-21	3.3	16	20	6/13/2001
OU5-HP-21	5 U	16	20	6/13/2001
OU5-HP-22	1 U	8	12	6/15/2001
OU5-HP-22	1 J	8	12	6/15/2001
OU5-HP-22	1 J	12	16	6/15/2001
OU5-HP-22	1 U	12	16	6/15/2001

bgs = below ground surface
ft = feet
J = Concentration approximated because data quality criteria were not met or because the concentration of the analyte was below the reporting limit.
U = The analyte was analyzed for, but was not detected at or above the reporting limit shown.
UJ = The analyte was not detected at or above the adjusted reporting level shown. However, the adjusted reporting level is approximate and may be inaccurate or imprecise.
µg/L = micrograms per liter

Table A-5

Statistics for Benzene Groundwater Analytical Data

Alameda Point Site 25/Annex IR-02 Groundwater RI/FS

Groundwater Data Statistic	Result
Total number of benzene results in the current groundwater database	597
Total number of benzene detections in the groundwater database	336
Percentage of the benzene results (monitoring wells or Hydropunch samples) that were "detect" in the current database	56 percent
Percentage of benzene results that were "detect" in monitoring well samples	59 percent
Percentage of benzene results that were "detect" in Hydropunch samples	47 percent
Maximum concentration of benzene found in an on-site monitoring well	1,620 µg/L
Maximum concentration of benzene found in a Hydropunch sample	6,000 µg/L
Average benzene concentration detected in monitoring well samples	58.1 µg/L
Average benzene concentration detected in Hydropunch samples	158.5 µg/L

Appendix B
Residential Risk Evaluation for U.S. Coast Guard Housing
(August 2002 Report)

RESIDENTIAL RISK EVALUATION FOR U.S. COAST GUARD HOUSING ALAMEDA, CALIFORNIA

Prepared for:
United States Coast Guard
Civil Engineering Unit Oakland
Oakland, California 94606-5337
PSN 33-001087

Prepared by:
Tetra Tech, Inc.
3746 Mt. Diablo Blvd., Suite 300
Lafayette, CA 94549

August 2002

Table of Contents

Section		Page
1.0	Introduction	1
2.0	Technical Approach and Investigative Findings	2
3.0	Indoor Air Quality Assessment	8
4.0	Polycyclic Aromatic Hydrocarbons in Soil	11
5.0	References	12

Appendices

A Human Health Risk Assessment
B Analytical Data and Chain of Custody Records
C Statistical Analyses
D Polycyclic Aromatic Hydrocarbons in Soil

1.0 INTRODUCTION

This report presents evaluations of potential health risks for the U.S. Coast Guard (USCG) personnel residing in U.S. Navy housing at the former Alameda Naval Air Station (Alameda NAS) in Alameda, California. The health risk evaluations include: 1) indoor air modeling, 2) ambient air sampling, and 3) assessment of polycyclic aromatic hydrocarbons (PAHs) in soils. These evaluations were undertaken in accordance with the three Statements of Work (SOWs) issued by the USCG for residential risk evaluations at their Alameda housing areas.

1.1 Site Description

Housing for the USCG in Alameda, hereafter referred to as the Site, occupies the northeastern portion of the former Alameda NAS (Figure 1). The Site has been divided into two separate areas, North Housing (Parcel 181) and Marina Housing (Parcel 178). Approximately 40 percent of the Site consists of houses or asphalt-paved parking areas. The remainder of the Site consists of open space, covered by lawn and trees. Miller Elementary School and the Alameda Child Development Center are located in between the two housing areas (Figure 2). Wind direction at the site is predominantly from the southeast and southwest (Neptune, 2001).

1.1.1 Site History

Prior to its development in the late 1800s and early 1900s, the area encompassing the Site was largely marshlands and tidal flats (Figure 3). At that time, there was widespread contamination of the former Oakland Inner Harbor shoreline and tidal channels with petroleum and petroleum byproducts from historical industrial operations in the area (Figure 3). To create usable land for development, the marshlands and tidal flats at the site were filled in with dredged material of uncertain origin (Neptune, 2001). Filling operations are believed to have trapped contamination in place, creating a layer of petroleum hydrocarbons below the fill that has been described as a black "marsh crust" (Neptune, 2001). Additionally, the dredged fill materials are themselves suspected to have contained petroleum-related contamination. According to historical photographs, the Alameda NAS was filled in two separate events, 1887 through 1915 and 1930 through 1939 (Neptune, 2001). Most of the area in which the USCG housing lies was filled during 1939 and 1940 (LSA Associates, 2001).

Prior to being used by the U.S. Navy, Alameda Point was used primarily for industrial purposes, including rail lines, rail yards, a civil and Army Air Corps airfield, a borax processing plant, and an oil refinery (LSA Associates, 2001) (Figure 3). In 1936, the U.S. Navy acquired the site and in 1940 it was officially commissioned (USEPA, 1999). When the site was used as a Naval Air Station, operations and activities on the base as a whole included machine shops, fueling facilities, fuel storage tanks, fabrication and maintenance shops, and waste treatment and disposal areas (LSA Associates, 2001). Aerial photographs from 1947 and 1958 show that barracks were present in the area now occupied by the USCG. In these photographs some large structures of unknown use are also present on the eastern half of the North Housing (Neptune, 2001). The U.S. Navy closed the air station in 1997 (USEPA, 1999) and the former NAS was put on the National Priority List (NPL) in 1999. Accordingly, Site investigations conform to the requirements and guidance associated with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980 as amended by the Superfund Amendments and Reauthorization Acts.

1.1.2 Current Site Conditions

USCG employees and their families currently occupy the multi-unit housing structures within Marina Housing and North Housing. The housing units are used by the USCG under an interim use agreement with the U.S. Navy. North Housing was constructed in 1969 and consists of 51 residential buildings, with four to five units per building. The buildings in North Housing have crawl spaces but no vapor barriers. Marina Housing consists of 157 residential buildings that are predominantly duplexes. The Marina housing units were built using slab-on-grade construction and had vapor barriers installed beneath the cement foundations (R. Duraski, pers. comm.).

1.1.3 Future Site Uses

The City of Alameda plans to redevelop the Alameda former NAS by 2020 (LSA Associates, 2001). Current plans for redevelopment of the Site indicate that it will continue to be a medium density residential area in the future. The USCG use agreement for the North and Marina Housing areas expires in 2025 (Joe Sabel, pers. comm.). Additionally, future plans indicate that the school and child development center in between the two housing areas will remain (LSA Associates, 2001).

1.2 Nature of the Problem

Soil and groundwater investigations conducted by the U.S. Navy discovered contaminants in soil and groundwater in the North Housing area of the Site and in Estuary Park, just north of the Site (Neptune, 2001). Contaminants include volatile organic compounds (VOCs) in the groundwater and subsurface soils and PAHs in surface and subsurface soils. Based on these findings, the USCG initiated evaluations of potential contaminant exposures of USCG personnel residing at the Marina and North Housing areas.

After the finding of elevated concentrations of PAHs in soils, the U.S. Navy conducted a removal action at North Housing (Figure 4) during winter 2001 and spring 2002. Soils with elevated levels of PAHs were removed from the Site to a depth of 2 feet below ground surface (bgs). The excavated areas were replaced with clean fill and sod.

1.3 Project Objectives

The purpose of this report is to evaluate the potential exposures to 1) VOCs emitted from subsurface sources (i.e., soil and groundwater) to indoor air and 2) PAHs in soils (although the surface soils have been remediated) at the Site. The technical approach used in the evaluation of indoor air exposures is presented in Section 2 and the indoor air quality assessment is presented in Section 3. The assessment of PAH exposures is presented in Section 4.

2.0 TECHNICAL APPROACH AND INVESTIGATION FINDINGS

The VOCs detected at the Site could potentially migrate from subsurface soils and groundwater into the onsite housing. Two sets of evaluations were conducted to assess the levels of potential exposure to VOCs at the housing: 1) prediction of chemical concentrations in indoor air, using a USEPA-approved model and 2) measurements of chemical concentrations in indoor and outdoor air. Each of these investigative activities is described in this section of the report. An assessment of the measured indoor air quality is provided in Section 3.

2.1 Indoor Air Modeling

Indoor air modeling was conducted in order to assess potential exposures of USCG personnel to VOCs detected in soil vapor and groundwater at the Site. The migration of VOCs into air indoor was modeled using the Johnson and Ettinger model (US EPA, 2000a). This model is recommended by the USEPA for screening level assessments of the vapor migration from subsurface sources to indoor air (US EPA, 1992, 2000a).

2.1.1 Chemical and Source Definition

The results of soil vapor, groundwater hydropunch, and groundwater monitoring well sampling conducted at the Site (Neptune, 2001) were used to identify VOCs present at the Site. The sampling consisted of the following:

- **Hydropunch Borings:** 61 hydropunch borings were sampled. At the 0 to 12-ft bgs depth interval, 31 samples were collected and analyzed for PAHs (EPA Method 8310) and 32 samples were collected and analyzed for VOCs and MTBE (EPA Method 8260B). At all other depth intervals, 83 samples were collected and analyzed for PAHs and 90 samples were collected and analyzed for VOCs.

- **Monitoring Wells:** Groundwater samples were collected from nine groundwater monitoring wells in the shallow water bearing zone and analyzed for VOCs and MTBE (EPA Method 8260B) and PAHs (EPA Method 8310).

- **Soil Vapor:** Soil vapor samples were collected from 32 locations. Thirty samples were collected at two feet bgs and 11 samples were collected at the 5 to 7-ft bgs depth interval, for a total of 41 samples. All were analyzed for VOCs, including naphthalene (EPA Method TO-15).

VOCs were defined as those organic chemicals that met both of the following criteria (USEPA, 1996, 2000b):

- Molecular weight < 200 g/mol

- Henry's law constant $\geq 1 \times 10^{-5}$ atm-m^3/mol

Based on these criteria, thirty-seven VOCs were detected in soil vapor, hydropunch, and monitoring well samples collected at the Site, including six volatile PAHs and 31 other VOCs (Table 1). All detected VOCs were included in the indoor air modeling.

Of note, elevated concentrations of benzene and naphthalene were detected in groundwater, with benzene concentrations exceeding the USEPA maximum contaminant level (MCL) for drinking water. Neptune (2001) identified benzene and naphthalene plumes under the southern portion of North Housing and the northeastern corner of Marina Housing (Figure 5) at 12 to 16 feet bgs. At 16 to 20 feet bgs, the plumes have a slightly greater lateral extent, but largely the same shape. The distribution of naphthalene in groundwater was largely similar, although larger, than the benzene plume.

2.1.2 Model Description

The Johnson and Ettinger indoor air model (USEPA, 2000a) is a screening-level model that calculates the intrusion and subsequent accumulation of vapors in buildings from subsurface sources. The model

incorporates both convective and diffusive mechanisms that drive vapor intrusion rates, and also accounts for subsurface soil and building properties. The model can incorporate both chemical sources that diminish and do not diminish over time. To provide a health-protective assessment, it was assumed that the chemical sources would not diminish over time; i.e., the infinite source model was used.

Four types of input data were used for the modeling, including:

- Soil properties (Table 2);
- Building properties (Table 2);
- Physical-chemical properties of the VOCs (Table 3); and
- Source concentrations (Table 4).

Soil properties were obtained from the RI conducted at the Site (Neptune, 2001) and VOC properties were obtained from USEPA (2000a, 2000b, 2002) and other sources as noted in the table.

Building properties were based on standard default assumptions for residential buildings, in accordance with the Johnson and Ettinger model user's guide (USEPA, 2000a). Indoor air modeling conducted by Neptune (2001) also used the same set of building properties that assume a house consists of a single family two-story house with slab-on-grade construction. This set of properties, however, differs somewhat from the current housing units that consist of two types: 1) two-story residential units (in a building of 4 to 6 units) with a crawl space (North Housing) and 2) two-story residential duplexes and a few single family units, using slab-on-grade construction (Marina Housing). It should also be noted that the current housing might be replaced in the future after it is turned over to the City of Alameda. Thus, these differences indicate that there are several sources of potential uncertainty in the chemical concentrations predicted for indoor air at the Site.

The source concentrations used in the indoor air modeling were based on sampling results for specific depth intervals at which soil vapor and groundwater samples were collected. Neptune (2001) sampled two depth intervals for soil vapors and four differing depth intervals for groundwater using hydropunch borings. For soil vapors, Neptune (2001) sampled at two depth intervals: 1) approximately 2-ft bgs and 2) 5-7 ft bgs. For modeling purposes, the highest concentration of each detected VOC was used as the source concentration, regardless of sampling depth. This assumed that soil vapors at 2 and 5-7 ft bgs are from the same contaminant source. For soil vapors, it was conservatively assumed that the contamination started immediately underneath the building's foundation (i.e., 15-cm bgs).

To model emissions to indoor air from VOCs in groundwater hydropunch samples, only data from the aquifer at 0 - 12 ft bgs (Neptune, 2001) were used. Neptune (2001) reported that there were three separate aquifers at the site; i.e., 0 - 12 ft bgs, 12 - 16 ft bgs, and 16 - 20 ft bgs. VOCs detected in the deeper aquifers would have to migrate upwards into the aquifer at 0 - 12 ft bgs before they could volatilize and migrate into indoor air. Therefore, VOC concentrations in the deeper aquifers would not necessarily be representative of the concentrations able to migrate upwards through the soil column to indoor air. For modeling emissions from groundwater to indoor air, it was assumed that the contamination was limited to groundwater and that the water table was at 8 feet bgs.

The maximum observed concentration of each VOC detected in soil vapor, hydropunch (0-12 ft bgs), and monitoring well samples was used as the starting concentration in the model (Table 4). The use of the

infinite source model with maximum detected VOC concentrations as source concentrations provide a highly health protective evaluation of potential indoor air exposures at the USCG housing.

2.1.3 Predicted Indoor Air Concentrations

The chemical concentrations predicted for indoor air at the Site are provided in Table 5. It can readily be seen that, for those VOCs that were detected in all three environmental media, predicted indoor air concentrations are generally the lowest for soil vapor sources, higher for hydropunch sources, and highest for monitoring well sources. Indoor air concentrations predicted for benzene differed most substantially for the three types of sources, with the indoor air concentration predicted using groundwater monitoring well data approximately three orders of magnitude higher than that using soil vapor data. Each set of predicted chemical concentrations was used in estimating potential VOC exposures and risks from inhaling VOCs in indoor air concentrations, as described below and in Appendix A.

2.1.4 Screening Risk Evaluation

Two types of screening level risk evaluations were conducted using the predicted indoor air VOC concentrations. The screening risk evaluations consisted of 1) comparison of predicted concentrations to the USEPA (2000b) Region IX Preliminary Remediation Goals (PRGs) for ambient air and 2) estimation of noncarcinogenic and carcinogenic risks for indoor VOC exposures, following USEPA (1989, 1991, and 1997) guidance. Both sets of screening level risk evaluations were performed for indoor air concentrations predicted from all three types of VOC samples collected at the Site; i.e., soil vapor, hydropunch, and monitoring well samples.

The ambient air PRGs are risk-based concentrations comparable to a carcinogenic risk of 1×10^{-6} or a noncarcinogenic hazard index (HI) of 1. The PRGs are based on the assumptions that a 70-kg individual would be exposed to airborne chemicals for 24-hours per day for 30 years (USEPA, 2000b). Table 6 shows that the predicted indoor air concentrations are at least an order of magnitude lower than the PRGs for all VOCs except benzene. The indoor air concentration for benzene predicted using monitoring well data is roughly an order of magnitude greater than its respective PRG. However, indoor air predictions for benzene based on soil vapor and hydropunch data do not exceed the PRG.

In accordance with the SOW and USEPA (1989, 1991a, 1997) guidance, the potential risks to residential receptors from the inhalation of VOCs in indoor air were estimated for three, six, and eight years of exposure. Potential future residential use of the Site was also evaluated by assuming a thirty-year exposure period (USEPA, 1991a). This exposure duration is also consistent with the calculation of the PRGs. Risks were estimated from assumed exposures to indoor air concentrations predicted using separate datasets for soil vapor, hydropunch, and monitoring well samples.

The screening risk estimates were compared to a carcinogenic risk of 1×10^{-5}, the maximum carcinogenic risk that the USCG will accept at its sites (R. Duraski, pers. comm.), and a noncarcinogenic HI of 1. The results of the risk screening (presented in detail in Appendix A) indicate that the carcinogenic risks and noncarcinogenic hazards are below these threshold values for all evaluations of predicted indoor air concentrations based on soil vapor and hydropunch data. However, potential exposures to predicted indoor air concentrations based on monitoring well data resulted in carcinogenic risk estimates greater than 1×10^{-5} for child residents at the Site longer than 3 years and for future residents assumed to be present at the Site for 30 years. Additionally, the noncarcinogenic HIs exceeded 1 for all receptors, regardless of exposure duration. These results are primarily due to assumed exposure to benzene, as was demonstrated in the PRG risk screening evaluation.

As the results of the two risk-screening evaluations exceeded health protective criteria (e.g., carcinogenic risk estimates were greater 1 x 10^{-5} and noncarcinogenic hazards were greater than 1.0), the USCG proceeded to collect air samples at the Site.

2.2 Air Sampling Activities and Results

Air sampling was conducted at the Site to verify the indoor air modeling results. Indoor and outdoor air sampling was conducted at three different housing areas, consisting of North Housing, Kollmann Circle (a sub-area of North Housing), and Marina Housing. All air samples were collected using Summa air canisters with sampling integrated over a 24-hour period. Sampling was conducted by a technician from SCA Environmental (Oakland). Air samples were analyzed by Air Toxics Laboratory using EPA Method TO-14. Sampling activities are summarized below.

- **North Housing:** In February 2002, 17 air samples were collected and analyzed for VOCs. Both unoccupied and occupied housing units were sampled. At unoccupied housing units, samples were collected from 2 crawl spaces, 2 outdoor locations, and 7 indoor locations. At occupied housing units, samples were collected from 2 crawl spaces, 2 outdoor locations, and 2 indoor locations.

- **Kollmann Circle:** In April 2002, 17 air samples were collected and analyzed for VOCs. The samples were collected from 1 outdoor location, 8 crawl spaces, and 8 indoor locations. All housing units were unoccupied.

- **Marina Housing:** In May 2002, 19 air samples were collected and analyzed for VOCs. Both unoccupied and occupied housing units were sampled. At unoccupied housing units, samples were collected from 5 outdoor locations and 12 indoor locations. At occupied housing units, samples were collected from 1 outdoor location and 1 indoor location.

The air samples collected at each housing area are summarized in Table 7. The sampling locations are listed in Table 8 and shown in Figure 6. The occupancy status of each housing unit is also given in Table 8.

The results of the air sampling are summarized below and in Table 9. All of the analytical results are provided in Appendix B.

2.2.1 North Housing Sampling Results

Ten of the 17 VOC analytes were detected in air sampling conducted at the North Housing, including benzene, 1,2-dichloroethane (1,2-DCA), ethylbenzene, methyl tert-butyl ether (MTBE), tetrachloroethene (PCE), toluene, 1,1,1-trichloroethane (1,1,1-TCA), trichloroethene (TCE), m,p-xylenes, and o-xylene. The measured concentrations of each detected VOC are shown in Table 10. From this table, it can be seen that the concentrations of each of the detected chemicals were, for the most part, relatively similar; i.e., chemical concentrations varied by factors of approximately 2 to 6.

A few of the chemical concentrations varied more than a factor of ten. However, two observations made during sampling activities may explain these observations. One observation was that 2006 East Mayport is occupied by a person who builds model cars and the occupant had made a model in the past week. The concentrations of toluene and TCE measured in indoor air at this unit were elevated relative to the other housing units. Both toluene and TCE are components of glues, suggesting that model glue may have contributed to the observed concentrations of these two VOCs. The second observation (by R. Duraski)

was that a fresh coat of latex-based paint that was still wet had apparently been applied at 2003C Annapolis. The highest concentrations of ethylbenzene, 1,2-DCA, m,p-xylenes, and o-xylene were found in indoor air at this housing unit. It is unknown whether this paint contained the VOCs that were detected at elevated levels in this unit, though the paint may be a possible source.

The maximum observed indoor air concentrations at the North Housing area exceed the predictions made previously using the Johnson and Ettinger model for all chemicals, except benzene. For benzene, the maximum observed concentration is approximately half the maximum predicted concentration (as shown in Table 9).

To determine whether the observed VOC concentrations are potential health concerns, the maximum measured indoor air concentrations were compared to the USEPA (2000) Region IX ambient air PRGs. The PRGs are risk-based criteria that assume daily exposure of residents to the airborne chemicals for an exposure duration of up to 30 years. The maximum indoor air concentrations of certain of the VOCs exceed their respective PRGs, including benzene, 1,2-DCA, MTBE, and PCE.

2.2.2 Kollmann Circle Sampling Results

Air samples were collected from housing units in Kollman Circle because previous investigations (Neptune, 2001) indicated that these homes are located in the area with the highest benzene concentrations in the groundwater. Nine of the 17 VOC analytes were detected in these housing units, including benzene, 1,2-DCA, ethylbenzene, PCE, toluene, 1,1,1-TCA, TCE, m,p-xylenes, and o-xylene. Unlike the air samples collected at the North Housing area, MTBE was not detected at Kollman Circle. The measured concentrations of each detected VOC are shown in Table 10. This table shows that the concentrations of each of the detected chemicals were, for the most part, relatively similar to outdoor air concentrations; i.e., chemical concentrations varied by factors of approximately 2 to 9.

The maximum measured indoor air concentrations for ethylbenzene and o-xylene were approximately equal to the maximum indoor air predictions for these two VOCs. In contrast, the maximum measured concentrations of 1,2-DCA, PCE, toluene, 1,1,1-TCA, and m,p-xylenes exceeded the maximum predicted concentrations. For benzene, the maximum observed concentration was approximately a tenth of the maximum predicted concentration.

As for the North Housing area, none of the maximum measured indoor air concentrations exceed their respective PRGs, except those for benzene and 1,2-DCA. For benzene and 1,2-DCA, none of the measured concentrations were less than their respective PRGs. MTBE and TCE were not detected in indoor air.

2.2.3 Marina Housing Sampling Results

Nine of the 17 VOC analytes were detected, including benzene, 1,2-DCA, 1,1-dichloroethene (1,1-DCE), ethylbenzene, PCE, toluene, 1,1,1-TCA, m,p-xylenes, and o-xylene. The measured concentrations of each detected VOC are shown in Table 10. The concentrations of each of the detected chemicals were, for the most part, relatively similar; i.e., the concentrations of each chemical varied by factors of approximately 2 to 8.

Chemical concentrations that differed substantially from this pattern were those measured at 4072A Seahorse and at 3054B Flint. The potential sources of these differences are uncertain, although the PCE detected in indoor air at 4072A Seahorse could possibly be related to newly varnished cabinets that were still "sticky" to the touch. In contrast, potential sources of elevated concentrations of benzene, toluene,

ethylbenzene, and the xylenes were not observed at 3054B Flint. Further, it is unknown why 1,1 DCE was detected in indoor air at this location, although it was detected at a concentration barely above the detection limit.

For all chemicals, the maximum observed indoor air concentrations exceeded the predictions made using the Johnson and Ettinger model, except for benzene. For benzene, the maximum observed concentration was approximately one-tenth of the maximum predicted concentration. The maximum indoor air concentrations of certain of the VOCs exceeded their respective PRGs, including benzene, 1,2-DCA, 1,1-DCE, and PCE.

Analyses of the relationships between indoor and outdoor chemical measurements for all of the housing units at this Site are discussed in Section 3 of this report.

Soil sampling to define the extent of PAH contamination in soil is described in Section 4 and Appendix D of this report.

3.0 INDOOR AIR QUALITY ASSESSMENT

This section of the report evaluates the analytical results of the air samples collected at the USCG Alameda housing area. Section 3.1 presents the results of statistical analyses performed on the data collected at the site. Section 3.2 presents a comparison of data collected at the Site to ambient air measurements collected by the California Air Resources Board (CARB). Finally, Section 3.3 presents the conclusions from the study.

3.1 Interpretation of Data Collected at the Site

The analytical results of the air samples collected at the Site (see Section 2) were statistically analyzed to answer one primary question:

- Do VOC concentrations in indoor and outdoor air differ?

The statistical analyses also addressed four other ancillary questions in order to fully evaluate the air sampling results:

- Do VOC concentrations in crawl spaces differ from those in indoor air (e.g., are there higher concentrations in crawl spaces than in indoor air)?
- Do residents affect indoor VOC concentrations?
- Do outdoor air VOC concentrations differ over time?
- Do the vapor barriers at Marina Housing affect indoor VOC concentrations?

Each of these questions was examined using standard statistical tests. In this part of the report, the statistical results are discussed qualitatively only. The complete quantitative set of statistical analyses is presented in Appendix C. All comparisons were made only for those chemicals that were detected in more than one sample (see Table 10). The measured chemical concentrations were compared for ten VOCs, including benzene, 1,2-DCA, ethylbenzene, MTBE, PCE, TCE, toluene, 1,1,1-TCA, m,p-xylenes, and o-xylene. Data from the three different areas sampled (i.e., North Housing, Kollmann Circle, and

Marina Housing) were pooled together for the analyses. Non-detected results were considered usable data (USEPA, 1989) and were analyzed using the detection limit.

3.1.1 Indoor vs. Outdoor Air

If there is a subsurface source of VOCs that can migrate to indoor air, then these VOCs may accumulate in indoor air. This occurs because the air inside a house generally has a low rate of mixing with "fresh" outdoor air. Mixing with "fresh" outdoor air would serve to dilute the concentrations of the VOCs that may have migrated to indoor air. However, the air inside of a house usually has a relatively low turnover rate with outdoor air, allowing the buildup of VOCs from subsurface sources. Due to the presence of VOCs in soil vapors and groundwater at the Site, indoor and outdoor air concentrations were compared to determine whether VOCs had accumulated in indoor air.

The statistical analyses indicated that the indoor air concentrations were not elevated over outdoor air concentrations measured at the Site for any VOC (see Appendix C). These results indicate that, although some indoor VOC concentration exceeded the ambient air PRGs, the measured indoor air concentrations for all detected VOCs were consistent with outdoor air concentrations.

3.1.2 Crawl space vs. Indoor Air

If VOCs are migrating from subsurface sources (e.g., groundwater or soil vapor) to indoor air and the house has a crawl space, then the concentration of VOCs should be higher in crawl space air than in indoor air (Olson and Corsi, 2001). This is because the VOCs must first enter the crawl space before they can enter indoor air and, therefore, could reach higher concentrations there.

Chemical concentration in indoor air were compared to concentrations in crawl space air. The comparisons indicated that only the concentration of benzene differed in crawl space air from indoor air. However, the concentrations in the crawl spaces were lower than in indoor air. The concentrations of all of the other VOCs measured in crawl spaces were consistent with indoor air (see Appendix C).

3.1.3 The Effect of Residents

Residents may use or bring objects into their houses that are VOC sources. Common residential sources of VOCs include paints, glues, fingernail polish, varnishes, plastics, linoleum, gasoline in cars or gas cans, and household cleaners. VOC concentrations measured in indoor air at occupied houses were compared to unoccupied houses to determine whether residents had affected indoor VOC concentrations.

The comparisons indicated that concentrations of benzene, MTBE, PCE, and toluene were higher in air measured at occupied residences than at unoccupied residences (see Appendix C). These are all common organic compounds that are used in a number of household applications and products. For example, toluene is a common component of glue, and one of the residents was a model builder. The concentration of toluene in indoor air at that residence was elevated over measurements taken at the other houses. These results indicate that residents can increase the concentrations of VOCs in indoor air.

3.1.4 Seasonal Effects on VOC Concentrations in Outdoor Air

The three different housing areas were sampled at different times of the year; i.e., North Housing was sampled during the winter and Kollmann Circle and Marina Housing were sampled in the spring (see Section 2). To determine whether there was a seasonal effect in outdoor air VOC concentrations, the outdoor air samples collected at the three housing areas were compared.

Comparisons of outdoor air samples indicated that there is no seasonal effect on chemical concentrations, with the exception of MTBE and PCE (see Appendix C). Concentrations of these two chemicals were higher in outdoor air sampled during the winter at North Housing. This result can be readily observed for MTBE in Table 10, since MTBE was detected only in outdoor air at North Housing and not at the other two housing units (with detection limits from 4 to 9 x 10^{-4} mg/m^3). MTBE concentrations typically are higher in gasoline in the winter months. Thus, higher, detectable concentrations of MTBE would be expected at this time. The reason for higher PCE concentrations during winter is uncertain, although it could possibly be related to decreased photodegradation associated with lower winter air temperatures (Mohamed et al., 2002).

While the statistical analyses indicated that there was no difference in VOC concentrations (except for PCE and MTBE) due to season, that analysis included the outdoor air sample collected at 3054B Flint Avenue in Marina Housing. Benzene, and other VOCs, in that sample were highly elevated with no obvious source. As that unit was recently repainted, it is possible that the elevated VOCs in outdoor air were from spilled paints or solvents. By excluding 3054B Flint from the analysis, all detected VOCs, except 1,2-DCA and TCE (i.e., benzene, ethylbenzene, MTBE, PCE, toluene, 111-TCA, m,p-xylenes, and o-xylene) concentrations were higher in outdoor air sampled during the winter at North Housing (see Appendix C). This may be related to lower photodegredation rates during the winter.

3.1.5 Vapor Barrier Effects

The Marina Housing units were constructed with vapor barriers (USCG SOW). These should function to retard the migration of VOCs from subsurface sources to indoor air, resulting in lower indoor air VOC concentrations. To examine whether there was an effect of vapor barriers on indoor VOC concentrations, VOC concentrations from Marina Housing, Kollmann Circle, and North Housing were compared.

The results of the statistical analyses indicated that only MTBE concentrations differed by area (see Appendix C). MTBE concentrations were higher in indoor air collected at North Housing than at Kollmann Circle or at Marina Housing. As shown in Table 10, MTBE was detected at concentrations greater than 2.4 x 10^{-3} mg/m^3 at North Housing and was not detected (with detection limits of 4 to 9 x 10^{-4} mg/m^3) at the other two housing units. These results might suggest that vapor barriers may be affecting MTBE emissions from soils or groundwater. However, MTBE concentrations in outdoor air samples collected at North Housing were elevated over outdoor air samples collected at the other locations. Thus, these results suggest that the elevated concentrations of MTBE observed in indoor air at North Housing are not due to a lack of vapor barriers, but rather to the elevated (i.e., detectable) outdoor air concentrations at that time of year.

3.2 Comparison with Ambient Air Data

One potential explanation for similar levels of VOCs in indoor and outdoor air at the Site is that both sets of analyses may have been measuring ambient air VOC concentrations. This is possible if the VOC concentrations in outdoor air are greater than the concentration in indoor air potentially migrating from subsurface sources. This explanation is supported by a comparison of the range of indoor concentrations measured at the Site and ambient air measurements for the San Francisco Bay Area for three VOCs (benzene, PCE, and toluene). Figures 7 through 12 show the relationships between the range of indoor air measurements and ambient air data collected from approximately 1990 through 2001. Ambient air data are shown for the two CARB monitoring stations closest to Alameda: (1) Oakland (Davie Stadium, 198 Oak Road) (Figures 7 through 9) and (2) San Francisco (10 Arkansas Street) (Figures 10 through 12). Ambient air data for the other VOCs are not available. The comparisons show that the maximum indoor

air concentrations for benzene, PCE, and toluene measured at the Site are within ambient levels observed at both Oakland and San Francisco over the past several years. This is consistent with the statistics presented above that showed that chemical concentrations in indoor and outdoor air at the Site were not different.

3.3 Conclusions

The results of the above comparisons indicate, among other things, that 1) VOC concentrations in crawl space air did not differ from indoor air concentrations and 2) indoor air VOC concentrations were consistent with both outdoor air concentrations and ambient air measurements collected by the CARB. Together, these lines of evidence suggest that, although the housing at the Site may be built over groundwater plumes of benzene and naphthalene, the concentrations of these chemicals in indoor air are not elevated over ambient conditions for the San Francisco Bay area. Thus, the risks to USCG personnel at the former Alameda NAS are not likely to differ from those of other individuals residing in the San Francisco Bay area.

Since groundwater monitoring is likely to continue at this Site, the above conclusion should be revisited if VOC contamination levels in groundwater increase over time. Based on the linear relationship assumed in the modeling predictions for VOC migration from groundwater to indoor air (USEPA, 2000a), additional air sampling should probably be considered if there is an increase of one or two orders of magnitude of any of the VOC concentrations detected in groundwater. In other words, ambient conditions could potentially be masking low levels of VOC transport from groundwater to indoor air. Thus, substantial increases in chemical concentrations in groundwater may be necessary before indoor air concentrations differ substantially, if at all, from ambient outdoor concentrations. Therefore, the finding that VOC concentrations in indoor air at the Site do not differ from ambient concentrations should be reevaluated if chemical concentrations in groundwater increase by one or two orders of magnitude.

4.0 POLYCYCLIC AROMATIC HYDROCARBONS IN SOIL

The USCG has calculated a cleanup goal for polycyclic aromatic hydrocarbons (PAHs) protective of residents at a carcinogenic risk of 10^{-5} (see Appendix D). This goal is expressed as 0.62 mg/kg benzo(a)pyrene- equivalents. Using the soil PAH data collected by Neptune (2001), several areas were identified at the Site by the USCG that exceeded the cleanup goal. These areas were prioritized for cleanup as follows:

- Level 1 Locations, the 95th percent upper confidence limit on the mean (UCL_{95}) benzo(a)pyrene-equivalent concentration was 7.3 mg/kg;
- Level 2 Locations, the UCL_{95} benzo(a)pyrene-equivalent concentration was 3 mg/kg;
- Level 3 Locations, the UCL_{95} benzo(a)pyrene-equivalent concentration was 1.3 mg/kg; and
- Level 4 and 5 Locations, the UCL_{95} benzo(a)pyrene-equivalent concentration was below 0.6 mg/kg.

Due to the elevated risks associated with PAHs in soils at the Site, the U.S. Navy has since removed the top two feet of soil in the Level 1 and 2 locations where the cleanup goal was exceeded (Figure 4). The removed soil has been replaced with clean imported fill and topped with sod. The U.S. Navy plans future action for the Level 3 areas (see Appendix D). The development of the cleanup goals and analysis of PAH concentrations in soil are presented in detail in Appendix D.

5.0 REFERENCES

LSA Associates. 2001. Alameda Point General Plan Amendment EIR. Available on-line at: http://www.ci.alameda.ca.us/news/a_general_plan.html

Mohamed, M. F., Kang, D., and Aneja, V. P. 2002. Volatile organic compounds in some urban locations in [the] United States. Atmospheric Environment 47: 863-882.

Neptune. 2001. Operable Unit 5 Remedial Investigation Report. Alameda Point, Alameda, CA. Draft.

Olson, D. A. and Corsi, R. L. 2001. Characterizing exposure to chemicals from soil vapor intrusion using a two-compartment model. Atmospheric Environment 35: 4201-4209.

U.S. Environmental Protection Agency (USEPA). 1989. Risk Assessment Guidance for Superfund (RAGS). Human Health Evaluation Manual Part A. Office of Emergency and Remedial Response. EPA/540/1-89/002.

U.S. Environmental Protection Agency (USEPA). 1990. National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (Final Rule). 40 CFR Part 300: 55 Federal Register 8666.

U.S. Environmental Protection Agency (USEPA). 1991a. Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. Publication 9285.6-03.

U.S. Environmental Protection Agency (USEPA). 1991b. Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions. OSWER Directive 9355.0-30.

U.S. Environmental Protection Agency (USEPA). 1992. Air/Superfund National Technical Guidance Study Series. Assessing Potential Indoor Air Impacts for Superfund Sites. Office of Air Quality Planning and Standards. EPA-451/R-92-002.

U.S. Environmental Protection Agency (USEPA). 1996b. Soil screening guidance: technical background document. Office of Solid Waste and Emergency Response. EPA/540/R-95/128.

U.S. Environmental Protection Agency (USEPA). 1997. Exposure Factors Handbook. Office of Research and Development, National Center for Environmental Assessment. EPA/600/P-95/002Fa.

U.S. Environmental Protection Agency (USEPA). 1999. NPL Narrative Site Listing for Alameda Naval Air Station. Available on-line at: http://www.epa.gov/superfund/sites/npl/nar1560.htm

U.S. Environmental Protection Agency (USEPA). 2000a. User's guide for the Johnson and Ettinger (1991) model for subsurface vapor intrusion into buildings. Available on-line at http://www.epa.gov/superfund/programs/risk/airmodel/johnson_ettinger.htm

U.S. Environmental Protection Agency (USEPA). 2000b. U.S. EPA Region IX Preliminary Remediation Goals (PRGs). Available online at: http://www.epa.gov/region9/waste/sfund/prg/index.html

Table 1
Chemicals of Potential Concern
USCG Alameda Housing
Alameda, California

		Environmental Media		
			Groundwater	
Group	**Chemical**	**Soil Vapor**	**Hydropunch (0-12 ft bgs)**	**Monitoring well**
Volatile PAHs				
	Acenaphthene		X	X
	Acenaphthylene		X	X
	Anthracene		X	X
	Fluorene		X	X
	Naphthalene	X	X	X
	Phenanthrene		X	X
Other VOCs				
	Acetone	X		
	Benzene	X	X	X
	Bromodichloromethane		X	
	2-Butanone	X		
	Chlorobenzene	X		
	Chloroethane	X		
	Chloroform	X		
	Chloromethane			X
	Dibromochloromethane		X	
	1,1-Dichloroethane	X		
	1,2-Dichloroethane			X
	cis-1,2-Dichloroethene	X	X	
	trans-1,2-Dichloroethene		X	
	Ethylbenzene	X	X	X
	2-Hexanone	X		
	Isopropylbenzene (cumene)		X	X
	4-Isopropyltoluene		X	
	4-Methyl-2-pentanone	X		
	Methylene chloride		X	X
	MTBE	X	X	X
	n-Propylbenzene			X
	Styrene	X		X
	Tetrachloroethene	X		
	Toluene	X	X	X
	1,1,1-Trichloroethane	X		
	Trichloroethene	X		
	1,2,4-Trimethylbenzene		X	X
	1,3,5-Trimethylbenzene		X	X
	Vinyl acetate	X		
	Vinyl chloride		X	
	Xylene	X	X	X

Definitions:

ft - feet.
bgs - below ground surface.
PAH - Polycyclic aromatic hydrocarbon.

Table 2
Parameters used in the
Johnson and Ettinger (USEPA, 2000) Indoor Air Model
USCG Alameda Housing
Alameda, California

Variable	Variable name	Units	Value	Notes/References
Soil physical properties				
ρ_b	Soil dry bulk density	(g/cm^3)	1.63	1
n	Soil total porosity	(unitless)	0.38	1
θ_w	Soil water-filled porosity	(cm^3/cm^3)	0.23	1
f_{oc}	Soil organic carbon fraction	(unitless)	0.0057	1
-	SCS soil type	-	LS	2
T_S	Average soil temperaure	(°C)	16.7	3
Building properties				
L_{crack}	Floor thickness	(cm)	15	3
L_B	Floor length	(cm)	961	3
W_B	Floor width	(cm)	961	3
H_B	Enclosed space height	(cm)	488	3
w	Floor-wall seam crack width	(cm)	0.1	3
ER	Indoor air exhange rate	(1/h)	0.45	3
ΔP	Soil-building pressure difference	($g/cm\text{-}s^2$)	40	3
L_F	Depth to bottom of floor	(cm)	15	3

Notes:

1- Neptune (2001).
2- Professional judgment based on the boring logs and soil analyses provided by Neptune (2001).

3- User's guide for the Johnson and Ettinger model for subsurface vapor intrusion in buildings (USEPA, 2000). Available online at: http://www.epa.gov/superfund/programs/risk/airmodel/johnson_ettinger.htm

Table 3
Physical-Chemical Properties
for VOCs
USCG Alameda Housing
Alameda, California

Chemical	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Pure component water solubility, S (mg/L)	Henry's law constant H' (unitless)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (°C)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Enthalpy of vaporization at the normal boiling point, $DH_{v,b}$ (cal/mol)	Physical state at soil temperature, (S,L,G)
Acenaphthene	4.57E+03	4.21E-02	7.69E-06	3.76E+00	3.24E-03	7.91E-05	25	5.51E+02	8.03E+02	1.22E+04	S
Acenaphthylene	4.79E+03	6.20E-02	6.60E-06	3.93E+00	4.61E-03	1.13E-04	25	5.53E+02	8.30E+02	NA	S
Acetone	5.75E-01	1.24E-01	1.14E-05	1.00E+06	1.59E-03	3.88E-05	25	3.29E+02	5.08E+02	6.96E+03	L
Anthracene	2.35E+04	3.24E-02	7.74E-06	4.34E-02	2.67E-03	6.50E-05	25	6.15E+02	8.73E+02	1.31E+04	S
Benzene	6.20E+01	8.80E-02	9.80E-06	1.75E+03	2.28E-01	5.55E-03	25	3.53E+02	5.62E+02	7.34E+03	L
Bromodichloromethane	1.00E+02	2.98E-02	1.06E-05	6.74E+03	6.56E-02	1.60E-03	25	3.63E+02	5.86E+02	7.80E+03	L
2-Butanone	4.50E+00	8.95E-02	9.80E-06	1.36E+05	1.12E-03	2.74E-05	25	3.53E+02	5.35E+02	7.48E+03	L
Chlorobenzene	2.24E+02	7.30E-02	8.70E-06	4.72E+02	1.52E-01	3.70E-03	25	4.05E+02	6.32E+02	8.41E+03	L
Chloroethane	1.47E+01	1.04E-01	1.15E-05	5.70E+03	4.51E-01	1.10E-02	25	3.06E+02	4.60E+02	5.89E+03	G
Chloroform	5.30E+01	1.04E-01	1.00E-05	7.92E+03	1.50E-01	3.67E-03	25	3.34E+02	5.36E+02	6.99E+03	L
Chloromethane	3.50E+01	1.09E-01	6.50E-06	8.20E+03	9.84E-01	2.40E-02	25	2.47E+02	4.16E+02	5.15E+03	G
Dibromochloromethane	4.68E+02	9.60E-02	1.00E-05	4.40E+03	3.49E-02	8.50E-04	25	3.95E+02	5.93E+02	NA	L
1,1-Dichloroethane	5.30E+01	7.42E-02	1.05E-05	5.06E+03	2.30E-01	5.62E-03	25	3.31E+02	5.23E+02	6.90E+03	L
1,2-Dichloroethane	3.80E+01	1.04E-01	9.90E-06	8.52E+03	4.01E-02	9.79E-04	25	3.57E+02	5.61E+02	7.64E+03	L
cis-1,2-Dichloroethene	3.55E+01	7.36E-02	1.13E-05	3.50E+03	1.67E-01	4.08E-03	25	3.34E+02	5.44E+02	7.19E+03	L
trans-1,2-Dichloroethene	3.80E+01	7.07E-02	1.19E-05	6.30E+03	3.85E-01	9.38E-03	25	3.21E+02	5.17E+02	6.72E+03	L
Ethylbenzene	2.04E+02	7.50E-02	7.80E-06	1.69E+02	3.23E-01	7.88E-03	25	4.09E+02	6.17E+02	8.50E+03	L
Fluorene	7.90E+03	6.08E-02	7.88E-06	1.90E+00	3.16E-03	7.70E-05	25	5.70E+02	8.70E+02	1.27E+04	S
2-Hexanone	1.35E+02	8.95E-02	7.80E+04	3.50E+04	7.18E+04	1.75E+03	25	4.01E+02	6.02E+02	1.03E+04	L
Isopropylbenzene	2.20E+02	7.50E-02	7.10E-06	6.10E+01	4.92E+01	1.20E+00	25	4.25E+02	6.31E+02	1.08E+04	L
4-Isopropyltoluene	2.20E+02	7.50E-02	7.10E-06	6.10E+01	4.92E+01	1.20E+00	25	4.25E+02	6.31E+02	1.08E+04	L
4-Methyl-2-pentanone	1.34E+02	7.50E-02	7.80E-06	1.90E+04	5.74E-03	1.40E-04	25	3.89E+02	5.76E+02	9.71E+03	L
Methylene chloride	1.00E+01	1.01E-01	1.17E-05	1.32E+04	8.98E-02	2.19E-03	25	3.13E+02	5.10E+02	6.71E+03	L
MTBE	1.12E+01	7.92E-02	9.41E-05	4.80E+04	2.40E-02	5.87E-04	25	3.28E+02	4.97E+02	7.18E+03	L
Naphthalene	1.19E+03	5.90E-02	7.50E-06	3.10E+01	1.98E-02	4.83E-04	25	4.91E+02	7.48E+02	1.04E+04	S
Phenanthrene	1.40E+04	5.80E-02	5.90E-06	1.20E+00	4.00E-05	1.64E-03	25	6.14E+02	8.69E+02	2.09E+04	S
n-Propylbenzene	2.83E+03	7.50E-02	7.80E-06	1.38E+01	5.37E-01	1.31E-02	25	4.32E+02	6.38E+02	1.11E+04	L
Styrene	9.12E+02	7.10E-02	8.00E-06	3.10E+02	1.13E-01	2.75E-03	25	4.18E+02	6.36E+02	8.74E+03	L
Tetrachloroethene	2.65E+02	7.20E-02	8.20E-06	2.00E+02	7.54E-01	1.84E-02	25	3.94E+02	6.20E+02	8.29E+03	L
Toluene	1.40E+02	8.70E-02	8.60E-06	5.26E+02	2.72E-01	6.64E-03	25	3.84E+02	5.92E+02	7.93E+03	L
1,1,1-Trichloroethane	1.35E+02	7.80E-02	8.80E-06	1.33E+03	7.05E-01	1.72E-02	25	3.47E+02	5.45E+02	7.14E+03	L
Trichloroethene	9.43E+01	7.90E-02	9.10E-06	1.10E+03	4.22E-01	1.03E-02	25	3.60E+02	5.44E+02	7.51E+03	L
1,2,4-Trimethylbenzene	3.72E+03	7.50E-02	7.10E-06	5.70E+01	2.34E-01	5.70E-03	25	4.42E+02	6.49E+02	1.15E+04	L
1,3,5-Trimethylbenzene	8.19E+02	7.50E-02	7.10E-06	4.80E+01	3.16E-01	7.71E-03	25	4.38E+02	6.39E+02	1.14E+04	L
Vinyl acetate	5.25E+00	8.50E-02	9.20E-06	2.00E+04	2.10E-02	5.11E-04	25	3.46E+02	5.19E+02	7.80E+03	L
Vinyl chloride	1.86E+01	1.06E-01	1.23E-06	2.76E+03	1.11E+00	2.70E-02	25	2.59E+02	4.32E+02	5.25E+03	G
Xylene	1.96E+02	7.00E-02	7.80E-06	1.61E+02	3.01E-01	7.34E-03	25	4.12E+02	6.17E+02	8.52E+03	L

Notes:

NA - Not available.
S - Solid.
L - Liquid.
G - Gas.

Sources:

A - US EPA (2000) Region IX (9) Preliminary Remediatation Goals. Available online at: http://www.epa.gov/region9/waste/sfund/prg/index.html
B - User's guide for the Johnson and Ettinger (1991) model (US EPA, 2000). Available online at: http://www.epa.gov/superfund/programs/risk/airmodel/johnson_ettinger.htm
C - Agency for Toxic Substances Registry and Control (2002) Toxicological Profiles. Available online at: http://www.atsdr.cdc.gov/toxpro2.html
D - NIST chmistry webbook (2002). Available online at: http://webbook.nist.gov/chemistry/
E - Montgomery. 1996. Groundwater Chemicals Desk Reference (2nd Edition). CRC Press.

Table 4
Source Concentrations of VOCs
USCG Alameda Housing
Alameda, California

	Source Concentration by Medium		
		Groundwater	
Chemical	**Soil Vapor (µg/L)[1]**	**Hydropunch (µg/L)[2]**	**Monitoring well (µg/L)[3]**
Acenaphthene	ND	50	66
Acenaphthylene	ND	40	190
Acetone	0.3	ND	ND
Anthracene	ND	3.1	8
Benzene	0.02	41	1,620
Bromodichloromethane	ND	0.2	ND
2-Butanone	0.2	ND	ND
Chlorobenzene	0.03	ND	ND
Chloroethane	0.005	ND	ND
Chloroform	0.09	ND	ND
Chloromethane	ND	ND	1
Dibromochloromethane	ND	0.2	ND
1,1-Dichloroethane	0.04	ND	ND
1,2-Dichloroethane	ND	ND	39
cis-1,2-Dichloroethene	0.02	1.2	ND
trans-1,2-Dichloroethene	ND	0.3	ND
Ethylbenzene	0.4	24	112
Fluorene	ND	0.9	36
2-Hexanone	0.03	ND	ND
Isopropylbenzene (cumene)	ND	0.3	2
4-Isopropyltoluene	ND	0.4	ND
4-Methyl-2-pentanone	0.08	ND	ND
Methylene chloride	ND	7	2
MTBE	0.2	1.2	19
Naphthalene	0.2	270	2,400
Phenanthrene	ND	4.1	80
n-Propylbenzene	ND	ND	2
Styrene	0.007	ND	57
Tetrachloroethene	0.09	ND	ND
Toluene	0.3	3	140
1,1,1-Trichloroethane	0.03	ND	ND
Trichloroethene	0.1	ND	ND
1,2,4-Trimethylbenzene	ND	2	11
1,3,5-Trimethylbenzene	ND	2	8
Vinyl acetate	0.08	ND	ND
Vinyl chloride	ND	0.8	ND
Xylene	2.8	23	120

Definitions:

ft - feet.
bgs - below ground surface,
ND - Chemical not detected in this sample medium.
Dection limits available in the RI (Neptune, 2001).

Notes:

1 - The maximum detected concentration for each chemical, regardless of depth (i.e., either 2 or 5-7 ft bgs).
2 - The maximum detected concentration for each chemical detected in the shallow water bearing zone (0-12 ft bgs).
3 - The maximum detected concentration for each chemical detected.

Table 5
Predicted Indoor Air Concentrations (mg/m^3)
USCG Alameda Housing
Alameda, California

	Source Medium		
		Groundwater	
Chemical	Soil Vapor	Hydropunch (0-12 ft bgs)	Monitoring well
Acenaphthene	ND	3.7E-06	4.1E-06
Acenaphthylene	ND	7.2E-06	3.4E-05
Acetone	3.3E-05	ND	ND
Anthracene	ND	1.4E-07	3.6E-07
Benzene	2.1E-06	2.4E-04	9.4E-03
Bromodichloromethane	ND	1.7E-07	ND
2-Butanone	2.4E-05	ND	ND
Chlorobenzene	2.6E-06	ND	ND
Chloroethane	6.0E-07	ND	ND
Chloroform	9.7E-06	ND	ND
Chloromethane	ND	ND	2.0E-05
Dibromochloromethane	ND	3.4E-07	ND
1,1-Dichloroethane	4.0E-06	ND	ND
1,2-Dichloroethane	ND	ND	4.7E-05
cis-1,2-Dichloroethene	2.0E-06	4.6E-06	ND
trans-1,2-Dichloroethene	ND	2.2E-06	ND
Ethylbenzene	3.6E-05	1.6E-04	7.4E-04
Fluorene	ND	6.5E-08	2.6E-06
2-Hexanone	4.3E-06	ND	ND
Isopropylbenzene (cumene)	ND	2.4E-04	1.7E-03
4-Isopropyltoluene	ND	3.4E-04	ND
4-Methyl-2-pentanone	6.7E-06	ND	ND
Methylene chloride	ND	1.9E-05	5.5E-06
MTBE	1.8E-05	1.1E-06	1.8E-05
Naphthalene	1.4E-05	9.8E-05	8.7E-04
Phenanthrene	ND	2.1E-06	4.1E-05
n-Propylbenzene	ND	ND	1.8E-05
Styrene	6.5E-07	ND	1.3E-04
Tetrachloroethene	8.3E-06	ND	ND
Toluene	2.9E-05	2.0E-05	9.1E-04
1,1,1-Trichloroethane	2.8E-06	ND	ND
Trichloroethene	1.3E-05	ND	ND
1,2,4-Trimethylbenzene	ND	7.9E-06	4.3E-05
1,3,5-Trimethylbenzene	ND	1.1E-05	4.2E-05
Vinyl acetate	7.5E-06	ND	ND
Vinyl chloride	ND	2.9E-05	ND
Xylene	2.6E-04	1.3E-04	6.9E-04

Definitions:

ft - feet.
bgs - below ground surface,
ND - Chemical not detected in this sample medium.

Table 6
Comparison of USEPA Preliminary Remediation Goals and Predicted Indoor Air Concentrations (mg/m^3)
USCG Alameda Housing
Alameda, California

		Predicted Indoor Concentrations by Source		
			Groundwater	
Chemical	Ambient Air PRG[1]	Soil Vapor	Hydropunch (0-12 ft bgs)	Monitoring well
Acenaphthene	2.2E-01	ND	3.7E-06	4.1E-06
Acenaphthylene	NA	ND	7.2E-06	3.4E-05
Acetone	3.7E-01	3.3E-05	ND	ND
Anthracene	1.1E+00	ND	1.4E-07	3.6E-07
Benzene	2.5E-04	2.1E-06	2.4E-04	**9.4E-03**
Bromodichloromethane	1.1E-04	ND	1.7E-07	ND
2-Butanone	1.0E+00	2.4E-05	ND	ND
Chlorobenzene	2.6E-06	2.6E-06	ND	ND
Chloroethane	2.3E-03	6.0E-07	ND	ND
Chloroform	8.4E-05	9.7E-06	ND	ND
Chloromethane	1.1E-03	ND	ND	2.0E-05
Dibromochloromethane	8.0E-05	ND	3.4E-07	ND
1,1-Dichloroethane	1.2E-03	4.0E-06	ND	ND
1,2-Dichloroethane	7.4E-05	ND	ND	4.7E-05
cis-1,2-Dichloroethene	3.7E-02	2.0E-06	4.6E-06	ND
trans-1,2-Dichloroethene	7.3E-02	ND	2.2E-06	ND
Ethylbenzene	1.1E+00	3.6E-05	1.6E-04	7.4E-04
Fluorene	NA	ND	6.5E-08	2.6E-06
2-Hexanone[2]	4.1E+02	4.5E-06	ND	ND
Isopropylbenzene (cumene)	4.0E-01	ND	2.4E-04	1.7E-03
4-Isopropyltoluene[3]	4.0E-01	ND	3.4E-04	ND
4-Methyl-2-pentanone	8.3E-02	6.7E-06	ND	ND
Methylene chloride	4.1E-03	ND	1.9E-05	5.5E-06
MTBE	3.7E-03	1.8E-05	1.1E-06	1.8E-05
Naphthalene	3.1E-03	1.4E-05	9.8E-05	8.7E-04
Phenanthrene[4]	3.1E-03	ND	2.1E-06	4.1E-05
n-Propylbenzene	3.7E-02	ND	ND	1.8E-05
Styrene	1.1E+00	6.5E-07	ND	1.3E-04
Tetrachloroethene	3.3E-03	8.3E-06	ND	ND
Toluene	4.0E-01	2.9E-05	2.0E-05	9.1E-04
1,1,1-Trichloroethane	1.0E+00	2.8E-06	ND	ND
Trichloroethene	1.1E-03	1.3E-05	ND	ND
1,2,4-Trimethylbenzene	6.2E-03	ND	7.9E-06	4.3E-05
1,3,5-Trimethylbenzene	6.2E-03	ND	1.1E-05	4.2E-05
Vinyl acetate	2.1E-01	7.5E-06	ND	ND
Vinyl chloride	2.2E-04	ND	2.9E-05	ND
Xylene	7.3E-01	2.6E-04	1.3E-04	6.9E-04

Definitions:

ft - feet.
bgs - below ground surface.
EPC - Exposure point concentration.
NA - Not available.
ND - Chemical not detected in this sample medium.
PEL - OSHA permissable exposure limits, available online at http://www.osha-slc.gov/SLTC/pel/index.html
PRG - US EPA Region IX preliminary remediation goals, available online at: http://www.epa.gov/region9/waste/sfund/prg/index.html
USEPA - U. S. Environmental Protection Agency.
Bold - Concentration exceeds the PRG.

Notes:

1 - CA modified PRGs are given where available.
2 - No PRG is available. The PEL is provided.
3 - No PRG is available, the isopropylbenzene PRG is provided.
4 - No PRG is available, the naphthalene PRG is provided

Table 7
Number of Air Samples by Location
USCG Alameda Housing
Alameda, California

	Location						
	Outdoor		Indoor		Crawlspace		
Area	Unoccupied	Occupied	Unoccupied	Occupied	Unoccupied	Occupied	**Total**
North Housing	2	2	7	2	2	2	17
Kollman Circle	1	0	8	0	8	0	17
Marina Housing	5	1	12	1	0	0	19

Table 8
Air Sampling Locations
USCG Alameda Housing
Alameda, California

Area and Date	Address	Type	Unit Occupied?
North Housing	2002 C Annapolis	Indoor	No
(February 2002)	2003 C Annapolis	Indoor	No
	2000 D Mayport	Crawl space	Yes
		Outdoor	Yes
		Indoor	Yes
	2004 D Mayport	Crawl space	No
		Outdoor	No
		Indoor	No
	2006 E Mayport	Crawl space	Yes
		Outdoor	Yes
		Indoor	Yes
	2009 C Mayport	Indoor	No
	300 C Mosley	Indoor	No
	2005 B Monterey	Indoor	No
	103 F Singleton	Crawl space	No
		Outdoor	No
		Indoor	No
Kollman Circle	2000 A Kollman	Indoor	No
(April 2002)		Crawl space	No
	2000 E Kollman	Indoor	No
		Crawl space	No
	2002 C Kollman	Indoor	No
		Crawl space	No
	2004 C Kollman	Indoor	No
		Crawl space	No
	2006 B Kollman	Indoor	No
		Crawl space	No
	2006 Kollman	Outdoor	No
	2006 E Kollman	Indoor	No
		Crawl space	No
	2008 D Kollman	Indoor	No
		Crawl space	No
	2010 C Kollman	Indoor	No
		Crawl space	No
Marina Housing	3009 A Arkansas	Indoor	No
(May 2002)	4030 A Chicago	Indoor	No
	4059 A Drum	Indoor	No
		Outdoor	No
	3001 B Enterprise	Indoor	No
	3054 B Flint	Indoor	No
		Outdoor	No
	4063 B Kirk	Indoor	Yes
		Outdoor	Yes

Table 8
Air Sampling Locations
USCG Alameda Housing
Alameda, California

Area and Date	Address	Type	Unit Occupied?
Marina Housing	4040 A Kiska	Indoor	No
(May 2002)		Outdoor	No
	4081 B Mt. Hood	Indoor	No
	4011 A Nimitz	Indoor	No
		Outdoor	No
	4014 Nimitz	Indoor	No
	4028 B Sacramento	Indoor	No
	4072 A Seahorse	Indoor	No
	4078 B Seahorse	Indoor	No
		Outdoor	No

Table 9
Comparison of Chemical
Concentrations Measured in Indoor Air
with Risk-based Criteria and Modeling Predictions
USCG Alameda Housing
Alameda, CA

	Maximum Indoor Concentration				
Parameter	**North Housing (mg/m^3)**	**Kollman Circle (mg/m^3)**	**Marina Housing (mg/m^3)**	**PRG[1] (mg/m^3)**	**Maximum Prediction[2] (mg/m^3)**
Benzene	4.6E-03	9.0E-04	6.5E-04	2.5E-04	9.4E-03
1,2-Dichloroethane (1,2-DCA)	2.4E-04	2.0E-04	2.2E-04	7.4E-05	4.7E-05
1,1-Dichloroethene (1,1-DCE)	ND	ND	9.0E-05	3.8E-05	ND
Ethylbenzene	1.5E-02	7.0E-04	2.0E-03	1.1E+00	7.4E-04
Methyl tert-butyl ether (MTBE)	7.7E-03	ND	ND	3.1E+00	1.8E-05
Tetrachloroethene (PCE)	1.7E-03	3.0E-04	1.8E-02	3.3E-03	8.3E-06
Toluene	2.7E-02	6.5E-03	8.0E-03	4.0E-01	9.1E-04
1,1,1-Trichloroethane (1,1,1-TCA)	3.2E-04	3.0E-04	4.7E-04	1.0E+00	2.8E-06
Trichloroethene (TCE)	3.9E-04	ND	ND	1.1E-03	1.3E-05
m,p-Xylene	6.2E-02	2.4E-03	9.3E-03	7.3E-01	6.9E-04
o-Xylene	2.3E-02	7.0E-04	2.4E-03	7.3E-01	6.9E-04

Notes:

1 - USEPA (2000a) Region IX ambient air Preliminary Remediation Goals (PRGs).
Does not include "CAL-modified" PRGs.

2 - Maximum predicted indoor air concentration, regardless of source medium.
See Section 2.1.

ND - Chemical not detected.
Detection limits provided in Appendix B.

Table 10
Chemical Concentrations Measured in Air
Detected Chemicals Only
USCG Alameda Housing
Alameda, CA

Area	Address	Sample Type	Occupancy	Chemical Concentration (mg/m^3) Benzene	1,2-DCA	1,1-DCE	Ethylbenzene
North Housing	103 F Singleton	Crawl	Unoccupied	1.1E-03	ND	ND	4.4E-04
		Indoor	Unoccupied	2.6E-03	ND	ND	1.7E-03
		Outdoor	Unoccupied	2.6E-03	1.4E-04	ND	2.3E-03
	2000 D Mayport	Crawl	Occupied	2.7E-03	ND	ND	1.9E-03
		Indoor	Occupied	3.9E-03	1.8E-04	ND	3.1E-03
		Outdoor	Occupied	5.2E-03	ND	ND	2.7E-03
	2002 C Annapolis	Indoor	Unoccupied	2.5E-03	ND	ND	2.1E-03
	2003 C Annapolis	Indoor	Unoccupied	2.9E-03	2.4E-04	ND	1.5E-02
	2004 D Mayport	Crawl	Unoccupied	2.4E-03	ND	ND	1.6E-03
		Indoor	Unoccupied	2.9E-03	ND	ND	2.3E-03
		Outdoor	Unoccupied	2.8E-03	ND	ND	1.9E-03
	2005 B Monterey	Indoor	Unoccupied	2.9E-03	2.1E-04	ND	3.2E-03
	2006 E Mayport	Crawl	Occupied	1.8E-03	ND	ND	8.8E-04
		Indoor	Occupied	4.6E-03	ND	ND	3.7E-03
		Outdoor	Occupied	3.1E-03	1.8E-04	ND	2.5E-03
	2009 C Mayport	Indoor	Unoccupied	3.6E-03	ND	ND	2.6E-03
	300 C Mosley	Indoor	Unoccupied	2.7E-03	ND	ND	2.6E-03
Kollmann Circle	2000 A Kollman	Crawl	Unoccupied	6.5E-04	1.6E-04	ND	5.3E-04
		Indoor	Unoccupied	5.9E-04	2.0E-04	ND	6.6E-04
	2000 E Kollman	Crawl	Unoccupied	4.9E-04	2.2E-04	ND	ND
		Indoor	Unoccupied	8.8E-04	2.4E-04	ND	ND
	2002 C Kollman	Crawl	Unoccupied	4.6E-04	2.6E-04	ND	2.3E-03
		Indoor	Unoccupied	6.5E-04	2.3E-04	ND	ND
	2004 C Kollman	Crawl	Unoccupied	4.6E-04	1.4E-04	ND	ND
		Indoor	Unoccupied	5.2E-04	2.2E-04	ND	ND
	2006 B Kollman	Crawl	Unoccupied	6.5E-04	2.5E-04	ND	ND
		Indoor	Unoccupied	5.2E-04	2.2E-04	ND	ND
	2006 E Kollman	Crawl	Unoccupied	4.9E-04	1.9E-04	ND	ND
		Indoor	Unoccupied	5.5E-04	1.8E-04	ND	5.7E-04
	2006 Kollman	Outdoor	Unoccupied	4.9E-04	2.1E-04	ND	ND
	2008 D Kollman	Crawl	Unoccupied	4.9E-04	2.3E-04	ND	ND
		Indoor	Unoccupied	5.9E-04	2.2E-04	ND	ND
	2010 C Kollman	Crawl	Unoccupied	5.2E-04	2.0E-04	ND	ND
		Indoor	Unoccupied	6.2E-04	2.3E-04	ND	4.4E-04
Marina	3001 B Enterprise	Indoor	Unoccupied	4.6E-04	ND	ND	ND
	3009 A Arkansas	Indoor	Unoccupied	4.2E-04	2.1E-04	ND	2.8E-04
	3054 B Flint	Indoor	Unoccupied	6.5E-04	2.2E-04	8.9E-05	1.0E-03
		Outdoor	Unoccupied	8.5E-02	ND	ND	9.7E-02
	4011 A Nimitz	Indoor	Unoccupied	3.9E-04	1.9E-04	ND	1.2E-03
		Outdoor	Unoccupied	ND	2.3E-04	ND	ND
	4014 Nimitz	Indoor	Unoccupied	3.9E-04	ND	ND	ND
	4028 B Sacramento	Indoor	Unoccupied	3.1E-04	2.1E-04	ND	ND
	4030 A Chicago	Indoor	Unoccupied	3.3E-04	1.6E-04	ND	2.0E-03
	4040 A Kiska	Indoor	Unoccupied	3.9E-04	1.9E-04	ND	4.0E-04
		Outdoor	Unoccupied	ND	1.4E-04	ND	ND
	4059 A Drum	Indoor	Unoccupied	4.6E-04	1.7E-04	ND	ND
		Outdoor	Unoccupied	ND	1.9E-04	ND	ND
	4063 B Kirk	Indoor	Occupied	4.9E-04	ND	ND	ND
		Outdoor	Occupied	3.6E-04	1.7E-04	ND	ND
	4072 A Seahorse	Indoor	Unoccupied	5.2E-04	1.8E-04	ND	ND
	4078 B Seahorse	Indoor	Unoccupied	4.9E-04	1.8E-04	ND	ND
		Outdoor	Unoccupied	2.8E-04	1.6E-04	ND	ND
	4081 B Mt. Hood	Indoor	Unoccupied	4.6E-04	1.8E-04	ND	ND

Notes:

ND - Chemical not detected.
Detection limits provided in Appendix B.

Table 10
Chemical Concentrations Measured in Air
Detected Chemicals Only
USCG Alameda Housing
Alameda, CA

Area	Address	Sample Type	Occupancy	Chemical Concentration (mg/m^3) MTBE	PCE	1,1,1-TCA	TCE
North Housing	103 F Singleton	Crawl	Unoccupied	2.4E-03	1.5E-03	3.1E-04	ND
		Indoor	Unoccupied	3.7E-03	1.1E-03	3.0E-04	ND
		Outdoor	Unoccupied	5.1E-03	1.4E-03	3.2E-04	2.2E-04
	2000 D Mayport	Crawl	Occupied	5.5E-03	2.3E-03	2.9E-04	2.6E-04
		Indoor	Occupied	5.9E-03	1.4E-03	3.0E-04	2.2E-04
		Outdoor	Occupied	5.9E-03	1.5E-03	3.1E-04	2.5E-04
	2002 C Annapolis	Indoor	Unoccupied	5.1E-03	1.4E-03	3.1E-04	2.3E-04
	2003 C Annapolis	Indoor	Unoccupied	4.8E-03	1.2E-03	3.1E-04	2.2E-04
	2004 D Mayport	Crawl	Unoccupied	5.1E-03	1.6E-03	3.3E-04	2.5E-04
		Indoor	Unoccupied	4.4E-03	1.4E-03	3.2E-04	2.3E-04
		Outdoor	Unoccupied	3.7E-03	1.1E-03	3.1E-04	2.3E-04
	2005 B Monterey	Indoor	Unoccupied	4.8E-03	1.4E-03	3.0E-04	3.1E-04
	2006 E Mayport	Crawl	Occupied	2.7E-03	1.7E-03	3.0E-04	1.9E-04
		Indoor	Occupied	4.8E-03	1.2E-03	3.1E-04	3.9E-04
		Outdoor	Occupied	5.5E-03	1.6E-03	3.2E-04	2.2E-04
	2009 C Mayport	Indoor	Unoccupied	7.7E-03	1.7E-03	3.2E-04	2.8E-04
	300 C Mosley	Indoor	Unoccupied	5.1E-03	1.3E-03	3.1E-04	2.6E-04
Kollmann Circle	2000 A Kollman	Crawl	Unoccupied	ND	2.7E-04	2.7E-04	ND
		Indoor	Unoccupied	ND	3.0E-04	2.4E-04	ND
	2000 E Kollman	Crawl	Unoccupied	ND	2.8E-04	2.6E-04	ND
		Indoor	Unoccupied	ND	2.8E-04	2.5E-04	ND
	2002 C Kollman	Crawl	Unoccupied	ND	1.1E-03	2.6E-04	ND
		Indoor	Unoccupied	ND	ND	2.7E-04	ND
	2004 C Kollman	Crawl	Unoccupied	ND	2.8E-04	2.8E-04	ND
		Indoor	Unoccupied	ND	ND	2.5E-04	ND
	2006 B Kollman	Crawl	Unoccupied	ND	4.0E-04	2.8E-04	3.1E-04
		Indoor	Unoccupied	ND	2.5E-04	2.5E-04	ND
	2006 E Kollman	Crawl	Unoccupied	ND	2.8E-04	2.6E-04	ND
		Indoor	Unoccupied	ND	ND	2.4E-04	ND
	2006 Kollman	Outdoor	Unoccupied	ND	2.6E-04	2.6E-04	ND
	2008 D Kollman	Crawl	Unoccupied	ND	3.0E-04	2.4E-04	ND
		Indoor	Unoccupied	ND	3.1E-04	2.4E-04	ND
	2010 C Kollman	Crawl	Unoccupied	ND	2.8E-04	2.6E-04	ND
		Indoor	Unoccupied	ND	ND	2.4E-04	ND
Marina	3001 B Enterprise	Indoor	Unoccupied	ND	ND	2.3E-04	ND
	3009 A Arkansas	Indoor	Unoccupied	ND	ND	4.7E-04	ND
	3054 B Flint	Indoor	Unoccupied	ND	1.1E-03	3.1E-04	ND
		Outdoor	Unoccupied	ND	ND	ND	ND
	4011 A Nimitz	Indoor	Unoccupied	ND	ND	2.4E-04	ND
		Outdoor	Unoccupied	ND	ND	2.3E-04	ND
	4014 Nimitz	Indoor	Unoccupied	ND	ND	2.6E-04	ND
	4028 B Sacramento	Indoor	Unoccupied	ND	ND	2.1E-04	ND
	4030 A Chicago	Indoor	Unoccupied	ND	1.1E-03	3.3E-04	ND
	4040 A Kiska	Indoor	Unoccupied	ND	ND	2.1E-04	ND
		Outdoor	Unoccupied	ND	ND	2.3E-04	ND
	4059 A Drum	Indoor	Unoccupied	ND	3.2E-04	2.9E-04	ND
		Outdoor	Unoccupied	ND	ND	2.2E-04	3.3E-04
	4063 B Kirk	Indoor	Occupied	ND	2.5E-04	2.0E-04	ND
		Outdoor	Occupied	ND	ND	2.0E-04	ND
	4072 A Seahorse	Indoor	Unoccupied	ND	1.8E-02	2.4E-04	ND
	4078 B Seahorse	Indoor	Unoccupied	ND	ND	2.4E-04	ND
		Outdoor	Unoccupied	ND	8.3E-04	2.3E-04	ND
	4081 B Mt. Hood	Indoor	Unoccupied	ND	ND	2.3E-04	ND

Notes:

ND - Chemical not detected.
Detection limits provided in Appendix B.

Table 10
Chemical Concentrations Measured in Air
Detected Chemicals Only
USCG Alameda Housing
Alameda, CA

Area	Address	Sample Type	Occupancy	Chemical Concentration (mg/m^3) Toluene	Vinyl Chloride	m,p-Xylene	o-Xylene
North Housing	103 F Singleton	Crawl	Unoccupied	3.7E-03	ND	1.5E-03	6.2E-04
		Indoor	Unoccupied	1.0E-02	ND	6.2E-03	2.3E-03
		Outdoor	Unoccupied	1.2E-02	ND	1.1E-02	3.5E-03
	2000 D Mayport	Crawl	Occupied	1.1E-02	ND	7.9E-03	3.2E-03
		Indoor	Occupied	2.1E-02	ND	1.3E-02	5.3E-03
		Outdoor	Occupied	1.4E-02	ND	1.1E-02	4.4E-03
	2002 C Annapolis	Indoor	Unoccupied	1.1E-02	ND	8.4E-03	3.4E-03
	2003 C Annapolis	Indoor	Unoccupied	1.6E-02	ND	6.2E-02	2.3E-02
	2004 D Mayport	Crawl	Unoccupied	1.0E-02	ND	6.6E-03	2.7E-03
		Indoor	Unoccupied	1.8E-02	ND	9.7E-03	3.8E-03
		Outdoor	Unoccupied	1.0E-02	ND	7.9E-03	3.2E-03
	2005 B Monterey	Indoor	Unoccupied	1.3E-02	ND	1.4E-02	5.3E-03
	2006 E Mayport	Crawl	Occupied	8.4E-03	ND	3.4E-03	1.5E-03
		Indoor	Occupied	2.7E-02	ND	1.5E-02	5.3E-03
		Outdoor	Occupied	1.3E-02	ND	1.1E-02	4.2E-03
	2009 C Mayport	Indoor	Unoccupied	2.0E-02	ND	1.0E-02	4.1E-03
	300 C Mosley	Indoor	Unoccupied	1.1E-02	ND	1.1E-02	4.4E-03
Kollmann Circle	2000 A Kollman	Crawl	Unoccupied	1.5E-02	ND	1.3E-03	6.2E-04
		Indoor	Unoccupied	6.5E-03	ND	2.4E-03	7.5E-04
	2000 E Kollman	Crawl	Unoccupied	1.2E-03	ND	6.6E-04	ND
		Indoor	Unoccupied	2.0E-03	ND	6.2E-04	ND
	2002 C Kollman	Crawl	Unoccupied	3.4E-02	ND	7.1E-03	2.5E-03
		Indoor	Unoccupied	1.7E-03	ND	5.3E-04	ND
	2004 C Kollman	Crawl	Unoccupied	1.3E-03	ND	4.9E-04	ND
		Indoor	Unoccupied	1.1E-03	ND	4.9E-04	ND
	2006 B Kollman	Crawl	Unoccupied	1.9E-03	ND	ND	ND
		Indoor	Unoccupied	3.6E-03	ND	1.1E-03	ND
	2006 E Kollman	Crawl	Unoccupied	1.6E-03	ND	5.3E-04	ND
		Indoor	Unoccupied	3.8E-03	ND	2.3E-03	6.6E-04
	2006 Kollman	Outdoor	Unoccupied	1.6E-03	9.6E-05	4.9E-04	ND
	2008 D Kollman	Crawl	Unoccupied	1.5E-03	ND	ND	ND
		Indoor	Unoccupied	3.8E-03	ND	1.1E-03	ND
	2010 C Kollman	Crawl	Unoccupied	2.0E-03	ND	6.2E-04	ND
		Indoor	Unoccupied	4.6E-03	ND	1.8E-03	6.2E-04
Marina	3001 B Enterprise	Indoor	Unoccupied	4.2E-03	ND	7.5E-04	ND
	3009 A Arkansas	Indoor	Unoccupied	2.2E-03	ND	1.1E-03	4.4E-04
	3054 B Flint	Indoor	Unoccupied	3.8E-03	ND	1.9E-03	8.8E-04
		Outdoor	Unoccupied	3.3E-01	ND	3.8E-01	2.2E-01
	4011 A Nimitz	Indoor	Unoccupied	3.5E-03	ND	5.3E-03	1.8E-03
		Outdoor	Unoccupied	6.9E-04	ND	ND	ND
	4014 Nimitz	Indoor	Unoccupied	2.1E-03	ND	7.5E-04	ND
	4028 B Sacramento	Indoor	Unoccupied	2.6E-03	ND	4.4E-04	ND
	4030 A Chicago	Indoor	Unoccupied	8.0E-03	ND	9.3E-03	2.4E-03
	4040 A Kiska	Indoor	Unoccupied	1.6E-03	ND	1.1E-03	4.9E-04
		Outdoor	Unoccupied	7.7E-04	ND	ND	ND
	4059 A Drum	Indoor	Unoccupied	1.7E-03	ND	6.2E-04	ND
		Outdoor	Unoccupied	7.3E-04	ND	ND	ND
	4063 B Kirk	Indoor	Occupied	2.6E-03	ND	7.9E-04	ND
		Outdoor	Occupied	1.2E-03	ND	6.2E-04	ND
	4072 A Seahorse	Indoor	Unoccupied	1.8E-03	ND	7.9E-04	3.7E-04
	4078 B Seahorse	Indoor	Unoccupied	2.6E-03	ND	5.7E-04	ND
		Outdoor	Unoccupied	1.6E-03	ND	ND	ND
	4081 B Mt. Hood	Indoor	Unoccupied	1.2E-03	ND	ND	ND

Notes:

ND - Chemical not detected.
Detection limits provided in Appendix B.

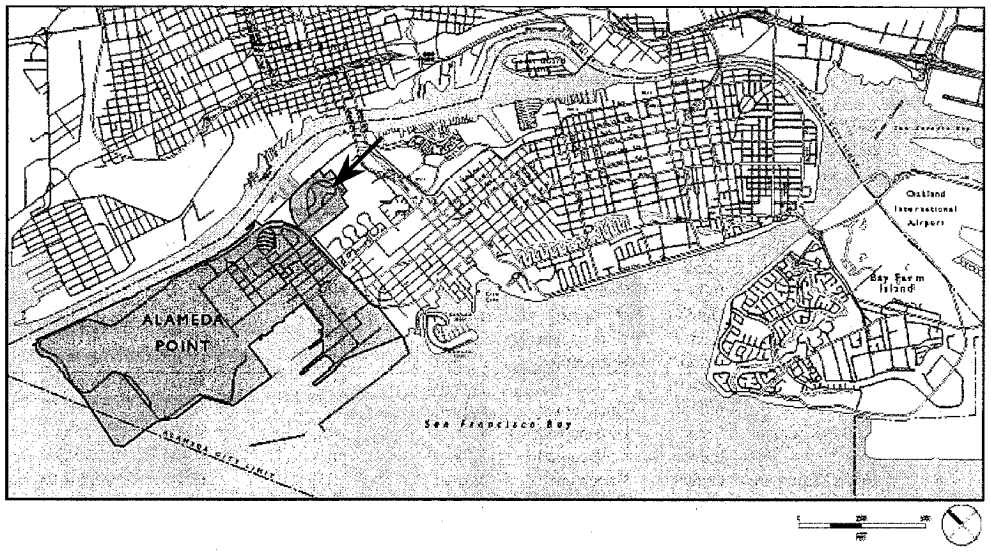
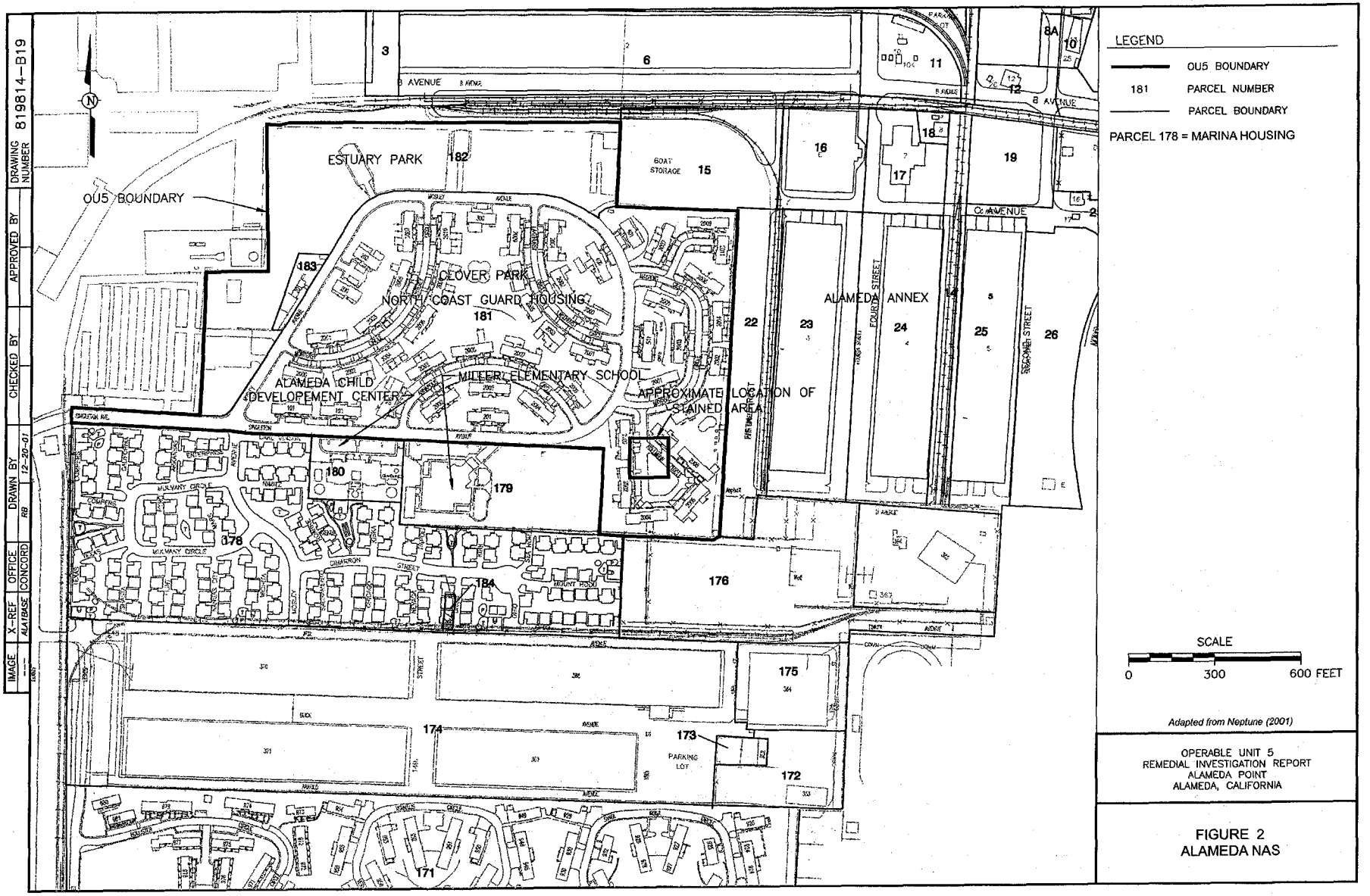
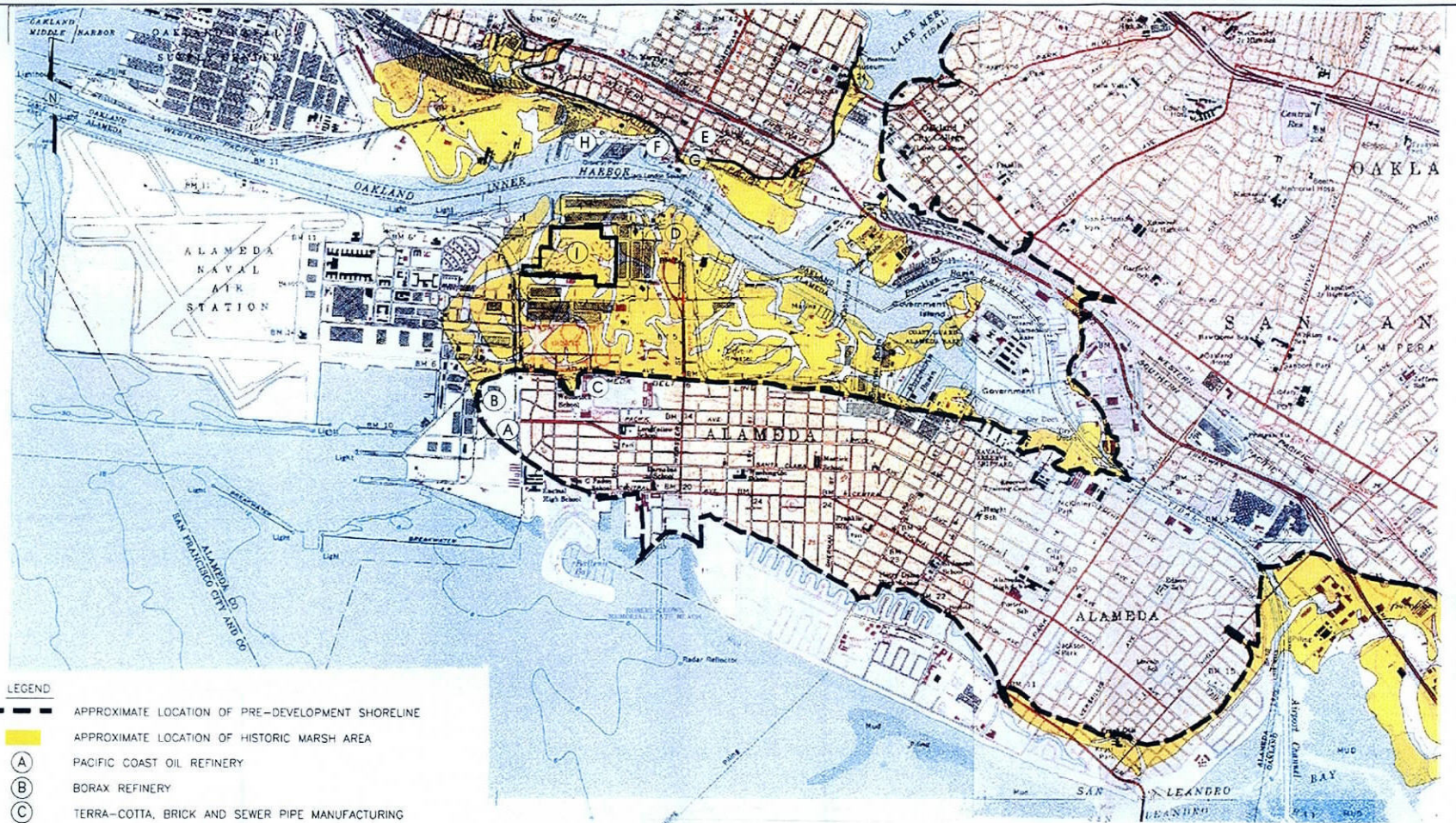


Figure 1: Alameda Naval Air Station (NAS) or Alameda Point. Arrow indicates the USCG Housing areas. Adapted from LSA Associates (2001).


ESTUARY PARK
182
OU5 BOUNDARY
183
CLOVER PARK
NORTH COAST GUARD HOUSING
181
ALAMEDA CHILD DEVELOPEMENT CENTER
MILLER ELEMENTARY SCHOOL
APPROXIMATE LOCATION OF STAINED AREA
180
179
178
184
176
175
174
173
172
171
ALAMEDA ANNEX
BOAT STORAGE
15
16
17
18
19
22
23
24
25
26
3
6
11
12
8A
10
PARKING LOT
B AVENUE
C AVENUE
FOURTH STREET
SECOND STREET
MCKINNEY CIRCLE
CIMARRON STREET
MOUNT POSO
LEGEND
OU5 BOUNDARY
181 PARCEL NUMBER
PARCEL BOUNDARY
PARCEL 178 = MARINA HOUSING
SCALE
0 300 600 FEET
Adapted from Neptune (2001)
OPERABLE UNIT 5
REMEDIAL INVESTIGATION REPORT
ALAMEDA POINT
ALAMEDA, CALIFORNIA
FIGURE 2
ALAMEDA NAS
DRAWING NUMBER 819814-B19
APPROVED BY
CHECKED BY
DRAWN BY RB 12-20-01
OFFICE CONCORD
X-REF ALAIBASE
IMAGE



LEGEND

- APPROXIMATE LOCATION OF PRE-DEVELOPMENT SHORELINE
- APPROXIMATE LOCATION OF HISTORIC MARSH AREA
- (A) PACIFIC COAST OIL REFINERY
- (B) BORAX REFINERY
- (C) TERRA-COTTA, BRICK AND SEWER PIPE MANUFACTURING
- (D) ELECTRIC CAR MANUFACTURING
- (E) MANUFACTURED GAS PLANTS
- (F) MALTHINE MANUFACTURING
- (G) COAL BULK STORAGE
- (H) NAIL MANUFACTURING
- (I) OPERABLE UNIT 5

0 1/2 1 MILE
1000 0 1000 2000 3000 4000 FEET

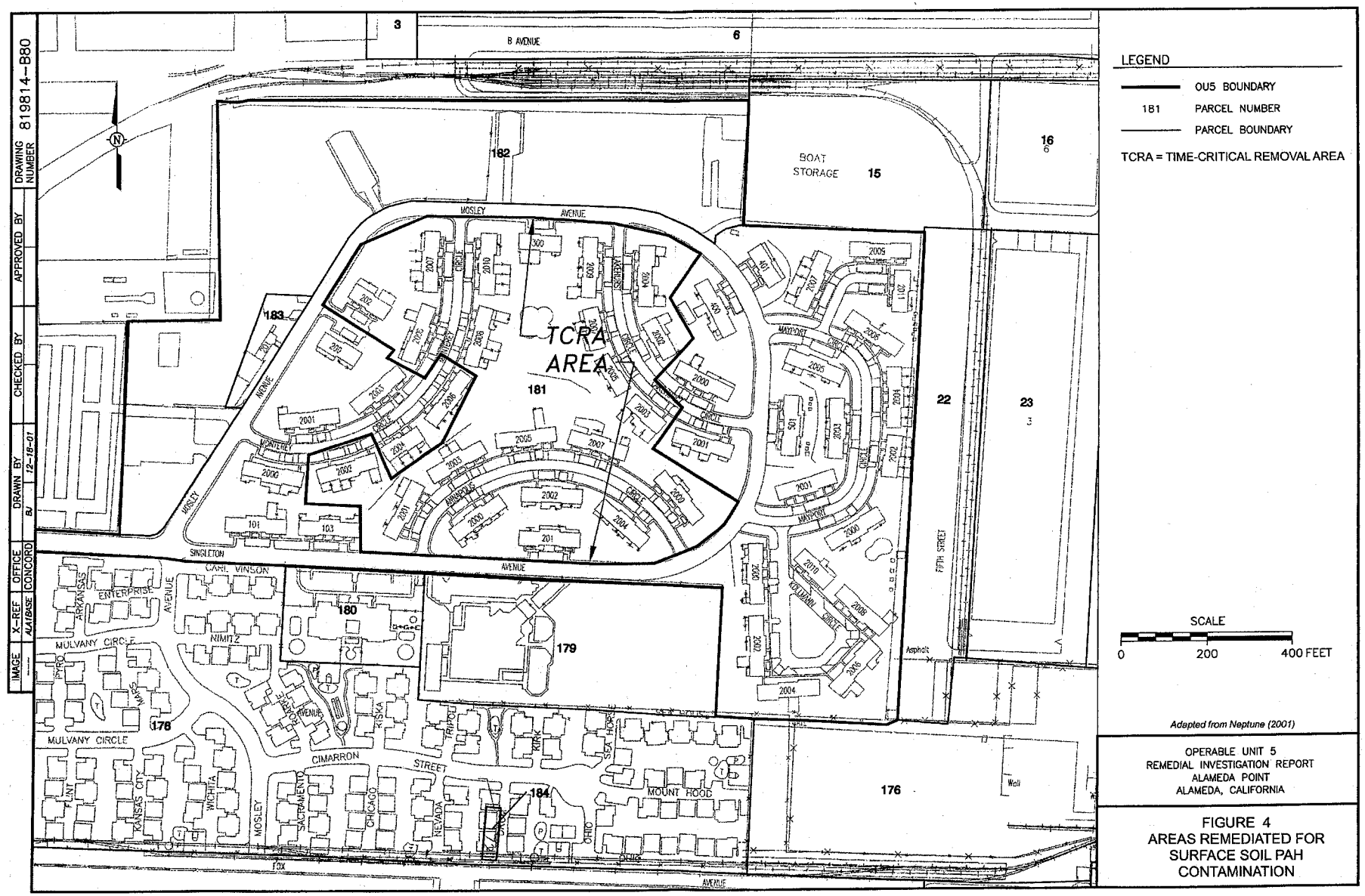
NOTE:
1. FIGURE COMPILED FROM U.S.G.S. TOPOGRAPHIC MAP OF OAKLAND EAST AND OAKLAND WEST QUADRANGLES DATED 1959, PHOTOREVISED 1980 AND MISCELLANEOUS GEOLOGIC INVESTIGATIONS MAP I-296-"SHORELINE FEATURES ALONG THE EAST SIDE OF SAN FRANCISCO BAY" DATED 1959.
2. DIGITAL TOPO FROM TOPO @ 1996 WILDFLOWER PRODUCTIONS (www.topo.com)

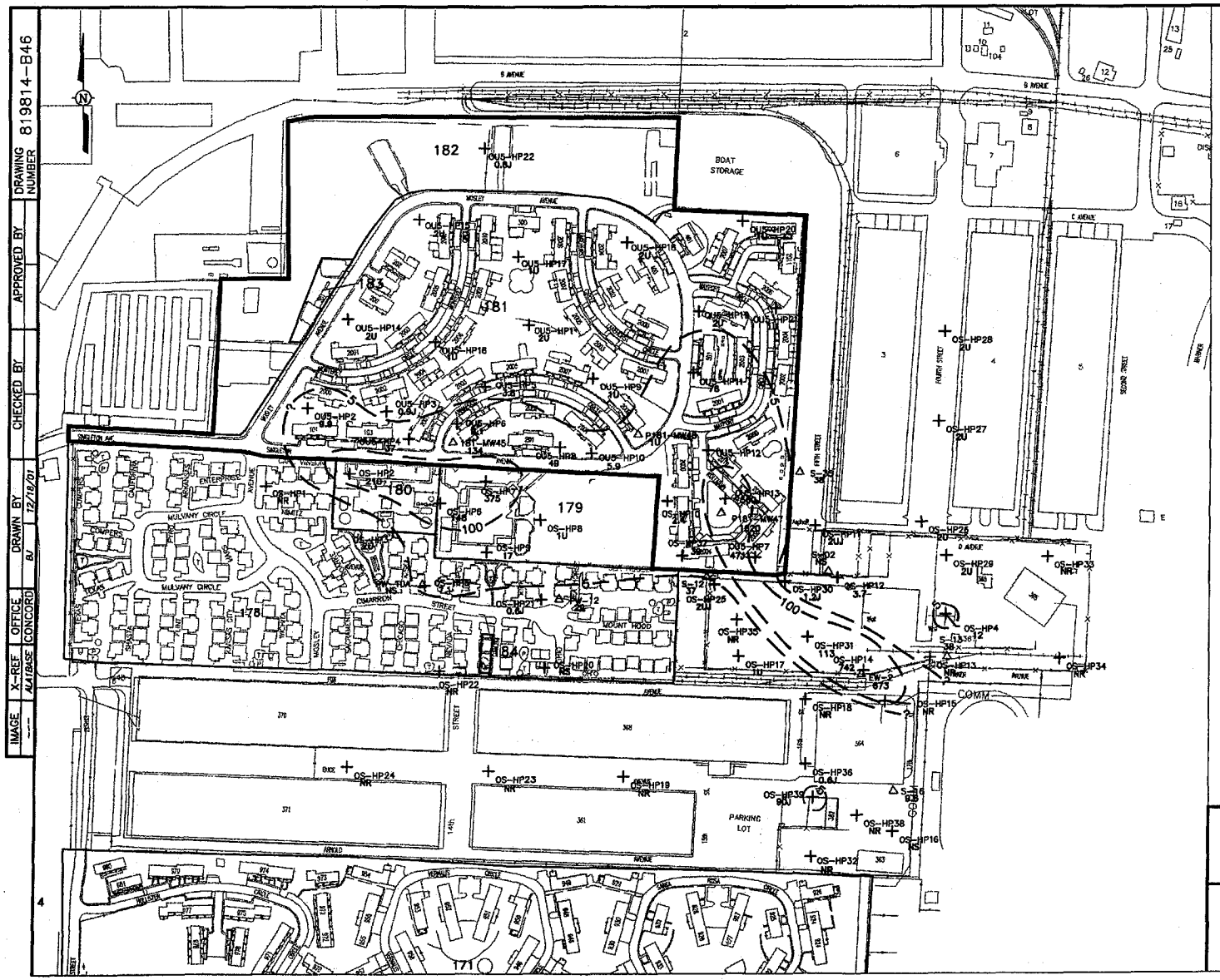
Adapted from Neptune (2001)

OPERABLE UNIT 5
REMEDIAL INVESTIGATION REPORT
ALAMEDA POINT
ALAMEDA, CALIFORNIA

FIGURE 3
HISTORIC FEATURES AND INDUSTRIES

IMAGE	X-REF	OFFICE	DRAWN BY	CHECKED BY	APPROVED BY	DRAWING NUMBER
		Concord	BJ 12-19-01			819814-B79


B AVENUE
BOAT STORAGE
TCRA AREA
MOSLEY AVENUE
SINGLETON AVENUE
CARL VINSON
ENTERPRISE AVENUE
MULVANY CIRCLE
NIMITZ
CIMARRON STREET
MOUNT HOOD
FIFTH STREET
Asphalt
Wall
LEGEND
OU5 BOUNDARY
181 PARCEL NUMBER
PARCEL BOUNDARY
TCRA = TIME-CRITICAL REMOVAL AREA
SCALE
0 200 400 FEET
Adapted from Neptune (2001)
OPERABLE UNIT 5
REMEDIAL INVESTIGATION REPORT
ALAMEDA POINT
ALAMEDA, CALIFORNIA
FIGURE 4
AREAS REMEDIATED FOR
SURFACE SOIL PAH
CONTAMINATION
DRAWING NUMBER 819814-B80
APPROVED BY
CHECKED BY
DRAWN BY BJ 12-18-01
OFFICE CONCORD
X-REF ALATBASE
IMAGE



LEGEND

▬▬▬	OU5–BOUNDARY
181	PARCEL NUMBER
———	PARCEL BOUNDARY
△ S–16	MONITORING WELL
+ OS–HP2	HYDROPUNCH GROUNDWATER SAMPLING LOCATION
OS	OFF–SITE LOCATION
OU5	OPERABLE UNIT 5 LOCATION
210	BENZENE CONCENTRATION IN MICROGRAMS PER LITER
NR	INSUFFICIENT VOLUME FOR SAMPLE
NS	INTERVAL OR WELL NOT SAMPLED
2U	NOT DETECTED ABOVE LISTED VALUE
3.5J	ESTIMATED VALUE
– – 5 – –	BENZENE ISOCONCENTRATION CONTOUR

NOTE: MONITORING WELL BENZENE CONCENTRATIONS ARE NOT USED IN CONTOURING OF HYDROPUNCH DATA.

SCALE

0 300 600 FEET

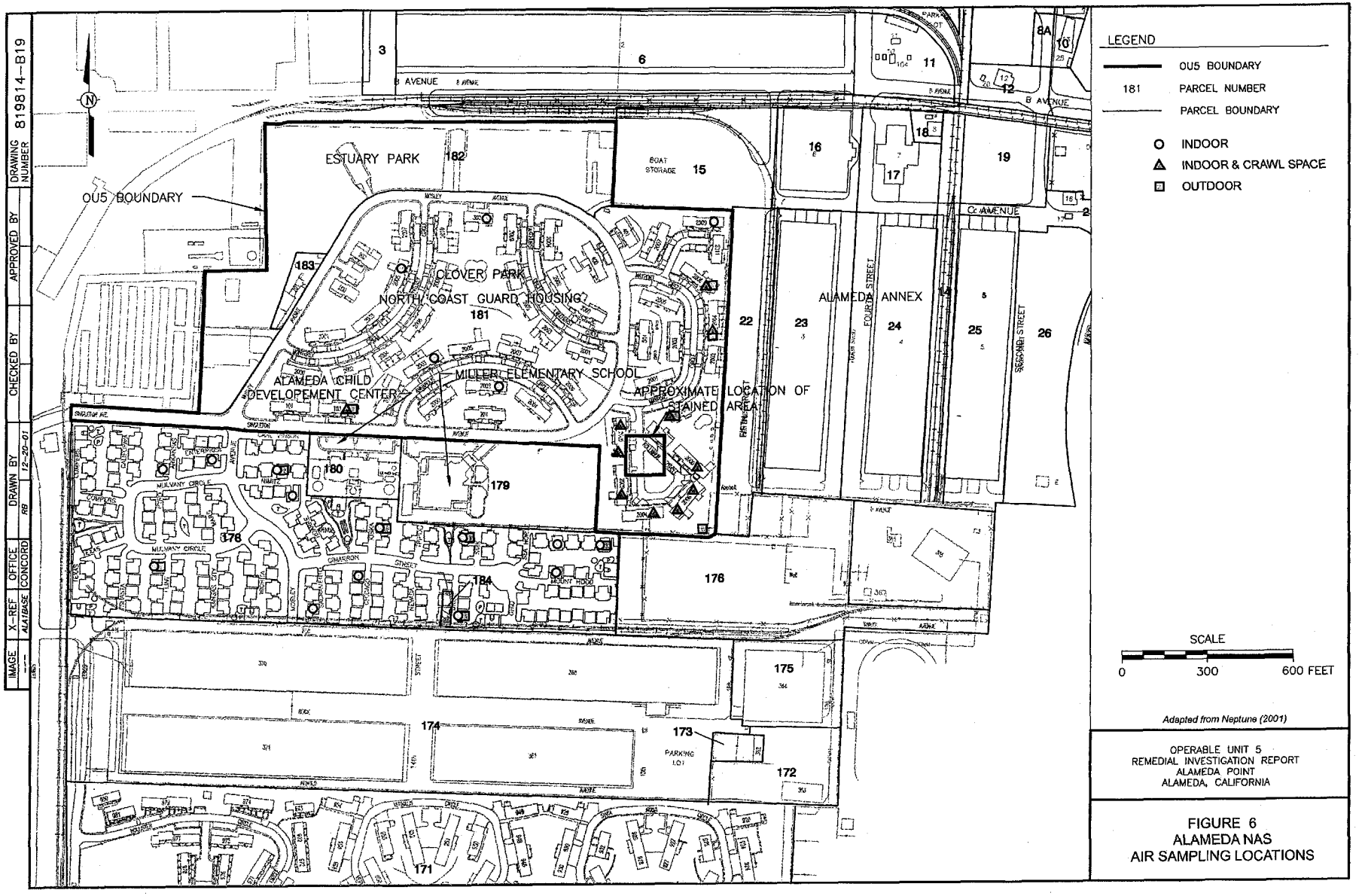
Adapted from Neptune (2001)

OPERABLE UNIT 5
REMEDIAL INVESTIGATION REPORT
ALAMEDA POINT
ALAMEDA, CALIFORNIA

FIGURE 5
GROUNDWATER BENZENE CONTOURS.
12-16 FT BGS.

IMAGE	X-REF	OFFICE	DRAWN BY	CHECKED BY	APPROVED BY	DRAWING NUMBER
---	AUTOBASE	CONCORD	BJ 12/19/01			819814-B46

4



OPERABLE UNIT 5
REMEDIAL INVESTIGATION REPORT
ALAMEDA POINT
ALAMEDA, CALIFORNIA

FIGURE 6
ALAMEDA NAS
AIR SAMPLING LOCATIONS

Benzene

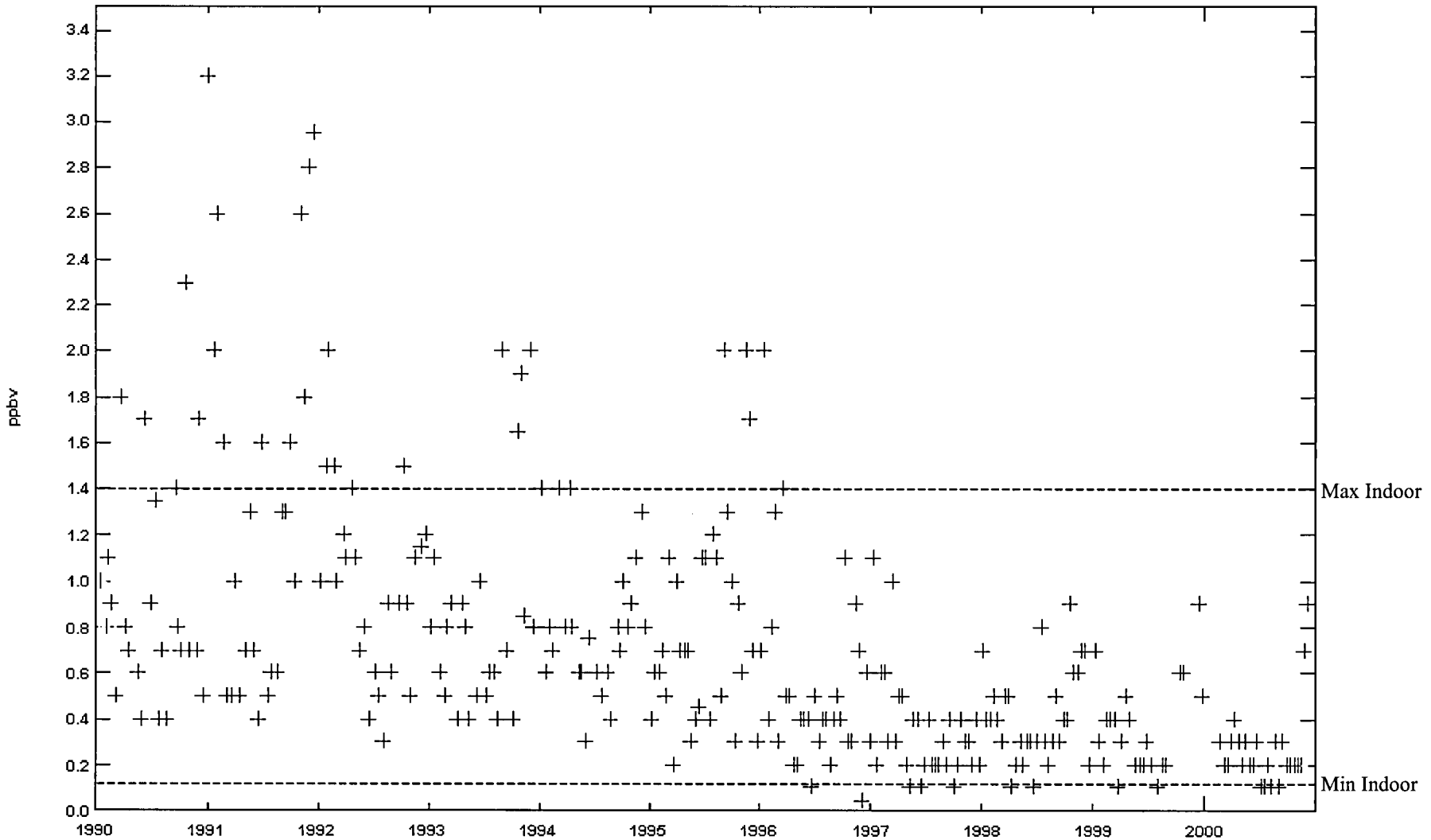


Figure 7: Benzene ambient air concentrations in Oakland compared to indoor concentrations at the Site.
(To convert to mg/m^3, multiply by 0.00325.)

Tetrachloroethene

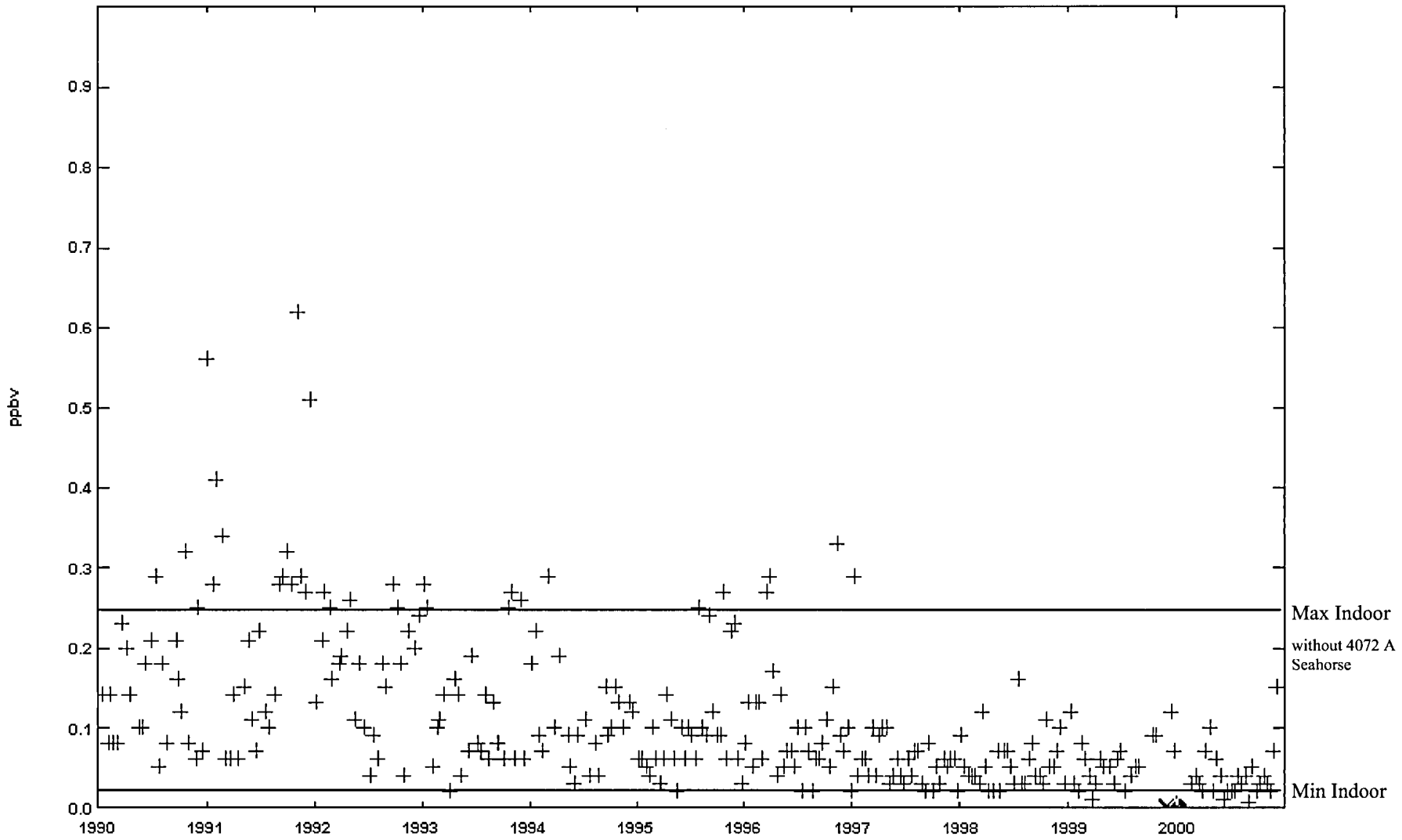


Figure 8: Tetrachloroethene (PCE) ambient air concentrations in Oakland compared to indoor concentrations at the Site. (To convert to mg/m^3, multiply by 0.00689.)

Toluene

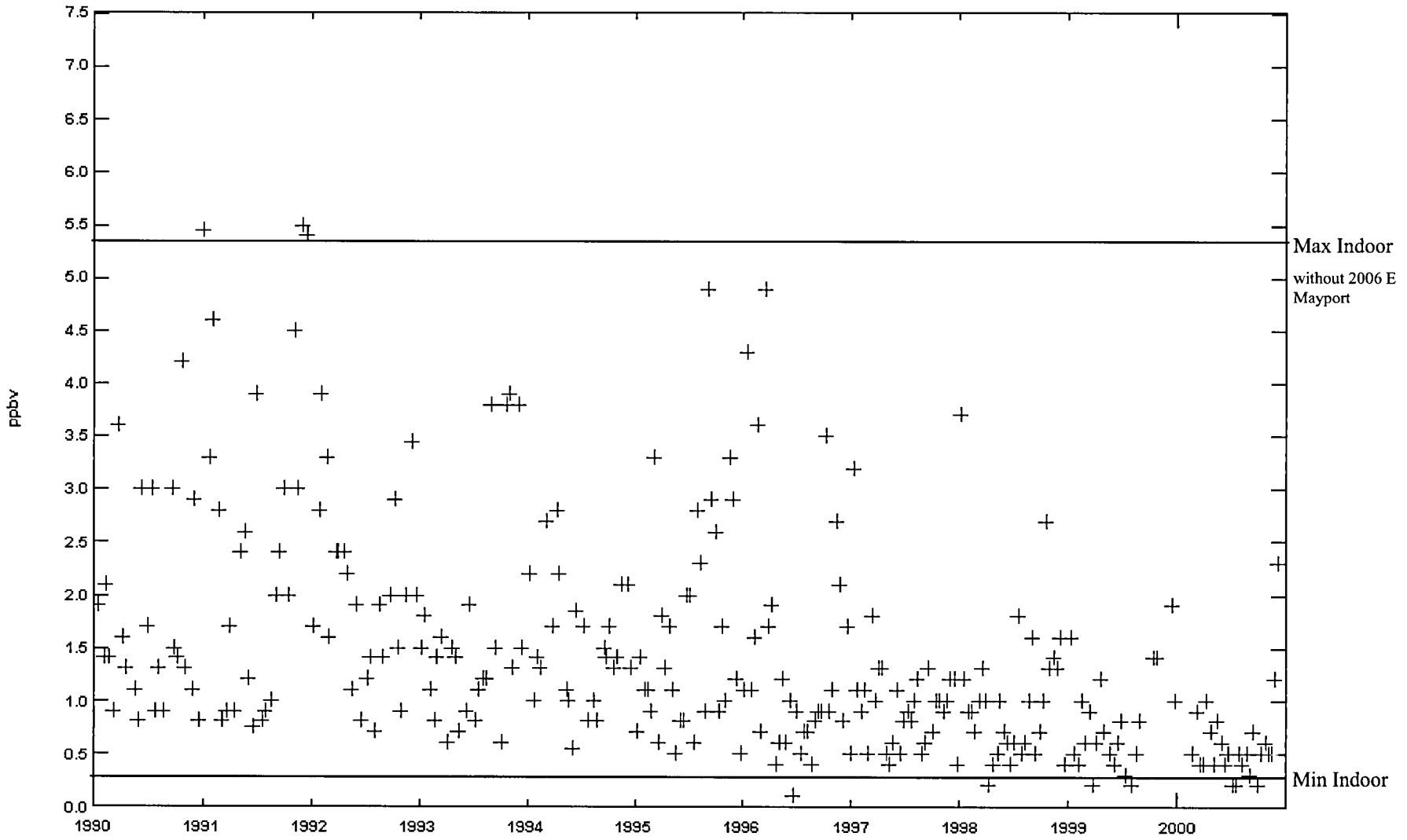


Figure 9: Toluene ambient air concentrations in Oakland compared to indoor concentrations at the Site.
(To convert to mg/m^3, multiply by 0.00383.)

Benzene

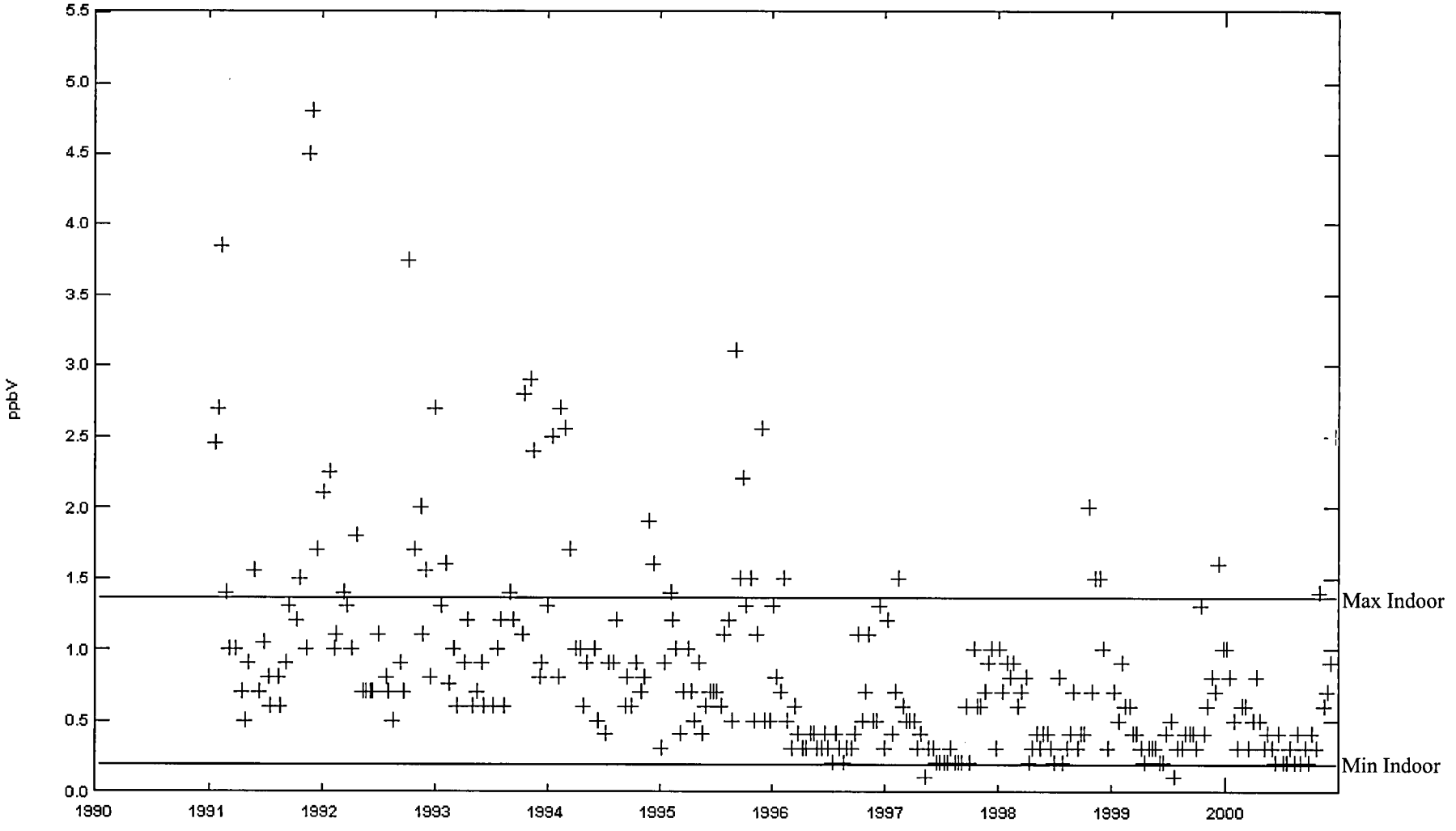


Figure 10: Benzene ambient air concentrations in San Francisco compared to indoor concentrations at the Site.
(To convert to mg/m^3, multiply by 0.00325.)

Tetrachloroethene

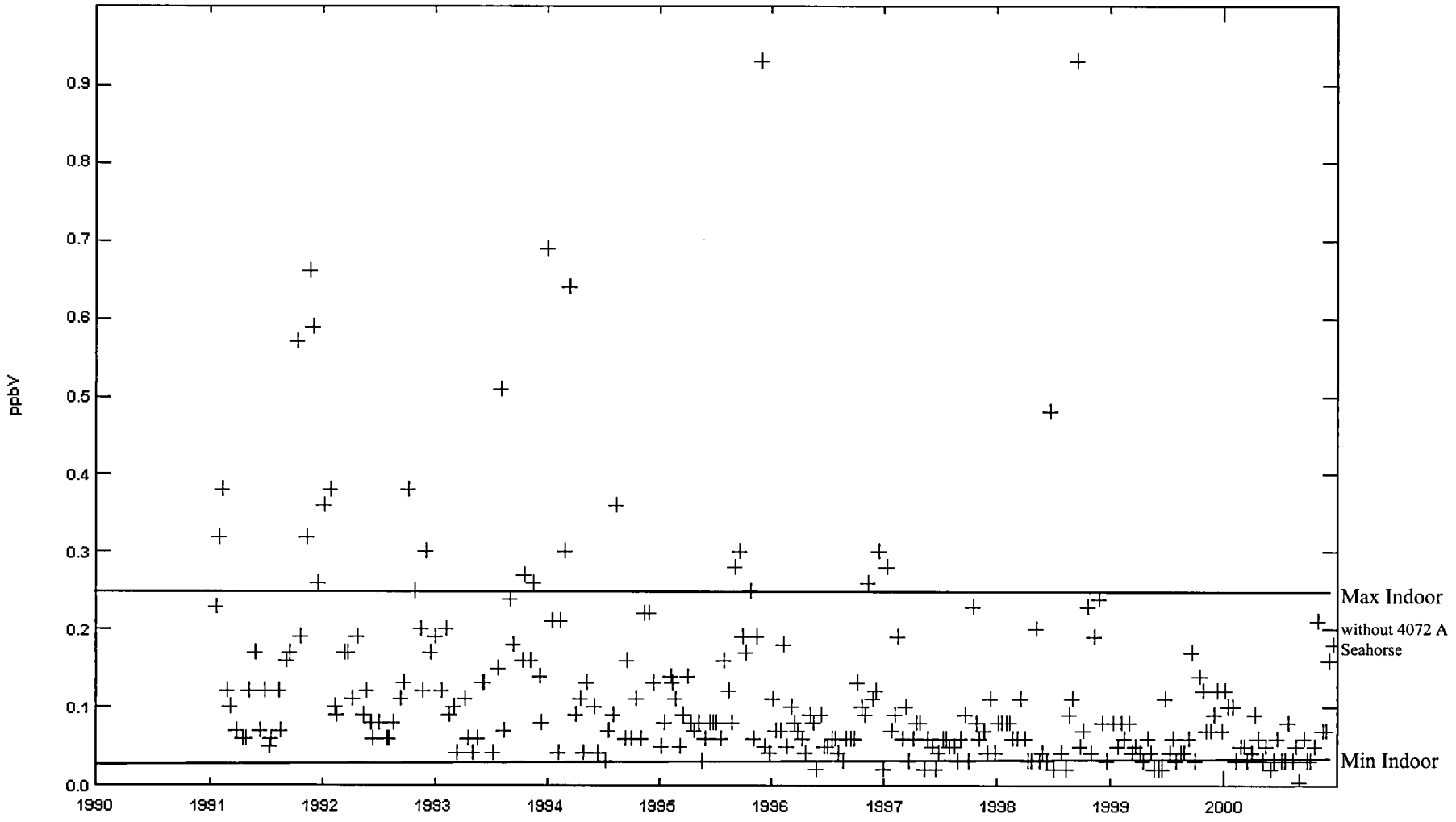


Figure 11: Tetrachloroethene (PCE) ambient air concentrations in San Francisco compared to indoor concentrations at the Site. (To convert to mg/m^3, multiply by 0.00689.)

Toluene

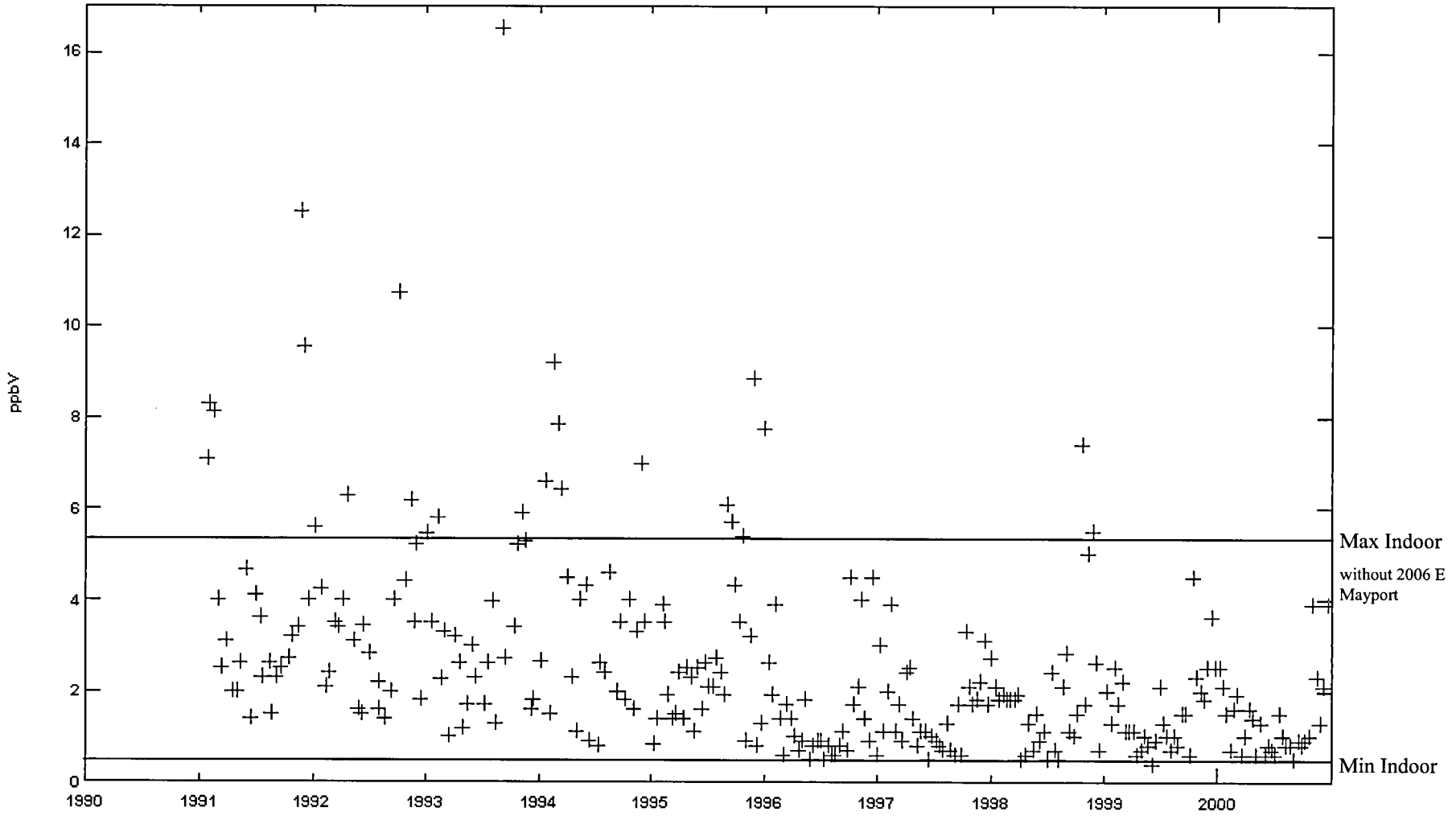


Figure 12: Toluene ambient air concentrations in San Francisco compared to indoor concentrations at the Site.
(To convert to mg/m^3, multiply by 0.00383.)

Appendix A
Human Health Risk Assessment

A.0 HUMAN HEALTH RISK ASSESSMENT

This section presents the methods and results of a human health risk assessment for receptors at the USCG Alameda housing area. The risk assessment was only performed for volatile PAHs and other organics detected at the Site. Section 4 of the report presents the results of the investigation of nonvolatile PAHs in soils at the Site.

A.1 Chemicals of Potential Concern

Neptune (2001) conducted a remedial investigation (RI) and sampled groundwater, soil vapor, and soils across Operable Unit 5 of the former Alameda NAS. In the RI, it was found that PAHs and VOCs, including benzene and naphthalene, occur in groundwater and soil vapor at the Site.

To ensure a health protective risk assessment, all of the chemicals detected at the Site were considered chemicals of potential concern (COPCs) (Table 1). As shown in Table 1, the COPCs consist of 6 volatile PAHs and 31 other organic compounds.

A.2 Identification of Exposure Pathways

The identification of exposure pathways is key to developing health-protective remedial goals. An exposure pathway describes the course that a chemical takes from a source to an exposed individual. Potential chemical exposures were evaluated for the Site by considering the following four factors:

- Sources of chemicals of potential concern;
- Environmental media in which COPCs have been detected (e.g., soil);
- Exposure or contact points with the environmental media (e.g., direct soil contact); and
- Means of entry into the receptor's body (e.g., dermal absorption).

The exposure pathways identified for receptors at the Site were based on evaluations of the likelihood of receptors directly contacting COPCs in the environment and the mechanisms governing the fate and transport of the chemicals of potential concern.

The Site is currently a residential area and is scheduled to remain as such through at least 2025. After that date, it will likely remain a residential district as well. Residential receptors also provide the most health-protective evaluation of conditions at the Site and were, therefore, selected as the only receptors evaluated at the Site.

The COPCs considered in this section of the report were not detected in soil samples. Therefore, it is assumed that no receptor will be exposed to the COPCs identified at the Site via direct contact and direct contact with soils was not evaluated. Groundwater at the Site is not used as a potable water source; water is piped in from municipal water supplies. Therefore, potable water use (i.e., ingestion and dermal contact during showering) was not considered to be a complete exposure pathway and was not evaluated. However, volatile chemicals were detected in soil vapor and groundwater at the Site. These chemicals in soil vapor or groundwater may migrate to the atmosphere where they may be inhaled by receptors at the Site. Therefore, the inhalation of vapors at the Site was considered to be the only complete exposure pathway. Further, the health-protective assumption was made that receptors at the Site are exposed to COPCs only via the inhalation of COPCs in indoor air. This provides a health protective evaluation of the health risks at the Site as VOCs can accumulate in indoor air to greater concentrations than are present in outdoor air.

A.3 Quantitative Exposure Analysis

Quantitative exposure analysis consists of estimates of the type, timing, and magnitude of exposures that human receptors may experience at the Site. Exposure parameters were determined based on USEPA (1989, 1991a, 1997, 2000b) guidance. Exposure parameters were estimated for current and future residents potentially exposed to COPCs as a result of the inhalation of volatile COPCs in indoor air.

Following the Neptune (2001) RI, residential receptors at the Site were assumed to be present at the Site for 350 days per year. Adult residential receptors were assumed to have an inhalation rate of 20 m^3/day and child receptors an inhalation rate of 10 m^3/day, with a body weight of 70 kg for adult receptors and 15 kg for child receptors (Neptune, 2001). Current adult and child receptors were evaluated separately for exposure durations of 3, 6, and 8 years following the statements of work (SOWs) provided by the USCG. To provide perspective, potential future residents were also evaluated using exposure durations of 24 years as an adult and 6 years as a child in combination with the other exposure parameters given above.

The exposure parameters and formulas used to estimate risks are shown in Table A-1.

The exposure point concentrations (EPCs) to which receptors were assumed to be exposed were the indoor air concentrations given in Section 2.1 of this report. All EPCs were based on the maximum detected concentration at the Site in soil vapor, hydropunch, or monitoring well samples (see Table 4, main report). EPCs were calculated for each source medium separately and are provided in Table 5 (in the main report).

A.4 Toxicity Assessment

The methods used to define the potentially toxic effects of the COPCs are described in this section of the report. Both the potentially carcinogenic and non-carcinogenic effects of the COPCs were considered in estimating the potential health risks for receptors at the Site.

The toxic effects of the COPCs were estimated by using toxicity assessments published by the USEPA. The USEPA has determined which COPCs are probable or possible carcinogens and have derived toxicity values, known as slope factors (SFs) that quantitatively define the relationship between exposure and the likelihood of carcinogenic effects. SFs are used for estimating the individual upperbound excess lifetime cancer risks associated with various levels of lifetime exposure to potential human carcinogens. In practice, SFs (expressed in units of $(mg/kg/day)^{-1}$) are derived from the results of human epidemiology studies or chronic animal bioassays. For this report, the toxicity values used in the Neptune (2001) RI were used, which were derived from various USEPA sources. However, no SF was available from the USEPA for MTBE. Instead, the Cal EPA (2001) SF was used. The inhalation SFs used are provided in Table A-2.

The USEPA has determined which constituents are noncarcinogenic, but potentially cause other types of adverse health effects. Typically, for noncarcinogens, adverse health effects may not occur until a specific level of exposure occurs. Toxicity values for noncarcinogens are therefore based on a threshold level of exposure, typically demonstrated in laboratory animals, with the incorporation of several uncertainty factors to ensure the protection of sensitive human individuals. The resulting chronic reference doses (RfDs) are defined as an estimate of the maximum daily exposure that will not produce an appreciable risk of adverse health effects during a lifetime. Again, the toxicity values used in the Neptune (2001) RI were used, which were derived from various USEPA sources. The inhalation RfDs are provided in Table A-3.

No toxicity data and no suitable surrogates were identified for 2-hexanone. Therefore, this chemical was not evaluated in the risk assessment. This remains a source of uncertainty.

A.5 Human Health Risk Characterization

Risk characterization integrates the exposure assessment and chemical toxicity information to quantitatively estimate potential health risks due to COPCs. Risk estimates were determined for individual routes of chemical exposure, as well as for additive effects. The results of the risk characterization provide a basis for decisions regarding further action at the Site.

A.5.1 Risk Estimation Procedures

Due to fundamental differences in the calculation of critical toxicity values, the estimates of potential individual excess carcinogenic risks and noncarcinogenic health effects were developed separately.

A.5.1.1 Carcinogenic Risk Probabilities

For carcinogens, the risk of cancer is assumed to be proportional to the dose with the assumption that any exposure results in a nonzero risk probability. Carcinogenic risk probabilities were calculated by multiplying the estimated exposure level by the route-specific cancer SF for each carcinogen:

$$R = E \times SF$$

where:

R = Estimated individual excess lifetime cancer risk;
E = Exposure or Intake level for each COPC (mg/kg/day); and
SF = Route- and chemical-specific slope factor ($(mg/kg/day)^{-1}$).

Risk probabilities determined for each carcinogen were also considered to be additive over all exposure pathways so that a carcinogenic risk probability was estimated for each group of potentially exposed receptors within each area evaluated.

Risk probabilities can be compared to the generally acceptable risk range specified by the U.S. EPA. According to the revised National Contingency Plan (NCP) (USEPA, 1990), carcinogenic risks from exposures at Superfund sites are considered to be unacceptable at a level greater than 1×10^{-4}, whereas risks smaller than 1×10^{-6} are considered to be of minimal concern. Action may not be necessary in the risk range of 10^{-6} to 10^{-4}. This is supported in the directive "Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions" (USEPA, 1991b), which indicates action is generally warranted at a site when the cumulative carcinogenic risk for any medium is greater than 10^{-4}. Altogether this range of potentially acceptable risks helps put the numerical risk estimates into perspective.

A.5.1.2 Noncarcinogenic Hazard Quotients and Hazard Indices

In contrast to carcinogens, noncarcinogens are considered to be threshold chemicals; a critical chemical dose must be exceeded before an adverse health effect is observed. The likelihood of a potential adverse health effect is represented by the ratio of the chemical exposure level and the route-specific RfD:

$$HQ = E / RfD$$

where:

HQ	=	Hazard Quotient for each chemical of potential concern;
E	=	Exposure or Intake level for COPC (mg/kg/day); and
RfD	=	Route- and chemical-specific Reference Dose ((mg/kg/day)).

Also, in a manner similar to carcinogens, hazard quotient (HQ) values were summed across exposure pathways and for all chemical exposures to develop Hazard Index (HI) values. An HQ or HI value greater than 1 indicates that an adverse health effect may occur due to a chemical exposure. HQs and HIs are not risk probabilities, but currently are accepted by the USEPA as quantitative levels of risk for noncarcinogens or the noncarcinogenic endpoints of carcinogens.

A.5.2 Risk Estimates

Carcinogenic risks and noncarcinogenic HI values were estimated separately for each receptor group that may be exposed to COPCs at the Site. Table A-4 summarizes the risk estimates for all receptors and Tables A-5 through A-25 show the risk estimates for each receptor from each source medium. A determination of the contribution (noted as percentages) of each COPC to the risk estimates for carcinogenic and noncarcinogenic effects for the given pathways is also provided. The risk analyses, therefore, provide an indication of the influence of individual organic compounds on the overall risk estimates.

The results are discussed briefly below by source medium.

A.5.2.1 Soil vapor

Potential exposures to the COPCs in soil vapor did not result in either carcinogenic risks or noncarcinogenic hazards that exceeded the USCG's criteria of a carcinogenic risk of 1×10^{-5} or a noncarcinogenic HQ of 1 for all receptors, regardless of exposure duration. Carcinogenic risks were below a risk of 1×10^{-5} by at least two orders of magnitude, indicating that the carcinogenic risks at the Site are acceptable. Additionally, the noncarcinogenic HIs estimated for all receptors at the Site were at least one order of magnitude below an HQ of 1, indicating that the noncarcinogenic hazards are negligible.

A.5.2.2 Hydropunch samples

Potential exposures to the COPCs in hydropunch groundwater samples did not result in either carcinogenic risks or noncarcinogenic hazards that exceeded the USCG's criteria of a carcinogenic risk of 1×10^{-5} or a noncarcinogenic HQ of 1 for all receptors, regardless of exposure duration. Carcinogenic risks were below a risk of 1×10^{-5} by at least one order of magnitude, indicating that the carcinogenic risks at the Site are acceptable. Additionally, the noncarcinogenic HIs estimated for all receptors at the Site were approximately an order of magnitude below an HQ of 1, indicating that the noncarcinogenic hazards are negligible.

A.5.2.3 Monitoring well samples

Potential exposures to the COPCs in monitoring well groundwater samples resulted in carcinogenic risks that exceeded the USCG's criteria of a carcinogenic risk of 1×10^{-5} for child receptors at the Site for 6 or 8 years and for future 30-year residents. Risks were estimated to be 1×10^{-5} for child residents present at the Site for 6 years, 1×10^{-5} for child residents present for 8 years, and 4×10^{-5} for future 30-year residents. It should be noted that the risks for adult residents and child residents present at the Site for 3 years are all in the 10^{-6} range (Table A-4). These risks are primarily due (98%) to assumed exposures to benzene. Noncarcinogenic HIs exceed the threshold value of 1 for all receptors. Regardless of exposure

duration, the HI for adult and future 30-year residents was 2 and the HI for child residents was 4. Again, these hazards are primarily due to the assumed inhalation of benzene vapors (82%). However, naphthalene also contributed 15% to the noncarcinogenic HIs. These results indicate that assumed exposures to vapors in indoor air at the Site might pose risks above the USCG's acceptable levels for both carcinogenic risks and noncarcinogenic hazards.

A.6 Summary

Using the health-protective assumption that indoor air exposures could be as high as those based on the maximum observed source concentrations, it was found that the potential health risks to residential receptors at the Site were below the USCG's criteria for carcinogenic and noncarcinogenic risks for two potential sources: soil vapor and hydropunch groundwater samples. Assumed exposures to the VOCs in groundwater monitoring well samples produced carcinogenic risk estimates exceeding the USCG's criterion of 1×10^{-5} for future 30-year residents and child residents present at the Site for more than 3 years. Additionally, noncarcinogenic hazards exceeded an HI of 1 for all receptors at the Site. These results indicate the potential for non-negligible health risks at the Site. These risk estimates indicate that air sampling should be conducted to verify potential levels of chemical exposures at the Site.

Table A-1
Exposure Formula and Parameters
Inhalation of Vapor
USCG Housing
Alameda, California

$$Intake\ (mg/kg/day) = \frac{C_a \times INR \times EF \times ED}{BW \times AT}$$

Variable	Parameter	Value	Source/Rationale[1]
C_a	Chemical concentration in air	- mg/m^3	Units for air
INR	Inhalation rate		
	Adult Residents	20 m^3/day	U.S. EPA 1991a
	Child Residents	10 m^3/day	U.S. EPA 1991a
EF	Exposure Frequency		
	Adult Residents	350 days/year	U.S. EPA 1991a
	Child Residents	350 days/year	U.S. EPA 1991a
ED	Exposure Duration		
	Adult Residents	3, 6, and 8 years	USCG SOWs
	Child Residents	3, 6, and 8 years	USCG SOWs
	Future Residents		
	Adult	24 years	U. S. EPA 1991a
	Child	6 years	U. S. EPA 1991a
BW	Body Weight		
	Adult Resident	70 kg	U.S. EPA 1989a
	Child Resident	15 kg	U.S. EPA 1989a
AT	Averaging Time		
	Carcinogen	70 years x 365 days/year	Lifetime (U.S. EPA 1989a)
	Non-carcinogen	ED x 365 days/year	U.S. EPA 1989a

Notes:

1 - All exposure parameters, and their cited sources, are from the Neptune (2001) RI, except for Exposure Duration. The sources for the Exposure Durations used in the risk analyses are as cited above.

Table A-2
Inhalation Carcinogenic Slope Factors
USCG Housing
Alameda, California

Chemical	Inhalation Slope Factor $(mg/kg/day)^{-1}$	U.S. EPA Unit Risk $(mg/m^3)^{-1}$	Weight of Evidence	Tumor	Test Species	Source	Date[1]
Acenaphthene	-	-	-	-	-	-	12/21/2001
Acenaphthylene	-	-	D	-	-	-	12/21/2001
Acetone	-	-	D	-	-	-	12/21/2001
Anthracene	-	-	D	-	-	-	12/21/2001
Benzene	2.7E-02	7.8E-03	A	Leukemia	Human	IRIS	12/21/2001
Bromodichloromethane	6.2E-02	-	B2	-	-	2	12/21/2001
2-Butanone	-	-	D	-	-	-	12/21/2001
Chlorobenzene	-	-	D	-	-	-	12/21/2001
Chloroethane	2.9E-03	-	-	-	-	NCEA; 2	12/21/2001
Chloroform	8.1E-02	2.3E-02	B2	Hepatocellular carcinoma	Mouse	IRIS	12/21/2001
Chloromethane (Methyl chloride)	-	-	D	-	-	-	1/17/2002
Dibromochloromethane	8.4E-02	-	C	-	-	2	12/21/2001
1,1-Dichloroethane	-	-	D	-	-	-	12/21/2001
1,2-Dichloroethane	9.1E-02	2.6E-02	B2	Hemangiosarcomas	Rat	IRIS	12/21/2001
cis-1,2-Dichloroethene	-	-	D	-	-	-	12/21/2001
trans-1,2-Dichloroethene	-	-	-	-	-	-	12/21/2001
Ethylbenzene	-	-	D	-	-	-	12/21/2001
Fluorene	-	-	D	-	-	-	12/21/2001
2-Hexanone	-	-	-	-	-	-	1/18/2002
Isopropylbenzene (cumene)	-	-	D	-	-	-	12/21/2001
4-Isopropyltoluene	-	-	D	-	-	4	12/21/2001
Methylene chloride	1.6E-03	4.7E-04	B2	Combined adenomas and carcinomas	Mouse	IRIS	12/21/2001
4-Methyl-2-Pentanone	-	-	-	-	-	-	12/21/2001
MTBE	1.8E-03	-	-	-	-	Cal/EPA	12/21/2001
Naphthalene	-	-	C	-	-	-	12/21/2001
Phenanthrene	-	-	D	-	-	-	12/21/2001
n-Propylbenzene	-	-	-	-	-	-	12/21/2001
Styrene	-	-	-	-	-	-	12/21/2001
Tetrachloroethene	2.0E-03	-	C-B2	-	-	NCEA	12/21/2001
Toluene	-	-	D	-	-	-	12/21/2001
1,1,1-Trichloroethane	-	-	D	-	-	-	12/21/2001
Trichloroethene	6.0E-03	-	C-B2	-	-	NCEA	12/21/2001
1,2,4-Trimethylbenzene	-	-	-	-	-	-	12/21/2001
1,3,5-Trimethylbenzene	-	-	-	-	-	-	12/21/2001
Vinyl acetate	-	-	-	-	-	-	12/21/2001
Vinyl chloride	3.1E-02	8.8E-03	A	Liver angiosarcomas, angiomas, hepatomas, and neoplastic nodules	Rat	IRIS	12/21/2001
Xylenes (Total)	-	-	D	-	-	-	12/21/2001

Definitions:

Cal EPA - California Environmental Protection Agency.
IRIS - Integrated Risk Information System.
$(mg/kg/day)^{-1}$ - Risk per milligrams per kilogram per day.
$(mg/m^3)^{-1}$ - Risk per milligrams per cubic meter.
NCEA - National Center for Environmental Assessment

Notes:

1 - Slope factors, weights of evidence, and sources taken from the Remedial Investigation Report by Neptune and Co. (2001), except for chloromethane.
2 - Based on route-to-route extrapolation from the oral exposure route.
3 - No toxicity data available.
4 - Isopropylbenzene was used as a surrogate.

Inhalation slope factors were calculated from U.S. EPA unit risks as follows: slope factor = (air unit risk)(70 kg)/(20 m^3/day)(10E-3).

Table A-3
Inhalation Noncarcinogenic Inhalation Reference Doses
USCG Housing
Alameda, California

Chemical	Inhalation RfD (mg/kg/day)	RfC (mg/m^3)	Confidence	MF	UF	Critical Effect	Test Species	Source	Date[1]
Acenaphthene	6.00E-02	-	-	-	-	-	-	2	12/21/2001
Acenaphthylene	8.57E-04	-	-	-	-	-	-	IRIS, 3	12/21/2001
Acetone	1.00E-01	-	-	-	-	-	-	2	12/21/2001
Anthracene	3.00E-01	-	-	-	-	-	-	2	12/21/2001
Benzene	1.70E-03	-	-	-	-	-	-	NCEA	12/21/2001
Bromodichloromethane	2.00E-02	-	-	-	-	-	-	2	12/21/2001
2-Butanone	2.90E-01	1.0E+00	Low	3	1000	Decreased fetal birth weight	Mouse	IRIS	12/21/2001
Chlorobenzene	1.70E-02	-	-	-	-	-	-	NCEA	12/21/2001
Chloroethane	2.90E+00	1.0E+01	Medium	1	300	Delayed fetal ossification	Mouse	IRIS	12/21/2001
Chloroform	8.60E-05	-	-	-	-	-	-	NCEA	12/21/2001
Chloromethane (Methyl chloride)	2.57E-02	9.0E-02	Medium	1	1000	Cerebellar lesions	Mouse	IRIS	1/17/2002
Dibromochloromethane	2.00E-02	-	-	-	-	-	-	2	12/21/2001
1,1-Dichloroethane	1.40E-01	-	-	-	-	-	-	HEAST	12/21/2001
1,2-Dichloroethane	1.40E-03	-	-	-	-	-	-	NCEA	12/21/2001
cis-1,2-Dichloroethene	1.00E-02	-	-	-	-	-	-	2	12/21/2001
trans-1,2-Dichloroethene	2.00E-02	-	-	-	-	-	-	2	12/21/2001
Ethylbenzene	2.90E-01	1.0E+00	Low	1	300	Developmental toxicity	Rat, rabbit	IRIS	12/21/2001
Fluorene	4.00E-02	-	-	-	-	-	-	2	12/21/2001
2-Hexanone	-	-	-	-	-	-	-	4	1/18/2002
Isopropylbenzene (cumene)	1.14E-01	4.0E-01	Medium	1	1000	Increased kidney and adrenal weight	Rat	IRIS	12/21/2001
4-Isopropyltoluene	1.14E-01	-	-	-	-	-	-	5	12/21/2001
Methylene Chloride	8.60E-01	-	-	-	-	-	-	HEAST	12/21/2001
4-Methyl-2-Pentanone	2.30E-02	-	-	-	-	-	-	HEAST	12/21/2001
MTBE	8.60E-01	3.0E+00	Medium	1	100	Increased kidney and adrenal weight, and swollen periocular tissue	Rat	IRIS	12/21/2001
Naphthalene	8.57E-04	3.0E-03	Medium	1	3000	Nasal effects in respiratory and olfactory epithelium	Mouse	IRIS	12/21/2001
Phenanthrene	8.57E-04	-	-	-	-	-	-	IRIS, 3	12/21/2001
Pyrene	3.00E-02	-	-	-	-	-	-	2	12/21/2001
n-Propylbenzene	1.00E-02	-	-	-	-	-	-	2	12/21/2001
Styrene	2.90E-01	1.0E+00	Medium	1	30	CNS effects	Human	IRIS	12/21/2001
Tetrachloroethene	1.10E-01	-	-	-	-	-	-	NCEA	12/21/2001
Toluene	1.10E-01	4.0E-01	Medium	1	300	Neurological effects	Human	IRIS	12/21/2001
1,1,1-Trichloroethane	2.90E-01	-	-	-	-	-	-	NCEA	12/21/2001
Trichloroethene	7.35E-03	-	-	-	-	-	-	2	12/21/2001
1,2,4-Trimethylbenzene	1.70E-03	-	-	-	-	-	-	NCEA	12/21/2001
1,3,5-Trimethylbenzene	1.70E-03	-	-	-	-	-	-	NCEA	12/21/2001
Vinyl acetate	5.71E-02	2.0E-01	High	1	30	Nasal epithelial lesions	Rat, mouse	IRIS	12/21/2001
Vinyl chloride	2.90E-02	1.0E-01	Medium	1	30	Liver cell polymorphism	Rat	IRIS	12/21/2001
Xylenes (Total)	2.00E+00	-	-	-	-	-	-	2	12/21/2001

Definitions:

DTSC - Department of Toxic Substances Control.
HEAST - Health Effects Assessment Summary Tables.
NCEA - National Center for Environmental Assessment
IRIS - Integrated Risk Information System.
MF - Modifying factor.
mg/kg/day - Milligram per kilogram per day.
mg/m^3 - Milligram per kilogram per day.
NA - Not available
RfC - Reference concentration.
RfD - Reference dose.
UF - Uncertainty factor.

Notes:

1 - Slope factors, weights of evidence, and sources taken from the Remedial Investigation Report by Neptune and Co. (2001), except for chloromethane.
2 - A route-to-route extrapolation was performed, the oral RfD was applied for the inhalation exposure route.
3 - The naphthalene RfD was applied.
4 - No toxicity data available.
5 - Isopropylbenzene was used as a surrogate.

Table A-4
Carcinogenic and Non-carcinogenic Risk Estimate Summary
USCG Housing
Alameda, CA

		Risk by Source Medium		
			Groundwater	
Receptor	Exposure Time (yrs)	Soil Vapor	Hydropunch (0-12 ft bgs)	Monitoring well[1]
Adult Resident				
	3	1.E-08	9.E-08	3.E-06
	6	2.E-08	2.E-07	6.E-06
	8	3.E-08	2.E-07	8.E-06
Child Resident				
	3	3.E-08	2.E-07	7.E-06
	6	5.E-08	4.E-07	**1.E-05**
	8	7.E-08	5.E-07	**2.E-05**
Future Resident				
	30	1.E-07	1.E-06	**4.E-05**

		HI by Source Medium		
			Groundwater	
Receptor	Exposure Time (yrs)	Soil Vapor	Hydropunch (0-12 ft bgs)	Monitoring well[1]
Adult Resident				
	3	0.04	0.08	**2**
	6	0.04	0.08	**2**
	8	0.04	0.08	**2**
Child Resident				
	3	0.09	0.2	**4**
	6	0.09	0.2	**4**
	8	0.09	0.2	**4**
Future Resident				
	30	0.05	0.1	**2**

Notes:

1 - 98% of the carcinogenic risk estimate is from potential exposure to benzene. 82% of the non-carcinogenic risk estimate (HI) is from potential exposure to benzene.

bgs - below ground surface.

ft - feet.

HI - Hazard Index.

yrs - years

Bold - Estimated carcinogenic risk exceeds 1 x 10-5 or estimated non-carinogenic hazard index (HI exceeds 1).

Table A-5
Risk Estimates for Current Adult Resident (3 yrs exposure)
Soil Vapor Source[1]
USCG Housing
Alameda, California

	Risk Probabilities	
Carcinogen	**Indoor Vapor Inhalation**	**Percent Contribution**
Benzene	6.53E-10	6%
Chloroethane	2.06E-11	0%
Chloroform	9.34E-09	81%
MTBE	3.74E-10	3%
Tetrachloroethene	1.94E-10	2%
Trichloroethene	9.29E-10	8%
Summation:	1.15E-08	

	Hazard Index (HI)	
Noncarcinogen	**Indoor Vapor Inhalation**	**Percent Contribution**
Acetone	8.90E-05	0%
Benzene	3.32E-04	1%
2-Butanone	2.28E-05	0%
Chlorobenzene	4.24E-05	0%
Chloroethane	5.71E-08	0%
Chloroform	3.09E-02	85%
1,1-Dichloroethane	7.91E-06	0%
cis-1,2-Dichloroethene	5.45E-05	0%
Ethylbenzene	3.42E-05	0%
4-Methyl-2-pentanone	8.03E-05	0%
MTBE	5.64E-06	0%
Naphthalene	4.64E-03	13%
Styrene	6.18E-07	0%
Tetrachloroethene	2.06E-05	0%
Toluene	7.30E-05	0%
1,1,1-Trichloroethane	2.67E-06	0%
Trichloroethene	4.92E-04	1%
Vinyl acetate	3.61E-05	0%
Xylene	3.55E-05	0%
Summation:	0.04	

Notes:

1 - Risk estimates are based on the maximum detected concentration of each COPC, regardless of location.

Table A-6
Risk Estimates for Current Adult Resident (6 yrs exposure)
Soil Vapor Source[1]
USCG Housing
Alameda, California

	Risk Probabilities	
Carcinogen	**Indoor Vapor Inhalation**	**Percent Contribution**
Benzene	1.31E-09	6%
Chloroethane	4.11E-11	0%
Chloroform	1.87E-08	81%
MTBE	7.48E-10	3%
Tetrachloroethene	3.88E-10	2%
Trichloroethene	1.86E-09	8%
Summation:	2.30E-08	

	Hazard Index (HI)	
Noncarcinogen	**Indoor Vapor Inhalation**	**Percent Contribution**
Acetone	8.90E-05	0%
Benzene	3.32E-04	1%
2-Butanone	2.28E-05	0%
Chlorobenzene	4.24E-05	0%
Chloroethane	5.71E-08	0%
Chloroform	3.09E-02	85%
1,1-Dichloroethane	7.91E-06	0%
cis-1,2-Dichloroethene	5.45E-05	0%
Ethylbenzene	3.42E-05	0%
4-Methyl-2-pentanone	8.03E-05	0%
MTBE	5.64E-06	0%
Naphthalene	4.64E-03	13%
Styrene	6.18E-07	0%
Tetrachloroethene	2.06E-05	0%
Toluene	7.30E-05	0%
1,1,1-Trichloroethane	2.67E-06	0%
Trichloroethene	4.92E-04	1%
Vinyl acetate	3.61E-05	0%
Xylene	3.55E-05	0%
Summation:	0.04	

Notes:

1 - Risk estimates are based on the maximum detected concentration of each COPC, regardless of location.

Table A-7
Risk Estimates for Adult Resident (8 yrs exposure)
Soil Vapor Source[1]
USCG Housing
Alameda, California

	Risk Probabilities	
Carcinogen	**Indoor Vapor Inhalation**	**Percent Contribution**
Benzene	1.74E-09	6%
Chloroethane	5.48E-11	0%
Chloroform	2.49E-08	81%
MTBE	9.97E-10	3%
Tetrachloroethene	5.17E-10	2%
Trichloroethene	2.48E-09	8%
Summation:	3.07E-08	

	Hazard Index (HI)	
Noncarcinogen	**Indoor Vapor Inhalation**	**Percent Contribution**
Acetone	8.90E-05	0%
Benzene	3.32E-04	1%
2-Butanone	2.28E-05	0%
Chlorobenzene	4.24E-05	0%
Chloroethane	5.71E-08	0%
Chloroform	3.09E-02	85%
1,1-Dichloroethane	7.91E-06	0%
cis-1,2-Dichloroethene	5.45E-05	0%
Ethylbenzene	3.42E-05	0%
4-Methyl-2-pentanone	8.03E-05	0%
MTBE	5.64E-06	0%
Naphthalene	4.64E-03	13%
Styrene	6.18E-07	0%
Tetrachloroethene	2.06E-05	0%
Toluene	7.30E-05	0%
1,1,1-Trichloroethane	2.67E-06	0%
Trichloroethene	4.92E-04	1%
Vinyl acetate	3.61E-05	0%
Xylene	3.55E-05	0%
Summation:	0.04	

Notes:

1 - Risk estimates are based on the maximum detected concentration of each COPC, regardless of location.

Table A-8
Risk Estimates for Child Resident (3 yrs exposure)
Soil Vapor Source[1]
USCG Housing
Alameda, California

	Risk Probabilities	
Carcinogen	**Indoor Vapor Inhalation**	**Percent Contribution**
Benzene	1.52E-09	6%
Chloroethane	4.80E-11	0%
Chloroform	2.18E-08	81%
MTBE	8.72E-10	3%
Tetrachloroethene	4.52E-10	2%
Trichloroethene	2.17E-09	8%
Summation:	2.69E-08	

	Hazard Index (HI)	
Noncarcinogen	**Indoor Vapor Inhalation**	**Percent Contribution**
Acetone	2.08E-04	0%
Benzene	7.75E-04	1%
2-Butanone	5.31E-05	0%
Chlorobenzene	9.89E-05	0%
Chloroethane	1.33E-07	0%
Chloroform	7.22E-02	84%
1,1-Dichloroethane	1.84E-05	0%
cis-1,2-Dichloroethene	1.27E-04	0%
Ethylbenzene	7.98E-05	0%
4-Methyl-2-pentanone	1.87E-04	0%
MTBE	1.32E-05	0%
Naphthalene	1.08E-02	13%
Styrene	1.44E-06	0%
Tetrachloroethene	4.80E-05	0%
Toluene	1.70E-04	0%
1,1,1-Trichloroethane	6.24E-06	0%
Trichloroethene	1.15E-03	1%
Vinyl acetate	8.43E-05	0%
Xylene	8.28E-05	0%
Summation:	0.09	

Notes:

1 - Risk estimates are based on the maximum detected concentration of each COPC, regardless of location.

Table A-9
Risk Estimates for Child Resident (6 yrs exposure)
Soil Vapor Source[1]
USCG Housing
Alameda, California

	Risk Probabilities	
Carcinogen	**Indoor Vapor Inhalation**	**Percent Contribution**
Benzene	3.05E-09	6%
Chloroethane	9.59E-11	0%
Chloroform	4.36E-08	81%
MTBE	1.74E-09	3%
Tetrachloroethene	9.05E-10	2%
Trichloroethene	4.34E-09	8%
Summation:	5.37E-08	

	Hazard Index (HI)	
Noncarcinogen	**Indoor Vapor Inhalation**	**Percent Contribution**
Acetone	2.08E-04	0%
Benzene	7.75E-04	1%
2-Butanone	5.31E-05	0%
Chlorobenzene	9.89E-05	0%
Chloroethane	1.33E-07	0%
Chloroform	7.22E-02	84%
1,1-Dichloroethane	1.84E-05	0%
cis-1,2-Dichloroethene	1.27E-04	0%
Ethylbenzene	7.98E-05	0%
4-Methyl-2-pentanone	1.87E-04	0%
MTBE	1.32E-05	0%
Naphthalene	1.08E-02	13%
Styrene	1.44E-06	0%
Tetrachloroethene	4.80E-05	0%
Toluene	1.70E-04	0%
1,1,1-Trichloroethane	6.24E-06	0%
Trichloroethene	1.15E-03	1%
Vinyl acetate	8.43E-05	0%
Xylene	8.28E-05	0%
Summation:	0.09	

Notes:

1 - Risk estimates are based on the maximum detected concentration of each COPC, regardless of location.

Table A-10
Risk Estimates for Child Resident (8 yrs exposure)
Soil Vapor Source[1]
USCG Housing
Alameda, California

	Risk Probabilities	
Carcinogen	**Indoor Vapor Inhalation**	**Percent Contribution**
Benzene	4.06E-09	6%
Chloroethane	1.28E-10	0%
Chloroform	5.81E-08	81%
MTBE	2.33E-09	3%
Tetrachloroethene	1.21E-09	2%
Trichloroethene	5.78E-09	8%
Summation:	7.16E-08	

	Hazard Index (HI)	
Noncarcinogen	**Indoor Vapor Inhalation**	**Percent Contribution**
Acetone	2.08E-04	0%
Benzene	7.75E-04	1%
2-Butanone	5.31E-05	0%
Chlorobenzene	9.89E-05	0%
Chloroethane	1.33E-07	0%
Chloroform	7.22E-02	84%
1,1-Dichloroethane	1.84E-05	0%
cis-1,2-Dichloroethene	1.27E-04	0%
Ethylbenzene	7.98E-05	0%
4-Methyl-2-pentanone	1.87E-04	0%
MTBE	1.32E-05	0%
Naphthalene	1.08E-02	13%
Styrene	1.44E-06	0%
Tetrachloroethene	4.80E-05	0%
Toluene	1.70E-04	0%
1,1,1-Trichloroethane	6.24E-06	0%
Trichloroethene	1.15E-03	1%
Vinyl acetate	8.43E-05	0%
Xylene	8.28E-05	0%
Summation:	0.09	

Notes:

1 - Risk estimates are based on the maximum detected concentration of each COPC, regardless of location.

Table A-11
Risk Estimates for Future Resident (30 yrs exposure)
Soil Vapor Source[1]
USCG Housing
Alameda, California

	Risk Probabilities	
Carcinogen	**Indoor Vapor Inhalation**	**Percent Contribution**
Benzene	8.27E-09	6%
Chloroethane	2.60E-10	0%
Chloroform	1.18E-07	81%
MTBE	4.74E-09	3%
Tetrachloroethene	2.46E-09	2%
Trichloroethene	1.18E-08	8%
Summation:	1.46E-07	

	Hazard Index (HI)	
Noncarcinogen	**Indoor Vapor Inhalation**	**Percent Contribution**
Acetone	1.13E-04	0%
Benzene	4.21E-04	1%
2-Butanone	2.88E-05	0%
Chlorobenzene	5.37E-05	0%
Chloroethane	7.23E-08	0%
Chloroform	3.92E-02	84%
1,1-Dichloroethane	1.00E-05	0%
cis-1,2-Dichloroethene	6.91E-05	0%
Ethylbenzene	4.33E-05	0%
4-Methyl-2-pentanone	1.02E-04	0%
MTBE	7.14E-06	0%
Naphthalene	5.87E-03	13%
Styrene	7.83E-07	0%
Tetrachloroethene	2.61E-05	0%
Toluene	9.24E-05	0%
1,1,1-Trichloroethane	3.39E-06	0%
Trichloroethene	6.23E-04	1%
Vinyl acetate	4.58E-05	0%
Xylene	4.49E-05	0%
Summation:	0.05	

Notes:

1 - Risk estimates are based on the maximum detected concentration of each COPC, regardless of location.

Table A-12
Risk Estimates for Adult Resident (3 yrs exposure)
Hydropunch Source[1]
USCG Housing
Alameda, California

		Risk Probabilities	
Carcinogen		**Indoor Vapor Inhalation**	**Percent Contribution**
	Benzene	7.54E-08	87%
	Bromodichloromethane	1.27E-10	0%
	Dibromochloromethane	3.36E-10	0%
	Methylene chloride	3.62E-10	0%
	MTBE	2.37E-11	0%
	Vinyl chloride	1.06E-08	12%
Summation:		8.68E-08	

		Hazard Index (HI)	
Noncarcinogen		**Indoor Vapor Inhalation**	**Percent Contribution**
	Acenaphthene	1.67E-05	0%
	Acenaphthylene	2.31E-03	3%
	Anthracene	1.29E-07	0%
	Benzene	3.84E-02	49%
	Bromodichloromethane	2.38E-06	0%
	Dibromochloromethane	4.67E-06	0%
	cis-1,2-Dichloroethene	1.27E-04	0%
	trans-1,2-Dichloroethene	2.97E-05	0%
	Ethylbenzene	1.49E-04	0%
	Fluorene	4.42E-07	0%
	Isopropylbenzene (cumene)	5.72E-04	1%
	4-Isopropyltoluene	8.17E-04	1%
	Methylene chloride	6.15E-06	0%
	MTBE	3.57E-07	0%
	Naphthalene	3.13E-02	40%
	Phenanthrene	6.68E-04	1%
	Toluene	4.88E-05	0%
	1,2,4-Trimethylbenzene	1.27E-03	2%
	1,3,5-Trimethylbenzene	1.71E-03	2%
	Vinyl chloride	2.75E-04	0%
	Xylene	1.82E-05	0%
Summation		0.08	

Notes:

1 - Risk estimates are based on the maximum detected concentration of each COPC, regardless of location.

Table A-13
Risk Estimates for Adult Resident (6 yrs exposure)
Hydropunch Source[1]
USCG Housing
Alameda, California

		Risk Probabilities	
Carcinogen		**Indoor Vapor Inhalation**	**Percent Contribution**
	Benzene	1.51E-07	87%
	Bromodichloromethane	2.53E-10	0%
	Dibromochloromethane	6.72E-10	0%
	Methylene chloride	7.25E-10	0%
	MTBE	4.73E-11	0%
	Vinyl chloride	2.12E-08	12%
Summation:		1.74E-07	

		Hazard Index (HI)	
Noncarcinogen		**Indoor Vapor Inhalation**	**Percent Contribution**
	Acenaphthene	1.67E-05	0%
	Acenaphthylene	2.31E-03	3%
	Anthracene	1.29E-07	0%
	Benzene	3.84E-02	49%
	Bromodichloromethane	2.38E-06	0%
	Dibromochloromethane	4.67E-06	0%
	cis-1,2-Dichloroethene	1.27E-04	0%
	trans-1,2-Dichloroethene	2.97E-05	0%
	Ethylbenzene	1.49E-04	0%
	Fluorene	4.42E-07	0%
	Isopropylbenzene (cumene)	5.72E-04	1%
	4-Isopropyltoluene	8.17E-04	1%
	Methylene chloride	6.15E-06	0%
	MTBE	3.57E-07	0%
	Naphthalene	3.13E-02	40%
	Phenanthrene	6.68E-04	1%
	Toluene	4.88E-05	0%
	1,2,4-Trimethylbenzene	1.27E-03	2%
	1,3,5-Trimethylbenzene	1.71E-03	2%
	Vinyl chloride	2.75E-04	0%
	Xylene	1.82E-05	0%
Summation		0.08	

Notes:

1 - Risk estimates are based on the maximum detected concentration of each COPC, regardless of location.

Table A-14
Risk Estimates for Adult Resident (8 yrs exposure)
Hydropunch Source[1]
USCG Housing
Alameda, California

	Risk Probabilities	
Carcinogen	**Indoor Vapor Inhalation**	**Percent Contribution**
Benzene	2.01E-07	87%
Bromodichloromethane	3.38E-10	0%
Dibromochloromethane	8.96E-10	0%
Methylene chloride	9.66E-10	0%
MTBE	6.31E-11	0%
Vinyl chloride	2.82E-08	12%
Summation:	2.31E-07	

	Hazard Index (HI)	
Noncarcinogen	**Indoor Vapor Inhalation**	**Percent Contribution**
Acenaphthene	1.67E-05	0%
Acenaphthylene	2.31E-03	3%
Anthracene	1.29E-07	0%
Benzene	3.84E-02	51%
Bromodichloromethane	2.38E-06	0%
Dibromochloromethane	4.67E-06	0%
cis-1,2-Dichloroethene	1.27E-04	0%
trans-1,2-Dichloroethene	2.97E-05	0%
Ethylbenzene	1.49E-04	0%
Fluorene	4.42E-07	0%
Isopropylbenzene (cumene)	5.72E-04	1%
4-Isopropyltoluene	8.17E-04	1%
Methylene chloride	6.15E-06	0%
MTBE	3.57E-07	0%
Naphthalene	3.13E-02	42%
Phenanthrene	6.68E-04	1%
Toluene	4.88E-05	0%
1,2,4-Trimethylbenzene	1.27E-03	2%
1,3,5-Trimethylbenzene	1.71E-03	2%
Vinyl chloride	2.75E-04	0%
Xylene	1.82E-05	0%
Summation:	0.08	

Notes:

1 - Risk estimates are based on the maximum detected concentration of each COPC, regardless of location.

Table A-15
Risk Estimates for Child Resident (3 yrs exposure)
Hydropunch Source[1]
USCG Housing
Alameda, California

	Risk Probabilities	
Carcinogen	**Indoor Vapor Inhalation**	**Percent Contribution**
Benzene	1.76E-07	87%
Bromodichloromethane	2.95E-10	0%
Dibromochloromethane	7.84E-10	0%
Methylene chloride	8.45E-10	0%
MTBE	5.52E-11	0%
Vinyl chloride	2.47E-08	12%
Summation:	2.03E-07	

	Hazard Index (HI)	
Noncarcinogen	**Indoor Vapor Inhalation**	**Percent Contribution**
Acenaphthene	3.90E-05	0%
Acenaphthylene	5.39E-03	3%
Anthracene	3.00E-07	0%
Benzene	8.95E-02	49%
Bromodichloromethane	5.56E-06	0%
Dibromochloromethane	1.09E-05	0%
cis-1,2-Dichloroethene	2.96E-04	0%
trans-1,2-Dichloroethene	6.94E-05	0%
Ethylbenzene	3.48E-04	0%
Fluorene	1.03E-06	0%
Isopropylbenzene (cumene)	1.33E-03	1%
4-Isopropyltoluene	1.91E-03	1%
Methylene chloride	1.43E-05	0%
MTBE	8.33E-07	0%
Naphthalene	7.31E-02	40%
Phenanthrene	1.56E-03	1%
Toluene	1.14E-04	0%
1,2,4-Trimethylbenzene	2.96E-03	2%
1,3,5-Trimethylbenzene	3.99E-03	2%
Vinyl chloride	6.41E-04	0%
Xylene	4.25E-05	0%
Summation:	0.2	

Notes:

1 - Risk estimates are based on the maximum detected concentration of each COPC, regardless of location.

Table A-16
Risk Estimates for Child Resident (6 yrs exposure)
Hydropunch Source[1]
USCG Housing
Alameda, California

	Risk Probabilities	
Carcinogen	**Indoor Vapor Inhalation**	**Percent Contribution**
Benzene	3.52E-07	87%
Bromodichloromethane	5.91E-10	0%
Dibromochloromethane	1.57E-09	0%
Methylene chloride	1.69E-09	0%
MTBE	1.10E-10	0%
Vinyl chloride	4.94E-08	12%
Summation:	4.05E-07	

	Hazard Index (HI)	
Noncarcinogen	**Indoor Vapor Inhalation**	**Percent Contribution**
Acenaphthene	3.90E-05	0%
Acenaphthylene	5.39E-03	3%
Anthracene	3.00E-07	0%
Benzene	8.95E-02	49%
Bromodichloromethane	5.56E-06	0%
Dibromochloromethane	1.09E-05	0%
cis-1,2-Dichloroethene	2.96E-04	0%
trans-1,2-Dichloroethene	6.94E-05	0%
Ethylbenzene	3.48E-04	0%
Fluorene	1.03E-06	0%
Isopropylbenzene (cumene)	1.33E-03	1%
4-Isopropyltoluene	1.91E-03	1%
Methylene chloride	1.43E-05	0%
MTBE	8.33E-07	0%
Naphthalene	7.31E-02	40%
Phenanthrene	1.56E-03	1%
Toluene	1.14E-04	0%
1,2,4-Trimethylbenzene	2.96E-03	2%
1,3,5-Trimethylbenzene	3.99E-03	2%
Vinyl chloride	6.41E-04	0%
Xylene	4.25E-05	0%
Summation:	0.2	

Notes:

1 - Risk estimates are based on the maximum detected concentration of each COPC, regardless of location.

Table A-17
Risk Estimates for Child Resident (8 yrs exposure)
Hydropunch Source[1]
USCG Housing
Alameda, California

	Risk Probabilities	
Carcinogen	**Indoor Vapor Inhalation**	**Percent Contribution**
Benzene	4.69E-07	87%
Bromodichloromethane	7.88E-10	0%
Dibromochloromethane	2.09E-09	0%
Methylene chloride	2.25E-09	0%
MTBE	1.47E-10	0%
Vinyl chloride	6.59E-08	12%
Summation:	5.40E-07	

	Hazard Index (HI)	
Noncarcinogen	**Indoor Vapor Inhalation**	**Percent Contribution**
Acenaphthene	3.90E-05	0%
Acenaphthylene	5.39E-03	3%
Anthracene	3.00E-07	0%
Benzene	8.95E-02	49%
Bromodichloromethane	5.56E-06	0%
Dibromochloromethane	1.09E-05	0%
cis-1,2-Dichloroethene	2.96E-04	0%
trans-1,2-Dichloroethene	6.94E-05	0%
Ethylbenzene	3.48E-04	0%
Fluorene	1.03E-06	0%
Isopropylbenzene (cumene)	1.33E-03	1%
4-Isopropyltoluene	1.91E-03	1%
Methylene chloride	1.43E-05	0%
MTBE	8.33E-07	0%
Naphthalene	7.31E-02	40%
Phenanthrene	1.56E-03	1%
Toluene	1.14E-04	0%
1,2,4-Trimethylbenzene	2.96E-03	2%
1,3,5-Trimethylbenzene	3.99E-03	2%
Vinyl chloride	6.41E-04	0%
Xylene	4.25E-05	0%
Summation:	0.2	

Notes:

1 - Risk estimates are based on the maximum detected concentration of each COPC, regardless of location.

Table A-18
Risk Estimates for Future Resident (30 yrs exposure)
Hydropunch Source[1]
USCG Housing
Alameda, California

	Risk Probabilities	
Carcinogen	**Indoor Vapor Inhalation**	**Percent Contribution**
Benzene	9.55E-07	87%
Bromodichloromethane	1.60E-09	0%
Dibromochloromethane	4.26E-09	0%
Methylene chloride	4.59E-09	0%
MTBE	3.00E-10	0%
Vinyl chloride	1.34E-07	12%
Summation:	1.10E-06	

	Hazard Index (HI)	
Noncarcinogen	**Indoor Vapor Inhalation**	**Percent Contribution**
Acenaphthene	2.12E-05	0%
Acenaphthylene	2.92E-03	3%
Anthracene	1.63E-07	0%
Benzene	4.86E-02	49%
Bromodichloromethane	3.02E-06	0%
Dibromochloromethane	5.92E-06	0%
cis-1,2-Dichloroethene	1.61E-04	0%
trans-1,2-Dichloroethene	3.77E-05	0%
Ethylbenzene	1.89E-04	0%
Fluorene	5.60E-07	0%
Isopropylbenzene (cumene)	7.25E-04	1%
4-Isopropyltoluene	1.04E-03	1%
Methylene chloride	7.79E-06	0%
MTBE	4.52E-07	0%
Naphthalene	3.97E-02	40%
Phenanthrene	8.46E-04	1%
Toluene	6.18E-05	0%
1,2,4-Trimethylbenzene	1.60E-03	2%
1,3,5-Trimethylbenzene	2.16E-03	2%
Vinyl chloride	3.48E-04	0%
Xylene	2.31E-05	0%
Summation:	0.1	

Notes:

1 - Risk estimates are based on the maximum detected concentration of each COPC, regardless of location.

Table A-19
Risk Estimates for Adult Resident (3 yrs exposure)
Monitoring Well Source[1]
USCG Housing
Alameda, California

		Risk Probabilities	
Carcinogen		**Indoor Vapor Inhalation**	**Percent Contribution**
	Benzene	2.98E-06	98%
	1,2-Dichloroethane	5.06E-08	2%
	Methylene chloride	1.03E-10	0%
	MTBE	3.74E-10	0%
Summation:		3.03E-06	

		Hazard Index (HI)	
Noncarcinogen		**Indoor Vapor Inhalation**	**Percent Contribution**
	Acenaphthene	1.87E-05	0%
	Acenaphthylene	1.10E-02	1%
	Anthracene	3.32E-07	0%
	Benzene	1.51E+00	82%
	Chloromethane	2.16E-04	0%
	1,2-Dichloroethane	9.28E-03	1%
	Ethylbenzene	6.95E-04	0%
	Fluorene	1.77E-05	0%
	Isopropylbenzene (cumene)	4.09E-03	0%
	Methylene chloride	1.75E-06	0%
	MTBE	5.64E-06	0%
	Naphthalene	2.78E-01	15%
	Phenanthrene	1.30E-02	1%
	n-Propylbenzene	5.04E-04	0%
	Styrene	1.21E-04	0%
	Toluene	2.27E-03	0%
	1,2,4-Trimethylbenzene	6.96E-03	0%
	1,3,5-Trimethylbenzene	6.85E-03	0%
	Xylene	9.51E-05	0%
Summation		**1.83**	

Notes:

1 - Risk estimates are based on the maximum detected concentration of each COPC, regardless of location.

Table A-20
Risk Estimates for Adult Resident (6 yrs exposure)
Monitoring Well Source[1]
USCG Housing
Alameda, California

		Risk Probabilities	
Carcinogen		**Indoor Vapor Inhalation**	**Percent Contribution**
	Benzene	5.96E-06	98%
	1,2-Dichloroethane	1.01E-07	2%
	Methylene chloride	2.07E-10	0%
	MTBE	7.48E-10	0%
Summation:		6.06E-06	

		Hazard Index (HI)	
Noncarcinogen		**Indoor Vapor Inhalation**	**Percent Contribution**
	Acenaphthene	1.87E-05	0%
	Acenaphthylene	1.10E-02	1%
	Anthracene	3.32E-07	0%
	Benzene	1.51E+00	82%
	Chloromethane	2.16E-04	0%
	1,2-Dichloroethane	9.28E-03	1%
	Ethylbenzene	6.95E-04	0%
	Fluorene	1.77E-05	0%
	Isopropylbenzene (cumene)	4.09E-03	0%
	Methylene chloride	1.75E-06	0%
	MTBE	5.64E-06	0%
	Naphthalene	2.78E-01	15%
	Phenanthrene	1.30E-02	1%
	n-Propylbenzene	5.04E-04	0%
	Styrene	1.21E-04	0%
	Toluene	2.27E-03	0%
	1,2,4-Trimethylbenzene	6.96E-03	0%
	1,3,5-Trimethylbenzene	6.85E-03	0%
	Xylene	9.51E-05	0%
Summation		**1.83**	

Notes:

1 - Risk estimates are based on the maximum detected concentration of each COPC, regardless of location.

Table A-21
Risk Estimates for Adult Resident (8 yrs exposure)
Monitoring Well Source[1]
USCG Housing
Alameda, California

	Risk Probabilities	
Carcinogen	**Indoor Vapor Inhalation**	**Percent Contribution**
Benzene	7.94E-06	98%
1,2-Dichloroethane	1.35E-07	2%
Methylene chloride	2.75E-10	0%
MTBE	9.97E-10	0%
Summation:	8.08E-06	

	Hazard Index (HI)	
Noncarcinogen	**Indoor Vapor Inhalation**	**Percent Contribution**
Acenaphthene	1.87E-05	0%
Acenaphthylene	1.10E-02	1%
Anthracene	3.32E-07	0%
Benzene	1.51E+00	82%
Chloromethane	2.16E-04	0%
1,2-Dichloroethane	9.28E-03	1%
Ethylbenzene	6.95E-04	0%
Fluorene	1.77E-05	0%
Isopropylbenzene (cumene)	4.09E-03	0%
Methylene chloride	1.75E-06	0%
MTBE	5.64E-06	0%
Naphthalene	2.78E-01	15%
Phenanthrene	1.30E-02	1%
n-Propylbenzene	5.04E-04	0%
Styrene	1.21E-04	0%
Toluene	2.27E-03	0%
1,2,4-Trimethylbenzene	6.96E-03	0%
1,3,5-Trimethylbenzene	6.85E-03	0%
Xylene	9.51E-05	0%
Summation:	**1.83**	

Notes:

1 - Risk estimates are based on the maximum detected concentration of each COPC, regardless of location.

Table A-22
Risk Estimates for Child Resident (3 yrs exposure)
Monitoring Well Source[1]
USCG Housing
Alameda, California

	Risk Probabilities	
Carcinogen	**Indoor Vapor Inhalation**	**Percent Contribution**
Benzene	6.95E-06	98%
1,2-Dichloroethane	1.18E-07	2%
Methylene chloride	2.41E-10	0%
MTBE	8.72E-10	0%
Summation:	7.07E-06	

	Hazard Index (HI)	
Noncarcinogen	**Indoor Vapor Inhalation**	**Percent Contribution**
Acenaphthene	4.36E-05	0%
Acenaphthylene	2.56E-02	1%
Anthracene	7.74E-07	0%
Benzene	3.53E+00	82%
Chloromethane	5.05E-04	0%
1,2-Dichloroethane	2.16E-02	1%
Ethylbenzene	1.62E-03	0%
Fluorene	4.12E-05	0%
Isopropylbenzene (cumene)	9.53E-03	0%
Methylene chloride	4.09E-06	0%
MTBE	1.32E-05	0%
Naphthalene	6.50E-01	15%
Phenanthrene	3.04E-02	1%
n-Propylbenzene	1.18E-03	0%
Styrene	2.82E-04	0%
Toluene	5.31E-03	0%
1,2,4-Trimethylbenzene	1.62E-02	0%
1,3,5-Trimethylbenzene	1.60E-02	0%
Xylene	2.22E-04	0%
Summation:	**4.31**	

Notes:

1 - Risk estimates are based on the maximum detected concentration of each COPC, regardless of location.

Table A-23
Risk Estimates for Child Resident (6 yrs exposure)
Monitoring Well Source[1]
USCG Housing
Alameda, California

	Risk Probabilities	
Carcinogen	**Indoor Vapor Inhalation**	**Percent Contribution**
Benzene	1.39E-05	98%
1,2-Dichloroethane	2.36E-07	2%
Methylene chloride	4.82E-10	0%
MTBE	1.74E-09	0%
Summation:	1.41E-05	

	Hazard Index (HI)	
Noncarcinogen	**Indoor Vapor Inhalation**	**Percent Contribution**
Acenaphthene	4.36E-05	0%
Acenaphthylene	2.56E-02	1%
Anthracene	7.74E-07	0%
Benzene	3.53E+00	82%
Chloromethane	5.05E-04	0%
1,2-Dichloroethane	2.16E-02	1%
Ethylbenzene	1.62E-03	0%
Fluorene	4.12E-05	0%
Isopropylbenzene (cumene)	9.53E-03	0%
Methylene chloride	4.09E-06	0%
MTBE	1.32E-05	0%
Naphthalene	6.50E-01	15%
Phenanthrene	3.04E-02	1%
n-Propylbenzene	1.18E-03	0%
Styrene	2.82E-04	0%
Toluene	5.31E-03	0%
1,2,4-Trimethylbenzene	1.62E-02	0%
1,3,5-Trimethylbenzene	1.60E-02	0%
Xylene	2.22E-04	0%
Summation:	**4.31**	

Notes:

1 - Risk estimates are based on the maximum detected concentration of each COPC, regardless of location.

Table A-24
Risk Estimates for Child Resident (8 yrs exposure)
Monitoring Well Source[1]
USCG Housing
Alameda, California

	Risk Probabilities	
Carcinogen	**Indoor Vapor Inhalation**	**Percent Contribution**
Benzene	1.85E-05	98%
1,2-Dichloroethane	3.15E-07	2%
Methylene chloride	6.42E-10	0%
MTBE	2.33E-09	0%
Summation:	1.88E-05	

	Hazard Index (HI)	
Noncarcinogen	**Indoor Vapor Inhalation**	**Percent Contribution**
Acenaphthene	4.36E-05	0%
Acenaphthylene	2.56E-02	1%
Anthracene	7.74E-07	0%
Benzene	3.53E+00	82%
Chloromethane	5.05E-04	0%
1,2-Dichloroethane	2.16E-02	1%
Ethylbenzene	1.62E-03	0%
Fluorene	4.12E-05	0%
Isopropylbenzene (cumene)	9.53E-03	0%
Methylene chloride	4.09E-06	0%
MTBE	1.32E-05	0%
Naphthalene	6.50E-01	15%
Phenanthrene	3.04E-02	1%
n-Propylbenzene	1.18E-03	0%
Styrene	2.82E-04	0%
Toluene	5.31E-03	0%
1,2,4-Trimethylbenzene	1.62E-02	0%
1,3,5-Trimethylbenzene	1.60E-02	0%
Xylene	2.22E-04	0%
Summation:	**4.31**	

Notes:

1 - Risk estimates are based on the maximum detected concentration of each COPC, regardless of location.

Table A-25
Risk Estimates for Future Resident (30 yrs exposure)
Monitoring Well Source[1]
USCG Housing
Alameda, California

	Risk Probabilities	
Carcinogen	**Indoor Vapor Inhalation**	**Percent Contribution**
Benzene	3.77E-05	98%
1,2-Dichloroethane	6.41E-07	2%
Methylene chloride	1.31E-09	0%
MTBE	4.74E-09	0%
Summation:	3.83E-05	

	Hazard Index (HI)	
Noncarcinogen	**Indoor Vapor Inhalation**	**Percent Contribution**
Acenaphthene	2.37E-05	0%
Acenaphthylene	1.39E-02	1%
Anthracene	4.20E-07	0%
Benzene	1.92E+00	82%
Chloromethane	2.74E-04	0%
1,2-Dichloroethane	1.17E-02	0%
Ethylbenzene	8.81E-04	0%
Fluorene	2.24E-05	0%
Isopropylbenzene (cumene)	5.18E-03	0%
Methylene chloride	2.22E-06	0%
MTBE	7.14E-06	0%
Naphthalene	3.53E-01	15%
Phenanthrene	1.65E-02	1%
n-Propylbenzene	6.39E-04	0%
Styrene	1.53E-04	0%
Toluene	2.88E-03	0%
1,2,4-Trimethylbenzene	8.82E-03	0%
1,3,5-Trimethylbenzene	8.68E-03	0%
Xylene	1.20E-04	0%
Summation:	**2.34**	

Notes:

1 - Risk estimates are based on the maximum detected concentration of each COPC, regardless of location.

Appendix B
Analytical Data and
Chain of Custody Records

AIR TOXICS LTD.

AN ENVIRONMENTAL ANALYTICAL LABORATORY

Air Toxics Ltd. Introduces the Electronic Report

Thank you for choosing Air Toxics Ltd. To better serve our customers, we are providing your report by e-mail. This document is provided in Portable Document Format which can be viewed with Acrobat Reader by Adobe.

This electronic report includes the following:

- Work order Summary;
- Laboratory Narrative;
- Results; and
- Chain of Custody (copy).

180 BLUE RAVINE ROAD, SUITE B FOLSOM, CA - 95630

(916) 985-1000 .FAX (916) 985-1020
Hours 8:00 A.M to 6:00 P.M. Pacific
E-mail to:samplereceiving@airtoxics.com

@ AIR TOXICS LTD.

AN ENVIRONMENTAL ANALYTICAL LABORATORY

WORK ORDER #: 0203019

Work Order Summary

CLIENT:	Mr. Chuck Siu SCA Environmental, Inc. 80 Grand Avenue Fourth Floor Oakland, CA 94612	**BILL TO:**	Mr. Chuck Siu SCA Environmental, Inc. 80 Grand Avenue Fourth Floor Oakland, CA 94612
PHONE:	510-465-9944	**P.O. #**	B 5368
FAX:	510-465-9109	**PROJECT #**	B 5368 USCG Marina Village
DATE RECEIVED:	3/1/02	**CONTACT:**	Karen Burden
DATE COMPLETED:	3/15/02		

FRACTION #	NAME	TEST	RECEIPT VAC./PRES.
01A	IU 300 C MOS	TO-14-S	2.0 "Hg
02A	IU 2000 D MAY	TO-14-S	9.0 "Hg
03A	C 2000 D MAY	TO-14-S	9.0 "Hg
04A	E 2000 D MAY	TO-14-S	10.0 "Hg
05A	IU 2005 B MON	TO-14-S	8.0 "Hg
06A	IU 2009 C MAY	TO-14-S	13.0 "Hg
07A	IO 2006 E MAY	TO-14-S	9.5 "Hg
08A	C 2006 E MAY	TO-14-S	7.0 "Hg
09A	E 2006 E MAY	TO-14-S	9.0 "Hg
10A	IU 2004 D MAY	TO-14-S	10.0 "Hg
11A	C 2004 D MAY	TO-14-S	9.0 "Hg
12A	E 2004 D MAY	TO-14-S	0.8 psi
13A	IU 2002 C ANN	TO-14-S	7.5 "Hg
14A	IU 2003 C ANN	TO-14-S	9.5 "Hg
15A	IU 103 F SIN	TO-14-S	9.5 "Hg
16A	C 103 F SIN	TO-14-S	10.0 "Hg
17A	E 103 F SIN	TO-14-S	0.0 "Hg
17AA	E 103 F SIN Duplicate	TO-14-S	0.0 "Hg
18A	Lab Blank	TO-14-S	NA
18B	Lab Blank	TO-14-S	NA

Coninued on next page

AIR TOXICS LTD.

AN ENVIRONMENTAL ANALYTICAL LABORATORY

WORK ORDER #: 0203019

Work Order Summary

CLIENT:	Mr. Chuck Siu SCA Environmental, Inc. 80 Grand Avenue Fourth Floor Oakland, CA 94612	**BILL TO:**	Mr. Chuck Siu SCA Environmental, Inc. 80 Grand Avenue Fourth Floor Oakland, CA 94612
PHONE:	510-465-9944	**P.O. #**	B 5368
FAX:	510-465-9109	**PROJECT #**	B 5368 USCG Marina Village
DATE RECEIVED:	3/1/02	**CONTACT:**	Karen Burden
DATE COMPLETED:	3/15/02		

FRACTION #	NAME	TEST	RECEIPT VAC./PRES.
18C	Lab Blank	TO-14-S	NA
19A	LCS	TO-14-S	NA
19B	LCS	TO-14-S	NA
19C	LCS	TO-14-S	NA

CERTIFIED BY: Linda J. Freeman

DATE: 03/15/02

Laboratory Director

Certfication numbers: CA ELAP - 1149, NY ELAP - 11291, UT ELAP - E-217, FL NELAP - E87680, LA - AI 30763
Name of Accrediting Agency: NELAP/State of New York Department of Health, Scope of Accreditation : Non Potable Water
Accreditation number :11291, Effective date: 6/7/01, Expiration date: 4/1/02

Air Toxics Ltd. certifies that the test results contained in this report meet all requirements of the NELAC standards

This report shall not be reproduced, except in full, without the written approval of Air Toxics Ltd.

180 BLUE RAVINE ROAD, SUITE B FOLSOM, CA - 95630
(916) 985-1000 . (800) 985-5955 . FAX (916) 985-1020

LABORATORY NARRATIVE
TO-14 SIM
SCA Environmental, Inc.
Workorder# 0203019

Thirteen 6 Liter Summa Canister (SIM Certified) and Four 6 Liter Silonite Canister samples were received on March 01, 2002. The laboratory performed analysis via EPA Method TO-14/15 using GC/MS in the SIM acquisition mode. The method involves concentrating up to 0.5 liters of air. The concentrated aliquot is then flash vaporized and swept through a water management system to remove water vapor. Following dehumidification, the sample passes directly into the GC/MS for analysis. See the data sheets for the reporting limits for each compound.

Method modifications taken to run these samples include:

Requirement	*TO-14/15 SIM*	*ATL Modifications*
Sampling/concentrator system	Nafion Drier	Multisorbent concentrator
Canister cleaning - clean air supply	Cryogenic Trap	Use of Humidified UHP Air
Canister certification	Pressurize w/humidified zero air.	Pressurize w/dry UHP nitrogen
Sample load volume	400 mL	Up to 0.5 liter
Blank	Humid air blank	Dry air blank for low level analysis.
Blank acceptance criteria	< 0.2 ppbv	< DL
BFB absolute abundance criteria	Within 10% of that from previous day.	CCV surrogate recoveries demonstrate stability from one day to the next
BFB acceptance criteria	CLP protocol	SW-846 protocol
Concentration of IS spike	Not specified	10 ppbv
Dilutions for initial calibration	Dynamic dilutions or static using canisters	Syringe dilutions
Flow rates/operating parameters	Not specified	Optimized. See procedures section.
ICAL RRF %RSD acceptance criteria	Not specified	30% or less for standard compounds, 40% or less for non-standard and polar compounds
IS recoveries	Within 40% of mean over ICAL for blanks, and w/in 40% of daily CCV for samples.	Within 40% of CCV recoveries for blank and samples.
IS RTs	Within .33 min from most recent calibration (either ICAL or daily)	Within 0.5 min. of RT in daily CCV
Daily CCV	70 - 130%	Standard compounds:70 - 130% for at least 90%; Non-standard and polar compounds: 60 - 140% for at least 80%
RF for quantitation	From ICAL	From ICAL
Canister leak check	24 hour, positive pressure	20 minute, vacuum check
MSD scan range	35 - 300 amu	35 - 350 amu

Requirement	*TO-14/15 SIM*	*ATL Modifications*
Canister cleaning - clean air supply	Cryogenic Trap	Use of Humidified UHP Air
Canister certification	Pressurize w/humidified zero air.	Pressurize w/dry UHP nitrogen
Sampling/concentrator system	Nafion Drier	Multisorbent concentrator

Receiving Notes

The chain of custody information for sample IU 2000 D MAY did not match the entry on the sample tag. The client was notified and the information on the chain of custody was used to process and report the sample.

Canister samples IU 300 C MOS, E 2004 D MAY, and E 103 F SIN were received at < 2.5" Hg despite the use of a flow controller for collection.

Analytical Notes

There were no analytical discrepancies.

Definition of Data Qualifying Flags

Six qualifiers may have been used on the data analysis sheets and indicates as follows:

B - Compound present in laboratory blank greater than reporting limit (background subtraction not performed).

J - Estimated value.

E - Exceeds instrument calibration range.

S - Saturated peak.

Q - Exceeds quality control limits.

U - Compound analyzed for but not detected above the reporting limit.

AIR TOXICS LTD.

SAMPLE NAME: IU 300 C MOS

ID#: 0203019-01A

EPA METHOD TO-14 GC/MS SIM

File Name:	**w031215**	**Date of Collection:**	**2/28/02**
Dil. Factor:	**1.44**	**Date of Analysis:**	**3/12/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.014	0.037	Not Detected	Not Detected
1,1-Dichloroethene	0.014	0.058	Not Detected	Not Detected
1,1-Dichloroethane	0.029	0.12	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.029	0.12	Not Detected	Not Detected
1,1,1-Trichloroethane	0.029	0.16	0.055	0.31
Benzene	0.072	0.23	0.82	2.6
1,2-Dichloroethane	0.029	0.12	Not Detected	Not Detected
Trichloroethene	0.029	0.16	0.048	0.26
Toluene	0.072	0.28	2.8	11
1,1,2-Trichloroethane	0.029	0.16	Not Detected	Not Detected
Tetrachloroethene	0.029	0.20	0.19	1.3
Ethyl Benzene	0.072	0.32	0.60	2.6
m,p-Xylene	0.072	0.32	2.4	11
o-Xylene	0.072	0.32	0.99	4.4
1,1,2,2-Tetrachloroethane	0.029	0.20	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.14	0.58	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.14	0.53	1.4	5.1

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	105	70-130
Toluene-d8	98	70-130
4-Bromofluorobenzene	107	70-130

AIR TOXICS LTD.

SAMPLE NAME: IU 2000 D MAY

ID#: 0203019-02A

EPA METHOD TO-14 GC/MS SIM

File Name:	**w031216**	**Date of Collection:**	**2/28/02**
Dil. Factor:	**1.91**	**Date of Analysis:**	**3/12/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.019	0.050	Not Detected	Not Detected
1,1-Dichloroethene	0.019	0.077	Not Detected	Not Detected
1,1-Dichloroethane	0.038	0.16	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.038	0.15	Not Detected	Not Detected
1,1,1-Trichloroethane	0.038	0.21	0.054	0.30
Benzene	0.096	0.31	1.2	3.9
1,2-Dichloroethane	0.038	0.16	0.043	0.18
Trichloroethene	0.038	0.21	0.041	0.22
Toluene	0.096	0.36	5.4	21
1,1,2-Trichloroethane	0.038	0.21	Not Detected	Not Detected
Tetrachloroethene	0.038	0.26	0.20	1.4
Ethyl Benzene	0.096	0.42	0.70	3.1
m,p-Xylene	0.096	0.42	2.9	13
o-Xylene	0.096	0.42	1.2	5.2
1,1,2,2-Tetrachloroethane	0.038	0.27	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.19	0.77	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.19	0.70	1.6	6.0

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	106	70-130
Toluene-d8	100	70-130
4-Bromofluorobenzene	108	70-130

AIR TOXICS LTD.

SAMPLE NAME: C 2000 D MAY

ID#: 0203019-03A

EPA METHOD TO-14 GC/MS SIM

File Name:	**w031217**	**Date of Collection:**	**2/28/02**
Dil. Factor:	**1.91**	**Date of Analysis:**	**3/12/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.019	0.050	Not Detected	Not Detected
1,1-Dichloroethene	0.019	0.077	Not Detected	Not Detected
1,1-Dichloroethane	0.038	0.16	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.038	0.15	Not Detected	Not Detected
1,1,1-Trichloroethane	0.038	0.21	0.052	0.29
Benzene	0.096	0.31	0.84	2.7
1,2-Dichloroethane	0.038	0.16	Not Detected	Not Detected
Trichloroethene	0.038	0.21	0.048	0.26
Toluene	0.096	0.36	2.8	11
1,1,2-Trichloroethane	0.038	0.21	Not Detected	Not Detected
Tetrachloroethene	0.038	0.26	0.33	2.3
Ethyl Benzene	0.096	0.42	0.43	1.9
m,p-Xylene	0.096	0.42	1.8	7.8
o-Xylene	0.096	0.42	0.73	3.2
1,1,2,2-Tetrachloroethane	0.038	0.27	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.19	0.77	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.19	0.70	1.5	5.6

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	106	70-130
Toluene-d8	100	70-130
4-Bromofluorobenzene	109	70-130

AIR TOXICS LTD.

SAMPLE NAME: E 2000 D MAY

ID#: 0203019-04A

EPA METHOD TO-14 GC/MS SIM

File Name:	**w031306**	**Date of Collection:**	**2/28/02**
Dil. Factor:	**2.01**	**Date of Analysis:**	**3/13/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.020	0.052	Not Detected	Not Detected
1,1-Dichloroethene	0.020	0.081	Not Detected	Not Detected
1,1-Dichloroethane	0.040	0.16	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.040	0.16	Not Detected	Not Detected
1,1,1-Trichloroethane	0.040	0.22	0.056	0.31
Benzene	0.10	0.33	1.6	5.0
1,2-Dichloroethane	0.040	0.16	Not Detected	Not Detected
Trichloroethene	0.040	0.22	0.046	0.25
Toluene	0.10	0.38	3.7	14
1,1,2-Trichloroethane	0.040	0.22	Not Detected	Not Detected
Tetrachloroethene	0.040	0.28	0.22	1.5
Ethyl Benzene	0.10	0.44	0.61	2.7
m,p-Xylene	0.10	0.44	2.5	11
o-Xylene	0.10	0.44	1.0	4.5
1,1,2,2-Tetrachloroethane	0.040	0.28	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.20	0.81	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.20	0.74	1.6	5.7

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	105	70-130
Toluene-d8	100	70-130
4-Bromofluorobenzene	107	70-130

AIR TOXICS LTD.

SAMPLE NAME: IU 2005 B MON

ID#: 0203019-05A

EPA METHOD TO-14 GC/MS SIM

File Name:	**w031307**	**Date of Collection:**	**2/28/02**
Dil. Factor:	**1.83**	**Date of Analysis:**	**3/13/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.018	0.048	Not Detected	Not Detected
1,1-Dichloroethene	0.018	0.074	Not Detected	Not Detected
1,1-Dichloroethane	0.037	0.15	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.037	0.15	Not Detected	Not Detected
1,1,1-Trichloroethane	0.037	0.20	0.054	0.30
Benzene	0.092	0.30	0.89	2.9
1,2-Dichloroethane	0.037	0.15	0.052	0.22
Trichloroethene	0.037	0.20	0.056	0.30
Toluene	0.092	0.35	3.4	13
1,1,2-Trichloroethane	0.037	0.20	Not Detected	Not Detected
Tetrachloroethene	0.037	0.25	0.20	1.4
Ethyl Benzene	0.092	0.40	0.72	3.2
m,p-Xylene	0.092	0.40	3.2	14
o-Xylene	0.092	0.40	1.2	5.1
1,1,2,2-Tetrachloroethane	0.037	0.26	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.18	0.74	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.18	0.67	1.3	4.7

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	105	70-130
Toluene-d8	100	70-130
4-Bromofluorobenzene	108	70-130

AIR TOXICS LTD.

SAMPLE NAME: IU 2009 C MAY

ID#: 0203019-06A

EPA METHOD TO-14 GC/MS SIM

File Name:	**w031308**	**Date of Collection:**	**2/28/02**
Dil. Factor:	**2.36**	**Date of Analysis:**	**3/13/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.024	0.061	Not Detected	Not Detected
1,1-Dichloroethene	0.024	0.095	Not Detected	Not Detected
1,1-Dichloroethane	0.047	0.19	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.047	0.19	Not Detected	Not Detected
1,1,1-Trichloroethane	0.047	0.26	0.057	0.32
Benzene	0.12	0.38	1.1	3.5
1,2-Dichloroethane	0.047	0.19	Not Detected	Not Detected
Trichloroethene	0.047	0.26	0.052	0.28
Toluene	0.12	0.45	5.2	20
1,1,2-Trichloroethane	0.047	0.26	Not Detected	Not Detected
Tetrachloroethene	0.047	0.32	0.25	1.7
Ethyl Benzene	0.12	0.52	0.58	2.6
m,p-Xylene	0.12	0.52	2.3	10
o-Xylene	0.12	0.52	0.94	4.1
1,1,2,2-Tetrachloroethane	0.047	0.33	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.24	0.95	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.24	0.86	2.1	7.7

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	106	70-130
Toluene-d8	99	70-130
4-Bromofluorobenzene	107	70-130

AIR TOXICS LTD.

SAMPLE NAME: IO 2006 E MAY

ID#: 0203019-07A

EPA METHOD TO-14 GC/MS SIM

File Name:	**w031309**	**Date of Collection:**	**2/28/02**
Dil. Factor:	**1.96**	**Date of Analysis:**	**3/13/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.020	0.051	Not Detected	Not Detected
1,1-Dichloroethene	0.020	0.079	Not Detected	Not Detected
1,1-Dichloroethane	0.039	0.16	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.039	0.16	Not Detected	Not Detected
1,1,1-Trichloroethane	0.039	0.22	0.056	0.31
Benzene	0.098	0.32	1.4	4.5
1,2-Dichloroethane	0.039	0.16	Not Detected	Not Detected
Trichloroethene	0.039	0.21	0.072	0.39
Toluene	0.098	0.38	7.1	27
1,1,2-Trichloroethane	0.039	0.22	Not Detected	Not Detected
Tetrachloroethene	0.039	0.27	0.18	1.2
Ethyl Benzene	0.098	0.43	0.83	3.7
m,p-Xylene	0.098	0.43	3.5	15
o-Xylene	0.098	0.43	1.2	5.5
1,1,2,2-Tetrachloroethane	0.039	0.27	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.20	0.79	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.20	0.72	1.3	4.9

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	107	70-130
Toluene-d8	100	70-130
4-Bromofluorobenzene	108	70-130

AIR TOXICS LTD.

SAMPLE NAME: C 2006 E MAY

ID#: 0203019-08A

EPA METHOD TO-14 GC/MS SIM

File Name:	**w031310**	**Date of Collection:**	**2/28/02**
Dil. Factor:	**1.75**	**Date of Analysis:**	**3/13/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.018	0.045	Not Detected	Not Detected
1,1-Dichloroethene	0.018	0.070	Not Detected	Not Detected
1,1-Dichloroethane	0.035	0.14	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.035	0.14	Not Detected	Not Detected
1,1,1-Trichloroethane	0.035	0.19	0.054	0.30
Benzene	0.088	0.28	0.54	1.8
1,2-Dichloroethane	0.035	0.14	Not Detected	Not Detected
Trichloroethene	0.035	0.19	0.035	0.19
Toluene	0.088	0.34	2.2	8.5
1,1,2-Trichloroethane	0.035	0.19	Not Detected	Not Detected
Tetrachloroethene	0.035	0.24	0.24	1.6
Ethyl Benzene	0.088	0.39	0.20	0.89
m,p-Xylene	0.088	0.39	0.77	3.4
o-Xylene	0.088	0.39	0.34	1.5
1,1,2,2-Tetrachloroethane	0.035	0.24	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.18	0.70	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.18	0.64	0.74	2.7

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	106	70-130
Toluene-d8	98	70-130
4-Bromofluorobenzene	107	70-130

AIR TOXICS LTD.

SAMPLE NAME: E 2006 E MAY

ID#: 0203019-09A

EPA METHOD TO-14 GC/MS SIM

File Name:	**w031311**	**Date of Collection:**	**2/28/02**
Dil. Factor:	**1.91**	**Date of Analysis:**	**3/13/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.019	0.050	Not Detected	Not Detected
1,1-Dichloroethene	0.019	0.077	Not Detected	Not Detected
1,1-Dichloroethane	0.038	0.16	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.038	0.15	Not Detected	Not Detected
1,1,1-Trichloroethane	0.038	0.21	0.058	0.32
Benzene	0.096	0.31	0.94	3.0
1,2-Dichloroethane	0.038	0.16	0.045	0.18
Trichloroethene	0.038	0.21	0.041	0.22
Toluene	0.096	0.36	3.3	13
1,1,2-Trichloroethane	0.038	0.21	Not Detected	Not Detected
Tetrachloroethene	0.038	0.26	0.23	1.6
Ethyl Benzene	0.096	0.42	0.56	2.4
m,p-Xylene	0.096	0.42	2.4	10
o-Xylene	0.096	0.42	0.95	4.2
1,1,2,2-Tetrachloroethane	0.038	0.27	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.19	0.77	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.19	0.70	1.5	5.6

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	107	70-130
Toluene-d8	100	70-130
4-Bromofluorobenzene	109	70-130

AIR TOXICS LTD.

SAMPLE NAME: IU 2004 D MAY

ID#: 0203019-10A

EPA METHOD TO-14 GC/MS SIM

File Name:	**w031312**	**Date of Collection:**	**2/28/02**
Dil. Factor:	**2.01**	**Date of Analysis:**	**3/13/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.020	0.052	Not Detected	Not Detected
1,1-Dichloroethene	0.020	0.081	Not Detected	Not Detected
1,1-Dichloroethane	0.040	0.16	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.040	0.16	Not Detected	Not Detected
1,1,1-Trichloroethane	0.040	0.22	0.058	0.32
Benzene	0.10	0.33	0.90	2.9
1,2-Dichloroethane	0.040	0.16	Not Detected	Not Detected
Trichloroethene	0.040	0.22	0.042	0.23
Toluene	0.10	0.38	4.6	18
1,1,2-Trichloroethane	0.040	0.22	Not Detected	Not Detected
Tetrachloroethene	0.040	0.28	0.20	1.4
Ethyl Benzene	0.10	0.44	0.53	2.4
m,p-Xylene	0.10	0.44	2.2	9.6
o-Xylene	0.10	0.44	0.87	3.9
1,1,2,2-Tetrachloroethane	0.040	0.28	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.20	0.81	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.20	0.74	1.2	4.5

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	107	70-130
Toluene-d8	100	70-130
4-Bromofluorobenzene	109	70-130

AIR TOXICS LTD.

SAMPLE NAME: C 2004 D MAY

ID#: 0203019-11A

EPA METHOD TO-14 GC/MS SIM

File Name:	**w031313**	**Date of Collection:**	**2/28/02**
Dil. Factor:	**1.91**	**Date of Analysis:**	**3/13/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.019	0.050	Not Detected	Not Detected
1,1-Dichloroethene	0.019	0.077	Not Detected	Not Detected
1,1-Dichloroethane	0.038	0.16	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.038	0.15	Not Detected	Not Detected
1,1,1-Trichloroethane	0.038	0.21	0.060	0.33
Benzene	0.096	0.31	0.75	2.4
1,2-Dichloroethane	0.038	0.16	Not Detected	Not Detected
Trichloroethene	0.038	0.21	0.046	0.25
Toluene	0.096	0.36	2.6	10
1,1,2-Trichloroethane	0.038	0.21	Not Detected	Not Detected
Tetrachloroethene	0.038	0.26	0.23	1.6
Ethyl Benzene	0.096	0.42	0.37	1.6
m,p-Xylene	0.096	0.42	1.5	6.5
o-Xylene	0.096	0.42	0.62	2.7
1,1,2,2-Tetrachloroethane	0.038	0.27	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.19	0.77	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.19	0.70	1.4	5.1

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	107	70-130
Toluene-d8	100	70-130
4-Bromofluorobenzene	110	70-130

AIR TOXICS LTD.

SAMPLE NAME: E 2004 D MAY

ID#: 0203019-12A

EPA METHOD TO-14 GC/MS SIM

File Name:	**w031314**	**Date of Collection:**	**2/28/02**
Dil. Factor:	**1.36**	**Date of Analysis:**	**3/13/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.014	0.035	Not Detected	Not Detected
1,1-Dichloroethene	0.014	0.055	Not Detected	Not Detected
1,1-Dichloroethane	0.027	0.11	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.027	0.11	Not Detected	Not Detected
1,1,1-Trichloroethane	0.027	0.15	0.055	0.30
Benzene	0.068	0.22	0.86	2.8
1,2-Dichloroethane	0.027	0.11	Not Detected	Not Detected
Trichloroethene	0.027	0.15	0.042	0.23
Toluene	0.068	0.26	2.6	9.8
1,1,2-Trichloroethane	0.027	0.15	Not Detected	Not Detected
Tetrachloroethene	0.027	0.19	0.16	1.1
Ethyl Benzene	0.068	0.30	0.43	1.9
m,p-Xylene	0.068	0.30	1.8	7.8
o-Xylene	0.068	0.30	0.72	3.2
1,1,2,2-Tetrachloroethane	0.027	0.19	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.14	0.55	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.14	0.50	1.0	3.8

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	108	70-130
Toluene-d8	99	70-130
4-Bromofluorobenzene	109	70-130

AIR TOXICS LTD.

SAMPLE NAME: IU 2002 C ANN

ID#: 0203019-13A

EPA METHOD TO-14 GC/MS SIM

File Name:	**w031315**	**Date of Collection:**	**2/28/02**
Dil. Factor:	**1.79**	**Date of Analysis:**	**3/13/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.018	0.046	Not Detected	Not Detected
1,1-Dichloroethene	0.018	0.072	Not Detected	Not Detected
1,1-Dichloroethane	0.036	0.15	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.036	0.14	Not Detected	Not Detected
1,1,1-Trichloroethane	0.036	0.20	0.056	0.31
Benzene	0.090	0.29	0.78	2.5
1,2-Dichloroethane	0.036	0.15	Not Detected	Not Detected
Trichloroethene	0.036	0.20	0.043	0.24
Toluene	0.090	0.34	2.9	11
1,1,2-Trichloroethane	0.036	0.20	Not Detected	Not Detected
Tetrachloroethene	0.036	0.25	0.21	1.4
Ethyl Benzene	0.090	0.39	0.47	2.1
m,p-Xylene	0.090	0.40	1.9	8.6
o-Xylene	0.090	0.40	0.76	3.4
1,1,2,2-Tetrachloroethane	0.036	0.25	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.18	0.72	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.18	0.66	1.4	5.1

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	109	70-130
Toluene-d8	101	70-130
4-Bromofluorobenzene	109	70-130

AIR TOXICS LTD.

SAMPLE NAME: IU 2003 C ANN

ID#: 0203019-14A

EPA METHOD TO-14 GC/MS SIM

File Name:	**x031311**	**Date of Collection:**	**2/28/02**
Dil. Factor:	**1.96**	**Date of Analysis:**	**3/13/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.020	0.051	Not Detected	Not Detected
1,1-Dichloroethene	0.020	0.079	Not Detected	Not Detected
1,1-Dichloroethane	0.039	0.16	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.039	0.16	Not Detected	Not Detected
1,1,1-Trichloroethane	0.039	0.22	0.056	0.31
Benzene	0.098	0.32	0.88	2.9
1,2-Dichloroethane	0.039	0.16	0.059	0.24
Trichloroethene	0.039	0.21	0.041	0.22
Toluene	0.098	0.38	4.1	16
1,1,2-Trichloroethane	0.039	0.22	Not Detected	Not Detected
Tetrachloroethene	0.039	0.27	0.17	1.2
Ethyl Benzene	0.098	0.43	3.3	15
m,p-Xylene	0.098	0.43	14	60
o-Xylene	0.098	0.43	5.2	23
1,1,2,2-Tetrachloroethane	0.039	0.27	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.20	0.79	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.20	0.72	1.3	4.6

Container Type: 6 Liter Silonite Canister

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	109	70-130
Toluene-d8	102	70-130
4-Bromofluorobenzene	98	70-130

AIR TOXICS LTD.

SAMPLE NAME: IU 103 F SIN

ID#: 0203019-15A

EPA METHOD TO-14 GC/MS SIM

File Name:	**x031312**	**Date of Collection:**	**2/28/02**
Dil. Factor:	**1.96**	**Date of Analysis:**	**3/13/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.020	0.051	Not Detected	Not Detected
1,1-Dichloroethene	0.020	0.079	Not Detected	Not Detected
1,1-Dichloroethane	0.039	0.16	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.039	0.16	Not Detected	Not Detected
1,1,1-Trichloroethane	0.039	0.22	0.054	0.30
Benzene	0.098	0.32	0.80	2.6
1,2-Dichloroethane	0.039	0.16	Not Detected	Not Detected
Trichloroethene	0.039	0.21	Not Detected	Not Detected
Toluene	0.098	0.38	2.7	10
1,1,2-Trichloroethane	0.039	0.22	Not Detected	Not Detected
Tetrachloroethene	0.039	0.27	0.16	1.1
Ethyl Benzene	0.098	0.43	0.39	1.7
m,p-Xylene	0.098	0.43	1.4	6.4
o-Xylene	0.098	0.43	0.53	2.3
1,1,2,2-Tetrachloroethane	0.039	0.27	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.20	0.79	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.20	0.72	1.0	3.7

Container Type: 6 Liter Silonite Canister

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	111	70-130
Toluene-d8	96	70-130
4-Bromofluorobenzene	101	70-130

AIR TOXICS LTD.

SAMPLE NAME: C 103 F SIN

ID#: 0203019-16A

EPA METHOD TO-14 GC/MS SIM

File Name:	**x031313**	**Date of Collection:**	**2/28/02**
Dil. Factor:	**2.01**	**Date of Analysis:**	**3/13/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.020	0.052	Not Detected	Not Detected
1,1-Dichloroethene	0.020	0.081	Not Detected	Not Detected
1,1-Dichloroethane	0.040	0.16	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.040	0.16	Not Detected	Not Detected
1,1,1-Trichloroethane	0.040	0.22	0.055	0.30
Benzene	0.10	0.33	0.33	1.1
1,2-Dichloroethane	0.040	0.16	Not Detected	Not Detected
Trichloroethene	0.040	0.22	Not Detected	Not Detected
Toluene	0.10	0.38	0.97	3.7
1,1,2-Trichloroethane	0.040	0.22	Not Detected	Not Detected
Tetrachloroethene	0.040	0.28	0.22	1.5
Ethyl Benzene	0.10	0.44	0.10	0.47
m,p-Xylene	0.10	0.44	0.35	1.6
o-Xylene	0.10	0.44	0.14	0.63
1,1,2,2-Tetrachloroethane	0.040	0.28	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.20	0.81	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.20	0.74	0.66	2.4

Container Type: 6 Liter Silonite Canister

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	110	70-130
Toluene-d8	106	70-130
4-Bromofluorobenzene	102	70-130

AIR TOXICS LTD.

SAMPLE NAME: E 103 F SIN

ID#: 0203019-17A

EPA METHOD TO-14 GC/MS SIM

File Name:	**x031314**	**Date of Collection:**	**2/28/02**
Dil. Factor:	**1.34**	**Date of Analysis:**	**3/13/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.013	0.035	Not Detected	Not Detected
1,1-Dichloroethene	0.013	0.054	Not Detected	Not Detected
1,1-Dichloroethane	0.027	0.11	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.027	0.11	Not Detected	Not Detected
1,1,1-Trichloroethane	0.027	0.15	0.058	0.32
Benzene	0.067	0.22	0.76	2.5
1,2-Dichloroethane	0.027	0.11	0.033	0.13
Trichloroethene	0.027	0.15	0.040	0.22
Toluene	0.067	0.26	3.2	12
1,1,2-Trichloroethane	0.027	0.15	Not Detected	Not Detected
Tetrachloroethene	0.027	0.18	0.20	1.4
Ethyl Benzene	0.067	0.30	0.53	2.3
m,p-Xylene	0.067	0.30	2.4	10
o-Xylene	0.067	0.30	0.80	3.5
1,1,2,2-Tetrachloroethane	0.027	0.19	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.13	0.54	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.13	0.49	1.4	5.3

Container Type: 6 Liter Silonite Canister

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	112	70-130
Toluene-d8	107	70-130
4-Bromofluorobenzene	108	70-130

AIR TOXICS LTD.

SAMPLE NAME: E 103 F SIN Duplicate

ID#: 0203019-17AA

EPA METHOD TO-14 GC/MS SIM

File Name:	**x031315**	**Date of Collection:**	**2/28/02**
Dil. Factor:	**1.34**	**Date of Analysis:**	**3/13/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.013	0.035	Not Detected	Not Detected
1,1-Dichloroethene	0.013	0.054	Not Detected	Not Detected
1,1-Dichloroethane	0.027	0.11	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.027	0.11	Not Detected	Not Detected
1,1,1-Trichloroethane	0.027	0.15	0.053	0.30
Benzene	0.067	0.22	0.80	2.6
1,2-Dichloroethane	0.027	0.11	0.032	0.13
Trichloroethene	0.027	0.15	0.035	0.19
Toluene	0.067	0.26	3.1	12
1,1,2-Trichloroethane	0.027	0.15	Not Detected	Not Detected
Tetrachloroethene	0.027	0.18	0.19	1.3
Ethyl Benzene	0.067	0.30	0.49	2.2
m,p-Xylene	0.067	0.30	2.2	9.5
o-Xylene	0.067	0.30	0.71	3.1
1,1,2,2-Tetrachloroethane	0.027	0.19	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.13	0.54	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.13	0.49	1.3	4.8

Container Type: 6 Liter Silonite Canister

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	122	70-130
Toluene-d8	110	70-130
4-Bromofluorobenzene	104	70-130

AIR TOXICS LTD.

SAMPLE NAME: Lab Blank

ID#: 0203019-18A

EPA METHOD TO-14 GC/MS SIM

File Name:	**w031207**	**Date of Collection: NA**	
Dil. Factor:	**1.00**	**Date of Analysis: 3/12/02**	

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.010	0.026	Not Detected	Not Detected
1,1-Dichloroethene	0.010	0.040	Not Detected	Not Detected
1,1-Dichloroethane	0.020	0.082	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.020	0.080	Not Detected	Not Detected
1,1,1-Trichloroethane	0.020	0.11	Not Detected	Not Detected
Benzene	0.050	0.16	Not Detected	Not Detected
1,2-Dichloroethane	0.020	0.082	Not Detected	Not Detected
Trichloroethene	0.020	0.11	Not Detected	Not Detected
Toluene	0.050	0.19	Not Detected	Not Detected
1,1,2-Trichloroethane	0.020	0.11	Not Detected	Not Detected
Tetrachloroethene	0.020	0.14	Not Detected	Not Detected
Ethyl Benzene	0.050	0.22	Not Detected	Not Detected
m,p-Xylene	0.050	0.22	Not Detected	Not Detected
o-Xylene	0.050	0.22	Not Detected	Not Detected
1,1,2,2-Tetrachloroethane	0.020	0.14	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.10	0.40	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.10	0.37	Not Detected	Not Detected

Container Type: NA - Not Applicable

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	103	70-130
Toluene-d8	100	70-130
4-Bromofluorobenzene	100	70-130

AIR TOXICS LTD.

SAMPLE NAME: Lab Blank

ID#: 0203019-18B

EPA METHOD TO-14 GC/MS SIM

File Name:	**w031305**	**Date of Collection: NA**	
Dil. Factor:	**1.00**	**Date of Analysis: 3/13/02**	

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.010	0.026	Not Detected	Not Detected
1,1-Dichloroethene	0.010	0.040	Not Detected	Not Detected
1,1-Dichloroethane	0.020	0.082	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.020	0.080	Not Detected	Not Detected
1,1,1-Trichloroethane	0.020	0.11	Not Detected	Not Detected
Benzene	0.050	0.16	Not Detected	Not Detected
1,2-Dichloroethane	0.020	0.082	Not Detected	Not Detected
Trichloroethene	0.020	0.11	Not Detected	Not Detected
Toluene	0.050	0.19	Not Detected	Not Detected
1,1,2-Trichloroethane	0.020	0.11	Not Detected	Not Detected
Tetrachloroethene	0.020	0.14	Not Detected	Not Detected
Ethyl Benzene	0.050	0.22	Not Detected	Not Detected
m,p-Xylene	0.050	0.22	Not Detected	Not Detected
o-Xylene	0.050	0.22	Not Detected	Not Detected
1,1,2,2-Tetrachloroethane	0.020	0.14	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.10	0.40	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.10	0.37	Not Detected	Not Detected

Container Type: NA - Not Applicable

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	104	70-130
Toluene-d8	100	70-130
4-Bromofluorobenzene	101	70-130

AIR TOXICS LTD.

SAMPLE NAME: Lab Blank

ID#: 0203019-18C

EPA METHOD TO-14 GC/MS SIM

File Name:	**x031307**	**Date of Collection: NA**	
Dil. Factor:	**1.00**	**Date of Analysis: 3/13/02**	

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.010	0.026	Not Detected	Not Detected
1,1-Dichloroethene	0.010	0.040	Not Detected	Not Detected
1,1-Dichloroethane	0.020	0.082	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.020	0.080	Not Detected	Not Detected
1,1,1-Trichloroethane	0.020	0.11	Not Detected	Not Detected
Benzene	0.050	0.16	Not Detected	Not Detected
1,2-Dichloroethane	0.020	0.082	Not Detected	Not Detected
Trichloroethene	0.020	0.11	Not Detected	Not Detected
Toluene	0.050	0.19	Not Detected	Not Detected
1,1,2-Trichloroethane	0.020	0.11	Not Detected	Not Detected
Tetrachloroethene	0.020	0.14	Not Detected	Not Detected
Ethyl Benzene	0.050	0.22	Not Detected	Not Detected
m,p-Xylene	0.050	0.22	Not Detected	Not Detected
o-Xylene	0.050	0.22	Not Detected	Not Detected
1,1,2,2-Tetrachloroethane	0.020	0.14	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.10	0.40	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.10	0.37	Not Detected	Not Detected

Container Type: NA - Not Applicable

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	119	70-130
Toluene-d8	87	70-130
4-Bromofluorobenzene	85	70-130

AIR TOXICS LTD.

SAMPLE NAME: LCS

ID#: 0203019-19A

EPA METHOD TO-14 GC/MS SIM

File Name:	**w031204**		**Date of Collection: NA**
Dil. Factor:	**1.00**		**Date of Analysis: 3/12/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	%Recovery
Vinyl Chloride	0.010	0.026	88
1,1-Dichloroethene	0.010	0.040	87
1,1-Dichloroethane	0.020	0.082	94
cis-1,2-Dichloroethene	0.020	0.080	83
1,1,1-Trichloroethane	0.020	0.11	92
Benzene	0.050	0.16	83
1,2-Dichloroethane	0.020	0.082	88
Trichloroethene	0.020	0.11	87
Toluene	0.050	0.19	86
1,1,2-Trichloroethane	0.020	0.11	94
Tetrachloroethene	0.020	0.14	89
Ethyl Benzene	0.050	0.22	92
m,p-Xylene	0.050	0.22	94
o-Xylene	0.050	0.22	105
1,1,2,2-Tetrachloroethane	0.020	0.14	94
trans-1,2-Dichloroethene	0.10	0.40	103
Methyl tert-Butyl Ether	0.10	0.37	83

Container Type: NA - Not Applicable

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	100	70-130
Toluene-d8	100	70-130
4-Bromofluorobenzene	100	70-130

AIR TOXICS LTD.

SAMPLE NAME: LCS

ID#: 0203019-19B

EPA METHOD TO-14 GC/MS SIM

File Name:	**w031303**		**Date of Collection: NA**
Dil. Factor:	**1.00**		**Date of Analysis: 3/13/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	%Recovery
Vinyl Chloride	0.010	0.026	92
1,1-Dichloroethene	0.010	0.040	89
1,1-Dichloroethane	0.020	0.082	96
cis-1,2-Dichloroethene	0.020	0.080	86
1,1,1-Trichloroethane	0.020	0.11	101
Benzene	0.050	0.16	85
1,2-Dichloroethane	0.020	0.082	93
Trichloroethene	0.020	0.11	90
Toluene	0.050	0.19	88
1,1,2-Trichloroethane	0.020	0.11	97
Tetrachloroethene	0.020	0.14	94
Ethyl Benzene	0.050	0.22	95
m,p-Xylene	0.050	0.22	98
o-Xylene	0.050	0.22	110
1,1,2,2-Tetrachloroethane	0.020	0.14	100
trans-1,2-Dichloroethene	0.10	0.40	106
Methyl tert-Butyl Ether	0.10	0.37	86

Container Type: NA - Not Applicable

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	100	70-130
Toluene-d8	100	70-130
4-Bromofluorobenzene	101	70-130

AIR TOXICS LTD.

SAMPLE NAME: LCS

ID#: 0203019-19C

EPA METHOD TO-14 GC/MS SIM

File Name:	**x031305**		**Date of Collection: NA**
Dil. Factor:	**1.00**		**Date of Analysis: 3/13/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	%Recovery
Vinyl Chloride	0.010	0.026	105
1,1-Dichloroethene	0.010	0.040	93
1,1-Dichloroethane	0.020	0.082	100
cis-1,2-Dichloroethene	0.020	0.080	88
1,1,1-Trichloroethane	0.020	0.11	105
Benzene	0.050	0.16	84
1,2-Dichloroethane	0.020	0.082	102
Trichloroethene	0.020	0.11	88
Toluene	0.050	0.19	80
1,1,2-Trichloroethane	0.020	0.11	107
Tetrachloroethene	0.020	0.14	93
Ethyl Benzene	0.050	0.22	86
m,p-Xylene	0.050	0.22	100
o-Xylene	0.050	0.22	111
1,1,2,2-Tetrachloroethane	0.020	0.14	97
trans-1,2-Dichloroethene	0.10	0.40	109
Methyl tert-Butyl Ether	0.10	0.37	83

Container Type: NA - Not Applicable

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	116	70-130
Toluene-d8	93	70-130
4-Bromofluorobenzene	103	70-130

@ AIR TOXICS LTD.
AN ENVIRONMENTAL ANALYTICAL LABORATORY

CHAIN-OF-CUSTODY RECORD

Sample Transportation Notice
Relinquishing signature on this document indicates that sample is being shipped in compliance with all applicable local, State, Federal, national, and international laws, regulations and ordinances of any kind. Air Toxics Limited assumes no liability with respect to the collection, handling or shipping of these samples. Relinquishing signature also indicates agreement to hold harmless, defend, and indemnify Air Toxics Limited against any claim, demand, or action of any kind, related to the collection, handling, or shipping of samples. D.O.T. Hotline (800) 467-4922

180 BLUE RAVINE ROAD, SUITE B
FOLSOM, CA 95630-4719
(916) 985-1000 FAX: (916) 985-1020

Contact Person: Jennifer Muehlhaus
Company: SCA Environmental
Address: 80 Grand Ave 4th Fl City: Oakland State: CA Zip: 94612
Phone: 510 465 9941 x 231 FAX: 510 465 9109
Collected By: Signature: Jennifer Muehlhaus

Project Info:
P.O. #: B5368
Project #: B 5368
Project Name: USCG Marina Village

Turn Around Time:
☒ Normal
☐ Rush _____ Specify

ML 3.02.02

Lab I.D.	Field Sample I.D.	ON Date & Time 2/27/02	OFF Date & Time 2/28/02	Analyses Requested	Canister Pressure / Vacuum Initial	Final	Receipt
01A	IU 3000 C MOS	1011	0717	TO-14 SIM (Std 17)	-30	-2.5 (B)	2.0"Hg
02A	IU 2000 D MAY	1103	1015		-30+	-10.5	9.0"Hg
03A	C 2000 D MAY	1117	1027		-30+	-10	9.0"Hg
04A	E 2000 D MAY	1131	1020		-30+	-11.9	10.2"Hg
05A	IU 2005 B MON	1029	0913		-30+	-9.5	9.0"Hg
06A	IU 2009 C MAY	1159	1003		-30	-13.5	15.0"Hg
07A	IO 2006 E MAY	1215	0946		-29	-10	9.5"Hg
08A	C 2006 E MAY	1209	0950		-29	-6.5	7.0"Hg
09A	E 2006 E MAY	1240	0934		-29	-9	9.0"Hg
10A	IU 2004 D MAY	1258	1641		-30	-10.6	10.2"Hg

Relinquished By: (Signature) Jennifer Muehlhaus Date/Time 2-28-02 1430
Received By: (Signature) Jennifer Thomas ATL Date/Time 3-1-02 1055
Relinquished By: (Signature) Date/Time
Received By: (Signature) Date/Time
Relinquished By: (Signature) Date/Time
Received By: (Signature) Date/Time

Notes:
(1) SAMPLES RAN FROM 2/27 TO 2/28.
(2) EMAIL ELECTRONIC REPORT TO:
CSJU@SCA-ENVIRO.COM
(3) See cover sheet.

Lab Use Only	Shipper Name	Air Bill #	Opened By:	Temp. (°C)	Condition	Custody Seals Intact?	Work Order #
	UPS	1Z892 7E7 13	[illegible]	—	Good	Yes No (None)	0203019
		4126 8138					

Form 1.03 Jan 02

(4) Do analyze all samples, including the 3 that showed poor vac readings at the end.

@ AIR TOXICS LTD.
AN ENVIRONMENTAL ANALYTICAL LABORATORY

CHAIN-OF-CUSTODY RECORD

Sample Transportation Notice
Relinquishing signature on this document indicates that sample is being shipped in compliance with all applicable local, State, Federal, national, and international laws, regulations and ordinances of any kind. Air Toxics Limited assumes no liability with respect to the collection, handling or shipping of these samples. Relinquishing signature also indicates agreement to hold harmless, defend, and indemnify Air Toxics Limited against any claim, demand, or action of any kind, related to the collection, handling, or shipping of samples. D.O.T. Hotline (800) 467-4922

180 BLUE RAVINE ROAD, SUITE B
FOLSOM, CA 95630-4719
(916) 985-1000 FAX: (916) 985-1020

Contact Person: Jennifer Muehlhaus
Company: SCA Environmental
Address: 80 Grand Ave 4th Fl City: Oakland State: CA Zip: 94612
Phone: 510 465 9941 x231 FAX: 510 465 9109
Collected By: Signature: Jennifer Muehlhaus

Project Info:
P.O. #: B 5368
Project #: B 5368
Project Name: USCG Marina Village

Turn Around Time:
☒ Normal
☐ Rush _____ Specify

ML 3-2-02

Lab I.D.	Field Sample I.D.	Date & Time ON 2/27/02	Date & Time OFF 2/28/02	Analyses Requested	Canister Pressure / Vacuum Initial	Final	Receipt
11A	C 2004 D MAY	1310	1047	TO-14 SIM (std 17)	-30+	-10	9.0" Hg
12A	E 2004 D MAY	1319	0738		-29	0 (3)	0.8" Hg
13A	IU 2002 C ANN	1344	1059		-28	-6.2	7.5" Hg
14A	IU 2003 C ANN	1404	1108		-30+	-10	9.5" Hg
15A	IU 103 F SIN	1425	1118		-30+	-10.4	9.5" Hg
16A	C 103 F SIN	1441	1127		-29.5	-11.5	10.0" Hg
17A	E 103 F SIN	1446	1132		-30	-1 (3)	0.0" Hg

Relinquished By: (Signature) Date/Time: Jennifer Muehlhaus 2:30 pm 2-28-02 — Received By: (Signature) Date/Time: Laurel Homer ATL 3-1-02 1055
Relinquished By: (Signature) Date/Time — Received By: (Signature) Date/Time
Relinquished By: (Signature) Date/Time — Received By: (Signature) Date/Time

Notes: See page 1

Lab Use Only	Shipper Name	Air Bill #	Opened By:	Temp. (°C)	Condition	Custody Seals Intact?	Work Order #
	UPS	1Z 892 7E7 13	[illegible]	—	Good	Yes No (None)	0203019
		4126 8135					

Form 1330 rev. 08

AIR TOXICS LTD.

AN ENVIRONMENTAL ANALYTICAL LABORATORY

Air Toxics Ltd. Introduces the Electronic Report

Thank you for choosing Air Toxics Ltd. To better serve our customers, we are providing your report by e-mail. This document is provided in Portable Document Format which can be viewed with Acrobat Reader by Adobe.

This electronic report includes the following:

- Work order Summary;
- Laboratory Narrative;
- Results; and
- Chain of Custody (copy).

180 BLUE RAVINE ROAD, SUITE B FOLSOM, CA - 95630

(916) 985-1000 .FAX (916) 985-1020
Hours 8:00 A.M to 6:00 P.M. Pacific
E-mail to:samplereceiving@airtoxics.com

@ AIR TOXICS LTD.

AN ENVIRONMENTAL ANALYTICAL LABORATORY

WORK ORDER #: 0204445

Work Order Summary

CLIENT:	Mr. Chuck Siu SCA Environmental, Inc. 80 Grand Avenue Fourth Floor Oakland, CA 94612	**BILL TO:**	Mr. Chuck Siu SCA Environmental, Inc. 80 Grand Avenue Fourth Floor Oakland, CA 94612
PHONE:	510-465-9944	**P.O. #**	B5454
FAX:	510-465-9109	**PROJECT #**	B5454 USCG Air Sampling
DATE RECEIVED:	4/20/2002	**CONTACT:**	Karen Burden
DATE COMPLETED:	5/6/2002		

FRACTION #	NAME	TEST	RECEIPT VAC./PRES.
01A	IN 2000A KOL	TO-14-S	7.0 "Hg
02A	CN 2000A KOL	TO-14-S	5.0 "Hg
03A	IN 2000E KOL	TO-14-S	7.0 "Hg
04A	CN 2000E KOL	TO-14-S	7.0 "Hg
05A	IN 2002C KOL	TO-14-S	11.5 "Hg
06A	CN 2002C KOL	TO-14-S	10.5 "Hg
07A	IN 2004C KOL	TO-14-S	7.5 "Hg
08A	CN 2004C KOL	TO-14-S	5.5 "Hg
09A	BKGSE	TO-14-S	6.0 "Hg
10A(cancelled)	BKGW	TO-14-S	29.0 "Hg
11A	IR 2006B KOL	TO-14-S	6.5 "Hg
12A	CR 2006B KOL	TO-14-S	12.0 "Hg
13A	IR 2006E KOL	TO-14-S	7.5 "Hg
14A	CR 2006E KOL	TO-14-S	2.0 "Hg
15A	IR 2008D KOL	TO-14-S	9.0 "Hg
16A	CR 2008D KOL	TO-14-S	8.0 "Hg
17A	IR 2010C KOL	TO-14-S	7.0 "Hg
17AA	IR 2010C KOL Duplicate	TO-14-S	7.0 "Hg
18A	CR 2010C KOL	TO-14-S	7.0 "Hg
18AA	CR 2010C KOL Duplicate	TO-14-S	7.0 "Hg

Coninued on next page

@ AIR TOXICS LTD.

AN ENVIRONMENTAL ANALYTICAL LABORATORY

WORK ORDER #: 0204445

Work Order Summary

CLIENT:	Mr. Chuck Siu SCA Environmental, Inc. 80 Grand Avenue Fourth Floor Oakland, CA 94612	**BILL TO:**	Mr. Chuck Siu SCA Environmental, Inc. 80 Grand Avenue Fourth Floor Oakland, CA 94612
PHONE:	510-465-9944	**P.O. #**	B5454
FAX:	510-465-9109	**PROJECT #**	B5454 USCG Air Sampling
DATE RECEIVED:	4/20/2002	**CONTACT:**	Karen Burden
DATE COMPLETED:	5/6/2002		

FRACTION #	NAME	TEST	RECEIPT VAC./PRES.
19A	Lab Blank	TO-14-S	NA
19B	Lab Blank	TO-14-S	NA
19C	Lab Blank	TO-14-S	NA
20A	LCS	TO-14-S	NA
20B	LCS	TO-14-S	NA
20C	LCS	TO-14-S	NA

CERTIFIED BY: Linda L. Freeman

Laboratory Director

DATE: 05/06/02

Certfication numbers: CA ELAP - 1149, NY NELAP - 11291, UT ELAP - E-217, LA - AI 30763
Name of Accrediting Agency: NELAP/Florida Department of Health, Scope of Application: Clean Air Act,
Accreditation number: E87680, Effective date: 01/01/02, Expiration date: 06/30/02

Air Toxics Ltd. certifies that the test results contained in this report meet all requirements of the NELAC standards

This report shall not be reproduced, except in full, without the written approval of Air Toxics Ltd.

180 BLUE RAVINE ROAD, SUITE B FOLSOM, CA - 95630
(916) 985-1000 . (800) 985-5955 . FAX (916) 985-1020

LABORATORY NARRATIVE
TO-14 SIM
SCA Environmental, Inc.
Workorder# 0204445

Sixteen 6 Liter Summa Canister (SIM Certified) and Two 6 Liter Silonite Canister samples were received on April 19, 2002. The laboratory performed analysis via EPA Method TO-14/15 using GC/MS in the SIM acquisition mode. The method involves concentrating up to 0.5 liters of air. The concentrated aliquot is then flash vaporized and swept through a water management system to remove water vapor. Following dehumidification, the sample passes directly into the GC/MS for analysis. See the data sheets for the reporting limits for each compound.

Method modifications taken to run these samples include:

Requirement	*TO-14/15 SIM*	*ATL Modifications*
Sampling/concentrator system	Nafion Drier	Multisorbent concentrator
Canister cleaning - clean air supply	Cryogenic Trap	Use of Humidified UHP Air
Canister certification	Pressurize w/humidified zero air.	Pressurize w/dry UHP nitrogen
Sample load volume	400 mL	Up to 0.5 liter
Blank	Humid air blank	Dry air blank for low level analysis.
Blank acceptance criteria	< 0.2 ppbv	< DL
BFB absolute abundance criteria	Within 10% of that from previous day.	CCV surrogate recoveries demonstrate stability from one day to the next
BFB acceptance criteria	CLP protocol	SW-846 protocol
Concentration of IS spike	Not specified	10 ppbv
Dilutions for initial calibration	Dynamic dilutions or static using canisters	Syringe dilutions
Flow rates/operating parameters	Not specified	Optimized. See procedures section.
ICAL RRF %RSD acceptance criteria	Not specified	30% or less for standard compounds, 40% or less for non-standard and polar compounds
IS recoveries	Within 40% of mean over ICAL for blanks, and w/in 40% of daily CCV for samples.	Within 40% of CCV recoveries for blank and samples.
IS RTs	Within .33 min from most recent calibration (either ICAL or daily)	Within 0.5 min. of RT in daily CCV
Daily CCV	70 - 130%	Standard compounds:70 - 130% for at least 90%; Non-standard and polar compounds: 60 - 140% for at least 80%
RF for quantitation	From ICAL	From ICAL
Canister leak check	24 hour, positive pressure	20 minute, vacuum check
MSD scan range	35 - 300 amu	35 - 350 amu

Requirement	*TO-14/15 SIM*	*ATL Modifications*
Canister cleaning - clean air supply	Cryogenic Trap	Use of Humidified UHP Air
Canister certification	Pressurize w/humidified zero air.	Pressurize w/dry UHP nitrogen
Sampling/concentrator system	Nafion Drier	Multisorbent concentrator

Receiving Notes

BKGW was cancelled per client's request.

Canister sample CR 2006E KOL was received at < 2.5" Hg despite the use of a flow controller for collection.

Analytical Notes

There were no analytical discrepancies.

Definition of Data Qualifying Flags

Six qualifiers may have been used on the data analysis sheets and indicates as follows:

B - Compound present in laboratory blank greater than reporting limit (background subtraction not performed).

J - Estimated value.

E - Exceeds instrument calibration range.

S - Saturated peak.

Q - Exceeds quality control limits.

U - Compound analyzed for but not detected above the reporting limit.

File extensions may have been used on the data analysis sheets and indicates as follows:

a-File was requantified

b-File was quantified by a second column and detector

r1-File was requantified for the purpose of reissue

AIR TOXICS LTD.

SAMPLE NAME: IN 2000A KOL

ID#: 0204445-01A

EPA METHOD TO-14 GC/MS SIM

File Name:	**w042911**	**Date of Collection:**	**4/19/02**
Dil. Factor:	**1.75**	**Date of Analysis:**	**4/29/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.018	0.045	Not Detected	Not Detected
1,1-Dichloroethene	0.018	0.070	Not Detected	Not Detected
1,1-Dichloroethane	0.035	0.14	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.035	0.14	Not Detected	Not Detected
1,1,1-Trichloroethane	0.035	0.19	0.044	0.24
Benzene	0.088	0.28	0.18	0.58
1,2-Dichloroethane	0.035	0.14	0.048	0.20
Trichloroethene	0.035	0.19	Not Detected	Not Detected
Toluene	0.088	0.34	1.7	6.6
1,1,2-Trichloroethane	0.035	0.19	Not Detected	Not Detected
Tetrachloroethene	0.035	0.24	0.043	0.30
Ethyl Benzene	0.088	0.39	0.15	0.67
m,p-Xylene	0.088	0.39	0.55	2.4
o-Xylene	0.088	0.39	0.17	0.77
1,1,2,2-Tetrachloroethane	0.035	0.24	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.18	0.70	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.18	0.64	Not Detected	Not Detected

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	126	70-130
Toluene-d8	100	70-130
4-Bromofluorobenzene	115	70-130

AIR TOXICS LTD.

SAMPLE NAME: CN 2000A KOL

ID#: 0204445-02A

EPA METHOD TO-14 GC/MS SIM

File Name:	**w043007**	**Date of Collection:**	**4/19/02**
Dil. Factor:	**1.61**	**Date of Analysis:**	**4/30/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.016	0.042	Not Detected	Not Detected
1,1-Dichloroethene	0.016	0.065	Not Detected	Not Detected
1,1-Dichloroethane	0.032	0.13	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.032	0.13	Not Detected	Not Detected
1,1,1-Trichloroethane	0.032	0.18	0.049	0.27
Benzene	0.080	0.26	0.20	0.66
1,2-Dichloroethane	0.032	0.13	0.040	0.16
Trichloroethene	0.032	0.18	Not Detected	Not Detected
Toluene	0.080	0.31	4.0	15
1,1,2-Trichloroethane	0.032	0.18	Not Detected	Not Detected
Tetrachloroethene	0.032	0.22	0.039	0.27
Ethyl Benzene	0.080	0.36	0.12	0.52
m,p-Xylene	0.080	0.36	0.30	1.3
o-Xylene	0.080	0.36	0.14	0.60
1,1,2,2-Tetrachloroethane	0.032	0.22	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.16	0.65	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.16	0.59	Not Detected	Not Detected

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	124	70-130
Toluene-d8	97	70-130
4-Bromofluorobenzene	119	70-130

AIR TOXICS LTD.

SAMPLE NAME: IN 2000E KOL

ID#: 0204445-03A

EPA METHOD TO-14 GC/MS SIM

File Name:	**w042913**	**Date of Collection:**	**4/19/02**
Dil. Factor:	**1.75**	**Date of Analysis:**	**4/29/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.018	0.045	Not Detected	Not Detected
1,1-Dichloroethene	0.018	0.070	Not Detected	Not Detected
1,1-Dichloroethane	0.035	0.14	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.035	0.14	Not Detected	Not Detected
1,1,1-Trichloroethane	0.035	0.19	0.045	0.25
Benzene	0.088	0.28	0.27	0.89
1,2-Dichloroethane	0.035	0.14	0.058	0.24
Trichloroethene	0.035	0.19	Not Detected	Not Detected
Toluene	0.088	0.34	0.51	1.9
1,1,2-Trichloroethane	0.035	0.19	Not Detected	Not Detected
Tetrachloroethene	0.035	0.24	0.040	0.28
Ethyl Benzene	0.088	0.39	Not Detected	Not Detected
m,p-Xylene	0.088	0.39	0.14	0.60
o-Xylene	0.088	0.39	Not Detected	Not Detected
1,1,2,2-Tetrachloroethane	0.035	0.24	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.18	0.70	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.18	0.64	Not Detected	Not Detected

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	127	70-130
Toluene-d8	100	70-130
4-Bromofluorobenzene	119	70-130

AIR TOXICS LTD.

SAMPLE NAME: CN 2000E KOL

ID#: 0204445-04A

EPA METHOD TO-14 GC/MS SIM

File Name:	**w042914**	**Date of Collection:**	**4/19/02**
Dil. Factor:	**1.75**	**Date of Analysis:**	**4/29/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.018	0.045	Not Detected	Not Detected
1,1-Dichloroethene	0.018	0.070	Not Detected	Not Detected
1,1-Dichloroethane	0.035	0.14	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.035	0.14	Not Detected	Not Detected
1,1,1-Trichloroethane	0.035	0.19	0.046	0.26
Benzene	0.088	0.28	0.15	0.48
1,2-Dichloroethane	0.035	0.14	0.054	0.22
Trichloroethene	0.035	0.19	Not Detected	Not Detected
Toluene	0.088	0.34	0.32	1.2
1,1,2-Trichloroethane	0.035	0.19	Not Detected	Not Detected
Tetrachloroethene	0.035	0.24	0.041	0.28
Ethyl Benzene	0.088	0.39	Not Detected	Not Detected
m,p-Xylene	0.088	0.39	0.15	0.68
o-Xylene	0.088	0.39	Not Detected	Not Detected
1,1,2,2-Tetrachloroethane	0.035	0.24	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.18	0.70	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.18	0.64	Not Detected	Not Detected

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	129	70-130
Toluene-d8	100	70-130
4-Bromofluorobenzene	115	70-130

AIR TOXICS LTD.

SAMPLE NAME: IN 2002C KOL

ID#: 0204445-05A

EPA METHOD TO-14 GC/MS SIM

File Name:	**w042915**	**Date of Collection:**	**4/19/02**
Dil. Factor:	**2.17**	**Date of Analysis:**	**4/29/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.022	0.056	Not Detected	Not Detected
1,1-Dichloroethene	0.022	0.087	Not Detected	Not Detected
1,1-Dichloroethane	0.043	0.18	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.043	0.17	Not Detected	Not Detected
1,1,1-Trichloroethane	0.043	0.24	0.048	0.26
Benzene	0.11	0.35	0.20	0.65
1,2-Dichloroethane	0.043	0.18	0.057	0.23
Trichloroethene	0.043	0.24	Not Detected	Not Detected
Toluene	0.11	0.42	0.45	1.7
1,1,2-Trichloroethane	0.043	0.24	Not Detected	Not Detected
Tetrachloroethene	0.043	0.30	Not Detected	Not Detected
Ethyl Benzene	0.11	0.48	Not Detected	Not Detected
m,p-Xylene	0.11	0.48	0.12	0.51
o-Xylene	0.11	0.48	Not Detected	Not Detected
1,1,2,2-Tetrachloroethane	0.043	0.30	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.22	0.87	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.22	0.80	Not Detected	Not Detected

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	125	70-130
Toluene-d8	98	70-130
4-Bromofluorobenzene	121	70-130

AIR TOXICS LTD.

SAMPLE NAME: CN 2002C KOL

ID#: 0204445-06A

EPA METHOD TO-14 GC/MS SIM

File Name:	**w042916**	**Date of Collection:**	**4/19/02**
Dil. Factor:	**2.06**	**Date of Analysis:**	**4/29/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.021	0.054	Not Detected	Not Detected
1,1-Dichloroethene	0.021	0.083	Not Detected	Not Detected
1,1-Dichloroethane	0.041	0.17	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.041	0.17	Not Detected	Not Detected
1,1,1-Trichloroethane	0.041	0.23	0.046	0.26
Benzene	0.10	0.33	0.14	0.45
1,2-Dichloroethane	0.041	0.17	0.063	0.26
Trichloroethene	0.041	0.22	Not Detected	Not Detected
Toluene	0.10	0.39	9.0	34
1,1,2-Trichloroethane	0.041	0.23	Not Detected	Not Detected
Tetrachloroethene	0.041	0.28	0.16	1.1
Ethyl Benzene	0.10	0.45	0.53	2.3
m,p-Xylene	0.10	0.45	1.6	7.0
o-Xylene	0.10	0.45	0.56	2.4
1,1,2,2-Tetrachloroethane	0.041	0.29	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.21	0.83	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.21	0.75	Not Detected	Not Detected

Container Type: 6 Liter Silonite Canister

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	127	70-130
Toluene-d8	103	70-130
4-Bromofluorobenzene	126	70-130

AIR TOXICS LTD.

SAMPLE NAME: IN 2004C KOL

ID#: 0204445-07A

EPA METHOD TO-14 GC/MS SIM

File Name:	**w042917**	**Date of Collection:**	**4/19/02**
Dil. Factor:	**1.79**	**Date of Analysis:**	**4/29/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.018	0.046	Not Detected	Not Detected
1,1-Dichloroethene	0.018	0.072	Not Detected	Not Detected
1,1-Dichloroethane	0.036	0.15	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.036	0.14	Not Detected	Not Detected
1,1,1-Trichloroethane	0.036	0.20	0.045	0.25
Benzene	0.090	0.29	0.16	0.51
1,2-Dichloroethane	0.036	0.15	0.054	0.22
Trichloroethene	0.036	0.20	Not Detected	Not Detected
Toluene	0.090	0.34	0.29	1.1
1,1,2-Trichloroethane	0.036	0.20	Not Detected	Not Detected
Tetrachloroethene	0.036	0.25	Not Detected	Not Detected
Ethyl Benzene	0.090	0.39	Not Detected	Not Detected
m,p-Xylene	0.090	0.40	0.11	0.49
o-Xylene	0.090	0.40	Not Detected	Not Detected
1,1,2,2-Tetrachloroethane	0.036	0.25	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.18	0.72	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.18	0.66	Not Detected	Not Detected

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	125	70-130
Toluene-d8	99	70-130
4-Bromofluorobenzene	120	70-130

AIR TOXICS LTD.

SAMPLE NAME: CN 2004C KOL

ID#: 0204445-08A

EPA METHOD TO-14 GC/MS SIM

File Name:	**w042918**	**Date of Collection:**	**4/19/02**
Dil. Factor:	**1.64**	**Date of Analysis:**	**4/29/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.016	0.043	Not Detected	Not Detected
1,1-Dichloroethene	0.016	0.066	Not Detected	Not Detected
1,1-Dichloroethane	0.033	0.13	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.033	0.13	Not Detected	Not Detected
1,1,1-Trichloroethane	0.033	0.18	0.051	0.28
Benzene	0.082	0.27	0.14	0.45
1,2-Dichloroethane	0.033	0.13	0.035	0.14
Trichloroethene	0.033	0.18	Not Detected	Not Detected
Toluene	0.082	0.31	0.34	1.3
1,1,2-Trichloroethane	0.033	0.18	Not Detected	Not Detected
Tetrachloroethene	0.033	0.23	0.040	0.28
Ethyl Benzene	0.082	0.36	Not Detected	Not Detected
m,p-Xylene	0.082	0.36	0.11	0.48
o-Xylene	0.082	0.36	Not Detected	Not Detected
1,1,2,2-Tetrachloroethane	0.033	0.23	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.16	0.66	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.16	0.60	Not Detected	Not Detected

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	120	70-130
Toluene-d8	97	70-130
4-Bromofluorobenzene	120	70-130

AIR TOXICS LTD.

SAMPLE NAME: BKGSE

ID#: 0204445-09A

EPA METHOD TO-14 GC/MS SIM

File Name:	**w043008**	**Date of Collection:**	**4/19/02**
Dil. Factor:	**1.68**	**Date of Analysis:**	**4/30/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.017	0.044	0.037	0.096
1,1-Dichloroethene	0.017	0.068	Not Detected	Not Detected
1,1-Dichloroethane	0.034	0.14	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.034	0.14	Not Detected	Not Detected
1,1,1-Trichloroethane	0.034	0.19	0.047	0.26
Benzene	0.084	0.27	0.15	0.48
1,2-Dichloroethane	0.034	0.14	0.052	0.22
Trichloroethene	0.034	0.18	Not Detected	Not Detected
Toluene	0.084	0.32	0.41	1.6
1,1,2-Trichloroethane	0.034	0.19	Not Detected	Not Detected
Tetrachloroethene	0.034	0.23	0.038	0.26
Ethyl Benzene	0.084	0.37	Not Detected	Not Detected
m,p-Xylene	0.084	0.37	0.11	0.49
o-Xylene	0.084	0.37	Not Detected	Not Detected
1,1,2,2-Tetrachloroethane	0.034	0.23	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.17	0.68	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.17	0.62	Not Detected	Not Detected

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	126	70-130
Toluene-d8	100	70-130
4-Bromofluorobenzene	118	70-130

AIR TOXICS LTD.

SAMPLE NAME: IR 2006B KOL

ID#: 0204445-11A

EPA METHOD TO-14 GC/MS SIM

File Name:	**w043009**	**Date of Collection:**	**4/19/02**
Dil. Factor:	**1.71**	**Date of Analysis:**	**4/30/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.017	0.044	Not Detected	Not Detected
1,1-Dichloroethene	0.017	0.069	Not Detected	Not Detected
1,1-Dichloroethane	0.034	0.14	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.034	0.14	Not Detected	Not Detected
1,1,1-Trichloroethane	0.034	0.19	0.045	0.25
Benzene	0.086	0.28	0.16	0.52
1,2-Dichloroethane	0.034	0.14	0.053	0.22
Trichloroethene	0.034	0.19	Not Detected	Not Detected
Toluene	0.086	0.33	0.93	3.6
1,1,2-Trichloroethane	0.034	0.19	Not Detected	Not Detected
Tetrachloroethene	0.034	0.24	0.036	0.24
Ethyl Benzene	0.086	0.38	Not Detected	Not Detected
m,p-Xylene	0.086	0.38	0.24	1.1
o-Xylene	0.086	0.38	Not Detected	Not Detected
1,1,2,2-Tetrachloroethane	0.034	0.24	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.17	0.69	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.17	0.63	Not Detected	Not Detected

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	129	70-130
Toluene-d8	102	70-130
4-Bromofluorobenzene	121	70-130

AIR TOXICS LTD.

SAMPLE NAME: CR 2006B KOL

ID#: 0204445-12A

EPA METHOD TO-14 GC/MS SIM

File Name:	**w043010**	**Date of Collection:**	**4/19/02**
Dil. Factor:	**2.23**	**Date of Analysis:**	**4/30/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.022	0.058	Not Detected	Not Detected
1,1-Dichloroethene	0.022	0.090	Not Detected	Not Detected
1,1-Dichloroethane	0.045	0.18	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.045	0.18	Not Detected	Not Detected
1,1,1-Trichloroethane	0.045	0.25	0.050	0.27
Benzene	0.11	0.36	0.20	0.64
1,2-Dichloroethane	0.045	0.18	0.062	0.26
Trichloroethene	0.045	0.24	0.057	0.31
Toluene	0.11	0.43	0.49	1.9
1,1,2-Trichloroethane	0.045	0.25	Not Detected	Not Detected
Tetrachloroethene	0.045	0.31	0.058	0.40
Ethyl Benzene	0.11	0.49	Not Detected	Not Detected
m,p-Xylene	0.11	0.49	Not Detected	Not Detected
o-Xylene	0.11	0.49	Not Detected	Not Detected
1,1,2,2-Tetrachloroethane	0.045	0.31	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.22	0.90	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.22	0.82	Not Detected	Not Detected

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	123	70-130
Toluene-d8	99	70-130
4-Bromofluorobenzene	118	70-130

AIR TOXICS LTD.

SAMPLE NAME: IR 2006E KOL

ID#: 0204445-13A

EPA METHOD TO-14 GC/MS SIM

File Name:	**w043011**	**Date of Collection:**	**4/19/02**
Dil. Factor:	**1.79**	**Date of Analysis:**	**4/30/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.018	0.046	Not Detected	Not Detected
1,1-Dichloroethene	0.018	0.072	Not Detected	Not Detected
1,1-Dichloroethane	0.036	0.15	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.036	0.14	Not Detected	Not Detected
1,1,1-Trichloroethane	0.036	0.20	0.043	0.24
Benzene	0.090	0.29	0.17	0.57
1,2-Dichloroethane	0.036	0.15	0.043	0.18
Trichloroethene	0.036	0.20	Not Detected	Not Detected
Toluene	0.090	0.34	1.0	3.9
1,1,2-Trichloroethane	0.036	0.20	Not Detected	Not Detected
Tetrachloroethene	0.036	0.25	Not Detected	Not Detected
Ethyl Benzene	0.090	0.39	0.13	0.59
m,p-Xylene	0.090	0.40	0.52	2.3
o-Xylene	0.090	0.40	0.15	0.67
1,1,2,2-Tetrachloroethane	0.036	0.25	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.18	0.72	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.18	0.66	Not Detected	Not Detected

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	128	70-130
Toluene-d8	100	70-130
4-Bromofluorobenzene	117	70-130

AIR TOXICS LTD.

SAMPLE NAME: CR 2006E KOL

ID#: 0204445-14A

EPA METHOD TO-14 GC/MS SIM

File Name:	**w043012**	**Date of Collection:**	**4/19/02**
Dil. Factor:	**1.44**	**Date of Analysis:**	**4/30/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.014	0.037	Not Detected	Not Detected
1,1-Dichloroethene	0.014	0.058	Not Detected	Not Detected
1,1-Dichloroethane	0.029	0.12	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.029	0.12	Not Detected	Not Detected
1,1,1-Trichloroethane	0.029	0.16	0.046	0.25
Benzene	0.072	0.23	0.15	0.50
1,2-Dichloroethane	0.029	0.12	0.046	0.19
Trichloroethene	0.029	0.16	Not Detected	Not Detected
Toluene	0.072	0.28	0.42	1.6
1,1,2-Trichloroethane	0.029	0.16	Not Detected	Not Detected
Tetrachloroethene	0.029	0.20	0.040	0.27
Ethyl Benzene	0.072	0.32	Not Detected	Not Detected
m,p-Xylene	0.072	0.32	0.12	0.54
o-Xylene	0.072	0.32	Not Detected	Not Detected
1,1,2,2-Tetrachloroethane	0.029	0.20	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.14	0.58	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.14	0.53	Not Detected	Not Detected

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	127	70-130
Toluene-d8	101	70-130
4-Bromofluorobenzene	121	70-130

AIR TOXICS LTD.

SAMPLE NAME: IR 2008D KOL

ID#: 0204445-15A

EPA METHOD TO-14 GC/MS SIM

File Name:	**w050106**	**Date of Collection:**	**4/19/02**
Dil. Factor:	**1.91**	**Date of Analysis:**	**5/1/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.019	0.050	Not Detected	Not Detected
1,1-Dichloroethene	0.019	0.077	Not Detected	Not Detected
1,1-Dichloroethane	0.038	0.16	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.038	0.15	Not Detected	Not Detected
1,1,1-Trichloroethane	0.038	0.21	0.044	0.24
Benzene	0.096	0.31	0.18	0.59
1,2-Dichloroethane	0.038	0.16	0.053	0.22
Trichloroethene	0.038	0.21	Not Detected	Not Detected
Toluene	0.096	0.36	1.0	4.0
1,1,2-Trichloroethane	0.038	0.21	Not Detected	Not Detected
Tetrachloroethene	0.038	0.26	0.045	0.31
Ethyl Benzene	0.096	0.42	Not Detected	Not Detected
m,p-Xylene	0.096	0.42	0.24	1.1
o-Xylene	0.096	0.42	Not Detected	Not Detected
1,1,2,2-Tetrachloroethane	0.038	0.27	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.19	0.77	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.19	0.70	Not Detected	Not Detected

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	128	70-130
Toluene-d8	98	70-130
4-Bromofluorobenzene	117	70-130

AIR TOXICS LTD.

SAMPLE NAME: CR 2008D KOL

ID#: 0204445-16A

EPA METHOD TO-14 GC/MS SIM

File Name:	**w050107**	**Date of Collection:**	**4/19/02**
Dil. Factor:	**1.83**	**Date of Analysis:**	**5/1/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.018	0.048	Not Detected	Not Detected
1,1-Dichloroethene	0.018	0.074	Not Detected	Not Detected
1,1-Dichloroethane	0.037	0.15	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.037	0.15	Not Detected	Not Detected
1,1,1-Trichloroethane	0.037	0.20	0.043	0.24
Benzene	0.092	0.30	0.15	0.50
1,2-Dichloroethane	0.037	0.15	0.055	0.23
Trichloroethene	0.037	0.20	Not Detected	Not Detected
Toluene	0.092	0.35	0.39	1.5
1,1,2-Trichloroethane	0.037	0.20	Not Detected	Not Detected
Tetrachloroethene	0.037	0.25	0.043	0.30
Ethyl Benzene	0.092	0.40	Not Detected	Not Detected
m,p-Xylene	0.092	0.40	Not Detected	Not Detected
o-Xylene	0.092	0.40	Not Detected	Not Detected
1,1,2,2-Tetrachloroethane	0.037	0.26	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.18	0.74	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.18	0.67	Not Detected	Not Detected

Container Type: 6 Liter Silonite Canister

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	126	70-130
Toluene-d8	99	70-130
4-Bromofluorobenzene	111	70-130

AIR TOXICS LTD.

SAMPLE NAME: IR 2010C KOL

ID#: 0204445-17A

EPA METHOD TO-14 GC/MS SIM

File Name:	**w050108**	**Date of Collection:**	**4/19/02**
Dil. Factor:	**1.75**	**Date of Analysis:**	**5/1/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.018	0.045	Not Detected	Not Detected
1,1-Dichloroethene	0.018	0.070	Not Detected	Not Detected
1,1-Dichloroethane	0.035	0.14	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.035	0.14	Not Detected	Not Detected
1,1,1-Trichloroethane	0.035	0.19	0.044	0.24
Benzene	0.088	0.28	0.19	0.60
1,2-Dichloroethane	0.035	0.14	0.055	0.23
Trichloroethene	0.035	0.19	Not Detected	Not Detected
Toluene	0.088	0.34	1.2	4.7
1,1,2-Trichloroethane	0.035	0.19	Not Detected	Not Detected
Tetrachloroethene	0.035	0.24	Not Detected	Not Detected
Ethyl Benzene	0.088	0.39	0.10	0.44
m,p-Xylene	0.088	0.39	0.40	1.8
o-Xylene	0.088	0.39	0.14	0.61
1,1,2,2-Tetrachloroethane	0.035	0.24	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.18	0.70	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.18	0.64	Not Detected	Not Detected

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	127	70-130
Toluene-d8	100	70-130
4-Bromofluorobenzene	119	70-130

AIR TOXICS LTD.

SAMPLE NAME: IR 2010C KOL Duplicate

ID#: 0204445-17AA

EPA METHOD TO-14 GC/MS SIM

File Name:	**w050110**	**Date of Collection:**	**4/19/02**
Dil. Factor:	**1.75**	**Date of Analysis:**	**5/1/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.018	0.045	Not Detected	Not Detected
1,1-Dichloroethene	0.018	0.070	Not Detected	Not Detected
1,1-Dichloroethane	0.035	0.14	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.035	0.14	Not Detected	Not Detected
1,1,1-Trichloroethane	0.035	0.19	0.044	0.24
Benzene	0.088	0.28	0.18	0.60
1,2-Dichloroethane	0.035	0.14	0.056	0.23
Trichloroethene	0.035	0.19	Not Detected	Not Detected
Toluene	0.088	0.34	1.2	4.8
1,1,2-Trichloroethane	0.035	0.19	Not Detected	Not Detected
Tetrachloroethene	0.035	0.24	Not Detected	Not Detected
Ethyl Benzene	0.088	0.39	0.11	0.49
m,p-Xylene	0.088	0.39	0.39	1.7
o-Xylene	0.088	0.39	0.13	0.56
1,1,2,2-Tetrachloroethane	0.035	0.24	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.18	0.70	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.18	0.64	Not Detected	Not Detected

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	127	70-130
Toluene-d8	101	70-130
4-Bromofluorobenzene	118	70-130

AIR TOXICS LTD.

SAMPLE NAME: CR 2010C KOL

ID#: 0204445-18A

EPA METHOD TO-14 GC/MS SIM

File Name:	**w050109**	**Date of Collection:**	**4/19/02**
Dil. Factor:	**1.75**	**Date of Analysis:**	**5/1/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.018	0.045	Not Detected	Not Detected
1,1-Dichloroethene	0.018	0.070	Not Detected	Not Detected
1,1-Dichloroethane	0.035	0.14	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.035	0.14	Not Detected	Not Detected
1,1,1-Trichloroethane	0.035	0.19	0.046	0.26
Benzene	0.088	0.28	0.16	0.53
1,2-Dichloroethane	0.035	0.14	0.048	0.20
Trichloroethene	0.035	0.19	Not Detected	Not Detected
Toluene	0.088	0.34	0.51	2.0
1,1,2-Trichloroethane	0.035	0.19	Not Detected	Not Detected
Tetrachloroethene	0.035	0.24	0.041	0.28
Ethyl Benzene	0.088	0.39	Not Detected	Not Detected
m,p-Xylene	0.088	0.39	0.14	0.61
o-Xylene	0.088	0.39	Not Detected	Not Detected
1,1,2,2-Tetrachloroethane	0.035	0.24	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.18	0.70	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.18	0.64	Not Detected	Not Detected

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	121	70-130
Toluene-d8	100	70-130
4-Bromofluorobenzene	118	70-130

AIR TOXICS LTD.

SAMPLE NAME: CR 2010C KOL Duplicate

ID#: 0204445-18AA

EPA METHOD TO-14 GC/MS SIM

File Name:	**w050111**	**Date of Collection:**	**4/19/02**
Dil. Factor:	**1.75**	**Date of Analysis:**	**5/1/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.018	0.045	Not Detected	Not Detected
1,1-Dichloroethene	0.018	0.070	Not Detected	Not Detected
1,1-Dichloroethane	0.035	0.14	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.035	0.14	Not Detected	Not Detected
1,1,1-Trichloroethane	0.035	0.19	0.044	0.24
Benzene	0.088	0.28	0.16	0.51
1,2-Dichloroethane	0.035	0.14	0.048	0.20
Trichloroethene	0.035	0.19	Not Detected	Not Detected
Toluene	0.088	0.34	0.50	1.9
1,1,2-Trichloroethane	0.035	0.19	Not Detected	Not Detected
Tetrachloroethene	0.035	0.24	0.040	0.27
Ethyl Benzene	0.088	0.39	Not Detected	Not Detected
m,p-Xylene	0.088	0.39	0.14	0.60
o-Xylene	0.088	0.39	Not Detected	Not Detected
1,1,2,2-Tetrachloroethane	0.035	0.24	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.18	0.70	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.18	0.64	Not Detected	Not Detected

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	120	70-130
Toluene-d8	100	70-130
4-Bromofluorobenzene	118	70-130

AIR TOXICS LTD.

SAMPLE NAME: Lab Blank

ID#: 0204445-19A

EPA METHOD TO-14 GC/MS SIM

File Name:	**w042906**	**Date of Collection: NA**	
Dil. Factor:	**1.00**	**Date of Analysis: 4/29/02**	

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.010	0.026	Not Detected	Not Detected
1,1-Dichloroethene	0.010	0.040	Not Detected	Not Detected
1,1-Dichloroethane	0.020	0.082	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.020	0.080	Not Detected	Not Detected
1,1,1-Trichloroethane	0.020	0.11	Not Detected	Not Detected
Benzene	0.050	0.16	Not Detected	Not Detected
1,2-Dichloroethane	0.020	0.082	Not Detected	Not Detected
Trichloroethene	0.020	0.11	Not Detected	Not Detected
Toluene	0.050	0.19	Not Detected	Not Detected
1,1,2-Trichloroethane	0.020	0.11	Not Detected	Not Detected
Tetrachloroethene	0.020	0.14	Not Detected	Not Detected
Ethyl Benzene	0.050	0.22	Not Detected	Not Detected
m,p-Xylene	0.050	0.22	Not Detected	Not Detected
o-Xylene	0.050	0.22	Not Detected	Not Detected
1,1,2,2-Tetrachloroethane	0.020	0.14	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.10	0.40	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.10	0.37	Not Detected	Not Detected

Container Type: NA - Not Applicable

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	130	70-130
Toluene-d8	98	70-130
4-Bromofluorobenzene	104	70-130

AIR TOXICS LTD.

SAMPLE NAME: Lab Blank

ID#: 0204445-19B

EPA METHOD TO-14 GC/MS SIM

File Name:	**w043005**	**Date of Collection: NA**	
Dil. Factor:	**1.00**	**Date of Analysis: 4/30/02**	

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.010	0.026	Not Detected	Not Detected
1,1-Dichloroethene	0.010	0.040	Not Detected	Not Detected
1,1-Dichloroethane	0.020	0.082	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.020	0.080	Not Detected	Not Detected
1,1,1-Trichloroethane	0.020	0.11	Not Detected	Not Detected
Benzene	0.050	0.16	Not Detected	Not Detected
1,2-Dichloroethane	0.020	0.082	Not Detected	Not Detected
Trichloroethene	0.020	0.11	Not Detected	Not Detected
Toluene	0.050	0.19	Not Detected	Not Detected
1,1,2-Trichloroethane	0.020	0.11	Not Detected	Not Detected
Tetrachloroethene	0.020	0.14	Not Detected	Not Detected
Ethyl Benzene	0.050	0.22	Not Detected	Not Detected
m,p-Xylene	0.050	0.22	Not Detected	Not Detected
o-Xylene	0.050	0.22	Not Detected	Not Detected
1,1,2,2-Tetrachloroethane	0.020	0.14	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.10	0.40	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.10	0.37	Not Detected	Not Detected

Container Type: NA - Not Applicable

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	129	70-130
Toluene-d8	98	70-130
4-Bromofluorobenzene	103	70-130

AIR TOXICS LTD.

SAMPLE NAME: Lab Blank

ID#: 0204445-19C

EPA METHOD TO-14 GC/MS SIM

File Name:	**w050105**	**Date of Collection: NA**	
Dil. Factor:	**1.00**	**Date of Analysis: 5/1/02**	

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.010	0.026	Not Detected	Not Detected
1,1-Dichloroethene	0.010	0.040	Not Detected	Not Detected
1,1-Dichloroethane	0.020	0.082	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.020	0.080	Not Detected	Not Detected
1,1,1-Trichloroethane	0.020	0.11	Not Detected	Not Detected
Benzene	0.050	0.16	Not Detected	Not Detected
1,2-Dichloroethane	0.020	0.082	Not Detected	Not Detected
Trichloroethene	0.020	0.11	Not Detected	Not Detected
Toluene	0.050	0.19	Not Detected	Not Detected
1,1,2-Trichloroethane	0.020	0.11	Not Detected	Not Detected
Tetrachloroethene	0.020	0.14	Not Detected	Not Detected
Ethyl Benzene	0.050	0.22	Not Detected	Not Detected
m,p-Xylene	0.050	0.22	Not Detected	Not Detected
o-Xylene	0.050	0.22	Not Detected	Not Detected
1,1,2,2-Tetrachloroethane	0.020	0.14	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.10	0.40	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.10	0.37	Not Detected	Not Detected

Container Type: NA - Not Applicable

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	128	70-130
Toluene-d8	99	70-130
4-Bromofluorobenzene	103	70-130

AIR TOXICS LTD.

SAMPLE NAME: LCS

ID#: 0204445-20A

EPA METHOD TO-14 GC/MS SIM

File Name:	**w042903**		**Date of Collection: NA**
Dil. Factor:	**1.00**		**Date of Analysis: 4/29/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	%Recovery
Vinyl Chloride	0.010	0.026	94
1,1-Dichloroethene	0.010	0.040	84
1,1-Dichloroethane	0.020	0.082	92
cis-1,2-Dichloroethene	0.020	0.080	79
1,1,1-Trichloroethane	0.020	0.11	115
Benzene	0.050	0.16	81
1,2-Dichloroethane	0.020	0.082	105
Trichloroethene	0.020	0.11	85
Toluene	0.050	0.19	84
1,1,2-Trichloroethane	0.020	0.11	99
Tetrachloroethene	0.020	0.14	93
Ethyl Benzene	0.050	0.22	92
m,p-Xylene	0.050	0.22	96
o-Xylene	0.050	0.22	102
1,1,2,2-Tetrachloroethane	0.020	0.14	101
trans-1,2-Dichloroethene	0.10	0.40	104
Methyl tert-Butyl Ether	0.10	0.37	74

Container Type: NA - Not Applicable

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	122	70-130
Toluene-d8	101	70-130
4-Bromofluorobenzene	106	70-130

AIR TOXICS LTD.

SAMPLE NAME: LCS

ID#: 0204445-20B

EPA METHOD TO-14 GC/MS SIM

File Name:	**w043003**		**Date of Collection: NA**
Dil. Factor:	**1.00**		**Date of Analysis: 4/30/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	%Recovery
Vinyl Chloride	0.010	0.026	88
1,1-Dichloroethene	0.010	0.040	77
1,1-Dichloroethane	0.020	0.082	86
cis-1,2-Dichloroethene	0.020	0.080	72
1,1,1-Trichloroethane	0.020	0.11	107
Benzene	0.050	0.16	78
1,2-Dichloroethane	0.020	0.082	102
Trichloroethene	0.020	0.11	82
Toluene	0.050	0.19	82
1,1,2-Trichloroethane	0.020	0.11	95
Tetrachloroethene	0.020	0.14	89
Ethyl Benzene	0.050	0.22	88
m,p-Xylene	0.050	0.22	92
o-Xylene	0.050	0.22	96
1,1,2,2-Tetrachloroethane	0.020	0.14	96
trans-1,2-Dichloroethene	0.10	0.40	99
Methyl tert-Butyl Ether	0.10	0.37	66

Container Type: NA - Not Applicable

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	118	70-130
Toluene-d8	102	70-130
4-Bromofluorobenzene	105	70-130

AIR TOXICS LTD.

SAMPLE NAME: LCS

ID#: 0204445-20C

EPA METHOD TO-14 GC/MS SIM

File Name:	**w050103**		**Date of Collection: NA**
Dil. Factor:	**1.00**		**Date of Analysis: 5/1/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	%Recovery
Vinyl Chloride	0.010	0.026	88
1,1-Dichloroethene	0.010	0.040	77
1,1-Dichloroethane	0.020	0.082	86
cis-1,2-Dichloroethene	0.020	0.080	72
1,1,1-Trichloroethane	0.020	0.11	107
Benzene	0.050	0.16	80
1,2-Dichloroethane	0.020	0.082	103
Trichloroethene	0.020	0.11	84
Toluene	0.050	0.19	84
1,1,2-Trichloroethane	0.020	0.11	97
Tetrachloroethene	0.020	0.14	91
Ethyl Benzene	0.050	0.22	90
m,p-Xylene	0.050	0.22	93
o-Xylene	0.050	0.22	97
1,1,2,2-Tetrachloroethane	0.020	0.14	99
trans-1,2-Dichloroethene	0.10	0.40	100
Methyl tert-Butyl Ether	0.10	0.37	66

Container Type: NA - Not Applicable

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	117	70-130
Toluene-d8	103	70-130
4-Bromofluorobenzene	102	70-130

@ AIR TOXICS LTD.
AN ENVIRONMENTAL ANALYTICAL LABORATORY

CHAIN-OF-CUSTODY RECORD

Sample Transportation Notice
Relinquishing signature on this document indicates that sample is being shipped in compliance with all applicable local, State, Federal, national and international laws, regulations and ordinances of any kind. Air Toxics Limited assumes no liability with respect to the collection, handling or shipping of these samples. Relinquishing signature also indicates agreement to hold harmless, defend, and indemnify Air Toxics Limited against any claim, demand, or action of any kind, related to the collection, handling, or shipping of samples. D.O.T. Hotline (800) 467-4922

180 BLUE RAVINE ROAD, SUITE B
FOLSOM, CA 95630-4710
(916) 985-1000 FAX: (916) 985-1020

Contact Person: Jennifer Muehlhaus / Chuck Si
Company: SCA Environmental
Address: 80 Grand Ave 4th Fl City: Oakland State: CA Zip: 94612
Phone: 510 465 9944 x226 FAX: 510 465 9109
Collected By: Signature: Jennifer Muehlhaus

Project Info:
P.O. #: B5454
Project #: B5454
Project Name: USCG Air Sampling

Turn Around Time:
☒ Normal
☐ Rush _____ Specify

ML 4.21.02

Lab I.D.	Field Sample I.D.	START Date 4-18-02	STOP & Time 4-19-02	Canister #	Analyses Requested	Canister Pressure / Vacuum Initial	Final	Receipt
-01A	IN 2000A KOL	1313	1219	22496	SIM TO-14	26.25	7.5	7.0"Hg
-02A	CN 2000A KOL	1318	1223	1743	↓	26	3	5.0"Hg
-03A	IN 2000E KOL	1346	1230	23927	↓	26.5	8	7.0"Hg
-04A	CN 2000E KOL	1349	1234	65409	↓	25.5	4.5	7.0"Hg
-05A	IN 2002C KOL	1442	1328	1734	↓	28	12	11.5"Hg
-06A	CN 2002C KOL	1446	1331	42165	↓	27	8.5	10.5"Hg
-07A	IN 2004C KOL	1329	1240	1614	↓	28	6.75	7.5"Hg
-08A	CN 2004C KOL	1337	1242	33576	↓	26	3.25	5.5"Hg
-09A	BKGSE	1529	1402	13858	↓	26.5	8	6.0"Hg
-10A	BKGW * see notes	1543	1425	94306		26.25	28	2.9"Hg

Relinquished By: (Signature)	Date/Time	Received By: (Signature)	Date/Time
Jennifer Muehlhaus	4-19-02 5pm	[signature]	4/19/02 17:00
[signature]	4-19-02 19:05		
		Mason ML 1905	4/19/02

Notes: * Canister # 94306 decreased pressure over the time period. Please verify pressure and do not analyze that canister. Also please check the filter + flow controller for possible blockage - marked w/ red tape. cont.

Lab Use Only	Shipper Name	Air Bill #	Opened By:	Temp. (°C)	Condition	Custody Seals Intact?	Work Order #
	Courier	—	[initials]	—	good	Yes No (None)	0204445

Form 1200 rev.03

@ AIR TOXICS LTD.

AN ENVIRONMENTAL ANALYTICAL LABORATORY

CHAIN-OF-CUSTODY RECORD

Sample Transportation Notice
Relinquishing signature on this document indicates that sample is being shipped in compliance with all applicable local, State, Federal, national, and international laws, regulations and ordinances of any kind. Air Toxics Limited assumes no liability with respect to the collection, handling or shipping of these samples. Relinquishing signature also indicates agreement to hold harmless, defend, and indemnify Air Toxics Limited against any claim, demand, or action of any kind, related to the collection, handling, or shipment of samples. D.O.T. Hotline (800) 467-4922

180 BLUE RAVINE ROAD, SUITE B
FOLSOM, CA 95630-4719
(916) 985-1000 FAX: (916) 985-1020

Contact Person: Jennifer Muehlhaus / Chuck Siu
Company: SCA Environmental
Address: 80 Grand Ave 4th Fl City: Oakland State: CA Zip: 94612
Phone: 510 465 9144 x226 FAX: 510 465 9109
Collected By: Signature: Jennifer Muehlhaus

Project Info:
P.O. #: B 5454
Project #: B 5454
Project Name: USCG Air Sampling

Turn Around Time:
☒ Normal
☐ Rush _____ Specify

M.L. 4-21-02

Lab I.D.	Field Sample I.D.	Start Date & Time 4-18-02	Stop Time 4-19-02	Canister #	Analyses Requested	Canister Pressure / Vacuum Initial	Final	Receipt
-11A	IR 2006 B KOL	1357	1250	10801	SIM TO-14	30	8	0.5"Hg
-12A	CR 2006 B KOL	1401	1252	33384	↓	26	12	12.0"Hg
-13A	IR 2006 E KOL	1407	1259	12082	↓	26	5.75	7.5"Hg
-14A	CR 2006 E KOL	1412	1301	11879	↓	28	2	7.0"Hg
-15A	IR 2008 D KOL	1418	1308	13654	↓	27	11.25	9.0"Hg
-16A	CR 2008 D KOL	1424	1309	4160	↓	30	9.5	8.0"Hg
-17A	IR 2010 C KOL	1429	1320	30850	↓	26.5	5.25	7.0"Hg
-18A	CR 2010 C KOL	1433	1322	1611	↓	27	5	7.0"Hg

Relinquished By: (Signature) Date/Time: 4-19-02 5pm — Received By: (Signature) Date/Time: 4/19/02 17:02
Relinquished By: (Signature) Date/Time: 4/19/02 19:05 — Received By: (Signature) Date/Time:
Relinquished By: (Signature) Date/Time: — Received By: (Signature) Date/Time: 4/19/02 1905

Notes: cont. from page 1. Speak w/ Chuck about removement. Pressure gauge wouldn't fit to any flowcont.

Email results to: csiu@sca-enviro.com

Lab Use Only	Shipper Name	Air Bill #	Opened By:	Temp. (°C)	Condition	Custody Seals Intact?	Work Order #
	Courier	—	CT	—	Good	Yes No (None)	020445

Form 1293 (Rev. 3)

AIR TOXICS LTD.

AN ENVIRONMENTAL ANALYTICAL LABORATORY

Air Toxics Ltd. Introduces the Electronic Report

Thank you for choosing Air Toxics Ltd. To better serve our customers, we are providing your report by e-mail. This document is provided in Portable Document Format which can be viewed with Acrobat Reader by Adobe.

This electronic report includes the following:

- Work order Summary;
- Laboratory Narrative;
- Results; and
- Chain of Custody (copy).

180 BLUE RAVINE ROAD, SUITE B FOLSOM, CA - 95630

(916) 985-1000 .FAX (916) 985-1020
Hours 8:00 A.M to 6:00 P.M. Pacific
E-mail to:samplereceiving@airtoxics.com

@ AIR TOXICS LTD.

AN ENVIRONMENTAL ANALYTICAL LABORATORY

WORK ORDER #: 0205103

Work Order Summary

CLIENT:	Mr. Chuck Siu SCA Environmental, Inc. 80 Grand Avenue Fourth Floor Oakland, CA 94612	**BILL TO:**	Mr. Chuck Siu SCA Environmental, Inc. 80 Grand Avenue Fourth Floor Oakland, CA 94612
PHONE:	510-465-9944	**P.O. #**	B5454.02
FAX:	510-465-9109	**PROJECT #**	B5454.02 USCG AIR SAMPLING
DATE RECEIVED:	5/4/02	**CONTACT:**	Karen Burden
DATE COMPLETED:	5/20/02		

FRACTION #	NAME	TEST	RECEIPT VAC./PRES.
01A	4078B-SEA-IU	TO-14-S	2.0 "Hg
02A	4078B-SEA-EU	TO-14-S	1.0 "Hg
03A	4072A-SEA-IU	TO-14-S	5.5 "Hg
04A	4081B-MTH-IU	TO-14-S	3.5 "Hg
05A	4059A-DRU-IU	TO-14-S	5.0 "Hg
06A	4059A-DRU-EU	TO-14-S	7.5 "Hg
07A	4040A-KIS-IU	TO-14-S	6.5 "Hg
08A	4040A-KIS-EU	TO-14-S	4.0 "Hg
08AA	4040A-KIS-EU Duplicate	TO-14-S	4.0 "Hg
09A	4030A-CHI-IU	TO-14-S	7.0 "Hg
10A	4028B-SAC-IU	TO-14-S	8.0 "Hg
11A	3009A-ARK-IU	TO-14-S	0.6 psi
12A	3001B-ENT-IU	TO-14-S	9.5 "Hg
13A	4011A-NIM-IU	TO-14-S	4.5 "Hg
14A	4014-NIM-IU	TO-14-S	9.5 "Hg
15A	4011A-NIM-EU	TO-14-S	11.0 "Hg
16A	3054B-FLI-IU	TO-14-S	8.5 "Hg
17A	3054B-FLI-EU	TO-14-S	7.0 "Hg
17AA	3054B-FLI-EU Duplicate	TO-14-S	7.0 "Hg
18A	Lab Blank	TO-14-S	NA

Continued on next page

180 BLUE RAVINE ROAD, SUITE B FOLSOM, CA - 95630
(916) 985-1000 . (800) 985-5955 . FAX (916) 985-1020

@ AIR TOXICS LTD.

AN ENVIRONMENTAL ANALYTICAL LABORATORY

WORK ORDER #: 0205103

Work Order Summary

CLIENT:	Mr. Chuck Siu SCA Environmental, Inc. 80 Grand Avenue Fourth Floor Oakland, CA 94612	**BILL TO:**	Mr. Chuck Siu SCA Environmental, Inc. 80 Grand Avenue Fourth Floor Oakland, CA 94612
PHONE:	510-465-9944	**P.O. #**	B5454.02
FAX:	510-465-9109	**PROJECT #**	B5454.02 USCG AIR SAMPLING
DATE RECEIVED:	5/4/02	**CONTACT:**	Karen Burden
DATE COMPLETED:	5/20/02		

FRACTION #	NAME	TEST	RECEIPT VAC./PRES.
18B	Lab Blank	TO-14-S	NA
18C	Lab Blank	TO-14-S	NA
18D	Lab Blank	TO-14-S	NA
19A	LCS	TO-14-S	NA
19B	LCS	TO-14-S	NA
19C	LCS	TO-14-S	NA
19D	LCS	TO-14-S	NA

CERTIFIED BY: Linda L. Freeman

Laboratory Director

DATE: 05/20/02

Certfication numbers: CA ELAP - 1149, NY NELAP - 11291, UT ELAP - E-217, LA - AI 30763
Name of Accrediting Agency: NELAP/Florida Department of Health, Scope of Application: Clean Air Act,
Accreditation number: E87680, Effective date: 01/01/02, Expiration date: 06/30/02

Air Toxics Ltd. certifies that the test results contained in this report meet all requirements of the NELAC standards

This report shall not be reproduced, except in full, without the written approval of Air Toxics Ltd.

180 BLUE RAVINE ROAD, SUITE B FOLSOM, CA - 95630
(916) 985-1000 . (800) 985-5955 . FAX (916) 985-1020

LABORATORY NARRATIVE
TO-14 SIM
SCA Environmental, Inc.
Workorder# 0205103

Two 6 Liter Silonite Canister and Fifteen 6 Liter Summa Canister (SIM Certified) samples were received on May 03, 2002. The laboratory performed analysis via EPA Method TO-14/15 using GC/MS in the SIM acquisition mode. The method involves concentrating up to 0.5 liters of air. The concentrated aliquot is then flash vaporized and swept through a water management system to remove water vapor. Following dehumidification, the sample passes directly into the GC/MS for analysis. See the data sheets for the reporting limits for each compound.

Method modifications taken to run these samples include:

Requirement	*TO-14/15 SIM*	*ATL Modifications*
Sampling/concentrator system	Nafion Drier	Multisorbent concentrator
Canister cleaning - clean air supply	Cryogenic Trap	Use of Humidified UHP Air
Canister certification	Pressurize w/humidified zero air.	Pressurize w/dry UHP nitrogen
Sample load volume	400 mL	Up to 0.5 liter
Blank	Humid air blank	Dry air blank for low level analysis.
Blank acceptance criteria	< 0.2 ppbv	< DL
BFB absolute abundance criteria	Within 10% of that from previous day.	CCV surrogate recoveries demonstrate stability from one day to the next
BFB acceptance criteria	CLP protocol	SW-846 protocol
Concentration of IS spike	Not specified	10 ppbv
Dilutions for initial calibration	Dynamic dilutions or static using canisters	Syringe dilutions
Flow rates/operating parameters	Not specified	Optimized. See procedures section.
ICAL RRF %RSD acceptance criteria	Not specified	30% or less for standard compounds, 40% or less for non-standard and polar compounds
IS recoveries	Within 40% of mean over ICAL for blanks, and w/in 40% of daily CCV for samples.	Within 40% of CCV recoveries for blank and samples.
IS RTs	Within .33 min from most recent calibration (either ICAL or daily)	Within 0.5 min. of RT in daily CCV
Daily CCV	70 - 130%	Standard compounds:70 - 130% for at least 90%; Non-standard and polar compounds: 60 - 140% for at least 80%
RF for quantitation	From ICAL	From ICAL
Canister leak check	24 hour, positive pressure	20 minute, vacuum check
MSD scan range	35 - 300 amu	35 - 350 amu

Requirement	*TO-14/15 SIM*	*ATL Modifications*
Canister cleaning - clean air supply	Cryogenic Trap	Use of Humidified UHP Air
Canister certification	Pressurize w/humidified zero air.	Pressurize w/dry UHP nitrogen
Sampling/concentrator system	Nafion Drier	Multisorbent concentrator

Receiving Notes

Canister samples 4078B-SEA-IU, 4078B-SEA-EU, and 3009A-ARK-IU were received at < 2.5" Hg despite the use of a flow controller for collection.

The chain of custody information for samples 4078B-SEA-IU, 4078B-SEA-EU, 4081B-MTH-IU, 4011A-NIM-EU, and 3054B-FLU-EU did not match the entry on the sample tags. The client was notified and the information on the chain of custody was used to process and report the samples.

Analytical Notes

There were no analytical discrepancies.

Definition of Data Qualifying Flags

Six qualifiers may have been used on the data analysis sheets and indicates as follows:

B - Compound present in laboratory blank greater than reporting limit (background subtraction not performed).

J - Estimated value.

E - Exceeds instrument calibration range.

S - Saturated peak.

Q - Exceeds quality control limits.

U - Compound analyzed for but not detected above the reporting limit.

File extensions may have been used on the data analysis sheets and indicates as follows:

a-File was requantified

b-File was quantified by a second column and detector

r1-File was requantified for the purpose of reissue

AIR TOXICS LTD.

SAMPLE NAME: 4078B-SEA-IU

ID#: 0205103-01A

EPA METHOD TO-14 GC/MS SIM

File Name:	**w050612**	**Date of Collection:**	**5/3/02**
Dil. Factor:	**1.44**	**Date of Analysis:**	**5/6/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.014	0.037	Not Detected	Not Detected
1,1-Dichloroethene	0.014	0.058	Not Detected	Not Detected
1,1-Dichloroethane	0.029	0.12	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.029	0.12	Not Detected	Not Detected
1,1,1-Trichloroethane	0.029	0.16	0.044	0.24
Benzene	0.072	0.23	0.15	0.49
1,2-Dichloroethane	0.029	0.12	0.044	0.18
Trichloroethene	0.029	0.16	Not Detected	Not Detected
Toluene	0.072	0.28	0.68	2.6
1,1,2-Trichloroethane	0.029	0.16	Not Detected	Not Detected
Tetrachloroethene	0.029	0.20	Not Detected	Not Detected
Ethyl Benzene	0.072	0.32	Not Detected	Not Detected
m,p-Xylene	0.072	0.32	0.13	0.58
o-Xylene	0.072	0.32	Not Detected	Not Detected
1,1,2,2-Tetrachloroethane	0.029	0.20	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.14	0.58	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.14	0.53	Not Detected	Not Detected

Container Type: 6 Liter Silonite Canister

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	123	70-130
Toluene-d8	100	70-130
4-Bromofluorobenzene	118	70-130

AIR TOXICS LTD.

SAMPLE NAME: 4078B-SEA-EU

ID#: 0205103-02A

EPA METHOD TO-14 GC/MS SIM

File Name:	**w050613**	**Date of Collection:**	**5/3/02**
Dil. Factor:	**1.39**	**Date of Analysis:**	**5/6/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.014	0.036	Not Detected	Not Detected
1,1-Dichloroethene	0.014	0.056	Not Detected	Not Detected
1,1-Dichloroethane	0.028	0.11	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.028	0.11	Not Detected	Not Detected
1,1,1-Trichloroethane	0.028	0.15	0.042	0.23
Benzene	0.070	0.22	0.087	0.28
1,2-Dichloroethane	0.028	0.11	0.039	0.16
Trichloroethene	0.028	0.15	Not Detected	Not Detected
Toluene	0.070	0.27	0.43	1.6
1,1,2-Trichloroethane	0.028	0.15	Not Detected	Not Detected
Tetrachloroethene	0.028	0.19	0.12	0.82
Ethyl Benzene	0.070	0.31	Not Detected	Not Detected
m,p-Xylene	0.070	0.31	Not Detected	Not Detected
o-Xylene	0.070	0.31	Not Detected	Not Detected
1,1,2,2-Tetrachloroethane	0.028	0.19	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.14	0.56	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.14	0.51	Not Detected	Not Detected

Container Type: 6 Liter Silonite Canister

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	122	70-130
Toluene-d8	100	70-130
4-Bromofluorobenzene	117	70-130

AIR TOXICS LTD.

SAMPLE NAME: 4072A-SEA-IU

ID#: 0205103-03A

EPA METHOD TO-14 GC/MS SIM

File Name:	**w050706**	**Date of Collection:**	**5/3/02**
Dil. Factor:	**1.64**	**Date of Analysis:**	**5/7/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.016	0.043	Not Detected	Not Detected
1,1-Dichloroethene	0.016	0.066	Not Detected	Not Detected
1,1-Dichloroethane	0.033	0.13	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.033	0.13	Not Detected	Not Detected
1,1,1-Trichloroethane	0.033	0.18	0.043	0.24
Benzene	0.082	0.27	0.16	0.52
1,2-Dichloroethane	0.033	0.13	0.044	0.18
Trichloroethene	0.033	0.18	Not Detected	Not Detected
Toluene	0.082	0.31	0.48	1.8
1,1,2-Trichloroethane	0.033	0.18	Not Detected	Not Detected
Tetrachloroethene	0.033	0.23	2.6	18
Ethyl Benzene	0.082	0.36	Not Detected	Not Detected
m,p-Xylene	0.082	0.36	0.18	0.82
o-Xylene	0.082	0.36	0.085	0.38
1,1,2,2-Tetrachloroethane	0.033	0.23	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.16	0.66	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.16	0.60	Not Detected	Not Detected

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	122	70-130
Toluene-d8	99	70-130
4-Bromofluorobenzene	117	70-130

AIR TOXICS LTD.

SAMPLE NAME: 4081B-MTH-IU

ID#: 0205103-04A

EPA METHOD TO-14 GC/MS SIM

File Name:	**w050707**	**Date of Collection:**	**5/3/02**
Dil. Factor:	**1.52**	**Date of Analysis:**	**5/7/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.015	0.039	Not Detected	Not Detected
1,1-Dichloroethene	0.015	0.061	Not Detected	Not Detected
1,1-Dichloroethane	0.030	0.12	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.030	0.12	Not Detected	Not Detected
1,1,1-Trichloroethane	0.030	0.17	0.042	0.23
Benzene	0.076	0.25	0.14	0.45
1,2-Dichloroethane	0.030	0.12	0.044	0.18
Trichloroethene	0.030	0.17	Not Detected	Not Detected
Toluene	0.076	0.29	0.31	1.2
1,1,2-Trichloroethane	0.030	0.17	Not Detected	Not Detected
Tetrachloroethene	0.030	0.21	Not Detected	Not Detected
Ethyl Benzene	0.076	0.34	Not Detected	Not Detected
m,p-Xylene	0.076	0.34	Not Detected	Not Detected
o-Xylene	0.076	0.34	Not Detected	Not Detected
1,1,2,2-Tetrachloroethane	0.030	0.21	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.15	0.61	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.15	0.56	Not Detected	Not Detected

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	122	70-130
Toluene-d8	99	70-130
4-Bromofluorobenzene	124	70-130

AIR TOXICS LTD.

SAMPLE NAME: 4059A-DRU-IU

ID#: 0205103-05A

EPA METHOD TO-14 GC/MS SIM

File Name:	**w050708**	**Date of Collection:**	**5/3/02**
Dil. Factor:	**1.61**	**Date of Analysis:**	**5/7/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.016	0.042	Not Detected	Not Detected
1,1-Dichloroethene	0.016	0.065	Not Detected	Not Detected
1,1-Dichloroethane	0.032	0.13	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.032	0.13	Not Detected	Not Detected
1,1,1-Trichloroethane	0.032	0.18	0.053	0.29
Benzene	0.080	0.26	0.14	0.44
1,2-Dichloroethane	0.032	0.13	0.042	0.17
Trichloroethene	0.032	0.18	Not Detected	Not Detected
Toluene	0.080	0.31	0.44	1.7
1,1,2-Trichloroethane	0.032	0.18	Not Detected	Not Detected
Tetrachloroethene	0.032	0.22	0.047	0.32
Ethyl Benzene	0.080	0.36	Not Detected	Not Detected
m,p-Xylene	0.080	0.36	0.14	0.60
o-Xylene	0.080	0.36	Not Detected	Not Detected
1,1,2,2-Tetrachloroethane	0.032	0.22	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.16	0.65	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.16	0.59	Not Detected	Not Detected

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	120	70-130
Toluene-d8	101	70-130
4-Bromofluorobenzene	121	70-130

AIR TOXICS LTD.

SAMPLE NAME: 4059A-DRU-EU

ID#: 0205103-06A

EPA METHOD TO-14 GC/MS SIM

File Name:	**w050709**	**Date of Collection:**	**5/3/02**
Dil. Factor:	**1.79**	**Date of Analysis:**	**5/7/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.018	0.046	Not Detected	Not Detected
1,1-Dichloroethene	0.018	0.072	Not Detected	Not Detected
1,1-Dichloroethane	0.036	0.15	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.036	0.14	Not Detected	Not Detected
1,1,1-Trichloroethane	0.036	0.20	0.040	0.22
Benzene	0.090	0.29	Not Detected	Not Detected
1,2-Dichloroethane	0.036	0.15	0.046	0.19
Trichloroethene	0.036	0.20	0.060	0.33
Toluene	0.090	0.34	0.19	0.72
1,1,2-Trichloroethane	0.036	0.20	Not Detected	Not Detected
Tetrachloroethene	0.036	0.25	Not Detected	Not Detected
Ethyl Benzene	0.090	0.39	Not Detected	Not Detected
m,p-Xylene	0.090	0.40	Not Detected	Not Detected
o-Xylene	0.090	0.40	Not Detected	Not Detected
1,1,2,2-Tetrachloroethane	0.036	0.25	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.18	0.72	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.18	0.66	Not Detected	Not Detected

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	123	70-130
Toluene-d8	100	70-130
4-Bromofluorobenzene	116	70-130

AIR TOXICS LTD.

SAMPLE NAME: 4040A-KIS-IU

ID#: 0205103-07A

EPA METHOD TO-14 GC/MS SIM

File Name:	**w050710**	**Date of Collection:**	**5/3/02**
Dil. Factor:	**1.71**	**Date of Analysis:**	**5/7/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.017	0.044	Not Detected	Not Detected
1,1-Dichloroethene	0.017	0.069	Not Detected	Not Detected
1,1-Dichloroethane	0.034	0.14	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.034	0.14	Not Detected	Not Detected
1,1,1-Trichloroethane	0.034	0.19	0.037	0.20
Benzene	0.086	0.28	0.12	0.40
1,2-Dichloroethane	0.034	0.14	0.046	0.19
Trichloroethene	0.034	0.19	Not Detected	Not Detected
Toluene	0.086	0.33	0.43	1.6
1,1,2-Trichloroethane	0.034	0.19	Not Detected	Not Detected
Tetrachloroethene	0.034	0.24	Not Detected	Not Detected
Ethyl Benzene	0.086	0.38	0.090	0.40
m,p-Xylene	0.086	0.38	0.25	1.1
o-Xylene	0.086	0.38	0.11	0.48
1,1,2,2-Tetrachloroethane	0.034	0.24	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.17	0.69	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.17	0.63	Not Detected	Not Detected

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	121	70-130
Toluene-d8	101	70-130
4-Bromofluorobenzene	119	70-130

AIR TOXICS LTD.

SAMPLE NAME: 4040A-KIS-EU

ID#: 0205103-08A

EPA METHOD TO-14 GC/MS SIM

File Name:	**w050711**	**Date of Collection:**	**5/3/02**
Dil. Factor:	**1.55**	**Date of Analysis:**	**5/7/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.016	0.040	Not Detected	Not Detected
1,1-Dichloroethene	0.016	0.062	Not Detected	Not Detected
1,1-Dichloroethane	0.031	0.13	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.031	0.12	Not Detected	Not Detected
1,1,1-Trichloroethane	0.031	0.17	0.041	0.23
Benzene	0.078	0.25	Not Detected	Not Detected
1,2-Dichloroethane	0.031	0.13	0.034	0.14
Trichloroethene	0.031	0.17	Not Detected	Not Detected
Toluene	0.078	0.30	0.20	0.75
1,1,2-Trichloroethane	0.031	0.17	Not Detected	Not Detected
Tetrachloroethene	0.031	0.21	Not Detected	Not Detected
Ethyl Benzene	0.078	0.34	Not Detected	Not Detected
m,p-Xylene	0.078	0.34	Not Detected	Not Detected
o-Xylene	0.078	0.34	Not Detected	Not Detected
1,1,2,2-Tetrachloroethane	0.031	0.22	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.16	0.62	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.16	0.57	Not Detected	Not Detected

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	122	70-130
Toluene-d8	100	70-130
4-Bromofluorobenzene	116	70-130

AIR TOXICS LTD.

SAMPLE NAME: 4040A-KIS-EU Duplicate

ID#: 0205103-08AA

EPA METHOD TO-14 GC/MS SIM

File Name:	**w050712**	**Date of Collection:**	**5/3/02**
Dil. Factor:	**1.55**	**Date of Analysis:**	**5/7/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.016	0.040	Not Detected	Not Detected
1,1-Dichloroethene	0.016	0.062	Not Detected	Not Detected
1,1-Dichloroethane	0.031	0.13	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.031	0.12	Not Detected	Not Detected
1,1,1-Trichloroethane	0.031	0.17	0.042	0.23
Benzene	0.078	0.25	Not Detected	Not Detected
1,2-Dichloroethane	0.031	0.13	0.045	0.18
Trichloroethene	0.031	0.17	Not Detected	Not Detected
Toluene	0.078	0.30	0.20	0.78
1,1,2-Trichloroethane	0.031	0.17	Not Detected	Not Detected
Tetrachloroethene	0.031	0.21	Not Detected	Not Detected
Ethyl Benzene	0.078	0.34	Not Detected	Not Detected
m,p-Xylene	0.078	0.34	Not Detected	Not Detected
o-Xylene	0.078	0.34	Not Detected	Not Detected
1,1,2,2-Tetrachloroethane	0.031	0.22	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.16	0.62	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.16	0.57	Not Detected	Not Detected

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	122	70-130
Toluene-d8	103	70-130
4-Bromofluorobenzene	118	70-130

AIR TOXICS LTD.

SAMPLE NAME: 4030A-CHI-IU

ID#: 0205103-09A

EPA METHOD TO-14 GC/MS SIM

File Name:	**w050713**	**Date of Collection:**	**5/3/02**
Dil. Factor:	**1.75**	**Date of Analysis:**	**5/7/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.018	0.045	Not Detected	Not Detected
1,1-Dichloroethene	0.018	0.070	Not Detected	Not Detected
1,1-Dichloroethane	0.035	0.14	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.035	0.14	Not Detected	Not Detected
1,1,1-Trichloroethane	0.035	0.19	0.060	0.33
Benzene	0.088	0.28	0.10	0.32
1,2-Dichloroethane	0.035	0.14	0.039	0.16
Trichloroethene	0.035	0.19	Not Detected	Not Detected
Toluene	0.088	0.34	2.1	8.2
1,1,2-Trichloroethane	0.035	0.19	Not Detected	Not Detected
Tetrachloroethene	0.035	0.24	0.16	1.1
Ethyl Benzene	0.088	0.39	0.45	2.0
m,p-Xylene	0.088	0.39	2.1	9.1
o-Xylene	0.088	0.39	0.55	2.4
1,1,2,2-Tetrachloroethane	0.035	0.24	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.18	0.70	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.18	0.64	Not Detected	Not Detected

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	116	70-130
Toluene-d8	108	70-130
4-Bromofluorobenzene	123	70-130

AIR TOXICS LTD.

SAMPLE NAME: 4028B-SAC-IU

ID#: 0205103-10A

EPA METHOD TO-14 GC/MS SIM

File Name:	**w050714**	**Date of Collection:**	**5/3/02**
Dil. Factor:	**1.83**	**Date of Analysis:**	**5/7/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.018	0.048	Not Detected	Not Detected
1,1-Dichloroethene	0.018	0.074	Not Detected	Not Detected
1,1-Dichloroethane	0.037	0.15	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.037	0.15	Not Detected	Not Detected
1,1,1-Trichloroethane	0.037	0.20	0.038	0.21
Benzene	0.092	0.30	0.096	0.31
1,2-Dichloroethane	0.037	0.15	0.051	0.21
Trichloroethene	0.037	0.20	Not Detected	Not Detected
Toluene	0.092	0.35	0.68	2.6
1,1,2-Trichloroethane	0.037	0.20	Not Detected	Not Detected
Tetrachloroethene	0.037	0.25	Not Detected	Not Detected
Ethyl Benzene	0.092	0.40	Not Detected	Not Detected
m,p-Xylene	0.092	0.40	0.10	0.46
o-Xylene	0.092	0.40	Not Detected	Not Detected
1,1,2,2-Tetrachloroethane	0.037	0.26	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.18	0.74	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.18	0.67	Not Detected	Not Detected

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	120	70-130
Toluene-d8	104	70-130
4-Bromofluorobenzene	113	70-130

AIR TOXICS LTD.

SAMPLE NAME: 3009A-ARK-IU

ID#: 0205103-11A

EPA METHOD TO-14 GC/MS SIM

File Name:	**w050715**	**Date of Collection:**	**5/3/02**
Dil. Factor:	**1.29**	**Date of Analysis:**	**5/7/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.013	0.034	Not Detected	Not Detected
1,1-Dichloroethene	0.013	0.052	Not Detected	Not Detected
1,1-Dichloroethane	0.026	0.11	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.026	0.10	Not Detected	Not Detected
1,1,1-Trichloroethane	0.026	0.14	0.085	0.47
Benzene	0.064	0.21	0.13	0.41
1,2-Dichloroethane	0.026	0.11	0.051	0.21
Trichloroethene	0.026	0.14	Not Detected	Not Detected
Toluene	0.064	0.25	0.57	2.2
1,1,2-Trichloroethane	0.026	0.14	Not Detected	Not Detected
Tetrachloroethene	0.026	0.18	Not Detected	Not Detected
Ethyl Benzene	0.064	0.28	0.064 J	0.28 J
m,p-Xylene	0.064	0.28	0.24	1.1
o-Xylene	0.064	0.28	0.10	0.46
1,1,2,2-Tetrachloroethane	0.026	0.18	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.13	0.52	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.13	0.47	Not Detected	Not Detected

J = Estimated value.

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	117	70-130
Toluene-d8	104	70-130
4-Bromofluorobenzene	115	70-130

AIR TOXICS LTD.

SAMPLE NAME: 3001B-ENT-IU

ID#: 0205103-12A

EPA METHOD TO-14 GC/MS SIM

File Name:	**w050716**	**Date of Collection:**	**5/3/02**
Dil. Factor:	**1.96**	**Date of Analysis:**	**5/7/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.020	0.051	Not Detected	Not Detected
1,1-Dichloroethene	0.020	0.079	Not Detected	Not Detected
1,1-Dichloroethane	0.039	0.16	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.039	0.16	Not Detected	Not Detected
1,1,1-Trichloroethane	0.039	0.22	0.042	0.24
Benzene	0.098	0.32	0.14	0.46
1,2-Dichloroethane	0.039	0.16	Not Detected	Not Detected
Trichloroethene	0.039	0.21	Not Detected	Not Detected
Toluene	0.098	0.38	1.1	4.3
1,1,2-Trichloroethane	0.039	0.22	Not Detected	Not Detected
Tetrachloroethene	0.039	0.27	Not Detected	Not Detected
Ethyl Benzene	0.098	0.43	Not Detected	Not Detected
m,p-Xylene	0.098	0.43	0.17	0.74
o-Xylene	0.098	0.43	Not Detected	Not Detected
1,1,2,2-Tetrachloroethane	0.039	0.27	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.20	0.79	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.20	0.72	Not Detected	Not Detected

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	121	70-130
Toluene-d8	109	70-130
4-Bromofluorobenzene	112	70-130

AIR TOXICS LTD.

SAMPLE NAME: 4011A-NIM-IU

ID#: 0205103-13A

EPA METHOD TO-14 GC/MS SIM

File Name:	**w050717**	**Date of Collection:**	**5/3/02**
Dil. Factor:	**1.58**	**Date of Analysis:**	**5/7/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.016	0.041	Not Detected	Not Detected
1,1-Dichloroethene	0.016	0.064	Not Detected	Not Detected
1,1-Dichloroethane	0.032	0.13	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.032	0.13	Not Detected	Not Detected
1,1,1-Trichloroethane	0.032	0.18	0.043	0.24
Benzene	0.079	0.26	0.12	0.38
1,2-Dichloroethane	0.032	0.13	0.046	0.19
Trichloroethene	0.032	0.17	Not Detected	Not Detected
Toluene	0.079	0.30	0.92	3.5
1,1,2-Trichloroethane	0.032	0.18	Not Detected	Not Detected
Tetrachloroethene	0.032	0.22	Not Detected	Not Detected
Ethyl Benzene	0.079	0.35	0.27	1.2
m,p-Xylene	0.079	0.35	1.2	5.2
o-Xylene	0.079	0.35	0.40	1.7
1,1,2,2-Tetrachloroethane	0.032	0.22	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.16	0.64	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.16	0.58	Not Detected	Not Detected

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	121	70-130
Toluene-d8	120	70-130
4-Bromofluorobenzene	110	70-130

AIR TOXICS LTD.

SAMPLE NAME: 4014-NIM-IU

ID#: 0205103-14A

EPA METHOD TO-14 GC/MS SIM

File Name:	**w050718**	**Date of Collection:**	**5/3/02**
Dil. Factor:	**1.96**	**Date of Analysis:**	**5/7/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.020	0.051	Not Detected	Not Detected
1,1-Dichloroethene	0.020	0.079	Not Detected	Not Detected
1,1-Dichloroethane	0.039	0.16	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.039	0.16	Not Detected	Not Detected
1,1,1-Trichloroethane	0.039	0.22	0.046	0.25
Benzene	0.098	0.32	0.12	0.38
1,2-Dichloroethane	0.039	0.16	Not Detected	Not Detected
Trichloroethene	0.039	0.21	Not Detected	Not Detected
Toluene	0.098	0.38	0.55	2.1
1,1,2-Trichloroethane	0.039	0.22	Not Detected	Not Detected
Tetrachloroethene	0.039	0.27	Not Detected	Not Detected
Ethyl Benzene	0.098	0.43	Not Detected	Not Detected
m,p-Xylene	0.098	0.43	0.17	0.77
o-Xylene	0.098	0.43	Not Detected	Not Detected
1,1,2,2-Tetrachloroethane	0.039	0.27	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.20	0.79	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.20	0.72	Not Detected	Not Detected

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	120	70-130
Toluene-d8	104	70-130
4-Bromofluorobenzene	123	70-130

AIR TOXICS LTD.

SAMPLE NAME: 4011A-NIM-EU

ID#: 0205103-15A

EPA METHOD TO-14 GC/MS SIM

File Name:	**w050806**	**Date of Collection:**	**5/3/02**
Dil. Factor:	**2.12**	**Date of Analysis:**	**5/8/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.021	0.055	Not Detected	Not Detected
1,1-Dichloroethene	0.021	0.085	Not Detected	Not Detected
1,1-Dichloroethane	0.042	0.17	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.042	0.17	Not Detected	Not Detected
1,1,1-Trichloroethane	0.042	0.24	0.042	0.24
Benzene	0.11	0.34	Not Detected	Not Detected
1,2-Dichloroethane	0.042	0.17	0.055	0.23
Trichloroethene	0.042	0.23	Not Detected	Not Detected
Toluene	0.11	0.40	0.18	0.70
1,1,2-Trichloroethane	0.042	0.24	Not Detected	Not Detected
Tetrachloroethene	0.042	0.29	Not Detected	Not Detected
Ethyl Benzene	0.11	0.47	Not Detected	Not Detected
m,p-Xylene	0.11	0.47	Not Detected	Not Detected
o-Xylene	0.11	0.47	Not Detected	Not Detected
1,1,2,2-Tetrachloroethane	0.042	0.30	0.081	0.57
trans-1,2-Dichloroethene	0.21	0.85	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.21	0.78	Not Detected	Not Detected

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	120	70-130
Toluene-d8	98	70-130
4-Bromofluorobenzene	118	70-130

AIR TOXICS LTD.

SAMPLE NAME: 3054B-FLI-IU

ID#: 0205103-16A

EPA METHOD TO-14 GC/MS SIM

File Name:	**w050807**	**Date of Collection:**	**5/3/02**
Dil. Factor:	**1.87**	**Date of Analysis:**	**5/8/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.019	0.048	Not Detected	Not Detected
1,1-Dichloroethene	0.019	0.075	0.022	0.088
1,1-Dichloroethane	0.037	0.15	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.037	0.15	Not Detected	Not Detected
1,1,1-Trichloroethane	0.037	0.21	0.055	0.30
Benzene	0.094	0.30	0.20	0.66
1,2-Dichloroethane	0.037	0.15	0.054	0.22
Trichloroethene	0.037	0.20	Not Detected	Not Detected
Toluene	0.094	0.36	1.0	4.0
1,1,2-Trichloroethane	0.037	0.21	Not Detected	Not Detected
Tetrachloroethene	0.037	0.26	0.16	1.1
Ethyl Benzene	0.094	0.41	0.23	1.0
m,p-Xylene	0.094	0.41	0.43	1.9
o-Xylene	0.094	0.41	0.20	0.88
1,1,2,2-Tetrachloroethane	0.037	0.26	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.19	0.75	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.19	0.68	Not Detected	Not Detected

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	118	70-130
Toluene-d8	106	70-130
4-Bromofluorobenzene	116	70-130

AIR TOXICS LTD.

SAMPLE NAME: 3054B-FLI-EU

ID#: 0205103-17A

EPA METHOD TO-14 GC/MS SIM

File Name:	**w051008**	**Date of Collection:**	**5/3/02**
Dil. Factor:	**5.83**	**Date of Analysis:**	**5/10/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.058	0.15	Not Detected	Not Detected
1,1-Dichloroethene	0.058	0.23	Not Detected	Not Detected
1,1-Dichloroethane	0.12	0.48	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.12	0.47	Not Detected	Not Detected
1,1,1-Trichloroethane	0.12	0.65	Not Detected	Not Detected
Benzene	0.29	0.95	26	84
1,2-Dichloroethane	0.12	0.48	Not Detected	Not Detected
Trichloroethene	0.12	0.64	Not Detected	Not Detected
Toluene	0.29	1.1	87	330
1,1,2-Trichloroethane	0.12	0.65	Not Detected	Not Detected
Tetrachloroethene	0.12	0.80	Not Detected	Not Detected
Ethyl Benzene	0.29	1.3	22	98
m,p-Xylene	0.29	1.3	86	380
o-Xylene	0.29	1.3	49	220
1,1,2,2-Tetrachloroethane	0.12	0.81	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.58	2.3	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.58	2.1	Not Detected	Not Detected

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	126	70-130
Toluene-d8	97	70-130
4-Bromofluorobenzene	105	70-130

AIR TOXICS LTD.

SAMPLE NAME: 3054B-FLI-EU Duplicate

ID#: 0205103-17AA

EPA METHOD TO-14 GC/MS SIM

File Name:	**w051009**	**Date of Collection:**	**5/3/02**
Dil. Factor:	**5.83**	**Date of Analysis:**	**5/10/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.058	0.15	Not Detected	Not Detected
1,1-Dichloroethene	0.058	0.23	Not Detected	Not Detected
1,1-Dichloroethane	0.12	0.48	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.12	0.47	Not Detected	Not Detected
1,1,1-Trichloroethane	0.12	0.65	Not Detected	Not Detected
Benzene	0.29	0.95	25	81
1,2-Dichloroethane	0.12	0.48	Not Detected	Not Detected
Trichloroethene	0.12	0.64	Not Detected	Not Detected
Toluene	0.29	1.1	84	320
1,1,2-Trichloroethane	0.12	0.65	Not Detected	Not Detected
Tetrachloroethene	0.12	0.80	Not Detected	Not Detected
Ethyl Benzene	0.29	1.3	21	94
m,p-Xylene	0.29	1.3	82	360
o-Xylene	0.29	1.3	47	210
1,1,2,2-Tetrachloroethane	0.12	0.81	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.58	2.3	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.58	2.1	Not Detected	Not Detected

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	126	70-130
Toluene-d8	97	70-130
4-Bromofluorobenzene	105	70-130

AIR TOXICS LTD.

SAMPLE NAME: Lab Blank

ID#: 0205103-18A

EPA METHOD TO-14 GC/MS SIM

File Name:	**w050606**	**Date of Collection: NA**	
Dil. Factor:	**1.00**	**Date of Analysis: 5/6/02**	

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.010	0.026	Not Detected	Not Detected
1,1-Dichloroethene	0.010	0.040	Not Detected	Not Detected
1,1-Dichloroethane	0.020	0.082	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.020	0.080	Not Detected	Not Detected
1,1,1-Trichloroethane	0.020	0.11	Not Detected	Not Detected
Benzene	0.050	0.16	Not Detected	Not Detected
1,2-Dichloroethane	0.020	0.082	Not Detected	Not Detected
Trichloroethene	0.020	0.11	Not Detected	Not Detected
Toluene	0.050	0.19	Not Detected	Not Detected
1,1,2-Trichloroethane	0.020	0.11	Not Detected	Not Detected
Tetrachloroethene	0.020	0.14	Not Detected	Not Detected
Ethyl Benzene	0.050	0.22	Not Detected	Not Detected
m,p-Xylene	0.050	0.22	Not Detected	Not Detected
o-Xylene	0.050	0.22	Not Detected	Not Detected
1,1,2,2-Tetrachloroethane	0.020	0.14	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.10	0.40	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.10	0.37	Not Detected	Not Detected

Container Type: NA - Not Applicable

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	127	70-130
Toluene-d8	98	70-130
4-Bromofluorobenzene	102	70-130

AIR TOXICS LTD.

SAMPLE NAME: Lab Blank

ID#: 0205103-18B

EPA METHOD TO-14 GC/MS SIM

File Name:	**w050705**	**Date of Collection: NA**	
Dil. Factor:	**1.00**	**Date of Analysis: 5/7/02**	

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.010	0.026	Not Detected	Not Detected
1,1-Dichloroethene	0.010	0.040	Not Detected	Not Detected
1,1-Dichloroethane	0.020	0.082	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.020	0.080	Not Detected	Not Detected
1,1,1-Trichloroethane	0.020	0.11	Not Detected	Not Detected
Benzene	0.050	0.16	Not Detected	Not Detected
1,2-Dichloroethane	0.020	0.082	Not Detected	Not Detected
Trichloroethene	0.020	0.11	Not Detected	Not Detected
Toluene	0.050	0.19	Not Detected	Not Detected
1,1,2-Trichloroethane	0.020	0.11	Not Detected	Not Detected
Tetrachloroethene	0.020	0.14	Not Detected	Not Detected
Ethyl Benzene	0.050	0.22	Not Detected	Not Detected
m,p-Xylene	0.050	0.22	Not Detected	Not Detected
o-Xylene	0.050	0.22	Not Detected	Not Detected
1,1,2,2-Tetrachloroethane	0.020	0.14	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.10	0.40	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.10	0.37	Not Detected	Not Detected

Container Type: NA - Not Applicable

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	127	70-130
Toluene-d8	98	70-130
4-Bromofluorobenzene	103	70-130

AIR TOXICS LTD.

SAMPLE NAME: Lab Blank

ID#: 0205103-18C

EPA METHOD TO-14 GC/MS SIM

File Name:	**w050805**	**Date of Collection: NA**	
Dil. Factor:	**1.00**	**Date of Analysis: 5/8/02**	

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.010	0.026	Not Detected	Not Detected
1,1-Dichloroethene	0.010	0.040	Not Detected	Not Detected
1,1-Dichloroethane	0.020	0.082	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.020	0.080	Not Detected	Not Detected
1,1,1-Trichloroethane	0.020	0.11	Not Detected	Not Detected
Benzene	0.050	0.16	Not Detected	Not Detected
1,2-Dichloroethane	0.020	0.082	Not Detected	Not Detected
Trichloroethene	0.020	0.11	Not Detected	Not Detected
Toluene	0.050	0.19	Not Detected	Not Detected
1,1,2-Trichloroethane	0.020	0.11	Not Detected	Not Detected
Tetrachloroethene	0.020	0.14	Not Detected	Not Detected
Ethyl Benzene	0.050	0.22	Not Detected	Not Detected
m,p-Xylene	0.050	0.22	Not Detected	Not Detected
o-Xylene	0.050	0.22	Not Detected	Not Detected
1,1,2,2-Tetrachloroethane	0.020	0.14	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.10	0.40	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.10	0.37	Not Detected	Not Detected

Container Type: NA - Not Applicable

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	124	70-130
Toluene-d8	98	70-130
4-Bromofluorobenzene	101	70-130

AIR TOXICS LTD.

SAMPLE NAME: Lab Blank

ID#: 0205103-18D

EPA METHOD TO-14 GC/MS SIM

File Name:	**w051007**	**Date of Collection: NA**	
Dil. Factor:	**1.00**	**Date of Analysis: 5/10/02**	

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.010	0.026	Not Detected	Not Detected
1,1-Dichloroethene	0.010	0.040	Not Detected	Not Detected
1,1-Dichloroethane	0.020	0.082	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.020	0.080	Not Detected	Not Detected
1,1,1-Trichloroethane	0.020	0.11	Not Detected	Not Detected
Benzene	0.050	0.16	Not Detected	Not Detected
1,2-Dichloroethane	0.020	0.082	Not Detected	Not Detected
Trichloroethene	0.020	0.11	Not Detected	Not Detected
Toluene	0.050	0.19	Not Detected	Not Detected
1,1,2-Trichloroethane	0.020	0.11	Not Detected	Not Detected
Tetrachloroethene	0.020	0.14	Not Detected	Not Detected
Ethyl Benzene	0.050	0.22	Not Detected	Not Detected
m,p-Xylene	0.050	0.22	Not Detected	Not Detected
o-Xylene	0.050	0.22	Not Detected	Not Detected
1,1,2,2-Tetrachloroethane	0.020	0.14	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.10	0.40	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.10	0.37	Not Detected	Not Detected

Container Type: NA - Not Applicable

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	126	70-130
Toluene-d8	97	70-130
4-Bromofluorobenzene	103	70-130

AIR TOXICS LTD.

SAMPLE NAME: LCS

ID#: 0205103-19A

EPA METHOD TO-14 GC/MS SIM

File Name:	**w050604**		**Date of Collection: NA**
Dil. Factor:	**1.00**		**Date of Analysis: 5/6/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	%Recovery
Vinyl Chloride	0.010	0.026	96
1,1-Dichloroethene	0.010	0.040	89
1,1-Dichloroethane	0.020	0.082	98
cis-1,2-Dichloroethene	0.020	0.080	83
1,1,1-Trichloroethane	0.020	0.11	118
Benzene	0.050	0.16	86
1,2-Dichloroethane	0.020	0.082	111
Trichloroethene	0.020	0.11	91
Toluene	0.050	0.19	90
1,1,2-Trichloroethane	0.020	0.11	105
Tetrachloroethene	0.020	0.14	99
Ethyl Benzene	0.050	0.22	98
m,p-Xylene	0.050	0.22	101
o-Xylene	0.050	0.22	108
1,1,2,2-Tetrachloroethane	0.020	0.14	107
trans-1,2-Dichloroethene	0.10	0.40	109
Methyl tert-Butyl Ether	0.10	0.37	76

Container Type: NA - Not Applicable

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	118	70-130
Toluene-d8	101	70-130
4-Bromofluorobenzene	104	70-130

AIR TOXICS LTD.

SAMPLE NAME: LCS

ID#: 0205103-19B

EPA METHOD TO-14 GC/MS SIM

File Name:	**w050703**		**Date of Collection: NA**
Dil. Factor:	**1.00**		**Date of Analysis: 5/7/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	%Recovery
Vinyl Chloride	0.010	0.026	96
1,1-Dichloroethene	0.010	0.040	84
1,1-Dichloroethane	0.020	0.082	96
cis-1,2-Dichloroethene	0.020	0.080	80
1,1,1-Trichloroethane	0.020	0.11	116
Benzene	0.050	0.16	87
1,2-Dichloroethane	0.020	0.082	109
Trichloroethene	0.020	0.11	89
Toluene	0.050	0.19	90
1,1,2-Trichloroethane	0.020	0.11	106
Tetrachloroethene	0.020	0.14	99
Ethyl Benzene	0.050	0.22	98
m,p-Xylene	0.050	0.22	101
o-Xylene	0.050	0.22	104
1,1,2,2-Tetrachloroethane	0.020	0.14	106
trans-1,2-Dichloroethene	0.10	0.40	107
Methyl tert-Butyl Ether	0.10	0.37	70

Container Type: NA - Not Applicable

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	116	70-130
Toluene-d8	102	70-130
4-Bromofluorobenzene	102	70-130

AIR TOXICS LTD.

SAMPLE NAME: LCS

ID#: 0205103-19C

EPA METHOD TO-14 GC/MS SIM

File Name:	**w050803**		**Date of Collection: NA**
Dil. Factor:	**1.00**		**Date of Analysis: 5/8/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	%Recovery
Vinyl Chloride	0.010	0.026	98
1,1-Dichloroethene	0.010	0.040	87
1,1-Dichloroethane	0.020	0.082	98
cis-1,2-Dichloroethene	0.020	0.080	82
1,1,1-Trichloroethane	0.020	0.11	118
Benzene	0.050	0.16	91
1,2-Dichloroethane	0.020	0.082	113
Trichloroethene	0.020	0.11	94
Toluene	0.050	0.19	95
1,1,2-Trichloroethane	0.020	0.11	109
Tetrachloroethene	0.020	0.14	103
Ethyl Benzene	0.050	0.22	101
m,p-Xylene	0.050	0.22	103
o-Xylene	0.050	0.22	107
1,1,2,2-Tetrachloroethane	0.020	0.14	110
trans-1,2-Dichloroethene	0.10	0.40	106
Methyl tert-Butyl Ether	0.10	0.37	68

Container Type: NA - Not Applicable

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	112	70-130
Toluene-d8	101	70-130
4-Bromofluorobenzene	100	70-130

AIR TOXICS LTD.

SAMPLE NAME: LCS

ID#: 0205103-19D

EPA METHOD TO-14 GC/MS SIM

File Name:	**w051005**		**Date of Collection: NA**
Dil. Factor:	**1.00**		**Date of Analysis: 5/10/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	%Recovery
Vinyl Chloride	0.010	0.026	106
1,1-Dichloroethene	0.010	0.040	108
1,1-Dichloroethane	0.020	0.082	112
cis-1,2-Dichloroethene	0.020	0.080	100
1,1,1-Trichloroethane	0.020	0.11	136 Q
Benzene	0.050	0.16	96
1,2-Dichloroethane	0.020	0.082	124
Trichloroethene	0.020	0.11	103
Toluene	0.050	0.19	98
1,1,2-Trichloroethane	0.020	0.11	116
Tetrachloroethene	0.020	0.14	112
Ethyl Benzene	0.050	0.22	108
m,p-Xylene	0.050	0.22	110
o-Xylene	0.050	0.22	123
1,1,2,2-Tetrachloroethane	0.020	0.14	118
trans-1,2-Dichloroethene	0.10	0.40	130
Methyl tert-Butyl Ether	0.10	0.37	102

Q = Exceeds Quality Control limits.

Container Type: NA - Not Applicable

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	120	70-130
Toluene-d8	98	70-130
4-Bromofluorobenzene	103	70-130

AIR TOXICS LTD.

AN ENVIRONMENTAL ANALYTICAL LABORATORY

Air Toxics Ltd. Introduces the Electronic Report

Thank you for choosing Air Toxics Ltd. To better serve our customers, we are providing your report by e-mail. This document is provided in Portable Document Format which can be viewed with Acrobat Reader by Adobe.

This electronic report includes the following:

- Work order Summary;
- Laboratory Narrative;
- Results; and
- Chain of Custody (copy).

180 BLUE RAVINE ROAD, SUITE B FOLSOM, CA - 95630

(916) 985-1000 .FAX (916) 985-1020
Hours 8:00 A.M to 6:00 P.M. Pacific
E-mail to:samplereceiving@airtoxics.com

@ AIR TOXICS LTD.

AN ENVIRONMENTAL ANALYTICAL LABORATORY

WORK ORDER #: 0205374

Work Order Summary

CLIENT:	Mr. Chuck Siu SCA Environmental, Inc. 80 Grand Avenue Fourth Floor Oakland, CA 94612	**BILL TO:**	Mr. Chuck Siu SCA Environmental, Inc. 80 Grand Avenue Fourth Floor Oakland, CA 94612
PHONE:	510-465-9944	**P.O. #**	
FAX:	510-465-9109	**PROJECT #**	B5454 USCG AIR SAMPLING
DATE RECEIVED:	5/17/2002	**CONTACT:**	Karen Burden
DATE COMPLETED:	6/3/2002		

FRACTION #	NAME	TEST	RECEIPT VAC./PRES.
01A	4063 B KIR IO	TO-14-S	4.0 "Hg
02A	4063 B KIR OU	TO-14-S	4.0 "Hg
02AA	4063 B KIR OU Duplicate	TO-14-S	4.0 "Hg
03A	Lab Blank	TO-14-S	NA
04A	LCS	TO-14-S	NA

CERTIFIED BY: Linda L. Freeman

Laboratory Director

DATE: 06/03/02

Certfication numbers: CA ELAP - 1149, NY NELAP - 11291, UT ELAP - E-217, LA - AI 30763
Name of Accrediting Agency: NELAP/Florida Department of Health, Scope of Application: Clean Air Act,
Accreditation number: E87680, Effective date: 01/01/02, Expiration date: 06/30/02

Air Toxics Ltd. certifies that the test results contained in this report meet all requirements of the NELAC standards

This report shall not be reproduced, except in full, without the written approval of Air Toxics Ltd.

180 BLUE RAVINE ROAD, SUITE B FOLSOM, CA - 95630
(916) 985-1000 . (800) 985-5955 . FAX (916) 985-1020

LABORATORY NARRATIVE
TO-14 SIM
SCA Environmental, Inc.
Workorder# 0205374

One 6 Liter Silonite Canister and One 6 Liter Summa Canister (SIM Certified) samples were received on May 17, 2002. The laboratory performed analysis via EPA Method TO-14/15 using GC/MS in the SIM acquisition mode. The method involves concentrating up to 0.5 liters of air. The concentrated aliquot is then flash vaporized and swept through a water management system to remove water vapor. Following dehumidification, the sample passes directly into the GC/MS for analysis. See the data sheets for the reporting limits for each compound.

Method modifications taken to run these samples include:

Requirement	*TO-14/15 SIM*	*ATL Modifications*
Sampling/concentrator system	Nafion Drier	Multisorbent concentrator
Sample load volume	400 mL	Up to 0.5 liter
Blank	Humid air blank	Dry air blank for low level analysis.
Blank acceptance criteria	< 0.2 ppbv	< DL
BFB absolute abundance criteria	Within 10% of that from previous day.	CCV surrogate recoveries demonstrate stability from one day to the next
BFB acceptance criteria	CLP protocol	SW-846 protocol
Concentration of IS spike	Not specified	10 ppbv
Dilutions for initial calibration	Dynamic dilutions or static using canisters	Syringe dilutions
Flow rates/operating parameters	Not specified	Optimized. See procedures section.
ICAL RRF %RSD acceptance criteria	Not specified	30% or less for standard compounds, 40% or less for non-standard and polar compounds
IS recoveries	Within 40% of mean over ICAL for blanks, and w/in 40% of daily CCV for samples.	Within 40% of CCV recoveries for blank and samples.
IS RTs	Within .33 min from most recent calibration (either ICAL or daily)	Within 0.5 min. of RT in daily CCV
Daily CCV	70 - 130%	Standard compounds:70 - 130% for at least 90%; Non-standard and polar compounds: 60 - 140% for at least 80%
RF for quantitation	From ICAL	From ICAL
MSD scan range	35 - 300 amu	35 - 350 amu
Sampling/concentrator system	Nafion Drier	Multisorbent concentrator

Receiving Notes

There were no receiving discrepancies.

Analytical Notes

There were no analytical discrepancies.

Definition of Data Qualifying Flags

Six qualifiers may have been used on the data analysis sheets and indicates as follows:

B - Compound present in laboratory blank greater than reporting limit (background subtraction not performed).

J - Estimated value.

E - Exceeds instrument calibration range.

S - Saturated peak.

Q - Exceeds quality control limits.

U - Compound analyzed for but not detected above the reporting limit.

File extensions may have been used on the data analysis sheets and indicates as follows:

a-File was requantified

b-File was quantified by a second column and detector

r1-File was requantified for the purpose of reissue

AIR TOXICS LTD.

SAMPLE NAME: 4063 B KIR IO

ID#: 0205374-01A

EPA METHOD TO-14 GC/MS SIM

File Name:	**w052416**	**Date of Collection:**	**5/16/02**
Dil. Factor:	**1.55**	**Date of Analysis:**	**5/24/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.016	0.040	Not Detected	Not Detected
1,1-Dichloroethene	0.016	0.062	Not Detected	Not Detected
1,1-Dichloroethane	0.031	0.13	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.031	0.12	Not Detected	Not Detected
1,1,1-Trichloroethane	0.031	0.17	0.036	0.20
Benzene	0.078	0.25	0.15	0.49
1,2-Dichloroethane	0.031	0.13	Not Detected	Not Detected
Trichloroethene	0.031	0.17	Not Detected	Not Detected
Toluene	0.078	0.30	0.68	2.6
1,1,2-Trichloroethane	0.031	0.17	Not Detected	Not Detected
Tetrachloroethene	0.031	0.21	0.036	0.25
Ethyl Benzene	0.078	0.34	Not Detected	Not Detected
m,p-Xylene	0.078	0.34	0.18	0.82
o-Xylene	0.078	0.34	Not Detected	Not Detected
1,1,2,2-Tetrachloroethane	0.031	0.22	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.16	0.62	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.16	0.57	Not Detected	Not Detected

Container Type: 6 Liter Silonite Canister

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	102	70-130
Toluene-d8	96	70-130
4-Bromofluorobenzene	121	70-130

AIR TOXICS LTD.

SAMPLE NAME: 4063 B KIR OU

ID#: 0205374-02A

EPA METHOD TO-14 GC/MS SIM

File Name:	**w052417**	**Date of Collection:**	**5/16/02**
Dil. Factor:	**1.55**	**Date of Analysis:**	**5/24/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.016	0.040	Not Detected	Not Detected
1,1-Dichloroethene	0.016	0.062	Not Detected	Not Detected
1,1-Dichloroethane	0.031	0.13	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.031	0.12	Not Detected	Not Detected
1,1,1-Trichloroethane	0.031	0.17	0.036	0.20
Benzene	0.078	0.25	0.11	0.37
1,2-Dichloroethane	0.031	0.13	0.041	0.17
Trichloroethene	0.031	0.17	Not Detected	Not Detected
Toluene	0.078	0.30	0.31	1.2
1,1,2-Trichloroethane	0.031	0.17	Not Detected	Not Detected
Tetrachloroethene	0.031	0.21	Not Detected	Not Detected
Ethyl Benzene	0.078	0.34	Not Detected	Not Detected
m,p-Xylene	0.078	0.34	0.14	0.64
o-Xylene	0.078	0.34	Not Detected	Not Detected
1,1,2,2-Tetrachloroethane	0.031	0.22	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.16	0.62	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.16	0.57	Not Detected	Not Detected

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	101	70-130
Toluene-d8	100	70-130
4-Bromofluorobenzene	123	70-130

AIR TOXICS LTD.

SAMPLE NAME: 4063 B KIR OU Duplicate

ID#: 0205374-02AA

EPA METHOD TO-14 GC/MS SIM

File Name:	**w052418**	**Date of Collection:**	**5/16/02**
Dil. Factor:	**1.55**	**Date of Analysis:**	**5/24/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.016	0.040	Not Detected	Not Detected
1,1-Dichloroethene	0.016	0.062	Not Detected	Not Detected
1,1-Dichloroethane	0.031	0.13	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.031	0.12	Not Detected	Not Detected
1,1,1-Trichloroethane	0.031	0.17	0.034	0.19
Benzene	0.078	0.25	0.10	0.34
1,2-Dichloroethane	0.031	0.13	0.036	0.15
Trichloroethene	0.031	0.17	Not Detected	Not Detected
Toluene	0.078	0.30	0.29	1.1
1,1,2-Trichloroethane	0.031	0.17	Not Detected	Not Detected
Tetrachloroethene	0.031	0.21	Not Detected	Not Detected
Ethyl Benzene	0.078	0.34	Not Detected	Not Detected
m,p-Xylene	0.078	0.34	0.13	0.59
o-Xylene	0.078	0.34	Not Detected	Not Detected
1,1,2,2-Tetrachloroethane	0.031	0.22	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.16	0.62	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.16	0.57	Not Detected	Not Detected

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	102	70-130
Toluene-d8	98	70-130
4-Bromofluorobenzene	122	70-130

AIR TOXICS LTD.

SAMPLE NAME: Lab Blank

ID#: 0205374-03A

EPA METHOD TO-14 GC/MS SIM

File Name:	**w052405**	**Date of Collection: NA**	
Dil. Factor:	**1.00**	**Date of Analysis: 5/24/02**	

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	Amount (ppbv)	Amount (uG/m3)
Vinyl Chloride	0.010	0.026	Not Detected	Not Detected
1,1-Dichloroethene	0.010	0.040	Not Detected	Not Detected
1,1-Dichloroethane	0.020	0.082	Not Detected	Not Detected
cis-1,2-Dichloroethene	0.020	0.080	Not Detected	Not Detected
1,1,1-Trichloroethane	0.020	0.11	Not Detected	Not Detected
Benzene	0.050	0.16	Not Detected	Not Detected
1,2-Dichloroethane	0.020	0.082	Not Detected	Not Detected
Trichloroethene	0.020	0.11	Not Detected	Not Detected
Toluene	0.050	0.19	Not Detected	Not Detected
1,1,2-Trichloroethane	0.020	0.11	Not Detected	Not Detected
Tetrachloroethene	0.020	0.14	Not Detected	Not Detected
Ethyl Benzene	0.050	0.22	Not Detected	Not Detected
m,p-Xylene	0.050	0.22	Not Detected	Not Detected
o-Xylene	0.050	0.22	Not Detected	Not Detected
1,1,2,2-Tetrachloroethane	0.020	0.14	Not Detected	Not Detected
trans-1,2-Dichloroethene	0.10	0.40	Not Detected	Not Detected
Methyl tert-Butyl Ether	0.10	0.37	Not Detected	Not Detected

Container Type: NA - Not Applicable

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	103	70-130
Toluene-d8	98	70-130
4-Bromofluorobenzene	100	70-130

AIR TOXICS LTD.

SAMPLE NAME: LCS

ID#: 0205374-04A

EPA METHOD TO-14 GC/MS SIM

File Name:	**w052403**		**Date of Collection: NA**
Dil. Factor:	**1.00**		**Date of Analysis: 5/24/02**

Compound	Rpt. Limit (ppbv)	Rpt. Limit (uG/m3)	%Recovery
Vinyl Chloride	0.010	0.026	107
1,1-Dichloroethene	0.010	0.040	86
1,1-Dichloroethane	0.020	0.082	100
cis-1,2-Dichloroethene	0.020	0.080	86
1,1,1-Trichloroethane	0.020	0.11	106
Benzene	0.050	0.16	93
1,2-Dichloroethane	0.020	0.082	101
Trichloroethene	0.020	0.11	94
Toluene	0.050	0.19	101
1,1,2-Trichloroethane	0.020	0.11	107
Tetrachloroethene	0.020	0.14	100
Ethyl Benzene	0.050	0.22	103
m,p-Xylene	0.050	0.22	110
o-Xylene	0.050	0.22	118
1,1,2,2-Tetrachloroethane	0.020	0.14	103
trans-1,2-Dichloroethene	0.10	0.40	65
Methyl tert-Butyl Ether	0.10	0.37	58 Q

Q = Exceeds Quality Control limits.

Container Type: NA - Not Applicable

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	97	70-130
Toluene-d8	102	70-130
4-Bromofluorobenzene	101	70-130

@ AIR TOXICS LTD.

AN ENVIRONMENTAL ANALYTICAL LABORATORY

CHAIN-OF-CUSTODY RECORD

Sample Transportation Notice

Relinquishing signature on this document indicates that sample is being shipped in compliance with all applicable local, State, Federal, national, and international laws, regulations and ordinances of any kind. Air Toxics Limited assumes no liability with respect to the collection, handling or shipping of these samples. Relinquishing signature also indicates agreement to hold harmless, defend, and indemnify Air Toxics Limited against any claim, demand, or action of any kind, related to the collection, handling, or shipping of samples. D.O.T. Hotline (800) 467-4922

180 BLUE RAVINE ROAD, SUITE B
FOLSOM, CA 95630-4719
(916) 985-1000 FAX: (916) 985-1020

Contact Person: Christina Tunter / Chuck Siu
Company: SCA Environmental
Address: 80 Grand Ave 4th Fl City: Oakland State: CA Zip: 94612
Phone: 510 465 9941 x226 FAX: 510 465 9109
Collected By: Signature: Christina Tunter

Project Info:
P.O. #: B5454
Project #: B5454
Project Name: USCG Air Sampling

Turn Around Time:
☒ Normal
☐ Rush _____ Specify

MLT-11-02

Lab I.D.	Field Sample I.D.	Start Date 5-10-02	Stop Time 5-12-02	Canister #	Analyses Requested	Canister Pressure / Vacuum Initial	Final	Receipt
01A	4063 B KIR TO	945	950	4145	SIM TO-14	-26.5	-4	4.0"Hg
02A	4063 B KIR OU	1002	945	24483	SIM TO-14	-27.5	-5	4.0"Hg
				31428	DO NOT ANALYZE — NOT SAMPLED			
				MH1181	DO NOT ANALYZE — NOT SAMPLED			

Relinquished By (Signature)	Date/Time	Received By (Signature)	Date/Time
Christina Tunter	5/17/02	K. Foley	5/17/02 1250
K. Foley	5/17/02 1455	[illegible]	AIL 5/17/02 1455
Relinquished By (Signature)	Date/Time	Received By (Signature)	Date/Time

Notes: EMAIL PDF & EDD REPORTS TO CSIU@sca-enviro.com

Lab Use Only	Shipper Name	Air Bill #	Opened By	Temp. (°C)	Condition	Custody Seals Intact?	Work Order #
	Courier		AT	—	Good	Yes No None	0205374

Form 1203-01 (0

@ AIR TOXICS LTD.

AN ENVIRONMENTAL ANALYTICAL LABORATORY

CHAIN-OF-CUSTODY RECORD

Sample Transportation Notice

Relinquishing signature on this document indicates that sample is being shipped in compliance with all applicable local, State, Federal, national, and international laws, regulations, and ordinances of any kind. Air Toxics Limited assumes no liability with respect to the collection, handling or shipping of these samples. Relinquishing signature also indicates agreement to hold harmless, defend, and indemnify Air Toxics Limited against any claim, demand, or action of any kind, related to the collection, handling, or shipping of samples. D.O.T. Hotline (800) 467-4922

180 BLUE RAVINE ROAD, SUITE B
FOLSOM, CA 95630-4719
(916) 985-1000 FAX: (916) 985-1020

Contact Person: Christina Tuntori / Chuck Siu
Company: SCF ENVIRONMENTAL
Address: 80 GRAND AVE 4th Floor, Oakland, State CA Zip 94612
Phone: 510-465-9941 x226 FAX: 510-465-9109
Collected By: Signature: Christina Tuntori

Project Info:
P.O. #: B5454.02
Project #: B5454.02
Project Name: USCG AIRSHIPPING
MARINA VILLAGE

Turn Around Time:
☒ Normal: 10-DAY
☐ Rush: Specify
05/14/02
pls email PDF and tab-delimited reports to:

Lab I.D.	Field Sample I.D.	Start Date 5-02-02	Stop Time 5-03-02	Canister #	Analyses Requested	Canister Pressure / Vacuum Initial	Final	Receipt
-01A	4078B-SEA-IU	1015	935	4247	SIM TO-14	-27.5	-5	2.0"Hg
-02A	4078B-SEA-EU	1030	930	4260	↓	-29.0	-6	1.0"Hg
-03A	4072A-SEA-IU	1050	950	1627	↓	-29.0	-7	5.5"Hg
-04A	4081B-MTH-IU	1115	1000	25262	↓	-29.0	-4	3.5"Hg
-05A	4059A-DRU-IU	1130	1010	14601	↓	-30	-6	5.0"Hg
-06A	4059A-DRU-EU	1150	1012	923	↓	-30	-10	7.5"Hg
-07A	4040A-KIS-IU	1215	1025	1514	↓	-29	-6	6.5"Hg
-08A	4040A-KIS-EU	1225	1030	6993	↓	-30	-4	4.0"Hg
-09A	4030A-CHI-IU	1240	1020	12010	↓	-26	-8	7.0"Hg
-10A	4028B-SOC-IU	1300	1040	19672	↓	-27	-9	8.0"Hg

Relinquished By: (Signature)	Date/Time	Received By: (Signature)	Date/Time
Christina Tuntori	5/03/02 2pm	[illegible]	5/3/02 1655
[illegible]	5/3/02-1915	[illegible]	5-3-02 1915
Relinquished By: (Signature)	Date/Time	Received By: (Signature)	Date/Time

Notes: We are sending 17 canisters, gages, flow controllers & filters in this batch. We'll be collecting 2-4 samples some time next week and we are therefore keeping 4 sets of canisters & accessories.

Lab Use Only	Shipper Name	Air Bill #	Opened By:	Temp (°C)	Condition	Custody Seals Intact?	Work Order #
	[illegible]	—	[illegible]	—	[illegible]	Yes No (None)	0205103

Form 1939 rev 02

@ AIR TOXICS LTD.
AN ENVIRONMENTAL ANALYTICAL LABORATORY

CHAIN-OF-CUSTODY RECORD

Sample Transportation Notice
Relinquishing signature on this document indicates that sample is being shipped in compliance with all applicable local, State, Federal, national, and international laws, regulations and ordinances of any kind. Air Toxics Ltd. assumes no liability with respect to the collection, handling or shipping of these samples. Relinquishing signature also indicates agreement to hold harmless, defend, and indemnify Air Toxics Ltd. against any claim, demand, or action of any kind, related to the collection, handling, or shipping of samples. D.O.T. Hotline (800) 467-4922

180 BLUE RAVINE ROAD, SUITE B
FOLSOM, CA 95630-4710
(916) 985-1000 FAX: (916) 985-1020

Contact Person: Christina Tunteri / Chuck Sill
Company: SCA ENVIRONMENTAL
Address: 80 GRAND AVE 4TH FL City: Oakland State: Zip: 94612
Phone: 510/465-9941 x226 FAX: 510/465-9109
Collected By: Signature: Christina Tunteri

Project Info:
P.O. #: 85454.02
Project #: 85454.02
Project Name: USCG AIR SAMPLING

Turn Around Time:
☒ Normal 10-DAY
☐ Rush _____ Specify:

5-4-02

Lab I.D.	Field Sample I.D.	Start Date & Time 5-2-02	Stop Time 5-3-02	Canister #	Analyses Requested	Canister Pressure / Vacuum Initial	Final	Receipt
-14A	3009A-ARK-IU	1540	1050	R-9	SIM TO-14	-28	Ø	0.6 psi
-12A	3001B-ENT-IU	1520	1105	13850	↓	-28	-8	9.5"Hg
-13A	4011A-NIM-IU	1545	1120	1243	↓	-28	-2.5	4.5"Hg
-14A	4014-NIM-IU	1600	1115	05360	↓	-26.5	-8	9.5"Hg
-15A	4011A-NIM-EU	1550	1120	13847	↓	-25.5	-9	11.0"Hg
-16A	3054B-FLT-IU	1630	1150	2513	↓	-26.0	-5	8.5"Hg
-17A	3054B-FLT-EU	1640	1155	1184	↓	-25.0	-3.5	7.0"Hg
	5/15							

Relinquished By (Signature)	Date/Time	Received By (Signature)	Date/Time
Christina Tunteri	5/3/02 2:30pm	[illegible]	5/3/02 1155
[illegible]	5/3/02 1310	[illegible]	5-3-02 1315
Relinquished By (Signature)	Date/Time	Received By (Signature)	Date/Time

Notes:

Lab Use Only:	Shipper Name	Air Bill #	Opened By:	Temp. (°C)	Condition	Custody Seals Intact?	Work Order #
	Direct Carrier	—	ES	—	good	Yes No None	020510 3

Form TAC rev. 99

Appendix C
Statistical Analyses

Appendix C
Statistical Analyses

This section presents, in detail, the statistical analyses summarized in Section 3. The text in Section 3 presented a qualitative summary of the analyses that were performed for examining the VOC concentrations in indoor air at the Site. The statistics used to answer each of the questions posed in Section 3 will be provided in turn below.

Statistical analyses were conducted only on those VOCs that were detected in more than one sample. This included ten VOCs; i.e., benzene, 1,2-dichloroethane, ethylbenzene, MTBE, PCE, TCE, toluene, 1,1,1-trichloroethane, m,p-xylenes, and o-xylene. Data from the three different areas sampled (i.e., North Housing, Kollmann Circle, and Marina Housing) were pooled together for the analyses. All Statistical analyses were performed using Statistica v 6.0.

C.1 Indoor vs. Outdoor Air

Air samples were collected at the Site from houses with and without vapor barriers. As the presence of vapor barriers may have affected the concentrations of VOCs in indoor air, the presence of vapor barriers in some of the housing units may bias any statistical analyses performed. Therefore, the potential effects of both factors should be investigated simultaneously in the statistical analyses. This was performed using a two factor analysis of variance (ANOVA). The statistical analyses performed addressed two questions: 1) indoor vs. outdoor air and 2) the effect of vapor barriers.

This type of analysis permits the examination of the effects of both factors simultaneously and is preferred to performing separate *t*-tests to test each effect separately. ANOVA is a robust statistical technique that is relatively insensitive to even large departures from its assumptions. As no equivalent non-parametric test is available and the ANOVA is robust, the ANOVA was used even if the data did not meet the assumptions of the test.

The statistical analyses indicated that only MTBE concentrations differed among the housing areas (in both indoor and outdoor air). MTBE concentrations were found to be higher in air samples collected in North housing than in Kollmann Circle and Marina Housing. However, as MTBE concentrations were observed to be higher in both indoor and outdoor air at North Housing, this likely reflects the increased MTBE levels in ambient air during the winter months (see previous section). Indoor and outdoor air were not found to differ (regardless of time) for any VOC. Overall, this suggests that VOCs are not accumulating in indoor air from subsurface sources and that there is no appreciable effect of vapor barriers.

The ANOVA output tables, and figures showing for the VOCs showing significant differences are provided following the text.

C.2 ANOVA tables and figures for Indoor air vs. Outdoor air

In the ANOVA tables presented below, "Area" refers to the sampling area (i.e., Marina Housing, Kollmann Circle, and North Housing); "Indoor" refers to whether the samples were collected indoors vs. outdoors.

Benzene

Univariate Tests of Significance for Value (ug/m3) (indoor vs. outdoor.sta) Sigma-restricted parameterization Effective hypothesis decomposition

	SS	Degr. of	MS	F	p
Intercept	291.706	1	291.7061	1.726018	0.197467
Area	196.025	2	98.0125	0.579938	0.565223
Indoor	113.618	1	113.6180	0.672275	0.417809
Area*Indoor	365.489	2	182.7445	1.081295	0.350216
Error	5915.183	35	169.0052		

1,2-Dichloroethane

Univariate Tests of Significance for Value (ug/m3) (indoor vs. outdoor.sta) Sigma-restricted parameterization Effective hypothesis decomposition

	SS	Degr. of	MS	F	p
Intercept	0.783365	1	0.783365	244.3286	0.000000
Area	0.014398	2	0.007199	2.2453	0.120935
Indoor	0.000239	1	0.000239	0.0745	0.786501
Area*Indoor	0.009821	2	0.004910	1.5315	0.230341
Error	0.112217	35	0.003206		

Ethylbenzene

Univariate Tests of Significance for Value (ug/m3) (indoor vs. outdoor.sta) Sigma-restricted parameterization Effective hypothesis decomposition

	SS	Degr. of	MS	F	p
Intercept	340.065	1	340.0653	1.503679	0.228293
Area	303.174	2	151.5870	0.670278	0.518010
Indoor	115.767	1	115.7667	0.511890	0.479068
Area*Indoor	569.697	2	284.8487	1.259526	0.296335
Error	7915.444	35	226.1555		

Tetrachloroethene

Univariate Tests of Significance for Value (ug/m3) (indoor vs. outdoor.sta) Sigma-restricted parameterization Effective hypothesis decomposition

	SS	Degr. of	MS	F	p
Intercept	17.1329	1	17.13295	2.098355	0.156358
Area	3.2901	2	1.64506	0.201479	0.818462
Indoor	0.9134	1	0.91344	0.111873	0.740018
Area*Indoor	3.4256	2	1.71281	0.209776	0.811778
Error	285.7730	35	8.16494		

Toluene

Univariate Tests of Significance for Value (ug/m3) (indoor vs. outdoor.sta) Sigma-restricted parameterization Effective hypothesis decomposition

	SS	Degr. of	MS	F	p
Intercept	4975.77	1	4975.774	1.886921	0.178285
Area	2951.86	2	1475.930	0.559704	0.576408
Indoor	1311.20	1	1311.195	0.497234	0.485385
Area*Indoor	6268.92	2	3134.460	1.188655	0.316629
Error	92294.33	35	2636.981		

1,1,1-Trichloroethane

Univariate Tests of Significance for Value (ug/m3) (indoor vs. outdoor.sta) Sigma-restricted parameterization Effective hypothesis decomposition

	SS	Degr. of	MS	F	p
Intercept	1.662629	1	1.662629	253.1089	0.000000
Area	0.010770	2	0.005385	0.8198	0.448821
Indoor	0.001425	1	0.001425	0.2169	0.644307
Area*Indoor	0.001000	2	0.000500	0.0761	0.926862
Error	0.229909	35	0.006569		

Trichloroethene

Univariate Tests of Significance for Value (ug/m3) (indoor vs. outdoor.sta) Sigma-restricted parameterization Effective hypothesis decomposition

	SS	Degr. of	MS	F	p
Intercept	1.046029	1	1.046029	165.7912	0.000000
Area	0.008005	2	0.004002	0.6344	0.536253
Indoor	0.001773	1	0.001773	0.2810	0.599363
Area*Indoor	0.032753	2	0.016377	2.5956	0.088897
Error	0.220826	35	0.006309		

m,p-Xylenes

Univariate Tests of Significance for Value (ug/m3) (indoor vs. outdoor.sta) Sigma-restricted parameterization Effective hypothesis decomposition

	SS	Degr. of	MS	F	p
Intercept	5081.0	1	5081.017	1.457131	0.235482
Area	4302.2	2	2151.076	0.616884	0.545386
Indoor	1712.5	1	1712.501	0.491110	0.488066
Area*Indoor	8675.6	2	4337.818	1.243997	0.300661
Error	122045.0	35	3487.001		

o-Xylene

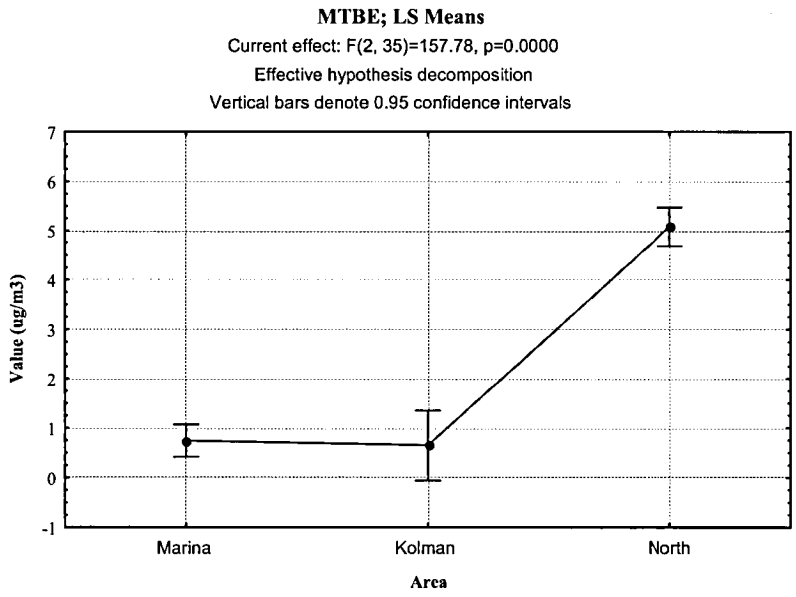
Univariate Tests of Significance for Value (ug/m3) (indoor vs. outdoor.sta) Sigma-restricted parameterization Effective hypothesis decomposition

	SS	Degr. of	MS	F	p
Intercept	1334.50	1	1334.503	1.194507	0.281888
Area	1698.89	2	849.445	0.760334	0.475076
Indoor	629.73	1	629.733	0.563671	0.457803
Area*Indoor	2732.14	2	1366.069	1.222762	0.306685
Error	39101.99	35	1117.200		

MTBE

Univariate Tests of Significance for Value (ug/m3) (indoor vs. outdoor.sta) Sigma-restricted parameterization Effective hypothesis decomposition

	SS	Degr. of	MS	F	p
Intercept	96.8327	1	96.83269	226.3789	0.000000
Area	**134.9765**	**2**	**67.48827**	**157.7765**	**0.000000**
Indoor	0.0073	1	0.00727	0.0170	0.897013
Area*Indoor	0.2260	2	0.11302	0.2642	0.769323
Error	14.9711	35	0.42775		


MTBE; LS Means
Current effect: F(2, 35)=157.78, p=0.0000
Effective hypothesis decomposition
Vertical bars denote 0.95 confidence intervals
Value (ug/m3)
7
6
5
4
3
2
1
0
-1
Marina
Kolman
North
Area

C.3 Crawlspace vs. Indoor Air

If VOCs are migrating from subsurface sources (e.g., groundwater or soil vapor) to indoor air and the house has a crawlspace, then the concentration of VOCs should be higher in crawlspace air than in indoor air (Olson and Corsi, 2001). This is because the VOCs must first enter the crawlspace before they can enter indoor air. Indoor air concentrations were compared to crawlspace air concentrations. However, because residents may use or bring objects into their houses that are VOC sources, the presence of residents in a housing unit may bias the comparison of indoor air to crawlspace air. Again, the potential effects of both factors should be investigated simultaneously in the statistical analyses. Therefore, a 2 factor ANOVA was again used to examine both factors; i.e., 1) crawlspace vs. indoor air and 2) the effect of residents.

The statistical analyses indicated that concentrations of benzene, MTBE, PCE, and toluene were higher in air from occupied residences than unoccupied residences. In contrast to the effect of occupants on VOC concentrations, only the concentration of benzene differed in crawlspace air from indoor air. However, the concentrations in the crawlspaces were lower than in indoor air. Together, this suggests that VOCs may not be migrating to indoor or crawlspace air from subsurface sources at the site at any appreciable level and that residents cause elevated levels of VOCs in indoor air.

The ANOVA output tables, and figures showing for the VOCs showing significant differences are provided following the text.

C.4 ANOVA tables and figures for Crawlspace air vs. Indoor air

In the ANOVA tables presented below, "Occupied" refers to whether the housing unit had residents; "Indoor" refers to whether the samples were collected indoors vs. in crawlspaces.

1,2-Dichloroethane

Univariate Tests of Significance for Value (ug/m3) (indoor vs. crawlspace.sta) Sigma-restricted parameterization Effective hypothesis decomposition

	SS	Degr. of	MS	F	p
Intercept	0.437357	1	0.437357	316.0860	0.000000
Indoor	0.000306	1	0.000306	0.2214	0.642038
Occupied	0.005117	1	0.005117	3.6985	0.065924
Indoor*Occupied	0.000280	1	0.000280	0.2026	0.656520
Error	0.034592	25	0.001384		

Ethylbenzene

Univariate Tests of Significance for Value (ug/m3) (indoor vs. crawlspace.sta) Sigma-restricted parameterization Effective hypothesis decomposition

	SS	Degr. of	MS	F	p
Intercept	50.5391	1	50.53912	6.900654	0.014505
Indoor	10.1627	1	10.16272	1.387626	0.249898
Occupied	2.9238	1	2.92377	0.399214	0.533231
Indoor*Occupied	0.2369	1	0.23686	0.032340	0.858732
Error	183.0954	25	7.32382		

1,1,1-Trichloroethane

Univariate Tests of Significance for Value (ug/m3) (indoor vs. crawlspace.sta) Sigma-restricted parameterization Effective hypothesis decomposition

	SS	Degr. of	MS	F	p
Intercept	1.132034	1	1.132034	1284.414	0.000000
Indoor	0.000188	1	0.000188	0.213	0.648401
Occupied	0.002107	1	0.002107	2.391	0.134631
Indoor*Occupied	0.000047	1	0.000047	0.053	0.819371
Error	0.022034	25	0.000881		

Trichloroethene

Univariate Tests of Significance for Value (ug/m3) (indoor vs. crawlspace.sta) Sigma-restricted parameterization Effective hypothesis decomposition

	SS	Degr. of	MS	F	p
Intercept	0.803864	1	0.803864	377.6089	0.000000
Indoor	0.007707	1	0.007707	3.6202	0.068661
Occupied	0.008872	1	0.008872	4.1675	0.051894
Indoor*Occupied	0.004078	1	0.004078	1.9157	0.178561
Error	0.053221	25	0.002129		

m,p-Xylenes

Univariate Tests of Significance for Value (ug/m3) (indoor vs. crawlspace.sta) Sigma-restricted parameterization Effective hypothesis decomposition

	SS	Degr. of	MS	F	p
Intercept	796.765	1	796.7655	5.902225	0.022642
Indoor	198.313	1	198.3126	1.469047	0.236827
Occupied	70.498	1	70.4975	0.522227	0.476600
Indoor*Occupied	2.418	1	2.4181	0.017913	0.894602
Error	3374.852	25	134.9941		

o-Xylene

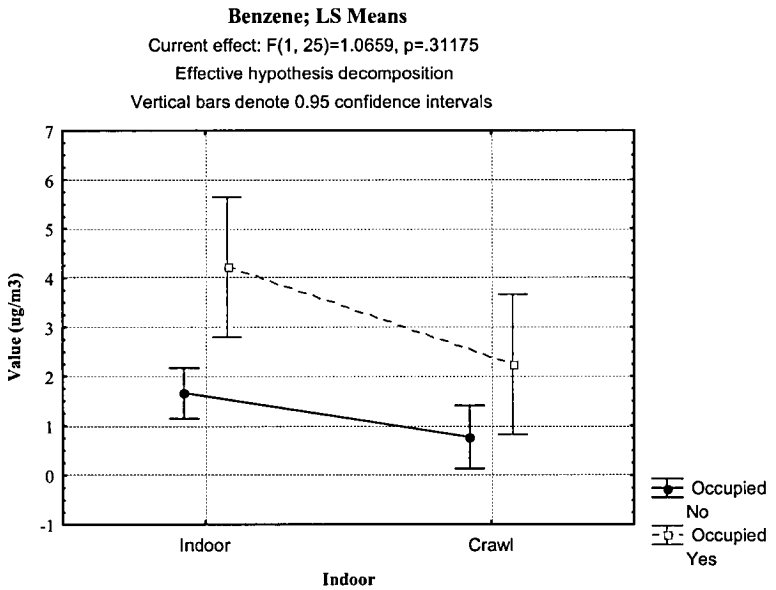
Univariate Tests of Significance for Value (ug/m3) (indoor vs. crawlspace.sta) Sigma-restricted parameterization Effective hypothesis decomposition

	SS	Degr. of	MS	F	p
Intercept	121.1211	1	121.1211	6.529681	0.017074
Indoor	25.1023	1	25.1023	1.353275	0.255690
Occupied	9.9985	1	9.9985	0.539024	0.469668
Indoor*Occupied	0.1764	1	0.1764	0.009509	0.923094
Error	463.7328	25	18.5493		

Benzene

Univariate Tests of Significance for Value (ug/m3) (indoor vs. crawlspace.sta) Sigma-restricted parameterization Effective hypothesis decomposition

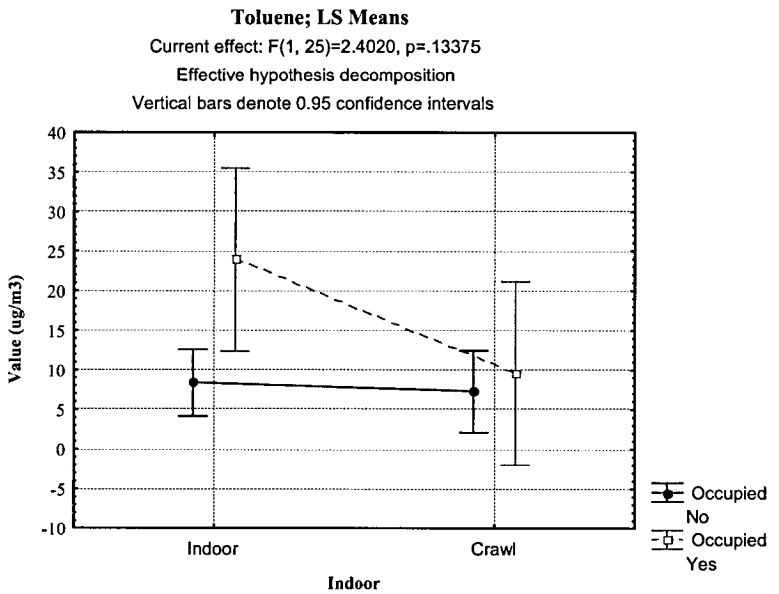
	SS	Degr. of	MS	F	p
Intercept	67.92099	1	67.92099	71.25717	0.000000
Indoor	**7.09098**	**1**	**7.09098**	**7.43928**	**0.011501**
Occupied	**13.94323**	**1**	**13.94323**	**14.62810**	**0.000776**
Indoor*Occupied	1.01604	1	1.01604	1.06594	0.311749
Error	23.82953	25	0.95318		



Toluene

Univariate Tests of Significance for Value (ug/m3) (indoor vs. crawlspace.sta) Sigma-restricted parameterization Effective hypothesis decomposition

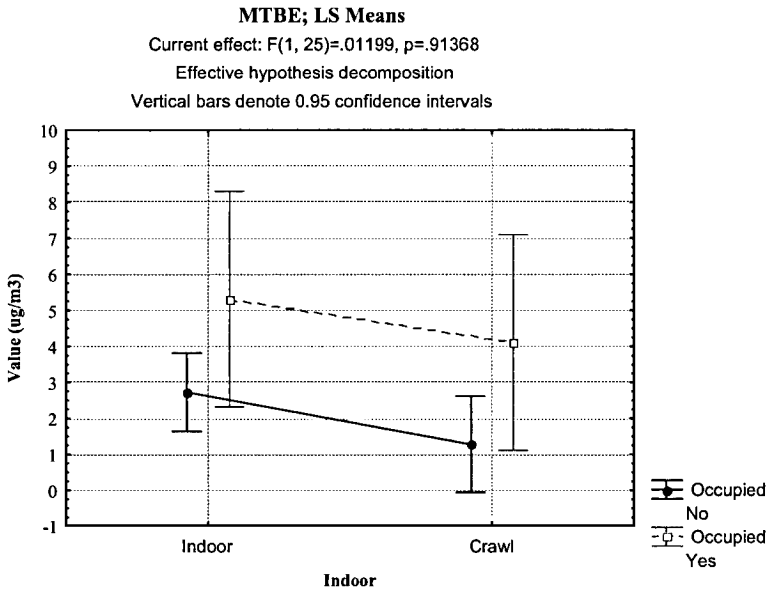
	SS	Degr. of	MS	F	p
Intercept	2072.696	1	2072.696	32.91012	0.000006
Indoor	204.338	1	204.338	3.24446	0.083741
Occupied	**273.116**	**1**	**273.116**	**4.33651**	**0.047691**
Indoor*Occupied	151.278	1	151.278	2.40198	0.133750
Error	1574.513	25	62.981		



MTBE

Univariate Tests of Significance for Value (ug/m3) (indoor vs. crawlspace.sta) Sigma-restricted parameterization Effective hypothesis decomposition

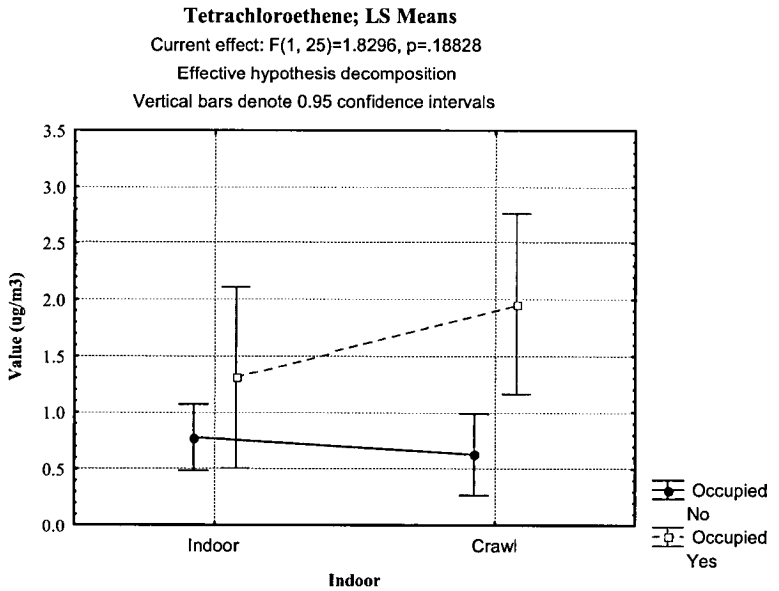
	SS	Degr. of	MS	F	p
Intercept	154.1719	1	154.1719	36.58593	0.000003
Indoor	6.0574	1	6.0574	1.43746	0.241792
Occupied	**25.0030**	**1**	**25.0030**	**5.93336**	**0.022322**
Indoor*Occupied	0.0505	1	0.0505	0.01199	0.913684
Error	105.3492	25	4.2140		



Tetrachloroethene

Univariate Tests of Significance for Value (ug/m3) (indoor vs. crawlspace.sta) Sigma-restricted parameterization Effective hypothesis decomposition

	SS	Degr. of	MS	F	p
Intercept	18.76730	1	18.76730	61.92620	0.000000
Indoor	0.21843	1	0.21843	0.72074	0.403958
Occupied	**2.98540**	**1**	**2.98540**	**9.85089**	**0.004317**
Indoor*Occupied	0.55447	1	0.55447	1.82959	0.188284
Error	7.57648	25	0.30306		



C.5 Seasonal Effects on VOC Concentrations in Outdoor Air

As mentioned in Section 2, samples were collected at the Site during different seasons. Samples were collected from North Housing in February, from Kollmann Circle in April, and from Marina Housing in May. To determine whether or not this affected the VOC concentrations measured at the Site, outdoor air samples collected from each of the three areas sampled were compared.

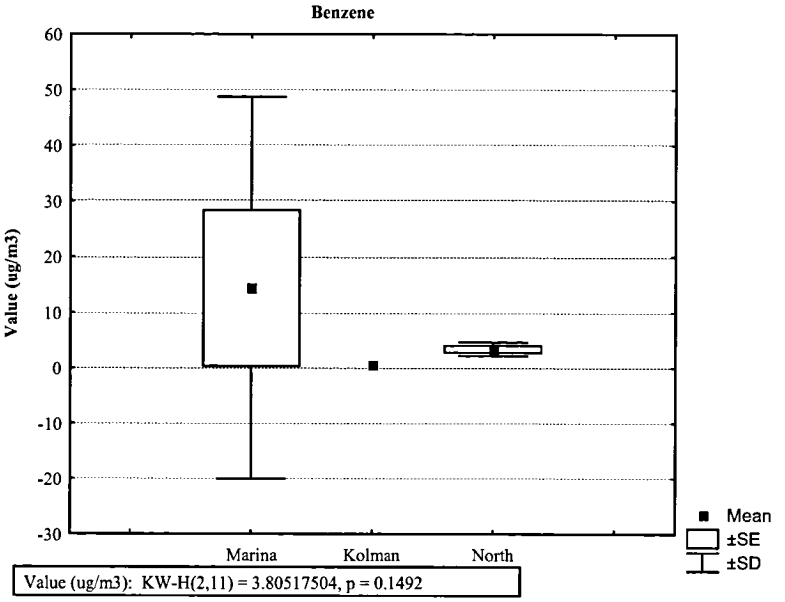
The data were compared using a non-parametric Kruskall-Wallis test. This test is almost as powerful as the ANOVA but is insensitive to departures from the assumptions of the ANOVA (i.e., non-normality and homoscedasticisty). The Kruskall-Wallis test, however, is only available in a single factor form and so, was not used in the analyses above whereas this analysis only requires a single factor; i.e., season.

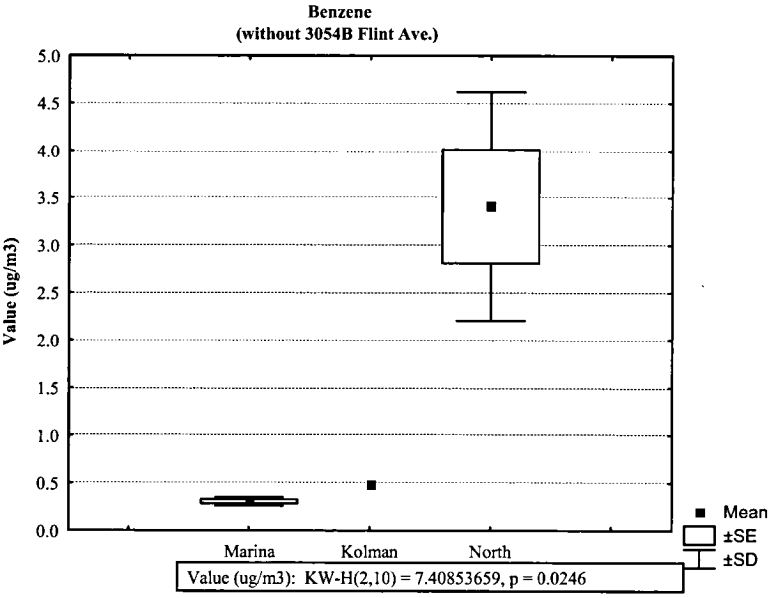
Comparisons of outdoor air samples indicated that MTBE and PCE concentrations were higher when sampled at North Housing. As MTBE concentrations are higher in gasoline in the winter months, higher outdoor air MTBE concentrations would be expected at this time. Higher PCE concentrations during winter may be related to lower winter air temperatures. The photodegredation rate increases with temperature; therefore, the photodegreadation rate is lower during winter when air temperatures are lower (Mohamed et al., 2002). However, this should apply to many of other other VOCs monitored in outdoor air at the site. As higher winter VOC concentrations were only observed for PCE and MTBE, this suggests that some effect other than temperature may be responsible for the differences observed.

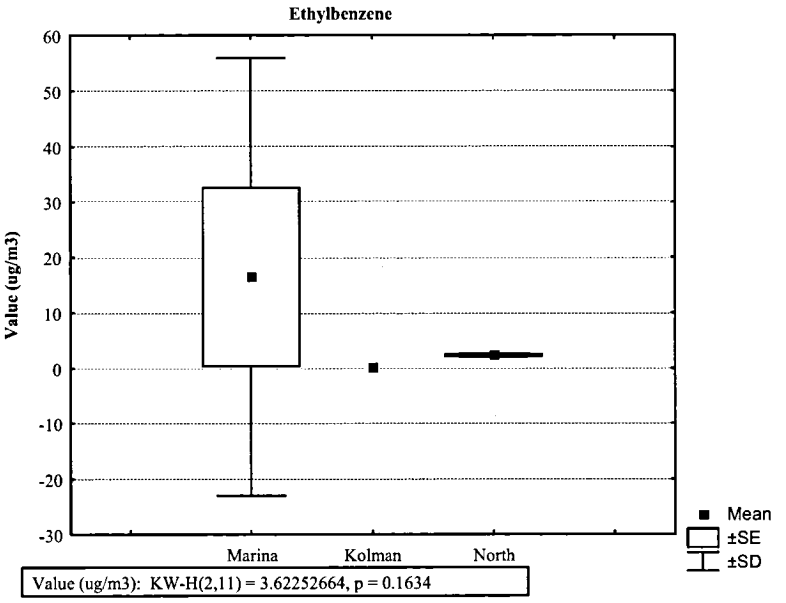
When the sample at 3054B Flint Ave. is excluded from the analyses, the benzene, ethylbenzene, MTBE, PCE, toluene, 111-TCA, m,p-xylenes, and o-xylene concentrations were higher when sampled at North Housing. The outdoor air at 3054B Flint Ave. was an apparent outlier with very high concentrations of VOCs. As the unit was recently repainted, it is possible that either paints or paint removing solvents were spilled at that unit, which may be responsible for the elevated VOC levels. When that sample is excluded from the analyses (see below), benzene, ethylbenzene, MTBE, PCE, toluene, 111-TCA, m,p-xylenes, and o-xylene in outdoor air sampled during the winter months at North Housing were higher. As stated above, one potential cause is the decreased photodegredation rate in winter.

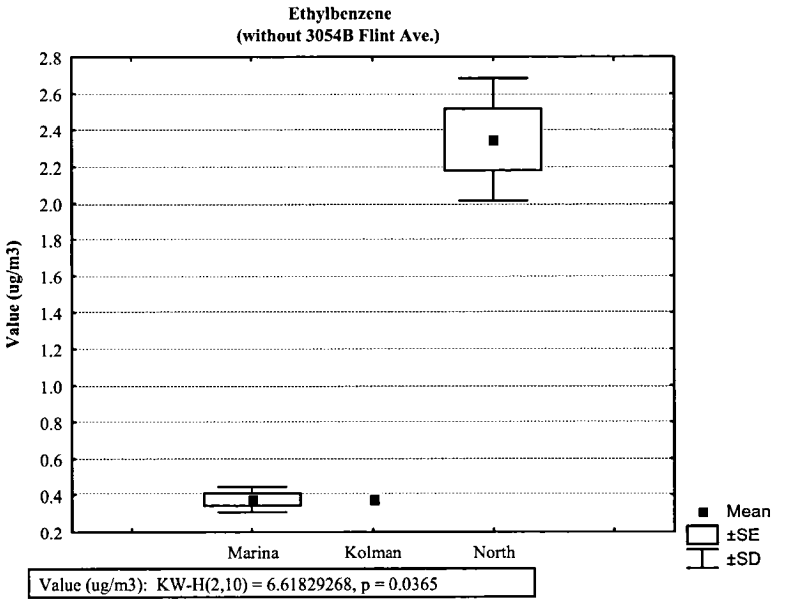
The figures containing the Kruskall-Wallis test results are given below.

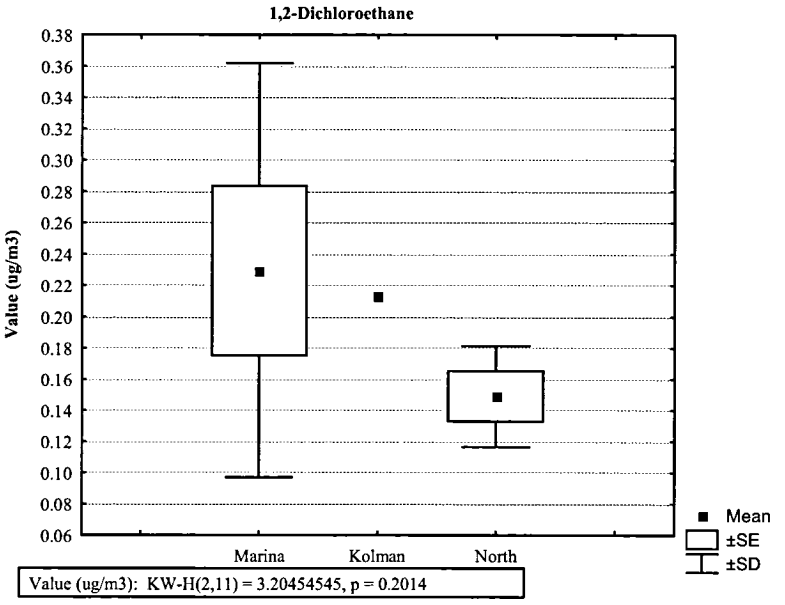
C.6 Box and Whisker plots with Kruskall-Wallis tests

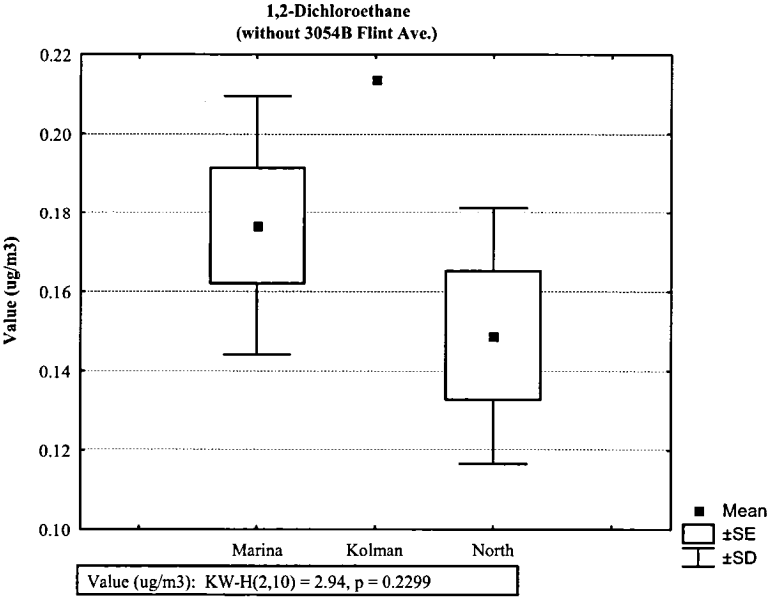


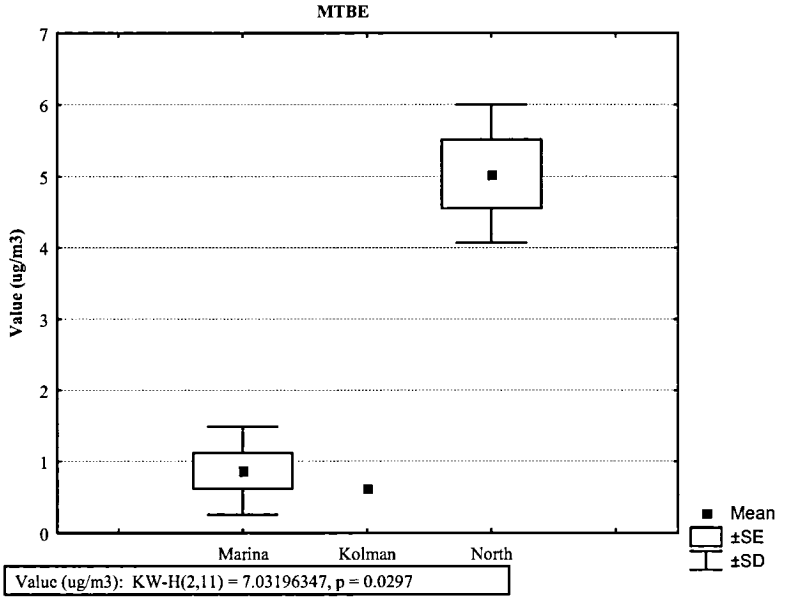


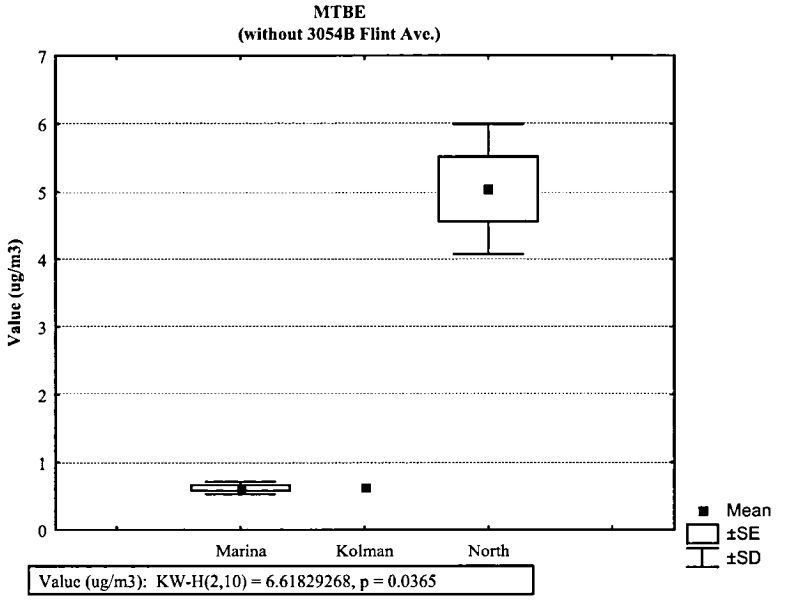

Ethylbenzene
Value (ug/m3)
60
50
40
30
20
10
0
-10
-20
-30
Marina
Kolman
North
Mean
±SE
±SD
Value (ug/m3): KW-H(2,11) = 3.62252664, p = 0.1634

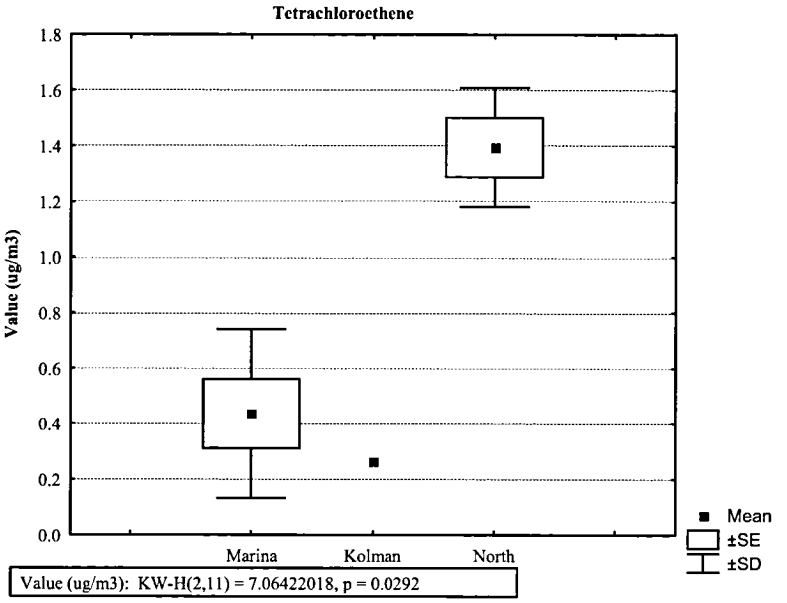

Ethylbenzene
(without 3054B Flint Ave.)
Value (ug/m3)
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
Marina
Kolman
North
Mean
±SE
±SD
Value (ug/m3): KW-H(2,10) = 6.61829268, p = 0.0365

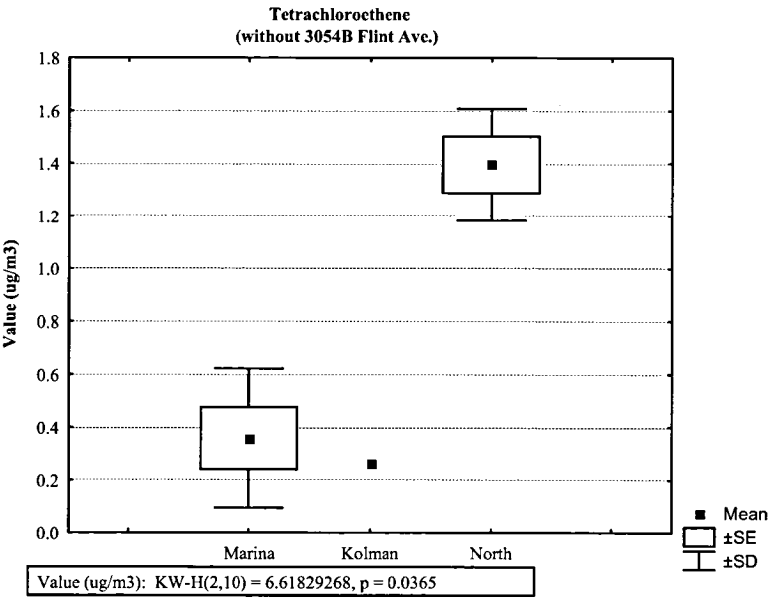

1,2-Dichloroethane
Value (ug/m3)
0.38
0.36
0.34
0.32
0.30
0.28
0.26
0.24
0.22
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
Marina
Kolman
North
Mean
±SE
±SD
Value (ug/m3): KW-H(2,11) = 3.20454545, p = 0.2014

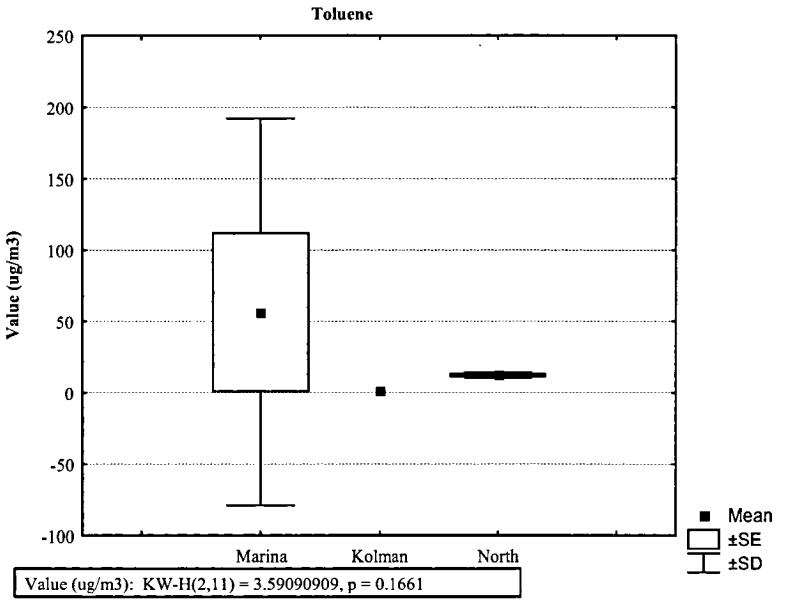

1,2-Dichloroethane
(without 3054B Flint Ave.)
Value (ug/m3)
0.22
0.20
0.18
0.16
0.14
0.12
0.10
Marina
Kolman
North
Mean
±SE
±SD
Value (ug/m3): KW-H(2,10) = 2.94, p = 0.2299

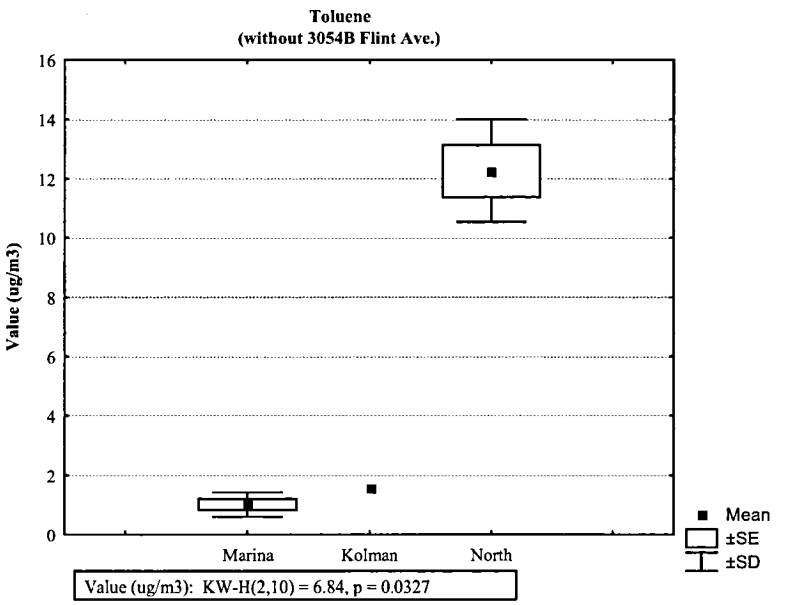

MTBE
Value (ug/m3)
7
6
5
4
3
2
1
0
Marina
Kolman
North
Mean
±SE
±SD
Value (ug/m3): KW-H(2,11) = 7.03196347, p = 0.0297

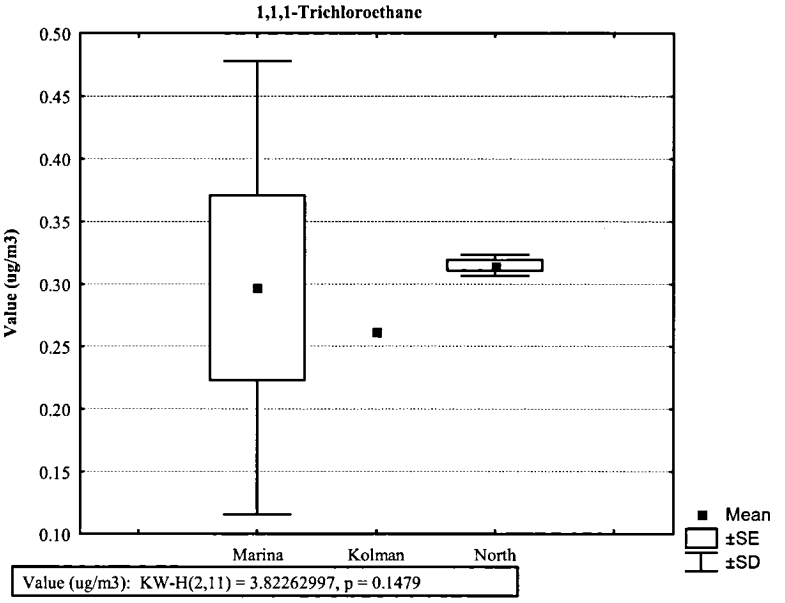

MTBE
(without 3054B Flint Ave.)
Value (ug/m3)
7
6
5
4
3
2
1
0
Marina
Kolman
North
Mean
±SE
±SD
Value (ug/m3): KW-H(2,10) = 6.61829268, p = 0.0365

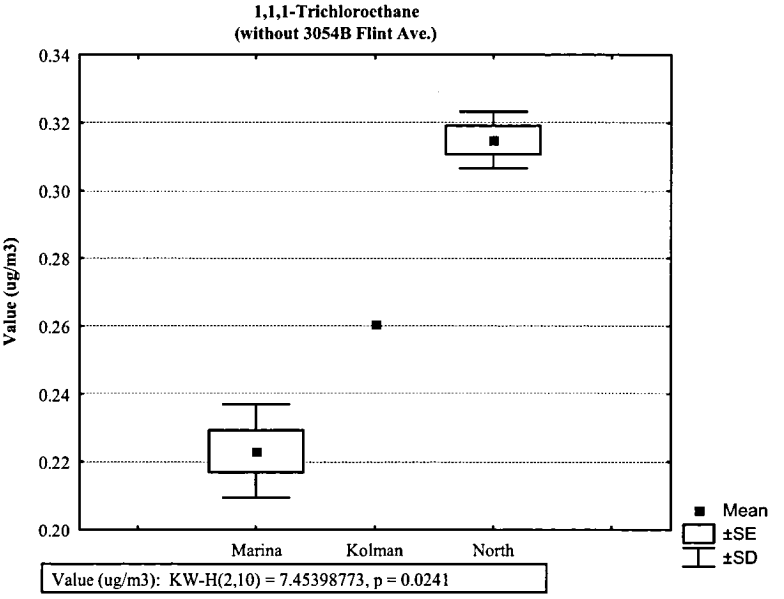

Tetrachloroethene
Value (ug/m3)
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Marina
Kolman
North
Mean
±SE
±SD
Value (ug/m3): KW-H(2,11) = 7.06422018, p = 0.0292

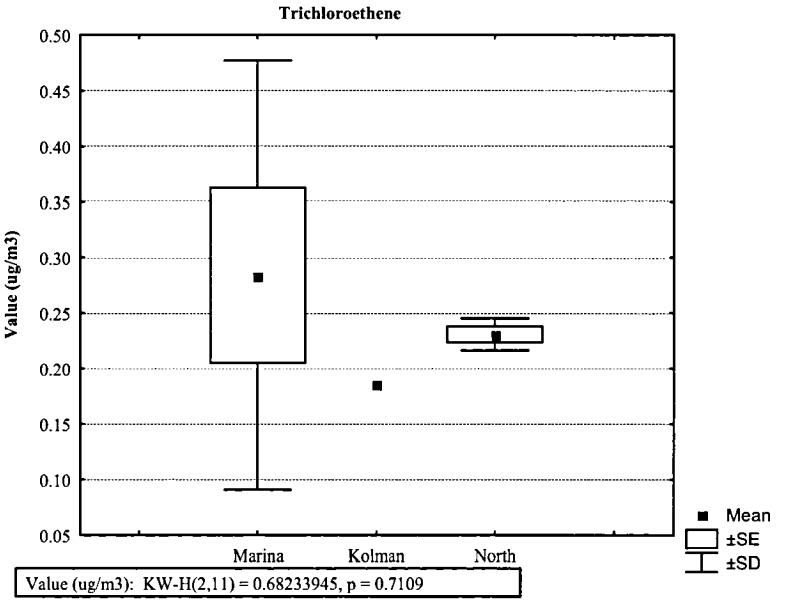

Tetrachloroethene
(without 3054B Flint Ave.)
Value (ug/m3)
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Marina
Kolman
North
Mean
±SE
±SD
Value (ug/m3): KW-H(2,10) = 6.61829268, p = 0.0365

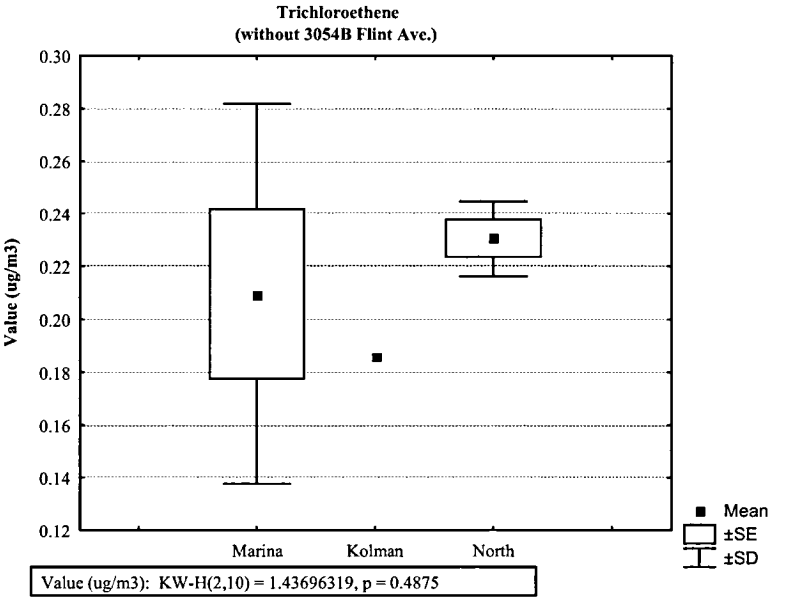

Toluene
250
200
150
100
50
0
-50
-100
Value (ug/m3)
Marina
Kolman
North
Mean
±SE
±SD
Value (ug/m3): KW-H(2,11) = 3.59090909, p = 0.1661

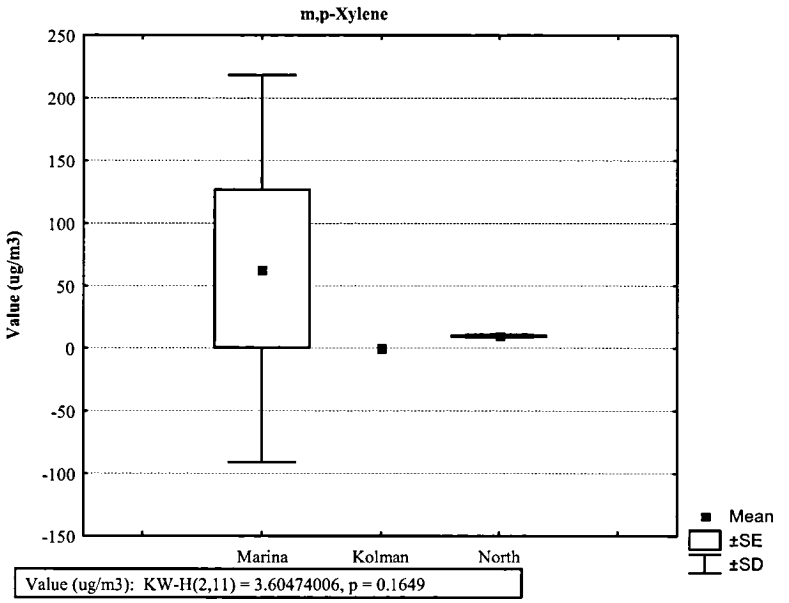

Toluene
(without 3054B Flint Ave.)
16
14
12
10
8
6
4
2
0
Value (ug/m3)
Marina
Kolman
North
Mean
±SE
±SD
Value (ug/m3): KW-H(2,10) = 6.84, p = 0.0327

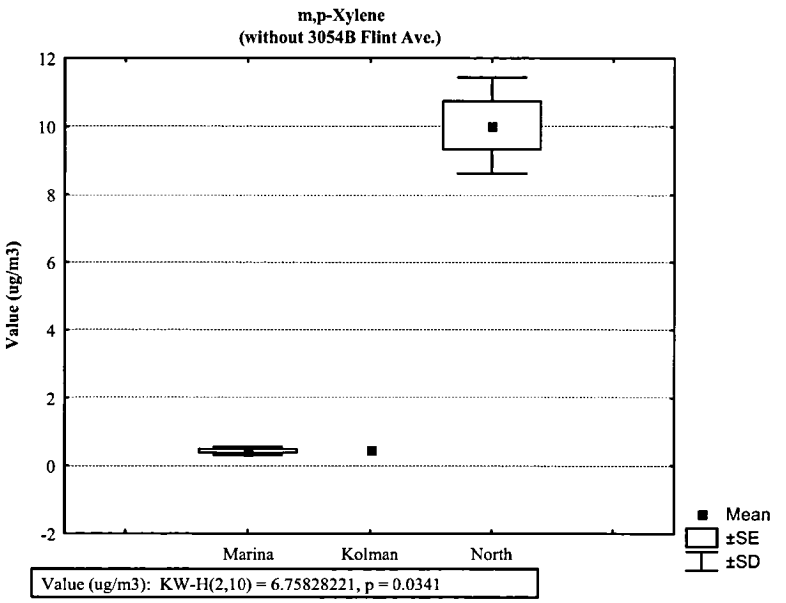

1,1,1-Trichloroethane
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
Value (ug/m3)
Marina
Kolman
North
Mean
±SE
±SD
Value (ug/m3): KW-H(2,11) = 3.82262997, p = 0.1479

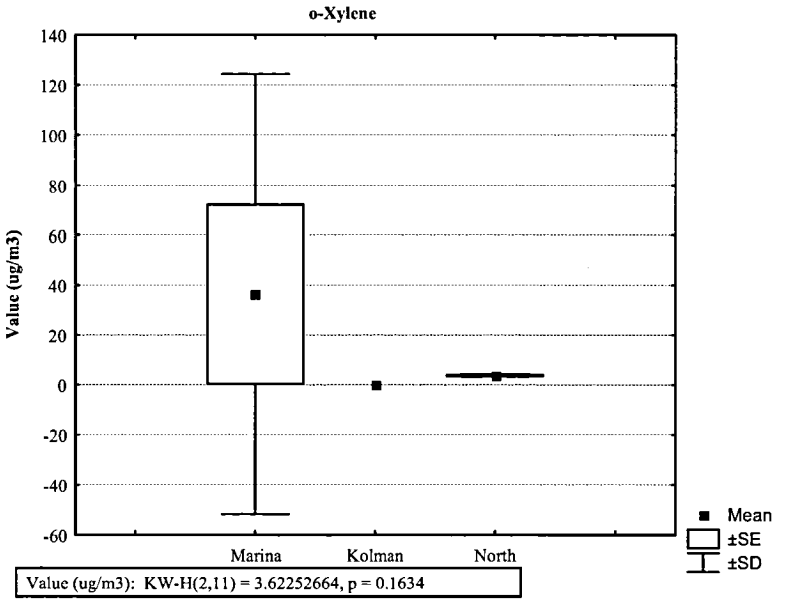

1,1,1-Trichloroethane
(without 3054B Flint Ave.)
0.34
0.32
0.30
0.28
0.26
0.24
0.22
0.20
Value (ug/m3)
Marina
Kolman
North
Mean
±SE
±SD
Value (ug/m3): KW-H(2,10) = 7.45398773, p = 0.0241

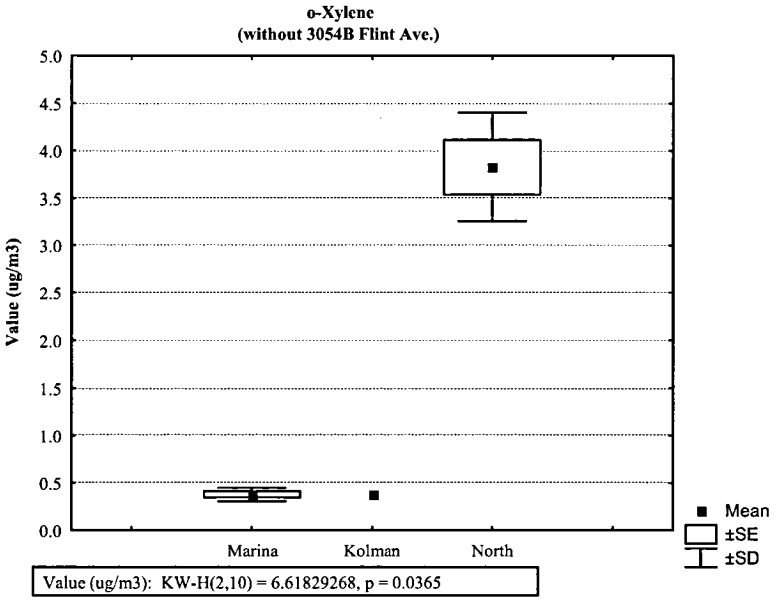

Trichloroethene
Value (ug/m3)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
Marina
Kolman
North
Mean
±SE
±SD
Value (ug/m3): KW-H(2,11) = 0.68233945, p = 0.7109


Trichloroethene
(without 3054B Flint Ave.)
Value (ug/m3)
0.30
0.28
0.26
0.24
0.22
0.20
0.18
0.16
0.14
0.12
Marina
Kolman
North
Mean
±SE
±SD
Value (ug/m3): KW-H(2,10) = 1.43696319, p = 0.4875


m,p-Xylene
250
200
150
100
50
0
-50
-100
-150
Value (ug/m3)
Marina
Kolman
North
Mean
±SE
±SD
Value (ug/m3): KW-H(2,11) = 3.60474006, p = 0.1649


m,p-Xylene
(without 3054B Flint Ave.)
12
10
8
6
4
2
0
-2
Value (ug/m3)
Marina
Kolman
North
Mean
±SE
±SD
Value (ug/m3): KW-H(2,10) = 6.75828221, p = 0.0341


o-Xylene
Value (ug/m3)
140
120
100
80
60
40
20
0
-20
-40
-60
Marina
Kolman
North
Mean
±SE
±SD
Value (ug/m3): KW-H(2,11) = 3.62252664, p = 0.1634


o-Xylene
(without 3054B Flint Ave.)
Value (ug/m3)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Marina
Kolman
North
Mean
±SE
±SD
Value (ug/m3): KW-H(2,10) = 6.61829268, p = 0.0365

Appendix D
Polycyclic Aromatic Hydrocarbons in Soil

Appendix D
Polycyclic Aromatic Hydrocarbons in Soils
(1 Dec 01; R. Duraski, USCG)

D.1 SOURCES OF CONTAMINATION:

The Alameda Housing location was originally a marsh filled from 1900 to 1929 with dredge spoils. Due to past industrial activities, two sources of contamination presently exist at the site. There is a subsurface benzene plume approximately six feet below North and Marina Housing that was introduced when local industries discharged directly to the marsh prior to fill. Benzene is a volatile compound and poses an airborne concern within the homes. The second contaminate consist of Polycyclic Aromatic Hydrocarbons (PAHs) and is limited to the North Housing area. It is believed that the dredge spoils used to fill the marsh in this area were contaminated by a coal gasification plant's discharge around the turn of the last century. Since PAHs are not volatile compounds, ingestion and absorption through the skin are the primary exposure paths. While the benzene is a concern, the PAHs posed a greater risk and were addressed first.

D.2 PAH RISK ACTION LEVELS

The following PAH risk levels for a given soil concentration were calculated using the EPA Superfund model. While the EPA usually assumes a 30 year "age adjusted" exposure for residential locations (six years as child and 24 as adult), for the USCG, a worst case scenario due to personnel rotation is an eight year exposure (six years as child and two as adult). This model is "age adjusted" by assuming a child under six consumes four times as much soil as a child over six or and adult. As with all risk calculations, these are "worst case" cancer risks and are only useful within an order of magnitude. The calculations were made for ingestion and dermal exposure (the contribution from inhalation is negligible). A risk of 10^{-5} corresponds to a maximum of one additional cancer per 10,000 people exposed to a of 0.62 ppm PAH soil concentration for 30 years. These numbers were derived to determine the risk the concentrations at North Housing posed to our personnel and to support recommended actions CEU made to the Navy:

Screening Level	10^{-6}	This equates to an exposure to soil containing 0.06 ppm PAHs for 30 years. It is also the level one finds in virgin soil (background). No actions are required at or below this concentration.
NAS Alameda Cleanup Goal	10^{-5}	This equates to an exposure to soil containing 0.62 ppm PAHs for 30 years using California exposure factors. This is the level the EPA and state consider acceptable for uncontrolled residential use at this site. No actions are required at or below this concentration.

Superfund Maximum Allowed Risk	10^{-4}	This equates to exposing a child to soil containing 9.0 ppm PAHs over a three year period. For an adult, the equivalent risk is reached when the soil contains 25 ppm PAHs and the exposure last three years. This is the maximum risk the EPA finds acceptable for any site on the NPL list and it is the point at which CEU believes exposure must be immediately addressed.
Normal ingestion from food	10^{-8} to 10^{-9}	Equates to less that 0.002 ppm.

D.3 NORTH HOUSING PAH RISK

To establish the risk to the residents, CEU used the Navy's 0" to 6" soil sample results. The primary concern was the exposure to children under six, the assumptions for these "age adjusted" risk calculations were:

- All the soils in the yards have been turned over due to dogs/kids digging and gardening. In other words, the clean couple of inches of topsoil was completely mixed with the contaminated fill to a depth of six inches (the actual disturbed area appears to be less than 1/2 the yard)
- The grass was not intact (true at a couple of homes).
- The risk due to dermal exposure is equal to ingestion (this is a conventional assumption with these types of contaminates)
- The residents take no protective measures (not true).
- A large dose over a short period poses the same risk as small dose over a long period (it is unlikely that this is true)
- There are no hot spots (not true, sector 14 had a 23 ppm hot spot. A 95% Upper Confidence Level (UCL)was derived to partially account for this phenomena).
- USCG exposures normally occur over a three year period with a maximum of eight years.

Using the above assumptions and the Navy data, the risk was calculated for each housing unit and classified as follows:

Level 1 Locations: The 95% UCL for these units was 7.3 ppm PAHs. This concentration poses a risk near $0.8X10^{-4}$ to a child under six that has been exposed for a three year period.

Level 2 Locations: The 95% UCL for these units was 3 ppm PAHs This concentration poses a risk near 0.3 $X10^{-4}$ to a child under six that has been exposed for a three year period.

Level 3 Locations The 95% UCL for these units was 1.3 ppm PAHs. This concentration poses a risk near $1.4X10^{-5}$ to a child under six that has been exposed for a three year period.

Level 4 and 5 Locations: The risk is < 10^{-5} over an eight year exposure.

D.4 CEU RECOMMENDATIONS

Based on the Navy data and CEU's risk calculations the following recommendations were presented to and accepted by the Navy:

Level 1 Locations: The potential to expose young children to a 10^{-4} risk over a very short period requires immediate action such as excavation or sampling the yards to better establish the risk. If yard samples do not indicate a significantly lower risk, exposure must be stopped. (The Navy will be excavating this winter; CEU collected yard samples as discussed below)

Level 2 Locations: While about half the Level 1 risk, should the exposure at these locations continue for another year or two, the risk at these units will be in the upper half of the 10^{-5} region. Given that these calculations are an "order of magnitude" estimate, sampling or excavation should be begin within one year. (The Navy will be excavating this winter; CEU has collected yard samples as discussed below)

Level 3 Locations: The risks at these locations are rather mild and will approach $4X10^{-5}$ over an eight year period. Sampling or excavation can be delayed several years. (The Navy will excavate a couple of these homes this winter; CEU has collected yard samples as discussed below. The Navy plans to address the remaining homes in FY 03 or 04)

Level 4 Locations: The risk is below USCG requirements for an eight year exposure but is an issue to the City of Alameda under the 30 year exposure model.

Level 5 Locations: Not an issue to the USCG, may be a concern of the City of Alameda.

Common Areas: Not an issue for the USCG as long as the grass is intact. (The Navy will be excavating common areas at the Risk Level 1 and 2 Locations this winter with the remaining common areas scheduled for FY 03 or 04)

D.5 CEU YARD SAMPLES FOR PAHs

On 11/9/01 CEU collected soil samples from eleven North Housing backyards where the exposure to children under 10 years of age was a concern. The samples were collected because the variability in the Navy data led k and CEU to believe a backyard could contain PAH concentrations well in excess of the numbers used to calculate the risk (the Navy did not sample backyards and the size of the hot spots they discovered were only a

few meters in diameter). The samples were collected from locations where the soil was obviously disturbed (pets digging or gardens) and bare areas.

Fortunately, no hot spots were discovered. Our results were approximately 20% lower than the Navy's. We believe this is due to limiting our sampling to the top three inches of soil while the Navy sampled the top six inches (the PAH concentrations increase as a function of depth).

CEU also sampled Vegetables from a garden in the Risk Level 1 area. All results were less than 0.05 ppm PAHs and assuming that:

- All fruit and vegetables consumed by a child over three years are grown in the yard;
- The consumption rate for fruit and vegetables is 472 g/day (one adult serving each of a raw vegetable, cooked vegetable and fruit per day as shown in Table 9-26 in the EPA exposure factors handbook), and;
- All fruits and vegetables consumed contain 0.05 ppm PAHs.

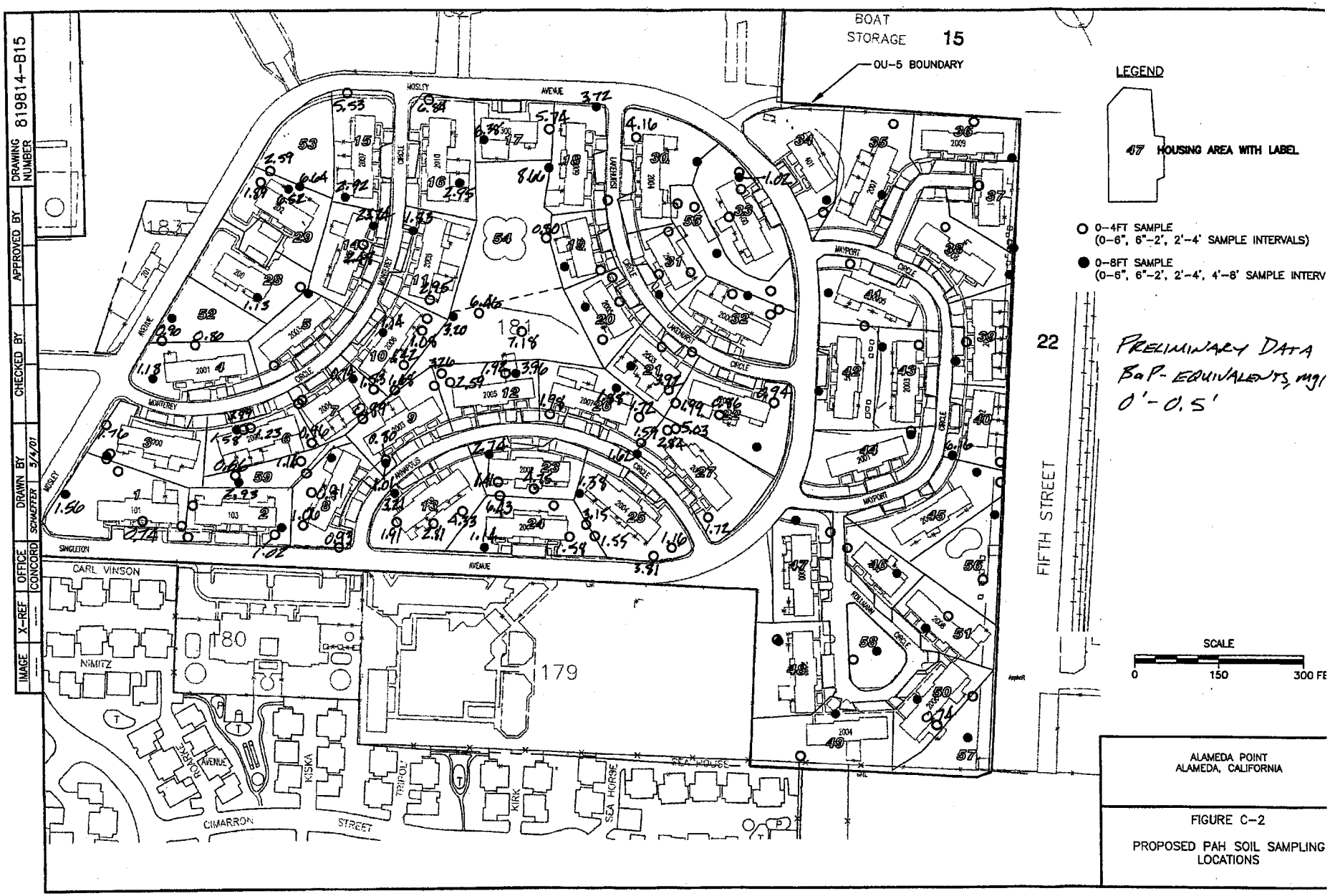
The maximum risk posed is $5.0X10^{-7}$. Since this is below the 10^{-6} risk level using rather conservative assumptions from vegetables grown in the area of highest contamination, the detection limit of the analysis is considered sufficient to demonstrate that the consumption of fruits and vegetables grown in the yards pose a negligible risk.

D.6 PAH CONCLUSIONS

While the concentrations of the PAHs are quite high, the problem was discovered and is scheduled for correction by the Navy prior to any of our personnel receiving a significant dose. Other that monitoring the excavation of the soils, CEU believes there is no further action required in the form of sampling or risk assessments for PAHs at this site as long as the Navy can complete the excavation within a reasonable time.

D.7 BENZENE

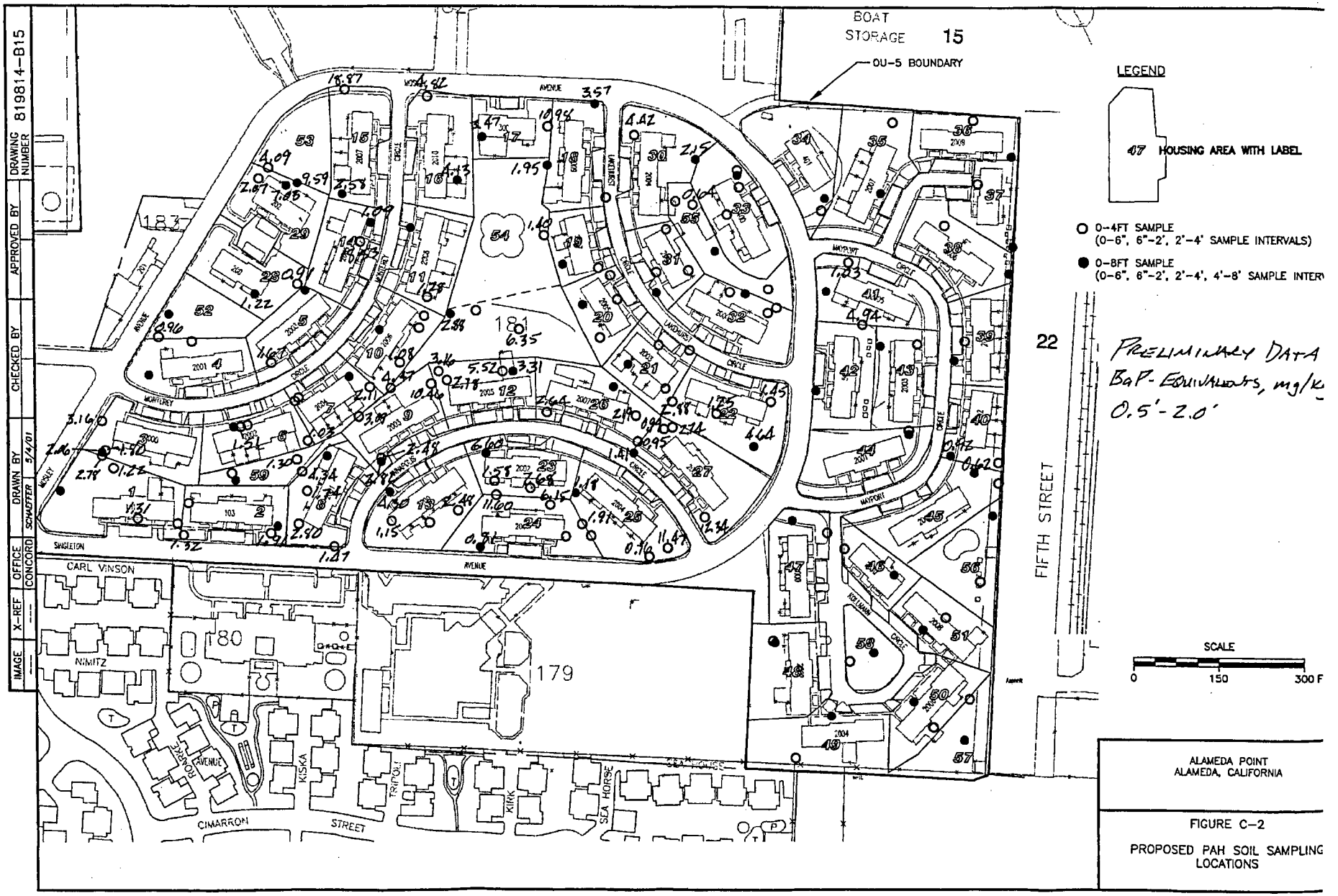
The benzene soil gas concentrations, while a concern, did not appear to pose as great a risk as the PAHs. CEU has contracted to conduct air sampling within selected homes where there is a potential for exposure.

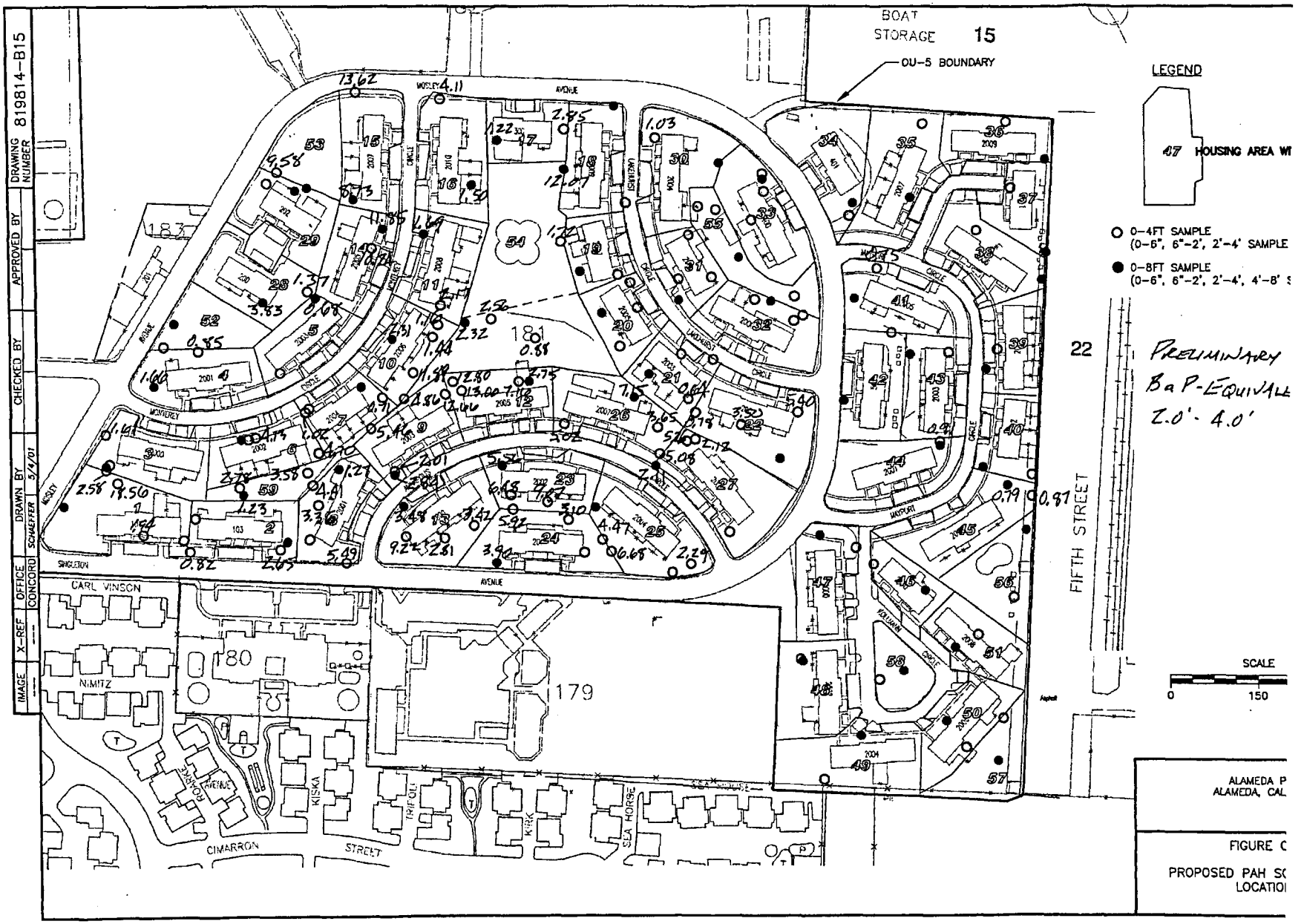


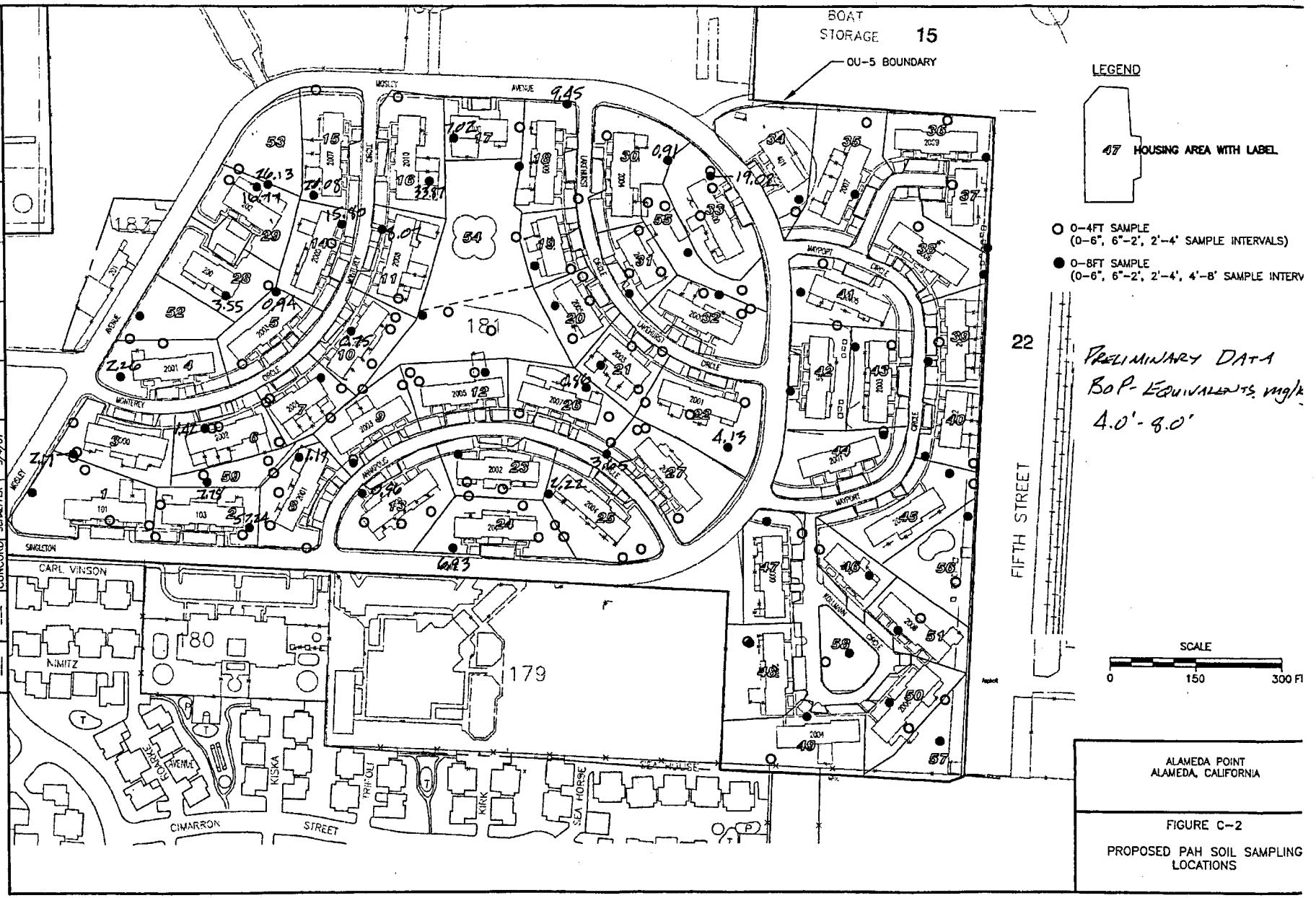
ALAMEDA POINT
ALAMEDA, CALIFORNIA

FIGURE C-2

PROPOSED PAH SOIL SAMPLING LOCATIONS


BOAT STORAGE 15
OU-5 BOUNDARY
LEGEND
47 HOUSING AREA WITH LABEL
O 0-4FT SAMPLE (0-6", 6"-2', 2'-4' SAMPLE INTERVALS)
● 0-8FT SAMPLE (0-6", 6"-2', 2'-4', 4'-8' SAMPLE INTER
PRELIMINARY DATA
BaP-EQUIVALENTS, mg/kg
0.5'-2.0'
SCALE
0 150 300 F
FIFTH STREET
22
CARL VINSON
NIMITZ
CIMARRON STREET
KISKA
KIRK
SEA HORSE
SINGLETON
MONTEREY
AVENUE
CIRCLE
WAYPORT
LANDFALL
KOLLMAN
183
181
180
179
54
ALAMEDA POINT
ALAMEDA, CALIFORNIA
FIGURE C-2
PROPOSED PAH SOIL SAMPLING LOCATIONS
DRAWING NUMBER 819814-B15
APPROVED BY
CHECKED BY
DRAWN BY SCHAFFER 5/14/01
OFFICE CONCORD
X-REF
IMAGE

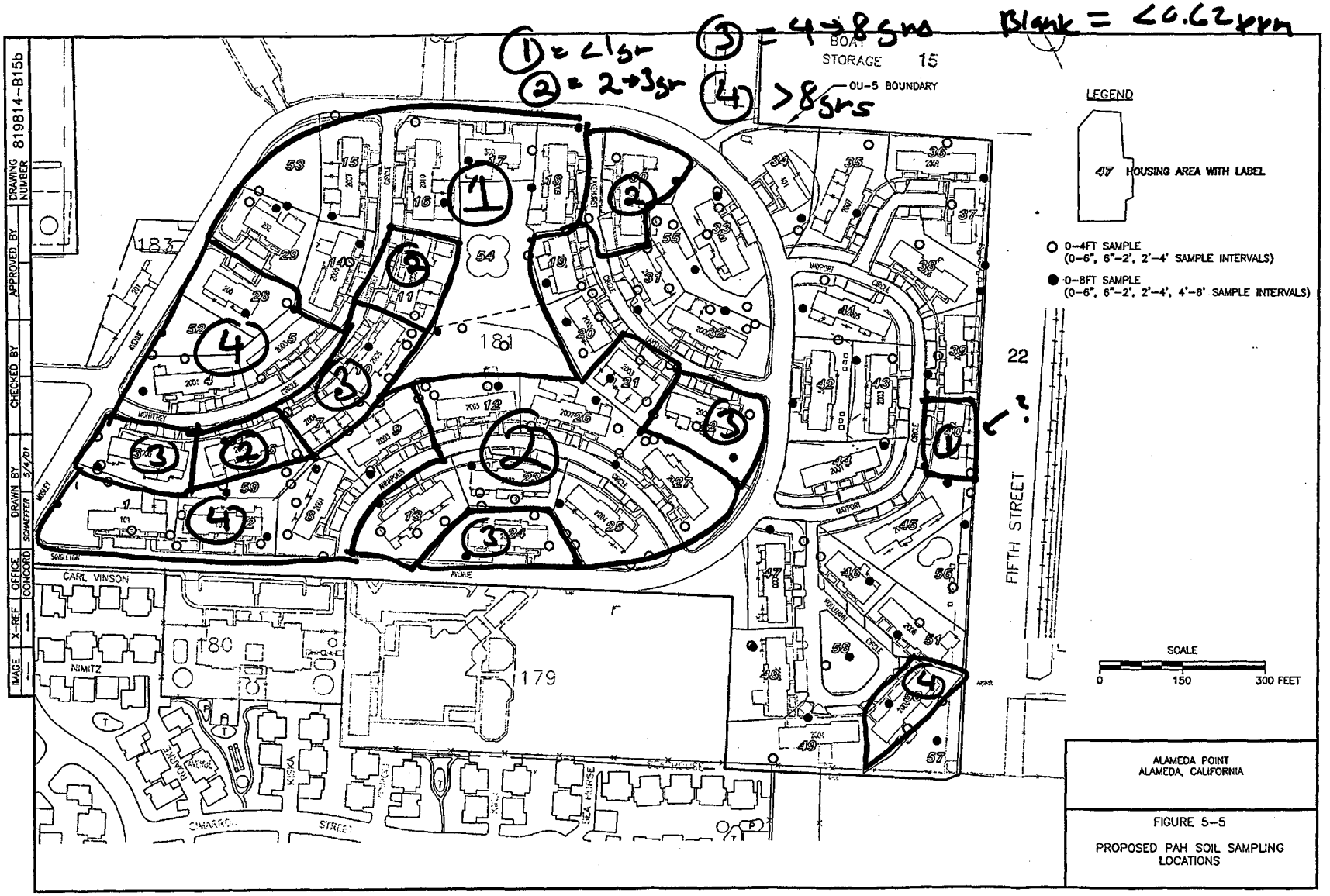

BOAT STORAGE 15
OU-5 BOUNDARY
LEGEND
47 HOUSING AREA WI
0-4FT SAMPLE (0-6", 6"-2', 2'-4' SAMPLE
0-8FT SAMPLE (0-6", 6"-2', 2'-4', 4'-8' S
PRELIMINARY
BaP-EQUIVALE
2.0'-4.0'
22
FIFTH STREET
SCALE
0
150
183
181
179
180
CARL VINSON
NIMITZ
CIMARRON
STREET
KISKA
KIRK
SEA HORSE
WOSLEY
AVENUE
SINGLETON
MONTEREY
CIRCLE
ALAMEDA P
ALAMEDA, CAL
FIGURE C
PROPOSED PAH SC
LOCATIO
DRAWING NUMBER 819814-B15
APPROVED BY
CHECKED BY
DRAWN BY SCHAEFFER 5/4/01
OFFICE CONCORD
X-REF
IMAGE



ALAMEDA POINT
ALAMEDA, CALIFORNIA

FIGURE C-2

PROPOSED PAH SOIL SAMPLING LOCATIONS



ALAMEDA POINT
ALAMEDA, CALIFORNIA

FIGURE 5-5

PROPOSED PAH SOIL SAMPLING LOCATIONS

Appendix C
Mann-Kendall Trend Evaluations

APPENDIX C – MANN KENDALL TREND EVALUATION

Because benzene and naphthalene concentrations have been variable in many of the monitoring wells at the Site, it is not readily apparent whether an overall trend exists. Therefore, the Mann-Kendall test was chosen to provide an objective mathematical interpretation of the data. The Mann-Kendall trend test is a non-parametric test that statistically determines whether the slope of a linear regression of time-ordered data is significantly greater or less than zero. The Mann-Kendall test does not take into account the magnitude of a trend or the variability of the data set.

The following procedure from *Statistical Methods for Environmental Pollution Monitoring* (Gilbert, 1987) was used to calculate the Mann-Kendal statistic:

- Sort the data in the order in which they were collected over time ($x_1, x_2, \ldots, x_n$). Use average concentrations in cases where multiple data points were collected at the same time (such as field duplicates).
- Determine the sign of all possible differences between the measurements ($x_j - x_k$, where $j > k$).

$$\begin{aligned} \mathrm{sgn}(x_j - x_k) &= 1 && \text{if } x_j - x_k > 0 \\ &= 0 && \text{if } x_j - x_k = 0 \\ &= -1 && \text{if } x_j - x_k < 0 \end{aligned}$$

- Compute the Mann Kendall statistic, S, by calculating the sum of the *signs* of the differences:

$$S = \sum_{k=1}^{n-1} \sum_{j=k+1}^{n} \mathrm{sgn}(x_j - x_k)$$

In general, if S is a large positive number, the benzene or naphthalene concentrations from samples collected later in time tend to be higher than the concentrations from samples collected earlier. If S is a large negative number, benzene or naphthalene concentrations from samples collected later in time tend to be lower than concentrations from samples collected earlier. However, S values are dependent on the size of the data set. To determine whether an apparent trend is statistically significant, the following steps were used:

- An a priori confidence level of 90 percent was chosen to meet the needs of the RI/FS.
- If fewer than ten data points exist for a given monitoring well, the probabilities listed in Table A18 of *Statistical Methods for Environmental Pollution Monitoring* (Gilbert, 1987) were used. The percentage listed in Table A18 is the probability that the Mann-Kendall statistic equals or exceeds the specified value of S when no trend is present. The listed percentages were subtracted from 100 percent to obtain the confidence values presented in the attached tables (C-1 and C-2).

- If more than ten data points exist for a given monitoring well, the variance of S was calculated according to the following equation, which takes into account that ties may be present:

$$VAR(S) = \frac{1}{18}\left[n(n-1)(2n+5) - \sum_{p=1}^{q} t_p(t_p - 1)(2t_p + 5) \right]$$

where: n = the total number of data points
q = the number of tied groups of data
t_p = the number of tied data points in the *p*th group

- Then S and VAR(S) were used to compute the test statistic Z, as follows:

$$Z = \frac{S-1}{[VAR(S)]^{1/2}} \qquad \text{if } S > 0$$

$$= 0 \qquad \text{if } S = 0$$

$$= \frac{S+1}{[VAR(S)]^{1/2}} \qquad \text{if } S < 0$$

- If no trend is present, the data would be normally distributed. Therefore, standard normal tables, such as Table A1 in *Statistical Methods for Environmental Pollution Monitoring* (Gilbert, 1987), can be used to determine the statistical significance of the Z test. A Z value of than -1.28 corresponds to the a priori confidence level of 90 percent. Therefore, if the calculated Z value for any monitoring well was less than -1.28, the data set was determined to have a statistically significant negative trend.

Table C-1
Mann-Kendall Trend Evaluation for Benzene Concentrations
Alameda Point Site 25/Alameda Annex IR-02 Groundwater RI/FS

Monitoring Well EW-2

Time:	6/15/1994	12/20/1994	3/31/1995	4/16/1996	7/17/1996	10/23/1996	2/26/1998	6/1/2001	Number of	Number of	Sum of
Result:	560	660	410	580	475	470	730	673	(+) Signs	(-) Signs	Signs (S)*
Calcs**:		100	(150)	20	(85)	(99)	170	113	4	-3	
			(250)	(80)	(185)	(190)	70	13	2	-4	
				170	65	60	320	263	5	0	
					(105)	(110)	150	93	2	-2	
						(5)	255	198	2	-1	
							260	203	2	0	
								(57)	0	1	
									17	-9	8

Statistical Evaluation[1]

n =	8
Confidence	80%

Monitoring Well P181-MW45

Time:	12/28/1994	4/3/1995	4/17/1996	7/15/1996	10/23/1996	2/23/1999	5/31/2001	6/1/2002	9/1/2002	12/19/2002	4/17/2003	7/3/2003	9/19/2004	12/11/2004	3/8/2004	Number of	Number of	Sum of
Result:	170	180	170	170	100	80.7	141.5	150	140	155	150	140	120	160	77	(+) Signs	(-) Signs	Signs (S)*
Calcs**:		10	0	0	(70)	(89)	(29)	(20)	(30)	(15)	(20)	(30)	(50)	(10)	(93)	1	-11	
			(10)	(10)	(80)	(99)	(39)	(30)	(40)	(25)	(30)	(40)	(60)	(20)	(103)	0	-13	
				0	(70)	(89)	(29)	(20)	(30)	(15)	(20)	(30)	(50)	(10)	(93)	0	-11	
					(70)	(89)	(29)	(20)	(30)	(15)	(20)	(30)	(50)	(10)	(93)	0	-11	
						(19)	42	50	40	55	50	40	20	60	(23)	8	-2	
							61	69	59	74	69	59	39	79	(4)	8	-1	
								8.5	(1.5)	14	9	(2)	(22)	19	(65)	4	-4	
									(19)	5	0	(10)	(30)	10	(73)	2	-4	
										15	10	0	(20)	20	(63)	3	-2	
											(5)	(15)	(35)	5	(78)	1	-4	
												(10)	(20)	10	(73)	1	-3	
													(20)	20	(63)	1	-2	
														40	(43)	1	-1	
															(83)	0	-1	
																30	-70	-40

Statistical Evaluation[2]

n=	15	
VAR(S)=	402.6666667	
$VAR(S)^{1/2}$=	20.06655592	
Z=	-1.94353232	
Confidence =	97%	
Tied Values:	Value	Quantity
t1	170	3
t2	150	2
t3	140	2

Monitoring Well P181-MW46

Time:	9/16/1994	12/28/1994	4/3/1995	4/16/1996	7/16/1996	10/23/1996	2/23/1999	12/13/1999	6/1/2001	6/1/2002	9/11/2004	12/19/2002	4/17/2003	7/3/2003	9/19/2003	12/11/2003	3/8/2004	Number of	Number of	Sum of
Result:	73	43	38	32	37	26	14	5.1	1	49	64	120	52	18	25	26	26	(+) Signs	(-) Signs	Signs (S)*
Calcs**:		(30)	(35)	(41)	(36)	(47)	(59)	(68)	(72)	(24)	(9)	47	(21)	(55)	(48)	(47)	(47)	1	-15	
			(5)	(11)	(6)	(17)	(29)	(38)	(42)	6	21	77	9	(25)	(18)	(17)	(17)	4	-11	
				(41)	(1)	(12)	(24)	(33)	(37)	11	26	82	14	(20)	(13)	(12)	(12)	4	-10	
					5	(6)	(18)	(27)	(31)	17	32	88	20	(14)	(7)	(6)	(6)	5	-8	
						(11)	(23)	(32)	(36)	12	27	83	15	(19)	(12)	(11)	(11)	4	-8	
							(12)	(21)	(25)	23	38	94	26	(8)	(1)	0	0	4	-5	
								(9)	(13)	35	50	106	38	4	11	12	12	8	-2	
									(4)	44	59	115	47	13	20	21	21	8	-1	
										48	63	119	51	17	24	25	25	8	0	
											15	71	3	(31)	(24)	(23)	(23)	3	-4	
												56	(12)	(46)	(39)	(38)	(38)	1	-5	
													(68)	(102)	(95)	(94)	(94)	0	-5	
														(34)	(27)	(26)	(26)	0	-4	
															7	8	8	3	0	
																1	1	2	0	
																	0	0	0	
																		55	-78	-23

Statistical Evaluation[2]

n=	17	
VAR(S)=	585.6666667	
$VAR(S)^{1/2}$=	24.20055096	
Z=	-0.909070212	
Confidence =	82%	
Tied Values:	Value	Quantity
t1	26	3

Monitoring Well P181-MW47

Time:	12/28/1994	4/3/1995	4/15/1996	7/16/1996	10/23/1996	2/23/1999	12/13/1999	5/31/2001	6/24/2002	12/19/2002	7/3/2003	12/11/2003	Number of	Number of	Sum of
Result:	1400	1200	920	1200	1150	251	329	1620	580	480	480	570	(+) Signs	(-) Signs	Signs (S)*
Calcs**:		(200)	(480)	(200)	(250)	(1149)	(1071)	220	(820)	(920)	(920)	(830)	1	-10	
			(280)	0	(50)	(949)	(871)	420	(620)	(720)	(720)	(630)	1	-8	
				(200)	230	(669)	(591)	700	(340)	(440)	(440)	(350)	2	-7	
					(50)	(949)	(871)	420	(620)	(720)	(720)	(630)	1	-7	
						(899)	(821)	470	(570)	(670)	(670)	(580)	1	-6	
							78	1369	329	229	229	319	6	0	
								1291	251	151	151	241	5	0	
									(1040)	(1140)	(1140)	(1050)	0	-4	
										(100)	(100)	(10)	0	-3	
											0	90	1	0	
												90	1	0	
													19	-45	-26

Statistical Evaluation[2]

n=	12	
VAR(S)=	210.6666667	
$VAR(S)^{1/2}$=	14.5143607	
Z=	-1.722432046	
Confidence =	95%	
Tied Values:	Value	Quantity
t1	1200	2
t2	480	2

Table C-1
Mann-Kendall Trend Evaluation for Benzene Concentrations
Alameda Point Site 25/Alameda Annex IR-02 Groundwater RI/FS

Monitoring Well PW-12

Time:	6/22/1994	9/16/1994	12/18/1994	4/4/1995	1/8/1996	4/17/1996	7/16/1996	10/23/1996	3/1/1999	6/1/2001	6/1/2002	9/12/2002	12/20/2002	4/16/2003	7/3/2003	9/22/2003	12/11/2003	3/8/2004	Number of (+) Signs	Number of (-) Signs	Sum of Signs (S)*
Result:	76	48	53	21	18	19	17	16	3.1	29	27	20	9.8	6.1	29	30	3	19			
Calcs**:		(28)	(23)	(55)	(58)	(57)	(59)	(60)	(73)	(47)	(49)	(56)	(68)	(70)	(47)	(46)	(73)	(57)	0	-17	
			5	(27)	(30)	(29)	(31)	(32)	(45)	(19)	(21)	(28)	(38)	(42)	(19)	(18)	(45)	(24)	1	-15	
				(55)	(35)	(34)	(36)	(37)	(50)	(24)	(26)	(33)	(43)	(47)	(24)	(23)	(50)	(34)	0	-15	
					(3)	(2)	(4)	(5)	(18)	8	6	(1)	(11)	(15)	8	9	(18)	(2)	4	-10	
						1	(1)	(2)	(15)	11	9	2	(8)	(12)	11	12	(15)	1	7	-6	
							(2)	(3)	(16)	10	8	1	(9)	(13)	10	11	(16)	0	5	-6	
								(1)	(14)	12	10	3	(7)	(11)	12	13	(14)	2	6	-5	
									(13)	13	11	4	(6)	(10)	13	14	(13)	3	6	-4	
										26	24	17	7	3	26	27	(0.1)	15.9	8	-1	
											(2)	(9)	(19)	(23)	0	1	(26)	(10)	1	-6	
												(7)	(17)	(21)	2	3	(24)	(8)	2	-5	
													(10)	(14)	9	10	(17)	(1)	2	-4	
														(4)	19	20	(7)	9	3	-2	
															23	24	(3)	13	3	-1	
																1	(26)	(10)	1	-2	
																	(27)	(11)	0	-2	
																		16	1	0	
																			50	-101	-51

Statistical Evaluation[2]

n=	18
VAR(S)=	695
$VAR(S)^{1/2}$=	26.36285
Z=	-1.896608
Confidence =	**97%**

Tied Values:	Value	Quantity
t1	29	2
t2	19	2

Monitoring Well S-02

Time:	9/2/1992	3/22/1994	6/14/1994	9/15/1994	12/23/1994	3/28/1995	4/16/1996	7/18/1996	10/23/1996	3/1/1999	Number of (+) Signs	Number of (-) Signs	Sum of Signs (S)*
Result:	5	9	6	12.5	6	2	6	6	5	0.5			
Calcs**:		4	1	8	1	(1)	1	1	0	(4.5)	5	-2	
			(3)	4	(3)	(7)	(3)	(3)	(4)	(8.5)	1	-7	
				8	0	(4)	0	0	(1)	(5.5)	1	-3	
					(7)	(11)	(7)	(7)	(8)	(12.0)	0	-6	
						(4)	0	0	(1)	(5.5)	0	-3	
							4	4	3	(1.5)	3	-1	
								0	(1)	(5.5)	0	-2	
									(1)	(5.5)	0	-2	
										(4.5)	0	-1	
											11	-27	-16

Statistical Evaluation[1]

n =	10
Confidence	**91%**

Monitoring Well S-12

Time:	3/24/1994	6/13/1994	9/13/1994	12/20/1994	3/28/1995	4/16/1996	7/17/1996	10/24/1996	3/1/1999	6/4/2001	Number of (+) Signs	Number of (-) Signs	Sum of Signs (S)*
Result:	37	51	73.5	66	55	26	30	40.5	0.5	37			
Calcs**:		14	37	29	18	(11)	(7)	4	(37)	0	5	-3	
			23	15	4	(25)	(21)	(11)	(51)	(14)	3	-5	
				29	(19)	(48)	(44)	(33)	(73)	(37)	1	-6	
					(11)	(40)	(36)	(26)	(65)	(29)	0	-6	
						(29)	(25)	(15)	(55)	(18)	0	-5	
							4	15	(26)	11	3	-1	
								11	(30)	7	2	-1	
									(40)	(4)	0	-2	
										37	1	0	
											15	-29	-14

Statistical Evaluation[1]

n =	10
Confidence	87%

Monitoring Well S-13

Time:	3/29/1994	6/14/1994	9/14/1994	12/20/1994	3/29/1995	4/19/1996	7/17/1996	10/23/1996	2/26/1999	6/1/2001	Number of (+) Signs	Number of (-) Signs	Sum of Signs (S)*
Result:	17	32	34	14	6	34	11	2	0.5	38			
Calcs**:		15	17	(3)	(11)	17	(6)	(15)	(17)	21	4	-5	
			2	(18)	(26)	2	(21)	(30)	(32)	6	3	-5	
				(3)	(28)	0	(23)	(32)	(34)	4	1	-5	
					(8)	20	(3)	(12)	(14)	24	2	-4	
						28	5	(4)	(6)	32	3	-2	
							(23)	(32)	(34)	4	1	-3	
								(9)	(11)	27	1	-2	
									(2)	36	1	-1	
										38	1	0	
											17	-27	-10

Statistical Evaluation[1]

n =	10
Confidence	78%

Table C-1
Mann-Kendall Trend Evaluation for Benzene Concentrations
Alameda Point Site 25/Alameda Annex IR-02 Groundwater RI/FS

Monitoring Well S-35

Time:	6/14/1994	9/13/1994	12/19/1994	4/17/1996	7/16/1996	10/25/1996	3/1/1999	6/6/2001	6/25/2002	9/11/2002	12/26/2002	4/17/2003	7/3/2003	9/22/2003	12/11/2003	3/8/2004	Number of (+) Signs	Number of (-) Signs	Sum of Signs (S)*
Result:	180	150	69	73	220	270	0.5	42	3.3	28	8.2	15	24	22	2.3	0.2			
Calcs**:		(30)	(111)	(107)	40	90	(180)	(138)	(177)	(152)	(172)	(165)	(156)	(158)	(178)	(180)	2	-13	
			(81)	(77)	70	120	(150)	(108)	(147)	(122)	(142)	(135)	(126)	(128)	(148)	(150)	2	-12	
				4	151	201	(69)	(27)	(66)	(41)	(61)	(54)	(45)	(47)	(67)	(69)	3	-10	
					147	197	(73)	(31)	(70)	(45)	(65)	(58)	(49)	(51)	(71)	(73)	2	-10	
						50	(220)	(178)	(217)	(192)	(212)	(205)	(196)	(198)	(218)	(220)	1	-10	
							(270)	(228)	(267)	(242)	(262)	(255)	(246)	(248)	(268)	(270)	0	-10	
								42	3	28	8	15	24	22	2	(6)	8	-1	
									(39)	(14)	(34)	(27)	(18)	(20)	(40)	(42)	0	-8	
										25	5	12	21	19	(1)	(3)	5	-2	
											(20)	(13)	(4)	(6)	(26)	(28)	0	-6	
												7	16	14	(6)	(8)	3	-2	
													9	7	(13)	(15)	2	-2	
														(2)	(22)	(24)	0	-3	
															(20)	(22)	0	-2	
																(2)	0	-1	
																	28	-92	-64

Statistical Evaluation[2]

n=	15
VAR(S)=	408.3333333
$VAR(S)^{1/2}$=	20.20725942
Z=	-3.117691454
Confidence =	99.9%

No tied values.

Monitoring Well S-16/S-16-2

Time:	3/29/1994	6/16/1994	9/20/1994	12/23/1994	3/30/1995	4/19/1996	7/18/1996	10/23/1996	2/26/1999	6/5/2001	6/25/2002	9/23/2003	12/19/2003	3/8/2004	Number of (+) Signs	Number of (-) Signs	Sum of Signs (S)*
Result:	14	11	11	15	9	5	8	10	2.4	9.6	4.6	14	11	7.2			
Calcs**:		(3)	(3)	1	(5)	(9)	(6)	(4)	(12)	(4)	(9)	0	(3)	(7)	1	-11	
			0	4	(2)	(6)	(3)	(1)	(9)	(1)	(6)	3	0	(4)	2	-8	
				4	(2)	(6)	(3)	(1)	(9)	(1)	(6)	3	0	(4)	2	-8	
					(6)	(10)	(7)	(5)	(13)	(5)	(10)	(1)	(4)	(8)	0	-10	
						(4)	(1)	1	(7)	1	(4)	5	2	(2)	4	-5	
							3	5	(3)	5	(0.4)	9.0	6.0	2.2	6	-2	
								2	(6)	2	(3)	6	3	(1)	4	-3	
									(8)	(0)	(5)	4	1	(3)	2	-4	
										7	2	12	9	5	5	0	
											(5)	4	1	(2)	2	-2	
												9	6	3	3	0	
													(3)	(7)	0	-2	
														(4)	0	-1	
															28	-53	-25

Statistical Evaluation[2]

n=	14	
VAR(S)=	329	
$VAR(S)^{1/2}$=	18.13835715	
Z=	-1.323162831	
Confidence =	91%	
Tied Values:	Value	Quantity
t1	11	3
t2	14	2

Monitoring Well PW-10A

Time:	8/22/1994	9/16/1994	12/28/1994	4/4/1995	1/15/1996	4/17/1996	7/16/1996	10/23/1996	3/1/1999	Number of (+) Signs	Number of (-) Signs	Sum of Signs (S)*
Result:	10	6	4	2	4	2	2	1	0.8			
Calcs**:		(4)	(6)	(8)	(6)	(8)	(8)	(9)	(9)	0	-6	
			(2)	(4)	(2)	(4)	(4)	(5)	(5)	0	-7	
				(6)	0	(2)	(2)	(3)	(3)	0	-5	
					2	0	0	(1)	(1)	1	-2	
						(2)	(2)	(3)	(3)	0	-4	
							0	(1)	(1)	0	-2	
								(1)	(1)	0	-2	
									(0)	0	-1	
										1	-31	-30

Statistical Evaluation[1]

n =	9
Confidence	99.96%

Average values were used for pairs of data collected at the same time (i.e., duplicate samples)

[1] Tabulated probabilities from Table A18 of Statistical Methods for Environmental Pollution Monitoring (Gilbert, 1987) have been used to determine the statistical confidence for data sets with less than or equal to 10 data points.
[2] Statistical calculations for data sets with more than ten data points are based on the procedure presented in Section 16.4.2 of Statistical Methods for Environmental Pollution Monitoring (Gilbert, 1987).

*If (S) is a large positive number, measurements taken later in time tend to be larger than the measurements taken earlier (i.e., upward trend)
If (S) is a large negative number, measurements taken later in time tend to be smaller than the measurements taken earlier (i.e., downward trend)

Table C-2
Mann-Kendall Trend Evaluation for Naphthalene Concentrations
Alameda Point Site 25/Alameda Annex IR-02 Groundwater RI/FS

Monitoring Well EW-2

Time:	6/15/1994	12/20/1994	3/31/1995	4/16/1996	7/17/1996	10/23/1996	6/1/2001	Number of (+) Signs	Number of (-) Signs	Sum of Signs (S)*
Result:	2100	1800	2200	2600	936.7	534.5	1483			
Calcs**:		(300)	100	500	(1163)	(1566)	(617)	2	4	
			400	800	(863)	(1266)	(317)	2	3	
				400	(1263)	(1666)	(717)	1	3	
					(1663)	(2066)	(1117)	0	3	
						(402)	546	1	1	
							949	1	0	
								0	0	
								7	14	-7

Statistical Evaluation[1]

n =	7
Confidence =	81%

Monitoring Well P181-MW45

Time:	12/28/1994	4/3/1995	4/17/1996	7/15/1996	10/23/1996	5/31/2001	6/24/2002	9/11/2002	12/19/2002	4/17/2003	7/3/2003	9/19/2004	12/11/2003	3/8/2004	Number of (+) Signs	Number of (-) Signs	Sum of Signs (S)*
Result:	3400	2250	2500	2200	2200	615	2350	1113	2000	2350	2050	1450	2450	1650			
Calcs**:		(1150)	(900)	(1200)	(1200)	(2785)	(1050)	(2287)	(1400)	(1050)	(1350)	(1950)	(950)	(1750)	0	-13	
			250	(50)	(50)	(1635)	100	(1137)	(250)	100	(200)	(800)	200	(600)	4	-8	
				(1200)	(300)	(1885)	(150)	(1387)	(500)	(150)	(450)	(1050)	(50)	(850)	0	-11	
					0	(1585)	150	(1087)	(200)	150	(150)	(750)	250	(550)	3	-6	
						(1585)	150	(1087)	(200)	150	(150)	(750)	250	(550)	3	-6	
							1735	498	1385	1735	1435	835	1835	1035	8	0	
								(1237.0)	(350.0)	0	(300)	(900)	100	(700)	1	-5	
									887	1237	937	337	1337	537	6	0	
										350	50	(550)	450	(350)	3	-2	
											(300)	(900)	100	(700)	1	-3	
												(600)	400	(400)	1	-2	
													1000	200	2	0	
														(800)	0	-1	
															32	-57	-25

Statistical Evaluation[2]

n=	14	
VAR(S)=	332.6666667	
$VAR(S)^{1/2}$=	18.23915203	
Z=	-1.315850647	
Confidence =	91%	
Tied Values:	Value	Quantity
t1	2200	2

Monitoring Well P181-MW46

Time:	9/16/1994	12/28/1994	4/3/1995	4/16/1996	7/16/1996	10/23/1996	2/23/1999	5/31/2001	6/24/2002	9/11/2002	12/19/2002	4/17/2003	7/3/2003	9/19/2003	12/11/2003	3/8/2004	Number of (+) Signs	Number of (-) Signs	Sum of Signs (S)*
Result:	1100	910	720	339	1200	450	71	200.2	1005	1250	2250	1400	485	360	610	465			
Calcs**:		(190)	(380)	(761)	100	(650)	(1029)	(900)	(95)	150	1150	300	(615)	(740)	(490)	(635)	4	-11	
			(190)	(571)	290	(460)	(839)	(710)	95	340	1340	490	(425)	(550)	(300)	(445)	5	-9	
				(761)	480	(270)	(649)	(520)	285	530	1530	680	(235)	(360)	(110)	(255)	5	-8	
					861	111	(268)	(139)	666	911	1911	1061	146	21	271	126	10	-2	
						(750)	(1129)	(1000)	(195)	50	1050	200	(715)	(840)	(590)	(735)	3	-8	
							(379)	(250)	555	800	1800	950	35	(90)	160	15	7	-3	
								129	934	1179	2179	1329	414	289	539	394	9	0	
									805	1050	2050	1200	285	160	410	265	8	0	
										245	1245	395	(520)	(645)	(395)	(540)	3	-4	
											1000	150	(765)	(890)	(640)	(785)	2	-4	
												(850)	(1765)	(1890)	(1640)	(1785)	0	-5	
													(915)	(1040)	(790)	(935)	0	-4	
														(125)	125	(20)	1	-2	
															250	105	2	0	
																(145)	0	-1	
																	59	-61	-2

Statistical Evaluation[2]

n=	16
VAR(S)=	493.333
$VAR(S)^{1/2}$=	22.2111
Z=	-0.1351
No tied values	
Confidence =	55%

Table C-2
Mann-Kendall Trend Evaluation for Naphthalene Concentrations
Alameda Point Site 25/Alameda Annex IR-02 Groundwater RI/FS

Monitoring Well P181-MW47

Time:	12/28/1994	4/3/1995	4/15/1996	7/16/1996	10/23/1996	2/23/1999	5/31/2001	6/24/2002	9/11/2002	12/19/2002	4/17/2003	7/3/2003	12/11/2003	3/8/2004	Number of (+) Signs	Number of (-) Signs	Sum of Signs (S)*
Result:	8400	4270	4100	6000	1672.6	617	10	2350	1800	1900	1500	1950	2100	1500			
Calcs**:		(4130)	(4300)	(2400)	(6727)	(7783)	(8390)	(6050)	(6600)	(6500)	(6900)	(6450)	(6300)	(6900)	0	-13	
			(170)	1730	(2597)	(3653)	(4260)	(1920)	(2470)	(2370)	(2770)	(2320)	(2170)	(2770)	1	-11	
				(2400)	(2427)	(3483)	(4090)	(1750)	(2300)	(2200)	(2600)	(2150)	(2000)	(2600)	0	-11	
					(4327)	(5383)	(5990)	(3650)	(4200)	(4100)	(4500)	(4050)	(3900)	(4500)	0	-10	
						(1056)	(1663)	677	127	227	(173)	277	427	(173)	5	-4	
							(607)	1733	1183	1283	883	1333	1483	883	7	-1	
								2340	1790	1890	1490	1940	2090	1490	7	0	
									(550)	(450)	(850)	(400)	(250)	(850)	0	-6	
										100	(300)	150	300	(300)	3	-2	
											(400)	50	200	(400)	2	-2	
												450	600	0	2	0	
													150	(450)	1	-1	
														(600)	0	-1	
															28	-62	-34

Statistical Evaluation[2]

n=	14	
VAR(S)=	332.6666667	
$VAR(S)^{1/2}$=	18.23915203	
Z=	-1.80929464	
Confidence =	**96%**	
Tied Values:	Value	Quantity
t1	1500	2

Monitoring Well PW-12

Time:	6/22/1994	9/16/1994	12/18/1994	4/4/1995	1/8/1996	4/17/1996	7/16/1996	10/23/1996	6/24/2002	9/12/2002	12/20/2002	4/16/2003	7/3/2003	9/22/2003	12/11/2003	3/8/2004	Number of (+) Signs	Number of (-) Signs	Sum of Signs (S)*
Result:	10	280	580	320	108	181.3	170	145	87.5	25	24	25	87.5	41.5	28.5	165			
Calcs**:		270	570	310	98	171	160	135	78	15	14	15	78	32	19	155	15	0	
			300	40	(172)	(99)	(110)	(135)	(193)	(255)	(256)	(255)	(193)	(239)	(252)	(115)	2	-12	
				310	(472)	(399)	(410)	(435)	(493)	(555)	(556)	(555)	(493)	(539)	(552)	(415)	1	-12	
					(212)	(139)	(150)	(175)	(233)	(295)	(296)	(295)	(233)	(279)	(292)	(155)	0	-12	
						73	62	37	(21)	(83)	(84)	(83)	(21)	(67)	(80)	57	4	-7	
							(11)	(36)	(94)	(156)	(157)	(156)	(94)	(140)	(153)	(16)	0	-10	
								(25)	(83)	(145)	(146)	(145)	(83)	(129)	(142)	(5)	0	-9	
									(58)	(120)	(121)	(120)	(58)	(104)	(117)	20	1	-7	
										(63)	(64)	(63)	0	(46)	(59)	78	1	-5	
											(1)	0	63	17	4	140	4	-1	
												1	64	18	5	141	5	0	
													63	17	4	140	4	0	
														(46)	(59)	78	1	-2	
															(13)	124	1	-1	
																137	1	0	
																	40	-78	-38

Statistical Evaluation[2]

n=	16	
VAR(S)=	491.333	
$VAR(S)^{1/2}$=	22.166	
Z=	-1.6692	
Confidence =	**95%**	
Tied Values:	Value	Quantity
t1	25	2
t2	87.5	2

Monitoring Well S-02

Time:	9/2/1992	3/22/1994	6/14/1994	9/15/1994	12/23/1994	3/28/1995	4/16/1996	7/18/1996	10/23/1996	Number of (+) Signs	Number of (-) Signs	Sum of Signs (S)*
Result:	10	260	320	610	400	168	480	450	142			
Calcs**:		250	310	600	390	158	470	440	132	8	0	
			60	350	140	(92)	220	190	(118)	5	-2	
				600	80	(152)	160	130	(178)	4	-2	
					(210)	(442)	(130)	(160)	(468)	0	-5	
						(232)	80	50	(258)	2	-2	
							312	282	(26)	2	-1	
								(30)	(338)	0	-2	
									(308)	0	-1	
										0	0	
										21	-15	6

Statistical Evaluation[1]

n =	9
Confidence =	69%

Table C-2
Mann-Kendall Trend Evaluation for Naphthalene Concentrations
Alameda Point Site 25/Alameda Annex IR-02 Groundwater RI/FS

Monitoring Well S-12

Time:	3/24/1994	6/13/1994	9/13/1994	12/20/1994	3/28/1995	4/16/1996	7/17/1996	10/24/1996	6/4/2001	Number of (+) Signs	Number of (-) Signs	Sum of Signs (S)*
Result:	10	690	12.5	920	670	410	71.5	77	3			
Calcs**:		680	3	910	660	400	62	67	(7)	7	-1	
			(678)	230	(20)	(280)	(619)	(613)	(687)	1	-6	
				910	658	398	59	65	(10)	5	-1	
					(250)	(510)	(849)	(843)	(917)	0	-5	
						(260)	(599)	(593)	(667)	0	-4	
							(339)	(333)	(407)	0	-3	
								6	(69)	1	-1	
									(74)	0	-1	
										0	0	
										14	-22	-8

Statistical Evaluation[1]

n =	9
Confidence =	76%

Monitoring Well S-13

Time:	3/29/1994	6/14/1994	9/14/1994	12/20/1994	3/29/1995	4/19/1996	7/17/1996	10/23/1996	6/1/2001	Number of (+) Signs	Number of (-) Signs	Sum of Signs (S)*
Result:	42	7	8	2.5	10	10	10	86	65			
Calcs**:		(35)	(34)	(40)	(32)	(32)	(32)	44	23	2	-6	
			1	(5)	3	3	3	79	58	6	-1	
				(40)	2	2	2	78	57	5	-1	
					8	8	8	84	63	5	0	
						0	0	76	55	2	0	
							0	76	55	2	0	
								76	55	2	0	
									(21)	0	-1	
										0	0	
										24	-9	15

Statistical Evaluation[1]

n =	9
Confidence =	93%

Monitoring Well S-35

Time:	6/14/1994	9/13/1994	12/19/1994	4/4/1995	4/17/1996	7/16/1996	10/25/1996	6/6/2001	6/25/2002	9/11/2002	12/26/2002	4/17/2003	7/3/2003	9/22/2003	12/11/2003	3/8/2004	Number of (+) Signs	Number of (-) Signs	Sum of Signs (S)*
Result:	10	150	175	10	60	255	214.5	67	24.8	235	55.5	215	292.5	325	51	2.3			
Calcs**:		140	165	0	50	245	205	57	15	225	45	205	283	315	41	(8)	13	-1	
			25	(140)	(90)	105	65	(83)	(125)	85	(95)	65	143	175	(99)	(148)	7	-7	
				(165)	(115)	80	40	(108)	(150)	60	(120)	40	118	150	(124)	(173)	6	-7	
					50	245	205	57	15	225	45	205	283	315	41	(8)	11	-1	
						195	155	7	(35)	175	(5)	155	233	265	(9)	(58)	7	-4	
							(41)	(188)	(230)	(20)	(200)	(40)	38	70	(204)	(253)	2	-8	
								(148)	(190)	21	(159)	1	78	111	(164)	(212)	4	-5	
									(42)	168	(12)	148	226	258	(16)	(65)	4	-4	
										210	31	190	268	300	26	(23)	6	-1	
											(180)	(20)	58	90	(184)	(233)	2	-4	
												160	237	270	(4)	(53)	3	-2	
													78	110	(164)	(213)	2	-2	
														33	(242)	(290)	1	-2	
															(274)	(323)	0	-2	
																(49)	0	-1	
																	68	-51	17

Statistical Evaluation[2]

n=	16	
VAR(S)=	492.333	
$VAR(S)^{1/2}$=	22.1886	
Z=	0.72109	
Confidence =	76%	
Tied Values:	Value	Quantity
t1	10	2

Table C-2
Mann-Kendall Trend Evaluation for Naphthalene Concentrations
Alameda Point Site 25/Alameda Annex IR-02 Groundwater RI/FS

Monitoring Well S-16/S-16-2

Time:	3/29/1994	6/16/1994	9/20/1994	12/23/1994	3/30/1995	4/19/1996	7/18/1996	10/23/1996	6/5/2001	6/25/2002	9/23/2003	12/19/2003	3/8/2004	Number of (+) Signs	Number of (-) Signs	Sum of Signs (S)*
Result:	5	19	15	15.5	10	10	10	85	6.45	27.5	29.5	24	6.85			
Calcs**:		14	10	11	5	5	5	80	1	23	25	19	2	12	0	
			(4)	(4)	(9)	(9)	(9)	66	(13)	9	11	5	(12)	4	-7	
				1	(5)	(5)	(5)	70	(9)	13	15	9	(8)	5	-5	
					(6)	(6)	(6)	70	(9)	12	14	9	(9)	4	-5	
						0	0	75	(4)	18	20	14	(3)	4	-2	
							0	75	(4)	18	19.5	14.0	(3.2)	4	-2	
								75	(4)	18	20	14	(3)	4	-2	
									(79)	(58)	(56)	(61)	(78)	0	-5	
										21	23	18	0.4	4	0	
											2	(4)	(21)	1	-2	
												(6)	(23)	0	-2	
													(17)	0	-1	
														42	-33	9

Statistical Evaluation[2]

n=	12	
VAR(S)=	209	
$VAR(S)^{1/2}$=	14.45683229	
Z=	0.553371571	
Confidence =	71%	
Tied Values:	Value	Quantity
t1	10	3

Monitoring Well PW-10A

Time:	6/22/1994	1/5/1996	4/17/1996	7/16/1996	10/24/1996	Number of (+) Signs	Number of (-) Signs	Sum of Signs (S)*
Result:	10	12	9.33	14	8			
Calcs**:		2	(1)	4	(2)	2	-2	
			(3)	2	(4)	1	-2	
				4	(1)	1	-1	
					(6)	0	-1	
						0	0	
						0	0	
						0	0	
						0	0	
						4	-6	-2

Statistical Evaluation[1]

n =	5
Confidence =	59%

Notes:
Average values were used for pairs of data collected at the same time (i.e., duplicate samples)

[1] Tabulated probabilities from Table A18 of Statistical Methods for Environmental Pollution Monitoring (Gilbert, 1987) have been used to determine the statistical confidence for data sets with less than or equal to 10 data points.
[2] Statistical calculations for data sets with more than ten data points are based on the procedure presented in Section 16.4.2 of Statistical Methods for Environmental Pollution Monitoring (Gilbert, 1987).

*If (S) is a large positive number, measurements taken later in time tend to be larger than the measurements taken earlier (i.e., upward trend)
If (S) is a large negative number, measurements taken later in time tend to be smaller than the measurements taken earlier (i.e., downward trend)

Appendix D
Vapor Intrusion Evaluation

APPENDIX D
Vapor Intrusion Evaluation
Alameda Point Site 25 / Alameda Annex IR-02 Groundwater RI/FS
Alameda, California

Tier 1 – primary screening

Question 1 *– are chemicals of sufficient volatility and toxicity known or reasonably suspected to be present in the subsurface (e.g., in unsaturated soils, soil gas, or the uppermost portions of the groundwater and/or capillary fringe)? Table 1*

Yes – benzene and naphthalene

Question 2 *– are currently (or potentially) inhabited buildings or areas of concern under future development scenarios located near subsurface contaminants found in Table 1?*

Yes

Question 3 *– does evidence suggest immediate action may be warranted to mitigate current risks?*

No – based on results of previous soil gas and indoor/outdoor air sampling

Tier 2 – secondary screening

Question 4a *– are indoor air quality data available?*

Yes

Question 4b *– Do measured indoor air concentrations of constituents of potential concern identified in Question 1 (and degradation products) exceed the target concentrations given in Tables 2(a), 2(b), or 2(c)?*

Yes - see Table D-1; however, concentrations are consistent with measured ambient air concentrations

Question 4c *– is there any potential contamination (source of vapors) in the unsaturated zone soil at any depth above the water table?*

Yes – various volatile organic compounds were detected in previous soil gas samples (see Tables 4-3 and D-2)

Question 4d *– do measured or reasonably estimated groundwater concentrations exceed the generic target media-specific concentrations given in Tables 2(a), 2(b), or 2(c)?*

Yes – see Table D-3

Question 4g *– do measured or reasonably estimated soil gas concentrations exceed the generic target media-specific concentrations given in Tables 2(a), 2(b), or 2(c)?*

Yes – see Table D-2

Question 5a *– do groundwater and/or soil gas concentrations for any constituents of potential concern exceed target media-specific concentrations by a factor greater than 50?* (Evaluation of limited site data in Question 5 allows the user to potentially screen sites using target concentrations that are higher by a factor of up to 50 times greater than the generic target concentrations used in Question 4. If observed concentrations are greater that 50 times the generic target concentrations, we recommend expeditious site-specific evaluation.)

Yes – see Tables D-2 and D-3

Tier 3 – Site-Specific Assessment

See Section 6 and Appendix E for Risk Assessment.

TABLE D-1
Maximum Detected Indoor and Crawl Space Air Concentrations Exceeding Risk Based Screening Values
Alameda Point Site 25/Alameda Annex IR-02 Groundwater RI/FS

Indoor and Crawl Space Air Data

Constituents	*1x10^{-6}* *Risk Based Screening Values for Indoor Air*[1] *(µg/m^3)*	1994-1995 EBS[2] Crawl Space Air Beneath School (µg/m^3)	2002 US Coast Guard Data[3] North Housing Max (µg/m^3) Indoor Air	North Housing Max (µg/m^3) Crawl Space Air	Kollman Circle Max (µg/m^3) Indoor Air	Kollman Circle Max (µg/m^3) Crawl Space Air	Marina Housing Max (µg/m^3) Indoor Air	Marina Housing Max (µg/m^3) Crawl Space Air	Overall Max (µg/m^3)
1,2-Dichloroethane	*0.094*	<8.1	**0.24**	<0.16	**0.24**	**0.26**	**0.22**	NA	**0.26**
Benzene	*0.31*	<6.4	**4.6**	**2.7**	**0.88**	**0.65**	**0.65**	NA	**4.6**
Ethylbenzene	*2.2*	<8.7	**15**	1.9	0.7	**2.3**	2	NA	**15**
Tetrachloroethene (PCE)	*0.81*	<14	**1.7**	**2.3**	0.3	**1.1**	**18**	NA	**18**
Trichloroethene	*0.022*	<11	**0.39**	**0.26**	<0.24	**0.31**	**1.1**	NA	**1.1**

Ambient Air Data

Constituents	*1x10^{-6}* *Ambient Air PRGs*[4] *(µg/m^3)*	1994-1995 EBS[2] Ambient Air Outside School (µg/m^3)	2002 US Coast Guard Data[3] North Housing Max Ambient Air (µg/m^3)	Kollman Circle Max Ambient Air (µg/m^3)	Marina Housing Max Ambient Air (µg/m^3)	Overall Max (µg/m^3)
1,2-Dichloroethane	*0.074*	<8.1	**0.18**	**0.21**	**0.23**	**0.23**
Benzene	*0.23*	<6.4	**5.2**	**0.49**	**85**	**85**
Ethylbenzene	*1.7*	<8.7	**2.7**	<0.37	**97**	**97**
m-Xylene	*110*	<8.7	11	0.49	**380**	**380**
p-Xylene						
o-Xylene			4.4	<0.37	**220**	**220**
Tetrachloroethene (PCE)	*0.67*	<14	**1.6**	0.26	**0.83**	**1.6**
Trichloroethene	*0.017*	<11	**0.25**	<0.18	**0.33**	**0.33**

Notes:
EBS = Environmental Baseline Survey
NA = not analyzed
µg/m^3 = micrograms per cubic meter

References:
[1] USEPA, 2002a. *Draft Guidance for Evaluation the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soil*. November.
[2] IT Corporation, 2001. *Parcel Evaluation Data Summary, Phase 2A Sampling, Zone 16: Housing Zone, Parcel 179: George P. Miller Elementary School, Alameda Point, Alameda, California.* January.
[3] Tetra Tech, Inc., 2002. *Residential Risk Evaluation for U.S. Coast Guard Housing, Alameda.* August.
[4] USEPA, 2002b. Region IX Preliminary Remediation Goals (PRGs)

TABLE D-2
Maximum Detected Soil Gas Concentrations Exceeding Risk Based Screening Values
Alameda Point Site 25/Alameda Annex IR-02 Groundwater RI/FS

Tier 2 - Secondary Screening - Question 4 Generic Screening Levels [1]

Constituent	Risk Based Screening Values (µg/m³)						Shallow Overall Max (µg/m³)	Deep Overall Max (µg/m³)
	$1x10^{-4}$		$1x10^{-5}$		$1x10^{-6}$			
	shallow	*deep*	*shallow*	*deep*	*shallow*	*deep*		
Acetone	*3,500*	*35,000*	*3,500*	*35,000*	*3,500*	*35,000*	**9,735**	166
Benzene	*310*	*3,100*	*31*	*310*	*3.1*	*31*	**400**	**5,588**
Chloroform	*110*	*1,100*	*11*	*110*	*1.1*	*11*	**92**	1.02
Ethylbenzene	*2,200*	*22,000*	*220*	*2,200*	*22*	*220*	**868**	**4,427**
Naphthalene	*30*	*300*	*30*	*300*	*30*	*300*	**2,106**	**362**
Tetrachloroethene (PCE)	*810*	*8,100*	*81*	*810*	*8.1*	*81*	**65**	**86**
Trichloroethene	*22*	*220*	*2.2*	*22*	*0.22*	*2.2*	**130**	ND

Tier 2 - Secondary Screening - Question 5 50X Generic Screening Levels [1]

Constituent	50X Risk Based Screening Values (µg/m³)						Shallow Overall Max (µg/m³)	Deep Overall Max (µg/m³)
	$1x10^{-4}$		$1x10^{-5}$		$1x10^{-6}$			
	shallow	*deep*	*shallow*	*deep*	*shallow*	*deep*		
Benzene	*15,500*	*155,000*	*1,550*	*15,500*	*155*	*1,550*	**400**	**5,588**
Chloroform	*5,500*	*55,000*	*550*	*5,500*	*55*	*550*	**92**	1.02
Naphthalene	*1,500*	*15,000*	*1,500*	*15,000*	*1,500*	*15,000*	**2,106**	362
Trichloroethene	*1,100*	*11,000*	*110*	*1,100*	*11*	*110*	**130**	ND

Notes:
ND = not detected above method reporting limits
µg/m³ = micrograms per cubic meter
shallow = less than or equal to 5 feet below ground surface
deep = greater than 5 feet below ground surface
References:
[1] USEPA, 2002a. *Draft Guidance for Evaluation the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soil*. November.

TABLE D-3
Maximum Detected Groundwater Concentrations Exceeding Risk Based Screening Values
Alameda Point Site 25/Alameda Annex IR-02 Groundwater RI/FS

Tier 2 - Secondary Screening - Question 4 Generic Screening Levels [1]

Constituent	Risk Based Screening Values (µg/L)			Overall Max Groundwater Concentration (µg/L)
	$1x10^{-4}$	*$1x10^{-5}$*	*$1x10^{-6}$*	
1,2,4-Trimethylbenzene	*24*	*24*	*24*	**55**
1,2-Dichloroethane	*230*	*23*	*5*	**50**
1,3,5-Trimethylbenzene	*25*	*25*	*25*	**29**
Benzene	*140*	*14*	*5*	**6,000**
Ethylbenzene	*700*	*700*	*700*	**800**
Methylene chloride	*5,800*	*580*	*58*	**180**
Napthalene	*150*	*150*	*150*	**19,000**
n-Butylbenzene	*260*	*260*	*260*	**1,800**

Tier 2 - Secondary Screening - Question 5 50X Generic Screening Levels [1]

Constituent	50X Risk Based Screening Values (µg/L)			Overall Max Groundwater Concentration (µg/L)
	$1x10^{-4}$	*$1x10^{-5}$*	*$1x10^{-6}$*	
Benzene	*7,000*	*700*	*250*	**6,000**
Napthalene	*7,500*	*7,500*	*7,500*	**19,000**

Notes:

µg/L = micrograms per liter

References:

[1] USEPA, 2002a. *Draft Guidance for Evaluation the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soil*. November.

Appendix E
Human Health Risk Assessment

BASELINE HUMAN HEALTH RISK ASSESSMENT
ALAMEDA POINT SITE 25/ANNEX IR-02
ALAMEDA, CALIFORNIA

Prepared By:

MWH AMERICAS, INC.
3321 POWER INN ROAD, SUITE 300
SACRAMENTO, CA 95826

Prepared For:

ERRG
and
DEPARTMENT OF THE NAVY
SOUTHWEST DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
SAN DIEGO, CALIFORNIA

AUGUST 2004

BASELINE HUMAN HEALTH RISK ASSESSMENT
ALAMEDA POINT SITE 25/ANNEX IR-02
ALAMEDA, CALIFORNIA

August 2004

Prepared by

MWH
3321 Power Inn Road, Suite 300
Sacramento, California 95826
916-924-8844

Sandra Dittmar
Staff Scientist

Kenneth L. Kiefer
Senior Scientist

Mark A. Bowland
Senior Scientist

Mark K. Jones
Supervising Scientist

CONTENTS

EXECUTIVE SUMMARY ..... **viii**

1.0 INTRODUCTION **1**
1.1 PURPOSE OF REPORT 1
1.2 METHODOLOGY 1
1.3 SITE BACKGROUND 2
1.4 ENVIRONMENTAL SETTING 3
1.4.1 Geology and Hydrogeology 3
1.4.2 Local Climate 5

2.0 HUMAN HEALTH RISK ASSESSMENT **6**
2.1 CONCEPTUAL SITE MODEL 6
2.1.1 Groundwater Use Analysis 6
2.1.2 Exposure Pathways and Receptors of Potential Concern 6
2.2 CHEMICALS OF POTENTIAL CONCERN 8
2.3 TIER 1 EXPOSURE ASSESSMENT 8
2.3.1 Exposure Point Concentrations 8
2.3.2 Exposure Parameters 13
2.3.3 Quantification of Exposure 14
2.4 TIER 1 TOXICITY ASSESSMENT 16
2.4.1 Toxicity Values 16
2.4.2 Carcinogenic Effects 17
2.4.3 Non-Carcinogenic Effects 17
2.5 TIER 1 RISK CHARACTERIZATION 17
2.5.1 Methods for Assessing Cancer Risks 18
2.5.2 Methods for Assessing Non-Cancer Health Effects 18
2.5.3 Tier 1 Quantitative Risk Assessment Results 19
2.6 TIER 2 EXPOSURE ASSESSMENT 19
2.6.1 Exposure Point Concentration 20
2.6.2 Exposure Parameters 21
2.7 TIER 2 RISK ASSESSMENT RESULTS 21
2.7.1 Potential Groundwater Beneficial Uses 22
2.7.2 Potential Groundwater Potable Uses 23

3.0 UNCERTAINTY ANALYSIS **26**
3.1 ENVIRONMENTAL SAMPLING AND ANALYSIS 26
3.2 FATE AND TRANSPORT MODELING 26
3.3 HUMAN HEALTH RISK ASSESSMENT 27
3.3.1 Exposure Assessment 27
3.3.2 Toxicological Data and Dose Response Extrapolations 28
3.4 COMBINATIONS OF SOURCES OF UNCERTAINTY 30

4.0 SUMMARY **31**

5.0 REFERENCES **32**

APPENDIX A FATE AND TRANSPORT MODELING TABLES

TABLES

ES.1 Tier 1 Risk Summary
ES.2 Tier 2 Risk Summary
1 Selection of Exposure Pathways
2.1 Occurrence, Distribution and Selection of Chemicals of Potential Concern – Groundwater
2.2 Occurrence, Distribution and Selection of Chemicals of Potential Concern – Shallow Soil Gas
2.3 Occurrence, Distribution and Selection of Chemicals of Potential Concern – Deep Soil Gas
3.1 Exposure Point Concentration Summary – Tier 1 Groundwater
3.2 Exposure Point Concentration Summary – Tier 1 Indoor Air (Groundwater)
3.3 Exposure Point Concentration Summary – Tier 1 Indoor Air (Soil Gas)
3.4 Exposure Point Concentration Summary – Tier 1 Car Wash Air – Average
3.5 Exposure Point Concentration Summary – Tier 1 Car Wash Air – Reasonable Maximum
3.6 Exposure Point Concentration Summary – Tier 1 Landscape Air – Average
3.7 Exposure Point Concentration Summary – Tier 1 Landscape Air – Reasonable Maximum
3.8 Exposure Point Concentration Summary – Tier 2 Groundwater
3.9 Exposure Point Concentration Summary – Tier 2 Indoor Air (Groundwater)
3.10 Exposure Point Concentration Summary – Tier 2 Indoor Air (Soil Gas)
3.11 Exposure Point Concentration Summary – Tier 2 Car Wash Air – Average
3.12 Exposure Point Concentration Summary – Tier 2 Car Wash Air – Reasonable Maximum
3.13 Exposure Point Concentration Summary – Tier 2 Landscape Air – Average
3.14 Exposure Point Concentration Summary – Tier 2 Landscape Air – Reasonable Maximum
4.1 Values Used For Daily Intake Calculations – Tier 1 Indoor Air – Central Exposure
4.2 Values Used For Daily Intake Calculations – Tier 1 Indoor Air – Reasonable Maximum
4.3 Values Used For Daily Intake Calculations – Tier 1 Groundwater Potable Use – Central Exposure
4.4 Values Used For Daily Intake Calculations – Tier 1 Groundwater Potable Use – Reasonable Maximum
4.5 Values Used For Daily Intake Calculations – Tier 1 Groundwater Household Vapors – Central Exposure
4.6 Values Used For Daily Intake Calculations – Tier 1 Groundwater Household Vapors – Reasonable Maximum
4.7 Values Used For Daily Intake Calculations – Tier 1 Industrial Use – Central Exposure

TABLES (Continued)

4.8 Values Used For Daily Intake Calculations – Tier 1 Industrial Use – Reasonable Maximum

4.9 Values Used For Daily Intake Calculations – Tier 1 Industrial Workspace Air – Central Exposure

4.10 Values Used For Daily Intake Calculations – Tier 1 Industrial Workspace Air – Reasonable Maximum

4.11 Values Used For Daily Intake Calculations – Tier 2 Indoor Air – Central Exposure

4.12 Values Used For Daily Intake Calculations – Tier 2 Indoor Air – Reasonable Maximum

4.13 Values Used For Daily Intake Calculations – Tier 2 Groundwater Potable Use – Central Exposure

4.14 Values Used For Daily Intake Calculations – Tier 2 Groundwater Potable Use – Reasonable Maximum

4.15 Values Used For Daily Intake Calculations – Tier 2 Groundwater Household Vapors – Central Exposure

4.16 Values Used For Daily Intake Calculations – Tier 2 Groundwater Household Vapors – Reasonable Maximum

4.17 Values Used For Daily Intake Calculations – Tier 2 Industrial Use – Central Exposure

4.18 Values Used For Daily Intake Calculations – Tier 2 Industrial Use – Reasonable Maximum

4.19 Values Used For Daily Intake Calculations – Tier 2 Industrial Workspace Air – Central Exposure

4.20 Values Used For Daily Intake Calculations – Tier 2 Industrial Workspace Air – Reasonable Maximum

5.1 Non-Cancer Toxicity Data – Oral/Dermal

5.2 Non-Cancer Toxicity Data – Inhalation

6.1 Cancer Toxicity Data – Oral/Dermal

6.2 Cancer Toxicity Data – Inhalation

7.1 Calculation of Chemical Cancer Risks and Non-Cancer Hazards – Tier 1 – Car Wash Worker – Central Exposure

7.2 Calculation of Chemical Cancer Risks and Non-Cancer Hazards – Tier 1 – Car Wash Worker – Reasonable Maximum

7.3 Calculation of Chemical Cancer Risks and Non-Cancer Hazards – Tier 1 – Landscape Worker – Central Exposure

7.4 Calculation of Chemical Cancer Risks and Non-Cancer Hazards – Tier 1 – Landscape Worker – Reasonable Maximum

TABLES (Continued)

7.5 Calculation of Chemical Cancer Risks and Non-Cancer Hazards – Tier 1 – On-Site Resident – Central Exposure

7.6 Calculation of Chemical Cancer Risks and Non-Cancer Hazards – Tier 1 – On-Site Resident – Reasonable Maximum

7.7 Calculation of Chemical Cancer Risks and Non-Cancer Hazards – Tier 1 – School Student – Central Exposure

7.8 Calculation of Chemical Cancer Risks and Non-Cancer Hazards – Tier 1 – School Student – Reasonable Maximum

7.9 Calculation of Chemical Cancer Risks and Non-Cancer Hazards – Tier 1 – School Worker – Central Exposure

7.10 Calculation of Chemical Cancer Risks and Non-Cancer Hazards – Tier 1 – School Worker – Reasonable Maximum

7.11 Calculation of Chemical Cancer Risks and Non-Cancer Hazards – Tier 2 – Car Wash Worker – Central Exposure

7.12 Calculation of Chemical Cancer Risks and Non-Cancer Hazards – Tier 2 – Car Wash Worker – Reasonable Maximum

7.13 Calculation of Chemical Cancer Risks and Non-Cancer Hazards – Tier 2 – Landscape Worker – Central Exposure

7.14 Calculation of Chemical Cancer Risks and Non-Cancer Hazards – Tier 2 – Landscape Worker – Reasonable Maximum

7.15 Calculation of Chemical Cancer Risks and Non-Cancer Hazards – Tier 2 – On-Site Resident – Central Exposure

7.16 Calculation of Chemical Cancer Risks and Non-Cancer Hazards – Tier 2 – On-Site Resident – Reasonable Maximum

7.17 Calculation of Chemical Cancer Risks and Non-Cancer Hazards – Tier 2 – School Student – Central Exposure

7.18 Calculation of Chemical Cancer Risks and Non-Cancer Hazards – Tier 2 – School Student – Reasonable Maximum

7.19 Calculation of Chemical Cancer Risks and Non-Cancer Hazards – Tier 2 – School Worker – Central Exposure

7.20 Calculation of Chemical Cancer Risks and Non-Cancer Hazards – Tier 2 – School Worker – Reasonable Maximum

8 Calculation of Radiation Cancer Risks (NOT APPLICABLE)

9.1 Summary of Receptor Risks and Hazards for COPCs – Tier 1 – Car Wash Worker – Central Exposure

TABLES (Continued)

9.2 Summary of Receptor Risks and Hazards for COPCs – Tier 1 – Car Wash Worker – Reasonable Maximum

9.3 Summary of Receptor Risks and Hazards for COPCs – Tier 1 – Landscape Worker – Central Exposure

9.4 Summary of Receptor Risks and Hazards for COPCs – Tier 1 – Landscape Worker – Reasonable Maximum

9.5 Summary of Receptor Risks and Hazards for COPCs – Tier 1 – On-Site Resident – Central Exposure

9.6 Summary of Receptor Risks and Hazards for COPCs – Tier 1 – On-Site Resident – Reasonable Maximum

9.7 Summary of Receptor Risks and Hazards for COPCs – Tier 1 – School Student – Central Exposure

9.8 Summary of Receptor Risks and Hazards for COPCs – Tier 1 – School Student – Reasonable Maximum

9.9 Summary of Receptor Risks and Hazards for COPCs – Tier 1 – School Worker – Central Exposure

9.10 Summary of Receptor Risks and Hazards for COPCs – Tier 1 – School Worker – Reasonable Maximum

9.11 Summary of Receptor Risks and Hazards for COPCs – Tier 2 – Car Wash Worker – Central Exposure

9.12 Summary of Receptor Risks and Hazards for COPCs – Tier 2 – Car Wash Worker – Reasonable Maximum

9.13 Summary of Receptor Risks and Hazards for COPCs – Tier 2 – Landscape Worker – Central Exposure

9.14 Summary of Receptor Risks and Hazards for COPCs – Tier 2 – Landscape Worker – Reasonable Maximum

9.15 Summary of Receptor Risks and Hazards for COPCs – Tier 2 – On-Site Resident – Central Exposure

9.16 Summary of Receptor Risks and Hazards for COPCs – Tier 2 – On-Site Resident – Reasonable Maximum

9.17 Summary of Receptor Risks and Hazards for COPCs – Tier 2 – School Student – Central Exposure

9.18 Summary of Receptor Risks and Hazards for COPCs – Tier 2 – School Student – Reasonable Maximum

9.19 Summary of Receptor Risks and Hazards for COPCs – Tier 2 – School Worker – Central Exposure

TABLES (Continued)

9.20 Summary of Receptor Risks and Hazards for COPCs – Tier 2 – School Worker – Reasonable Maximum
10.1 Risk Summary – Tier 1 – Car Wash Worker – Central Exposure
10.2 Risk Summary – Tier 1 – Car Wash Worker – Reasonable Maximum
10.3 Risk Summary – Tier 1 – Landscape Worker – Central Exposure
10.4 Risk Summary – Tier 1 – Landscape Worker – Reasonable Maximum
10.5 Risk Summary – Tier 1 – On-Site Resident – Central Exposure
10.6 Risk Summary – Tier 1 – On-Site Resident – Reasonable Maximum
10.7 Risk Summary – Tier 1 – School Student – Central Exposure
10.8 Risk Summary – Tier 1 – School Student – Reasonable Maximum
10.9 Risk Summary – Tier 1 – School Worker – Central Exposure
10.10 Risk Summary – Tier 1 – School Worker – Reasonable Maximum
10.11 Risk Summary – Tier 2 – Car Wash Worker – Central Exposure
10.12 Risk Summary – Tier 2 – Car Wash Worker – Reasonable Maximum
10.13 Risk Summary – Tier 2 – Landscape Worker – Central Exposure
10.14 Risk Summary – Tier 2 – Landscape Worker – Reasonable Maximum
10.15 Risk Summary – Tier 2 – On-Site Resident – Central Exposure
10.16 Risk Summary – Tier 2 – On-Site Resident – Reasonable Maximum
10.17 Risk Summary – Tier 2 – School Student – Central Exposure
10.18 Risk Summary – Tier 2 – School Student – Reasonable Maximum
10.19 Risk Summary – Tier 2 – School Worker – Central Exposure
10.20 Risk Summary – Tier 2 – School Worker – Reasonable Maximum

EXECUTIVE SUMMARY

The purpose of this human health risk assessment (HRA) is to evaluate potential risks to human health posed by chemical substances that have been detected in groundwater and soil gas at the Alameda Point Site 25/Annex IR-02 Site in Alameda, California. The results of this assessment will provide decision makers with a scientific basis for determining whether groundwater and soil gas at the site will adversely limit possible future potable and non-potable beneficial uses of water. The risks presented herein are for potential exposures to groundwater and soil gas only. Incremental risks associated with chemicals detected in soil are not included in this assessment.

This HRA evaluates potential risks associated with direct and indirect exposures to organic chemicals from groundwater associated with the potential future beneficial uses associated with bringing groundwater to the surface and for use in commercial and/or industrial purposes. Additionally, the HRA quantitatively assesses theoretical health risks associated with volatilization of groundwater and soil gas constituents into indoor air at a current or future school placed at the site.

The approach follows the basic procedures outlined by the U.S. Environmental Protection Agency (USEPA) and California Environmental Protection Agency (Cal/EPA). The following five basic steps are employed in the performance of the HRA: (1) data evaluation, (2) qualitative assessment, (3) exposure assessment, (4) toxicity assessment, and (5) quantitative risk characterization. Chemicals of potential concern (COPCs) identified in groundwater at the site include inorganic constituents (*e.g.*, arsenic, iron, vanadium, and thallium), volatile organic compounds (*e.g.*, benzene, ethylbenzene, and toluene) and semi-volatile organic compounds (*e.g.*, benzo(a)pyrene, phenanthrene, pyrene, and acenaphthene). COPCs identified for soil gas include benzene, chloroform, ethylbenzene, xylenes, naphthalene, tetrachloroethene, and trichloroethene.

Quantitative Human Health Risk Assessment

This quantitative HRA is a deterministic assessment, which means all values used in the various equations and models to calculate theoretical exposures and risks are single values. Because many of these single values are based on conservative assumptions and are upper bound, the calculated risk estimates reflect compounded conservatism and as a result are highly likely to exceed the true risks at the site.

The objective of the HRA is to estimate the potential relationship between theoretical exposure to COPCs in groundwater and theoretical upper-bound risks to human health at the site. This relationship was quantified for two theoretical beneficial groundwater use scenarios (workers theoretically exposed to COPCs in groundwater during the operation of a commercial car wash, and a maintenance/landscape worker theoretically exposed to COPCs in groundwater through irrigation activities). These receptors are based upon a qualitative human health evaluation conducted as part of the NewFields (2000) HRA. In addition, a school scenario (children and adult workers) was also evaluated based on the assumption of theoretical exposure to volatile COPCs transferred from groundwater to indoor air of an existing or future school placed at the site. Furthermore, future hypothetical use of the groundwater beneath the property as a potable

water supply was evaluated. Finally, vapor intrusion into potential current and future residential developments at the site was evaluated.

For the worker beneficial groundwater use exposure scenarios, theoretical inhalation of COPCs volatilized from water during operation of spray jets and sprinklers, and dermal contact with water during these operations was assessed. Use of groundwater as a potable water supply was also assessed. For the school site scenario, theoretical inhalation of adult workers and children resulting from vapor migration from groundwater into the indoor school air was estimated using the Johnson and Ettinger model (USEPA, 2000). Lastly, for the residential scenario, theoretical inhalation exposures resulting from vapor migration from groundwater into the indoor air, and exposures associated with use of groundwater as a potable water supply were evaluated. Quantification of theoretical health risks for all exposure scenarios consisted of a two-tiered approach. Tier 1 employed the most conservative assumptions and required minimal data evaluation and exposure parameter development. Only COPCs and exposure pathways that indicated greater potential health risks in Tier 1 were evaluated in Tier 2. Tier 2 utilized more sophisticated and realistic data evaluation techniques than were employed in Tier 1. The tiered approach makes efficient use of time and resources by applying more advanced and time consuming techniques to COPCs and scenarios where necessary.

The Tier 2 assessment was conducted using geostatistically derived COPC concentrations and refined exposure parameters specific to each of the receptors assessed. The geostatistical approach used herein resulted in a 95 percent upper confidence level (UCL) of groundwater concentrations for specific COPCs. These calculated values were the assumed exposure point concentrations instead of the maximum concentration. A geostatistical method called block kriging was employed for calculating a 95 percent UCL for an area of interest taking into consideration multiple sampling locations. As explained in Section 6.5, kriging radii of 500 feet and 725 feet were chosen based on conservative estimates of the area that groundwater would be drawn from, if groundwater supply wells were installed at the site.

Results

Beneficial Groundwater Use Exposures

Tier 1 results are summarized in Table ES.1. Tier 1 theoretical upper-bound incremental lifetime cancer risks (ILCRs) and hazard indices (HIs) exceeded acceptable levels. Therefore, a Tier 2 assessment for all receptors was performed assuming groundwater beneficial use. Benzene was found to be responsible for 95 percent of the Tier 1 theoretical cancer risk, and naphthalene and benzene was found to be responsible for 98 percent of the Tier 1 HI associated with beneficial uses of groundwater. Therefore, for potentially complete exposure pathways (groundwater use for car wash and landscape, and vapor intrusion into residential and school buildings), only Tier 2 exposure point concentrations for benzene and naphthalene were calculated in Tier 2. The Tier 1 exposure point concentrations for other COPCs were carried forward and used in the Tier 2 assessment. The Tier 2 benzene and naphthalene concentrations and Tier 2 exposure parameters were utilized to further refine the risk estimates.

Tier 2 results are summarized in Table ES.2. The Tier 2 theoretical upper-bound ILCRs for the car wash worker ranged from 1×10^{-6} to 2×10^{-5} and, theoretical HI ranged from 0.30 to 0.99.

For the landscape worker, theoretical Tier 2 ILCRs ranged from 2×10^{-6} to 3×10^{-5}, and Tier 2 theoretical HIs ranged from 0.51 to 0.98. For the resident, theoretical Tier 2 ILCRs ranged from 5×10^{-8} to 1×10^{-5}, and Tier 2 theoretical HIs ranged from 0.0076 to 0.29. For the school receptors, theoretical Tier 2 ILCRs ranged from 5×10^{-8} to 2×10^{-6} for children, and 5×10^{-8} to 7×10^{-6} for workers. Tier 2 school receptor theoretical HIs ranged from 0.0076 to 0.29. These theoretical upper-bound ILCRs fall within or below EPA's risk management range of 10^{-4} to 10^{-6}, and are below the target hazard index of 1.0.

Groundwater Potable Use Exposures

Groundwater currently is not used as a potable water source, and all developments occurring in the area requiring municipal water are tied directly into the existing municipal water supply. Furthermore, because the groundwater contains elevated total dissolved solid (TDS) concentrations greater than 3,000 parts per million, it does not meet the standards for a potable groundwater supply (San Francisco Bay Regional Water Quality Board [RWQCB], 1995). In fact, the RWQCB has officially concluded that this groundwater is not a potable water source and that such use should not be identified as a potential beneficial use (RWQCB, 1999). However, assessment of risks associated with theoretical use of groundwater as a potable water supply was completed. For commercial and residential receptors, HI's for all receptors exceeded 1.0 and ILCRs exceeded 10^{-4}. Therefore, groundwater beneath the site in its current state is not suitable for use as a drinking water supply.

Summary

The results of this HRA demonstrate that for non-potable water beneficial uses, theoretical upper-bound ILCRs do not exceed a probability of 10^{-4} (1 in 10,000) for all worker receptors or 10^{-5} (1 in 100,000) for school children and current or future residential receptors. In addition, theoretical non-cancer HIs are below 1.0 for all receptors.

BASELINE RISK ASSESSMENT

1.0 INTRODUCTION

This report, which presents the results of a human health risk assessment (HRA) prepared for the Navy Alameda Facility/Alameda Annex in Alameda, California, quantifies the magnitude and upper-bound probability of theoretical human health risks posed by chemicals in groundwater and soil gas. The assessment assumes hypothetical future human exposure pathways: (1) potential beneficial use of the groundwater as a commercial and/or industrial water source; and current or future exposure pathways: (1) the placement of a school or residence at the site, and (2) use of groundwater at the site as a potable water source.

1.1 Purpose of Report

The purpose of the HRA is to quantify theoretical upper-bound human health risks from chemical substances that have been detected in groundwater and soil gas at the site. The results of the HRA provide decision-makers with a scientific basis for determining whether groundwater beneath the site will adversely limit possible non-potable beneficial uses of the water, or that placement of a school or residence near the site is an acceptable land-use option.

1.2 Methodology

This evaluation follows the basic procedures outlined in the U.S. Environmental Protection Agency (USEPA) *Risk Assessment Guidance for Superfund: Volume I—Human Health Evaluation Manual* (USEPA, 1989), and California Department of Toxic Substances Control (DTSC) *Supplemental Guidance for Human Health Multimedia Risk Assessments of Hazardous Waste Sites and Permitted Facilities* (DTSC, 1992). Other guidance documents consulted include:

- USEPA. 1991. *Risk Assessment Guidance for Superfund: Volume I—Human Health Evaluation Manual. Supplemental Guidance.*
- USEPA. 1992a. *Guidelines for Exposure Assessment.*
- USEPA. 1992b. *Supplemental Guidance to RAGS: Calculating the Concentration Term.*
- USEPA. 2002. *Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils.*

This risk assessment follows a series of steps common to many risk assessments. First, the extent and types of chemicals at the site are evaluated, and those suspected of presenting a threat to human health are identified. Then, the ways in which people could be exposed to the chemicals are identified, and assumptions are made about the extent to which people could be exposed. Lastly, the estimated exposure rates are combined with chemical toxicity criteria to estimate the risks associated with the exposures. The assessment consisted of the following steps:

1. Exposure assessment: (a) characterization of the ways in which people could be exposed to the chemicals of potential concern (COPCs), (b) assumptions about the extent to which people could be exposed, and (c) assessment of the rates at which people could potentially intake chemicals at the site

2. Toxicity assessment: (a) review of the health effects associated with exposure to different levels of the COPCs, and (b) summary of the relevant criteria used to estimate the risks associated with various exposure levels

3. Risk characterization: comparison of the rates at which people could potentially be exposed to the COPCs at the site to chemical toxicity criteria. The risk characterization provides a quantitative estimation of the carcinogenic risks and adverse non-cancer health effects associated with the estimated exposures to the COPCs.

1.3 Site Background

A detailed site description and background for the site is presented in the Remedial Investigation (RI) report completed for the facility by PRC Environmental Management, Inc. (PRC, 1996). The facility where the site is located is approximately 150 acres in size and is near the Naval Air Station Alameda, along the southern shore of Oakland Inner Harbor Alameda. It is believed that petroleum hydrocarbons may have been introduced into the vadose zone by surface disposal and runoff of distillate wastes from previous industrial oil works at the property in addition to possible Navy activities at the site. The site is currently zoned for industrial uses. Both organics and inorganics have been detected in groundwater beneath the site during numerous sampling events.

Previous risk assessment work was conducted for the site as part of the facility RI report (PRC, 1996). This assessment evaluated potential risks associated with direct and indirect exposures to soil and volatilization of volatile organic chemicals (VOCs) from groundwater through the vadose zone into outdoor and indoor air. Although the PRC (1996) assessment is a useful and informative tool for addressing the potential risks associated with soils and *in situ* volatilization from groundwater, the assessment as it stands does not provide a complete picture of the human health risks associated with groundwater or soil gas at the site. Specifically, the PRC (1996) assessment did not address any of the potential future beneficial uses associated with bringing groundwater to the surface and for use in commercial or industrial purposes.

Use of the groundwater at the site as a potable water supply is not likely to ever be a complete exposure pathway. Because the groundwater contains elevated total dissolved solid (TDS) concentrations greater than 3,000 parts per million, it does not meet the standards for a potable groundwater supply (San Francisco Bay Regional Water Quality Board [RWQCB], 1995). In fact, the RWQCB has officially agreed that this groundwater is not a potable water source and that such use should not be identified as a potential beneficial use (RWQCB, 1999). However, other uses of the water, such as a commercial or industrial supply, do fall within the potential beneficial use definition of the RWQCB. Because the PRC (1996) risk assessment did not address these other potential beneficial water use scenarios, DTSC expressed concern that the PRC (1996) assessment was incomplete.

Also, since the PRC (1996) assessment was completed, the City of Alameda has proposed a development plan that includes placement of a school adjacent to the Alameda Annex. Because the PRC (1996) assessment did not specifically assess risks to adult workers and school children at such a school site, DTSC expressed concern regarding potential health risks associated with volatilization of VOCs from groundwater into indoor air at the potential school (DTSC, 1999a, 1999b, and 1999c). Since that time, a school and daycare have been built and are operational.

Therefore, in direct response to agency comments and to comply with the Navy's goal of protecting public health and safety, in January of 2000, NewFields, Inc. conducted an HRA to address the potential risks associated with non-potable uses of groundwater at the site. Based upon the results of the most recent groundwater data at the time (1999), the NewFields (2000) HRA concluded that no restrictions on non-potable use of groundwater at the property were scientifically warranted, and that placement of a school near the site posed no significant risk to human health. Since the publishing of the NewFields (2000) HRA, new groundwater and soil gas data have become available.

1.4 Environmental Setting

1.4.1 Geology and Hydrogeology

1.4.1.1 Regional Geology

The following information is taken from the remedial investigation report completed by PRC (1996). For additional information the reader is referred to this report.

> *"The San Francisco Bay Region lies near the region of the Pacific and North American crustal plates. Because these crustal plates are moving relative to each other, the region is tectonically active, and experiences numerous and frequent earthquakes. Movement in the area occurs two principal fault systems: the San Andreas fault (which parallels the California coast west of the Bay), and the Hayward fault (subparallel to the San Andreas fault on the east side of the Bay) (Norris and Webb 1976).*
>
> *The San Francisco Bay structural basin was formed during the past 1 to 3 million years as a subsiding or down-warping block between the San Andreas fault and the Hayward fault. During the mid-Pleistocene age (approximately 1 million years before present [bp]), the ancestral Bay basin began to subside and fill with sediments of both marine and terrestrial origin. The sediments deposited during the Quaternary age (approximately 1.8 million years to present) overlay an irregular bedrock surface that consists of sandstone, siltstone, chert, and greenstone of the Franciscan Formation (Helley et al. 1979)."*

1.4.1.2 Local Geology

The following information describing the local geology was taken from the final cumulative groundwater monitoring report (Tetra Tech EM, 1998a).

"Lithologic data have been obtained from soil borings and monitoring wells completed at the facility. Soil boring and well construction logs are provided in Appendix A [of the report]. Based on soil boring log data, shallow subsurface sediments can be divided into two major groups: (1) the shallow, artificial fill that occurs within the uppermost 10 to 20 feet bgs and (2) the underlying native sediments that comprise the Bay Mud and Merritt Sand formations. These native sediments are present to a minimum depth of 135 feet bgs, the maximum logged depth at the facility...

Based on lithologic data collected from previous subsurface investigations, fill materials at the facility are a heterogeneous, laterally discontinuous mixture of sand, silt, and clay (including dredged Bay Mud) with some construction debris and organic materials...the fill materials were reportedly dredged from the historical tidal flats and offshore areas (Radbruch 1959). Thickness of the artificial fill layer varies from approximately 10 to 20 feet across the facility. Thickness of the fill is probably influenced by historical tidal channels that once transected the facility...

Based on four deep soil borings completed at the central portion of the facility...native sediments encountered directly beneath the artificial fill are the Bay Mud, consisting primarily of grey to black, medium to high-plasticity silty clay with occasional thin lenses of fine sand. No extensive sand layers were observed within the Bay Mud in any of the deep borings. Lithologic logs...indicate that the thickness of the Bay Mud ranges from approximately 25 to 80 feet...

The contact between the artificial fill and the underlying native sediments may be difficult to distinguish, particularly for fine-grained fill materials that exhibit similar characteristics as the underlying native Bay Mud sediments. The inferred contact between the upper fill materials and the underlying native sediments has primarily been based on the following criteria:

- *Soil characteristics. The artificial fill layer is characterized by heterogeneous sand, silt and clay sediments. The upper surface of the Bay Mud is characterized by a thick sequence of dark greenish grey, high-plasticity clay that is rich in organic materials. A relatively clear distinction between these soil types has been used as the primary basis for estimating the contact between the two stratigraphic units.*

- *The presence of marsh crust. In some borings, a thin organic-rich peat layer (approximately 2 to 6 inches thick), called "marsh crust" by Lee and Praszker (1979), was observed within the soil column, sometimes within the Bay Mud sediments. This marsh crust may serve as an indicator of a historical tidal flat boundary. As such, fill boundaries were inferred at those boring locations that showed a distinctive marsh crust horizon.*

- *Historical tidal channel locations. Some borings and wells may have been placed at locations of historical channels... In areas that show relatively thick sequences of fill materials, information provided in the historical tidal channel map has been used to further estimate the boundary between the fill and underlying native Bay Mud.*

As observed in the deep soil borings, the top of the Merritt Sand was encountered at depths ranging from approximately 55 to 95 feet bgs. Sediments of the Merritt Sand are composed of (1) greenish grey, grey, and brown silty sand and (2) well sorted, fine- and medium-grained sand with occasional lenses of clay. The deep borings drilled at the facility did not fully penetrate the Merritt Sand; this unit may be as much as 65 feet thick in the vicinity of the facility (Radbruch 1957)."

1.4.1.3 Groundwater Levels and Flow Directions

The following information describing groundwater levels and flow directions was taken from the final cumulative groundwater monitoring report (Tetra Tech EM, 1998b).

"The artificial fill forms the shallow, unconfined water bearing zone beneath the facility. The lateral extent of the fill and the shallow water bearing zone in the vicinity of the facility is currently undefined. Groundwater elevation data indicate that shallow groundwater generally flows to the north-northwest...depth to groundwater in the artificial fill varied between approximately 2 and 12 feet bgs...the horizontal hydraulic gradient in the shallow water bearing zone ranges from 0.002 ft/ft in the central portion of the facility to 0.02 ft/ft on the flanks of a large convergent flow zone...The Bay Mud serves as a confining layer for the underlying Merritt Sand aquifer. Hydraulic conductivity of the Bay Mud is estimated to be 0.001 to 0.0001 feet per day...depth to groundwater [in the Merritt Sand aquifer] ranged from approximately 4 to 13 feet bgs, and groundwater elevations ranged from -5.45 to 5.68 feet above msl."

1.4.2 Local Climate

Mean precipitation for the area is 18.69 inches annually. Most precipitation (in the form of rainfall) occurs between the months of November and April. Mean range of temperatures (yearly low and high) is 50.7 and 64.0 degrees Fahrenheit, respectively. The predominant wind direction is primarily to the southeast and southwest.

2.0 HUMAN HEALTH RISK ASSESSMENT

This chapter presents the HRA conducted in accordance with USEPA and DTSC guidance. The risk assessment is a deterministic assessment; that is, single values based on conservative assumptions were used for all modeling and exposure parameters. These conservative estimates compound each other so that the calculated risks likely exceed the true risks at the site.

2.1 Conceptual Site Model

Based on a review of existing data (site history, environmental setting, previous site characterization studies; see the RI) and the work plan, a conceptual site model (CSM) was developed. Pursuant to DTSC (1992) and USEPA (1989) regulatory guidance, the purpose of a CSM is to identify "... all potential or suspected sources of contamination, types and concentrations of contaminants detected at the site, potentially contaminated media, and potential exposure pathways, including receptors." The CSM also serves the purpose of guiding the progression of the HRA process, thereby functioning both as an organizational tool and as a check against omissions that might result in under-estimations of health risk. A discussion of three of the most important elements of the CSM (water use, potential exposure pathways, and potential receptors) is presented in the following sections.

2.1.1 Groundwater Use Analysis

For reasons already presented in this report, it was assumed that the groundwater could potentially be used for commercial, industrial, or irrigation use in the future. These uses are possible at the site based on the RWQCB Basin Plan (RWQCB, 1995) for the aquifer of interest. In addition, hypothetical future use of groundwater as a potable source is also evaluated.

2.1.2 Exposure Pathways and Receptors of Potential Concern

Based on the descriptions of assumed future hypothetical groundwater uses, several preliminary exposure pathways and receptors of potential concern are identified (Figure 2). Each of these pathways and receptors is first evaluated qualitatively. Those pathways considered to pose the greatest potential risk are further evaluated quantitatively in this report.

2.1.2.1 Potential Receptors

According to the Basin Plan for the San Francisco Bay Region (RWQCB, 1995), beneficial water uses for the aquifer could include irrigation water, commercial water, and industrial service supply water. Therefore, relevant receptors associated with these water-use scenarios are commercial/industrial workers and potential recreational receptors. Additionally, current (Parcels 178, 179, 180, and 184) and current or future residents and school receptors have also been assessed.

2.1.2.2 Potential Exposure Pathways

In a risk assessment, the possible exposures of populations are examined to determine if the COPCs at a site could pose a threat to that population's health. The risks associated with exposure to COPCs depend not only on the concentration of the chemicals in each media, but also on the duration and frequency of exposure to those media. For example, the risks associated with exposure to chemicals for one hour a day are less than those associated with exposure to the same chemicals at the same concentrations for two hours a day.

An exposure pathway is a description of the ways in which a person could be exposed to COPCs. Potential health impacts from constituents in a medium can occur via one or more exposure pathways. Selection of exposure pathways are presented in Table 1. At the Alameda Annex, the potential exposure pathways and exposure routes for the relevant receptors (commercial/industrial workers and recreational receptors) and that are consistent with identified potential beneficial future use of the aquifer are the following:

- Worker dermal exposure in commercial car washes
- Worker inhalation exposure in commercial car washes
- Worker inhalation exposure in industrial cooling towers or as a process coolant
- Worker dermal exposure in industrial emergency shower
- Worker inhalation exposure in industrial emergency shower
- Worker dermal exposure during janitorial activities
- Worker inhalation exposure during janitorial activities
- Recreational dermal exposure to irrigation sprinkler activity
- Recreational inhalation exposure to irrigation sprinkler activity
- Recreational dermal exposure to irrigated lawns
- Landscape worker dermal exposure to irrigation water and irrigated vegetation
- Landscape worker inhalation exposure to irrigation water
- Public dermal exposure to commercial car washes
- Public inhalation exposure to commercial car washes

Based upon a qualitative review and analysis of the above potentially complete exposure pathways, the following pathways are considered to have the greatest exposure potential associated with beneficial use of groundwater:

- Worker dermal exposure in commercial car washes
- Worker inhalation exposure in commercial car washes
- Landscape worker dermal exposure to irrigation water and irrigated vegetation
- Landscape worker inhalation exposure to irrigation water

Current development of the site includes construction of residential units, or placement of an elementary school on or near the property. The potential exposure pathways and exposure routes for these current or future receptors includes:

- Resident and school receptor inhalation exposures following vapor intrusion into indoor air.

The potential exposure pathways and exposure routes associated with hypothetical use of groundwater as a potable water supply include:

- Ingestion of water by commercial and residential receptors
- Inhalation of COPCs from water by residential receptors resulting from household use (showering, etc)

2.2 Chemicals of Potential Concern

In order to ensure that a risk assessment focuses on those substances that contribute the greatest to the overall risk (USEPA, 1989), allows for screening steps to identify the chemical constituents of potential concern (COPCs) for quantitative evaluation in the Tier 2 and 3 risk assessment. In general, chemicals exhibiting a low frequency of detection (FOD) do not contribute significantly to risk estimates. US EPA (1989) suggests that chemicals with a FOD less than or equal to five percent may be considered for elimination. Lead is the only constituent for which a maximum site concentration was compared to a screening level. Because lead is typically not assessed with other COPCs to evaluate non-carcinogenic and carcinogenic risks, the maximum lead concentration was compared to the California Public Health Goal (PHG). The maximum lead concentration of 0.37 µg/L is below the PHG of 2 µg/L, and was therefore not considered a COPC.

Detection limits were also examined, in order to identify if high detection limits were an issue in selecting COPCs. There is a single case of high detection limits for several compounds (2000 µg/L); however, this is for a single sample and the remainder of the analyses are an order of magnitude lower or more. In addition, only those chemicals with available toxicity criteria were quantified.

For each chemical detected in a shallow (less than 5 ft bgs) or deep (greater than 5 ft bgs) soil gas location, the maximum measured concentration from the sampling period was screened against shallow and deep screening values, respectively, from USEPA's Vapor Intrusion Guidance (USEPA 2002). Each chemical at each depth interval that exceeded the screening value was considered a COPC and was carried through the Tier 1 analysis.

For inorganic constituents, comparisons to background concentrations were not done for the purposes of screening COPCs. The contribution of background to total risks is discussed in Section 2.7 (Tier 2 Risk Assessment Results). The occurrence, distribution and selection of COPCs are presented in Tables 2.1 through 2.3.

2.3 Tier 1 Exposure Assessment

2.3.1 Exposure Point Concentrations

This HRA is based on the results of groundwater and soil gas samples that have been collected at the site. The groundwater data collected during the field-sampling program conducted in 2001 through 2003 were compiled, tabulated, and evaluated for direct use in the HRA. The soil gas data were collected between 2001 and 2003. They include data from the 2001 remedial

investigation and the 2002-2003 basewide groundwater monitoring program. A summary of the maximum detected concentrations for each constituent is presented in Tables 3.1 through 3.14.

For each chemical detected in groundwater in a location, the maximum measured concentration was used as the Tier 1 value. The use of maximum concentrations for a Tier 1 assessment is consistent with USEPA (1989) and American Society for Testing and Materials (ASTM, 1999) guidelines. The use of maximum concentrations provides the most conservative estimate of exposure point concentrations and is a screening tool only. It is not consistent with regulatory guidance (e.g., USEPA, 1989, 2001a; ASTM, 1999) or recent California statutes (SB47, 1999) to make final decisions based on screening-level approaches and assumptions, unless the screening level results indicate no further investigation or consideration is necessary.

For soil gas, the Tier 1 value is the maximum measured concentration at either shallow or deep depths which exceeded the screening value.

2.3.1.1 Fate and Transport Modeling

Exposure point concentrations for air were calculated for two water use scenarios, car wash and irrigation, and also for vapor intrusion into indoor air for a school site and hypothetical future residential developments. The air concentrations resulting from water use scenarios are based on an activity-specific water use rates, chemical transfer efficiency from air to water and ambient air dilution. Fate and transport modeling equations and parameters are presented in Appendix A.

Estimated indoor air concentrations for a school or residential building are based the volatilization of chemicals through soil and cracks or pores in building foundations from subsurface groundwater. Vapor intrusion scenarios (school and resident scenarios), air concentrations were only estimated for volatile organic compounds (VOCs), because of their greater potential for volatilization. For the beneficial water use scenarios (landscape and car wash scenarios), air concentrations were estimated for semi-volatile organic compounds (SVOCs) exhibiting Henry's Law coefficients greater than 10^{-5} atm-m^3/mol. Air concentrations for these SVOCs under these scenarios were assessed because the water is being forced at high pressure through nozzles that may create turbulent conditions and increase the liberation of chemicals from water.

<u>Car Wash</u>

The estimates of water volumes used during a car wash were taken from the range of flow rates provided by two car wash equipment manufacturers, Pro Equipment Co. and Custom Kraft (personal communication, 1999). The average and maximum flow rates were 0.14 and 0.22 liters per second, respectively. These flow rates were used to evaluate the rate at which constituents in groundwater may be brought above ground and made available for volatilization. Water usage rates were multiplied by the assumed fraction of the workday spent by a car washer continuously spraying water to arrive at an average rate of water used over the course of the workday. The portion of the day spent spraying water (continuously) was conservatively estimated to range from 3 to 5 hours per day, or a fraction of the day spent continuously spraying water ranging from 0.38 to 0.63. The resulting average and maximum adjusted flow rates were 0.05 and 0.14 liters/second, respectively (see Appendix A).

To estimate the amount of chemical that volatilizes during water spraying, the efficiency at which a chemical transfers from water to air is needed. The mass transfer efficiency for each of the VOCs is estimated using the method outlined by McKone (1987) and recommended by DTSC (1994a):

$$\phi_x = 0.6 \times \frac{3 \times 10^6 (m^2/s)^{-2/3}}{\left[\frac{2.5}{D_l^{2/3}} + \frac{RT}{H \times D_a^{2/3}}\right]}$$

where,

R = the universal gas constant 8319 (Pa-L/mol-K)
T = temperature in Kelvin 273.16 (K) as recommended (McKone, 1987)
D_l = chemical specific diffusion coefficient in water (m^2/s)
D_a = chemical specific diffusion coefficient in air (m^2/s)
H = chemical specific Henry's law constant (Pa-L/mol)

This relationship was developed for chemical transfer during domestic showering. Water use during a car wash was assumed to have similar pattern and spray distance as a shower. The flow rates for the car wash, 0.14 and 0.22 liters per second are higher than typical showers (0.1 liters per second, McKone and Knezovich, 1991) and should result in lower transfer efficiencies due to reduced residence time in air. The chemical-specific properties used are listed in Appendix A. Based on DTSC concerns regarding the possible effects water recycling (DTSC 1999d) might have on the transfer efficiency of a compound, a minimum transfer efficiency of 50 percent (or 0.5) was used. In other words, where the estimated efficiency was less than 0.5, a default value of 0.5 was used.

The chemical volatilization rate was then based on the water use rate, transfer efficiency and the groundwater concentration:

$$E = W \times C_w \times \phi_x$$

where,

E = emission rate over car wash area (mg/sec)
W = water use rate (L/sec)
C_w = groundwater concentration (mg/L)
ϕ_x = chemical-specific transfer efficiency (unitless)

Once the amount of chemical volatilized during an event was estimated, an air concentration was derived based on simple mixing and diffusion with ambient outdoor air. The estimation method used for an outdoor air concentration was based on DTSC (1994b) recommendations:

$$C_a = \frac{E}{LS \times V \times MH}$$

where,

C_a = ambient air concentration (mg/m^3)
E = emission rate over car wash area (mg/sec)
LS = length dimension perpendicular to the wind (m), 6.1 m based on observed car wash area dimensions of 21 feet × 30 feet.
V = average wind speed within the mixing zone (m/s), 2.25 m/s default value.
MH = mixing height (m), 2 meter default value.

This model is presented in Appendix A.

Irrigation

The water use rate for lawn irrigation is based on water needs for growing lawn in the Alameda area. This was estimated using methods recommended by the Wateright Homepage (http://www.wateright.org) developed by the Center for Irrigation Technology, CSU Fresno and the U.S. Bureau of Reclamation. This method relies on measured evapotranspiration rate of a location and specific turf crop factors. The calculations estimate the amount of water needed to keep turf green. The formula for calculating drop water needs was:

$$P = ET_o \times Kc \times Ka \times \frac{D}{Irri.}$$

where,

P = turf crop watering needs (m/irrigation)
ET_o = Evapotranspiration rate (m/day)
Kc = turf crop factor
Ka = turf crop factor adjustment
D = days per week (7d/wk).
Irri = irrigation events per week (5), One irrigation event per workday.

The ETo data was taken from average monthly ETo data for Oakland, CA (CIMIS, 1999). Crop factors were used from eight different turf crops:

- Bentgrass
- Bermuda
- Bluegrass
- Kikuyu
- Paspalm
- Ryegrass
- St. Augustine
- Tall Fescue

A crop irrigation need was calculated based on each month and crop. An average irrigation need per workday, 0.0033 meters, and a maximum, 0.0076 meters, were used in developing air exposure concentrations. An area based application rate was then calculated:

$$AR = IR \times 1 {m^2}/{m^2} \times 1000 {L}/{m^3} \times \frac{workday}{28{,}800s} \times A$$

where,

AR	=	application rate (L/s)
IR	=	irrigation rate (m/work day), assumed to be = water irrigation need above
workday	=	8 hours per day, 60 min per hour, and 60 sec per minute.
A	=	area of irrigation application (m^2), default of 929 m^2, based on default area of 100 feet × 100 feet.

The results of this calculation are presented in Appendix A. The chemical emission rate was then based on the application rate, transfer efficiency and the groundwater concentration:

$$E = AR \times C_w \times \phi_x$$

where,

E	=	emission rate over car wash area (mg/sec)
AR	=	water use rate (L/sec)
C_w	=	groundwater concentration (mg/L)
ϕ_x	=	chemical-specific transfer efficiency (unitless)

Once the amount of chemical released during an event was estimated, an air concentration was derived based on simple mixing and diffusion with ambient outdoor air. The estimation method used for an outdoor air concentration was based on DTSC (1994b) recommendations:

$$C_a = \frac{E}{LS \times V \times MH}$$

where,

C_a	=	ambient air concentration (mg/m^3)
E	=	emission rate over car wash area (mg/sec)
LS	=	length dimension perpendicular to the wind (m), 30.5 m based on observed car wash area dimensions of 100 feet × 100 feet.
V	=	average wind speed within the mixing zone (m/s), 2.25 m/s default value.
MH	=	mixing height (m), 2 meter default value.

The results of this model are presented in Appendix A. The estimated ambient air concentrations for both car wash and irrigation exposure scenarios were used as the inhalation exposure point concentrations for each respective exposure scenario.

School Site and Residential Homes

The Tier 1 groundwater and soil gas exposure point concentrations were incorporated into modeling based on the Johnson and Ettinger (1991) model following USEPA guidelines (USEPA, 2000). The Johnson and Ettinger model incorporates indoor air concentration modeling with exposure and risk calculations. The Johnson and Ettinger model, as modified by DTSC to include Cal/EPA toxicity criteria, was utilized in this HRA. The Johnson and Ettinger model

provides an output of predicted health risks associated with the groundwater or soil gas COPC concentrations in indoor air.

The default chemical properties provided in the USEPA guidance (2000) were used where available. A slab on grade construction was assumed and the 15 cm default value was used for the depth below grade to the bottom of the enclosed space floor. For groundwater, an average depth to groundwater of 7.2 feet below ground surface (bgs) was used based on observed depths to groundwater at SWMU 1 (PRC, 1996). For soil gas, average depths were chosen separately for shallow (2 ft bgs) and deep (6 ft bgs) based on observed depths in OU-5 (IT, 2001; Shaw, 2004a,b). The groundwater concentrations used are listed in Table 3.1 and the soil gas concentrations are listed in Table 3.3. The soil properties were taken from soil boring logs collected at the site. Based on the soil borings collected from the site and discussions with Tetra Tech geologists, the soil type in SWMU 1 was identified as a sandy loam. The Johnson and Ettinger model and the guidance for the model (USEPA, 2000) assign default soil properties based on this soil type. The parameters that went into the model are listed in Appendix A.

2.3.2 Exposure Parameters

The risks associated with exposure to chemicals at the property depend not only on their concentrations, but also on the extent to which receptors are exposed. For example, the risks associated with exposure for one hour per day are less than those associated with exposure at the same concentration for two hours per day. Because risks depend upon both the concentration and the extent of the exposure, the assumptions regarding the extent of exposure are discussed in this section for each of the complete exposure pathways identified above. Tables 4.1 through 4.10 presents each of the Tier 1 exposure parameters used in this HRA for each pathway.

Many of the assumptions regarding the extent of exposure to COPCs are a combination of reasonable maximum exposure (RME) and average exposure factors developed by USEPA's Superfund program. Default values (USEPA, 1991; 1997; 2001b; DTSC, 1992, 1994b) were used in the HRA. For the Tier 1 school assessment, it was conservatively assumed that school receptors are exposed at the same frequency and magnitude as residential receptors.

The permeability coefficients for the dermal contact with water exposure pathways were obtained either directly from USEPA (2001b), or calculated using the chemical's octanol water coefficient (K_{ow}) and molecular weight. These values are presented in Appendix A. The formula for calculating permeability coefficients is:

$$\log K_p = -2.72 + 0.71 \log K_{ow} - 0.0061\,MW$$

For polyaromatic hydrocarbons (PAHs) and similar lipophilic organic constituents, it was determined that the groundwater samples collected were unfiltered, and that high total suspended solid (TSS) and total dissolved solid (TDS) were detected in these samples. Due to the very high organic carbon partitioning coefficients ($\log K_{ow} \geq 4$) for lipophilic organic constituents, an analysis was conducted to determine whether sufficient concentrations of lipophilic organic constituents would be available in dissolved form to represent a significant risk by dermal absorption. To determine this, the relative 'carrying capacity' of the TSS and TDS in groundwater was estimated. Utilizing the K_{oc} for each constituent, the USEPA (1996) default

organic carbon content for soil (0.6 percent), and the concentration of TSS or TDS in groundwater, the equilibrium concentration of a constituent in suspended and dissolved sediment could be calculated.

For example, the measured benzo(a)pyrene concentration in water is 0.06 mg B(a)P/liter. Sediment in contact with this water, at equilibrium, would contain: C_{water} B(a)P/L × Koc (L/kg) × Foc (unitless) = 0.06 mg B(a)P/L × 1,020,000 L/kg × 0.006 = 367.2 mg B(a)P/kg sediment. If water contains 30 mg suspended sediment per liter of water, then groundwater containing suspended sediment in equilibrium with benzo(a)pyrene in water could contain $C_{w,sediment}$ × $C_{B(a)P,\ sediment}$ = 30 mg TSS/L water × 10^{-6} kg/mg × 367 mg B(a)P/kg sediment = 0.15 mg B(a)P/L water. Because this value (capacity) exceeds the measured value of benzo(a)pyrene in water, one can therefore determine that the measured benzo(a)pyrene in water at the site is associated with suspended sediment and is not available for dermal absorption.

USEPA concurs with this premise in the RAGS supplemental dermal exposure assessment guidance (2001b), which states:

> *...it should be noted that particulate-bound chemicals in an aqueous medium (e.g., suspended sediment particles) would be considered to be much less bioavailable for dermal absorption, due to inefficient adsorption of suspended particles onto the skin surface and a slower rate of absorption into the skin.*

These calculations are also likely to be conservative (underestimate the lipophilic organic constituents binding potential of TSS) because the default organic carbon content than 0.6 percent is likely to be substantially lower than the organic carbon content of sediment from the site. This is because the site is a former wetlands, and wetland sediments tend to contain large concentrations of organic carbon from decomposition of organic matter. Therefore, based upon this information, for the purposes of estimating risks from dermal exposure to groundwater, it is assumed that the dermal permeability of PAHs, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, n-butylbenzene, n-propylbenzene and sec-butylbenzene in groundwater is zero, as they are assumed to be bound to suspended sediment. The K_p values utilized in the assessment are presented in Appendix A.

2.3.3 Quantification of Exposure

In this section, the concentrations of COPCs at the points of potential human exposure are combined with assumptions about the behavior of the populations potentially at risk in order to estimate the ADD of COPCs that may be taken in by the exposed individuals. Later, in the risk characterization step of the assessment, the ADDs are combined with toxicity parameters for COPCs to estimate whether the calculated intake levels pose a threat to human health.

The method used to estimate the ADD of the COPCs via each of the complete exposure pathways is based on USEPA (1989, 1992a) guidance. For carcinogens, LADD estimates are based on chronic lifetime exposure, extrapolated over the estimated average lifetime (assumed to be 70 years). This establishes consistency with cancer slope factors (CSFs), which are based on chronic lifetime exposures. For non-carcinogens, ADD estimates are averaged over the estimated

exposure period. ADDs and LADDs were calculated for each exposure scenario listed above using the following equations:

- Inhalation

For workers and children:

$$ADD\ or\ LADD\ (mg/kg\text{ - }day) = \frac{(C\ x\ IR\ x\ EF\ x\ ED\ x\ AF)}{AT\ x\ BW}$$

For age-weighted residents:

- $$ADDorLADD_{inhalation}(mg/kg-d) = \frac{C \times IR_{awa} \times EF \times ABS_i}{AT \times 365d/yr}$$

- Dermal

For workers and children:

$$ADD\ or\ LADD\ (mg/kg\text{ - }day) = \frac{(C\ x\ SA\ x\ EF\ x\ ET\ x\ ED\ x\ Kp\ x\ CF)}{AT\ x\ BW}$$

For age-weighted residents:

$$ADD\ or\ LADD\ (mg/kg\text{ - }day) = \frac{(C\ x\ SA_{awa}\ x\ EF\ x\ ET\ \ x\ Kp\ x\ CF)}{AT\ x365d/y}$$

- Ingestion

For commercial and construction workers, and child residents:

$$ADDorLADD_{ingestion}(mg/kg-d) = \frac{C \times IR_s \times EF \times ED \times ABS_o}{BW \times AT \times 365d/yr}$$

For age-weighted residents:

$$ADD\ or\ LADD_{ingestion}(mg/kg-d) = \frac{C \times IR_{awa} \times EF \times CF \times ABS_o}{AT \times 365d/yr}$$

where,

$$IR_{awa} = \frac{IR_{child} \times ED_{child}}{BW_{child}} + \frac{IR_{adult} \times ED_{adult}}{BW_{adult}}$$

C = COPC concentration (*e.g.*, mg/m^3, mg/L)
IR = intake rate; the amount of the transport medium contacted per unit time (*e.g.*, m^3/day)
EF = exposure frequency (days/year)
ET = exposure time (hours/day)
ED = exposure duration (years)
AF = absorption factor (*e.g.*, assumed to be 100% for inhalation)
K_p = dermal permeability factor (*e.g.*, cm/hr)
CF = media conversion factors (L/1000 cm^3)
SA = skin surface area exposed (cm^2)
AT = averaging time; the time over which the exposure is averaged (days)
BW = body weight (kilograms)

2.4 Tier 1 Toxicity Assessment

This section describes the toxicity of the COPCs at the site. Numerical toxicity values were developed for use in the calculation of the hazard quotients (for non-carcinogens) and risks (for carcinogens).

2.4.1 Toxicity Values

Toxicity values, when available, are published by the USEPA in the on-line Integrated Risk Information System (IRIS [USEPA, 2004]) and the Health Effects Assessment Summary Tables (HEAST). CSFs are chemical-specific, experimentally-derived potency values used to calculate the risk of cancer resulting from exposure to carcinogenic chemicals. Cal/EPA publishes cancer slope factors for use in Cal/EPA oversight projects (OEHHA, 2004). A higher value implies a more potent carcinogen. Reference doses (RfDs) are experimentally derived "no-effect" values used to quantify the extent of adverse non-cancer health effects from exposure to chemicals. Here, a lower RfD implies a more potent toxicant. These criteria are generally developed by USEPA risk assessment work groups and listed in USEPA risk assessment guidance documents and databases. Non-cancer toxicity criteria for each of the COPCs evaluated in this assessment are presented in Tables 5.1 and 5.2. Cancer toxicity criteria for each of the COPCs evaluated in this assessment are presented in Tables 6.1 and 6.2. The hierarchy for selecting toxicity criteria is as follows:

- OEHHA Cancer Potency Factors
- USEPA's IRIS
- USEPA's HEAST

With the exception of oral toxicity values being used to characterize risks from dermal exposures, route to route extrapolation of toxicity criteria for pathways (inhalation, oral) without established criteria was not undertaken.

2.4.2 Carcinogenic Effects

USEPA and Cal/EPA develop CSFs from chronic animal studies or, where possible, epidemiological data. Because animal studies use much higher doses over shorter periods of time than the exposures generally expected for humans, the data from these studies are adjusted, typically using a linearized multi-stage (LMS) mathematical model. To ensure protectiveness, CSFs are typically derived from the upper 95th percentile confidence limit of the slope, and thus the actual risks are unlikely to be higher than those predicted using the CSF, and may be considerably lower.

2.4.3 Non-Carcinogenic Effects

For adverse non-cancer health effects, USEPA assumes that a dose threshold exists, below which adverse effects are not expected to occur. A chronic RfD of a chemical is an estimate of a lifetime daily dose to humans that is likely to be without appreciable deleterious non-carcinogenic effects. To derive an RfD, a series of professional judgments is made to assess the quality and relevance of the human or animal data and to identify the critical study and the most critical toxic effect. Data typically used in developing the RfD are the highest no-observable-adverse-effect-levels (NOAELs) for the critical studies and effects of the non-carcinogen. For each factor representing a specific area of uncertainty inherent in the extrapolation from the available data, an uncertainty factor is applied. Uncertainty factors generally consist of multiples of 10, although values less than 10 are sometimes used.

Four major types of uncertainty factors are typically applied to NOAELs in the derivation of RfDs. Uncertainty factors of 10 are used to (1) account for the variability between humans, (2) extrapolate from animals to humans, (3) account for a NOAEL based on a subchronic study instead of a chronic study, and (4) extrapolate from a lowest-observed-adverse-effect-level (LOAEL) to a NOAEL, if necessary. In addition, a modifying factor can be used to account for adequacy of the database. Typically, the modifying factor is set equal to one.

To obtain the RfD, all uncertainty factors associated with the NOAEL are multiplied together, and the NOAEL is divided by the total uncertainty factor. Therefore, each uncertainty factor adds a degree of conservatism (usually one order of magnitude) to the RfD. An understanding of the uncertainties associated with RfDs is important in evaluating the significance of the hazard indices calculated in the risk characterization portion of the HRA.

2.5 Tier 1 Risk Characterization

In the last step of a risk assessment, the estimated rate at which a person intakes a COPC is compared with information about the toxicity of that COPC to estimate the potential risks to human health posed by exposure to the COPC. This step is known as the risk characterization. In the risk characterization, cancer risks are evaluated separately from adverse non-cancer health effects. The methods used for assessing cancer risks and adverse non-cancer health effects are discussed below.

2.5.1 Methods for Assessing Cancer Risks

In the risk characterization, carcinogenic risk is estimated as the incremental probability of an individual developing cancer over a lifetime as a result of a chemical exposure. Carcinogenic risks are evaluated by multiplying the estimated average exposure rate (*i.e.*, LADD calculated in the exposure assessment) by the chemical's CSF (listed in Tables 6.1 and 6.2). The CSF converts estimated daily intakes averaged over a lifetime to incremental risk of an individual developing cancer. Because cancer risks are averaged over a person's lifetime, longer-term exposure to a carcinogen will result in higher risks than shorter-term exposure to the same carcinogen, if all other exposure assumptions are constant. Theoretical risks associated with low levels of exposure in humans are assumed to be directly related to an observed cancer incidence in animals associated with high levels of exposure. According to USEPA (1989), this approach is appropriate for theoretical upper-bound cancer risks of less than 1×10^{-2}. The following equations were used to calculate chemical-specific risks and total risks:

$$\text{Risk} = \text{LADD} \times \text{CSF}$$

where,

LADD = lifetime average daily dose (mg/kg-d)
CSF = cancer slope factor $(\text{mg/kg-d})^{-1}$

and

$$\textit{Total Carcinogenic Risk} = \sum \textit{Individual Risk}$$

It is assumed that cancer risks from various exposure routes are additive. That is, theoretical carcinogenic risks for all potentially carcinogenic COPCs and individual receptors are summed across all relevant exposure pathways to obtain a total theoretical carcinogenic risk for an area of interest. Thus, the result of the assessment is a high-end estimate of the total carcinogenic risk. High-end carcinogenic risk estimates are then compared to USEPA's acceptable risk range of one in one million (10^{-6}) to one in ten thousand (10^{-4}). If the estimated risk falls below the risk value considered acceptable by USEPA, the chemical is considered unlikely to pose a carcinogenic health risk to individuals under the given exposure conditions. A risk level of 10^{-6} represents a probability of one in one million that an individual could develop cancer from exposure to the potentially carcinogenic COPCs under a defined set of exposure assumptions.

2.5.2 Methods for Assessing Non-Cancer Health Effects

Adverse non-cancer health effects are estimated by comparing the estimated average exposure rate (*i.e.*, ADDs estimated in the exposure assessment) with an exposure level at which no adverse health effects are expected to occur for a long period of exposure (*i.e.*, the RfDs listed in Table 5.1 and 5.2). ADDs and RfDs are compared by dividing the ADD by the RfD to obtain the ADD:RfD ratio, as follows:

$$\textit{Hazard Quotient} = \frac{ADD}{RfD}$$

where,

ADD = average daily dose (mg/kg-d)
RfD = reference dose (mg/kg-d)

The ADD:RfD ratio is known as a hazard quotient. If a person's average exposure is less than the RfD (*i.e.*, if the hazard quotient is less than one), the chemical is considered unlikely to pose a significant non-carcinogenic health hazard to individuals under the given exposure conditions. Unlike carcinogenic risk estimates, a hazard quotient is not expressed as a probability. Therefore, while both cancer and non-cancer risk characterizations indicate a relative potential for adverse effects to occur from exposure to a chemical, a non-cancer health threat estimate is not directly comparable with a cancer risk estimate.

If more than one non-carcinogen or pathway is evaluated, the hazard quotients for each chemical and each pathway are summed to determine whether exposure to a combination of pathways and chemicals poses a health concern. This sum of the hazard quotients is known as a hazard index (HI).

$$\text{Hazard Index} = \sum \text{Hazard Quotients}$$

By using USEPA and Cal/EPA-developed RfDs and CSFs, along with reasonable maximum estimates of exposure, the risk characterization is likely to be conservative. A conservative risk characterization indicates that the cancer risks and adverse non-cancer health effects are not likely to be underestimated.

2.5.3 Tier 1 Quantitative Risk Assessment Results

Non-cancer health hazards and cancer risks for on-site commercial workers, school workers and students, and residents are presented in Tables 7.1 through 7.10. Summaries of these risks for each of these receptors are presented in Tables 9.1 through 9.10. Tier 1 risk summaries are presented in Tables 10.1 through 10.10. It should be noted that though these results contain "average" and "RME" exposure and risk estimates, they are based on the use of maximum detected groundwater or soil gas concentrations for each constituent. However, the use of the maximum detected concentration for a location is a screening tool only. In those cases where a given chemical yielded a screening risk of potential concern, the chemical was carried forward and a Tier 2 assessment was conducted.

Because the estimated theoretical upper-bound incremental lifetime cancer risks (ILCRs) exceeds 10^{-4} and the HIs exceed 1.0 and over 95 percent of these risks are due to benzene and naphthalene for groundwater and benzene alone for soil gas, these compounds are recommended for further evaluation in a Tier 2 assessment to further understand the risk implications associated with a more realistic set of exposure variables (including concentration terms).

2.6 Tier 2 Exposure Assessment

The results of the Tier 1 exposure assessment outlined above indicated that estimated HIs and ILCRs were of potential concern. Because these risks were associated with the maximum

detected groundwater concentrations and highly conservative (in most cases, default) exposure parameters, they were carried through to a Tier 2 assessment so that the implications of using more realistic exposure point concentrations and exposure parameters can be understood.

Because the general methodology used for the Tier 2 exposure quantification, toxicity assessment, and risk characterization is the same in most cases as the Tier 1 assessment, only those elements that were modified from the Tier 1 assessment are discussed here.

2.6.1 Exposure Point Concentration

Because cancer risks and HIs for reasonably foreseeable complete exposure pathways were driven by the estimated exposures to benzene and naphthalene, respectively, Tier 2 concentrations are derived for benzene and naphthalene for groundwater and benzene for soil gas.

For groundwater, the Tier 2 assessment used appropriate geostatistical methods for determining relevant groundwater exposure point concentrations for each COPC and/or location. These concentrations were used to estimate theoretical human exposure to COPCs in both the theoretical exposure scenarios -- the potential beneficial uses scenarios and the school site scenario. Calculations were based on groundwater data compiled from the quarterly groundwater monitoring program conducted in 2001.

USEPA's defines a representative exposure concentration as the concentration of contaminant occurring at the point of exposure. The representative exposure concentration, which is also referred to as the concentration term in the exposure assessment intake equation, is not a point value but rather is a value associated with an exposure domain (an area over which the exposed population is likely to come into contact with a substance). In cases where data are collected randomly and are uncorrelated, the representative exposure concentration is estimated as the upper confidence level (UCL) of the arithmetic mean concentration. However, if the available sampling data are collected non-randomly and display a degree of spatial continuity, which is the case at the site, employing geostatistical methods for calculating the representative exposure concentration is a reasonable and appropriate approach.

The specific geostatistical method employed for calculating 95 percent UCL concentrations for individual areas and COPC is called block kriging. Block kriging techniques compute spatial correlation models for data points within a specified geographical area. The goal of such an analysis is to determine an area-specific average value. In computing these spatial averages, kriging methods incorporate the fact that not all samples are weighted equally. Some samples are associated with locations at greater distances from each other while others are much closer together. The kriging technique takes into account the spatial differences between points in determining the weight of influence of a single data point on an area average (Clark, 1979).

The first task in performing this statistical analysis is determining the spatial correlation through computation and determination of the COPC-specific "variogram" model. The ArcView Spatial Analyst program was used for developing the variogram models for benzene and naphthalene. Because the reliability of a variogram model is directly related to the size of the data set (*i.e.,* the number of sampling locations), the 2001-2003 groundwater data were used to develop the

variogram model for benzene and naphthalene. The variogram model is then tested using measured values to ensure its fit (*i.e.,* adequacy and appropriateness). The selected model is then used to estimate the block average and kriging standard deviation for the chemical over an area. The area used in this assessment was a circular area around monitoring well OS-HP-10, the well with the highest measured benzene concentration. Two radii around this well were used: a 500 foot radius, and a 725 foot radius. The rationale for selecting these radii is described in Section 6.5 of the Remedial Investigation/Feasibility Study. The calculated 95 percent UCLs from the block kriging with these radii were used as the Tier 2 exposure point concentrations for benzene and naphthalene.

For soil gas, four exposure areas were defined based on current land use. They include the Alameda Annex, Alameda Point - Site 25, Alameda Point – Site 30, and Alameda Point - Site 31. Alameda Annex is not used for residential purposes at this time. However, Alameda Point – Site 31 is currently used for residential and Alameda Point – Site 30 is occupied by a school. The maximum benzene values were selected as the Tier 2 values for each of these four locations.

Tables 3.7 through 3.12 present the Tier 2 exposure point concentrations. For all fate and transport modeling, the same Tier 1 procedures outlined in Section 2.3.1.1 were implemented in the Tier 2 assessment. Therefore, they are not repeated here.

2.6.2 Exposure Parameters

For the hypothetical workers, the exposure duration was the only exposure parameter customized to more closely reflect job-specific occupational tenure estimates. Data from USEPA (1997) and Carey (1988) were used to identify distributions of occupation tenure for the car wash worker (using "garage and service station related occupations" data) and for the landscape worker (using "groundskeepers and gardeners, except farm"). The median values for each distribution (2.6 years for car wash workers and 3.6 years for landscape workers) were used as the average exposure parameters. Using the years of tenure ranges coupled with their associated frequencies, distributions were set up using Crystal Ball®'s custom distribution option. The distribution was forecast and Crystal Ball® was run 10,000 times. The 90th percentile value of the executed distribution profile for each receptor type was selected for use as the RME exposure duration (13.6 and 17.6 years for car wash and landscape workers, respectively). See Tables 4.11 through 4.20 for the exposure parameters used in the Tier 2 assessment.

For school receptors, school specific exposure parameters were incorporated into the Johnson and Ettinger model. These parameters are presented in Appendix A.

2.7 Tier 2 Risk Assessment Results

Non-cancer health hazards and cancer risks for on-site commercial workers, school workers and students, and residents are presented in Tables 7.11 through 7.20. Summaries of these risks for each of these receptors are presented in Tables 9.11 through 9.20. The results of the Tier 2 assessment are summarized in Tables 10.11 through 10.20. The Tier 2 results for individual receptors are discussed below.

2.7.1 Potential Groundwater Beneficial Uses

2.7.1.1 Car Wash Worker

Non-Cancer. For the car wash worker, Tier 2 average and RME theoretical HIs using data kriged to 500 foot radius were 0.38 and 0.99, respectively. Tier 2 average and RME theoretical HIs using data kriged to 725 foot radius were 0.30 and 0.77, respectively. Approximately 45 percent of the HI is due to naphthalene.

Cancer. Average and RME ILCRs for the car wash worker data using kriged to 500 foot radius were 2×10^{-6} and 2×10^{-5}, respectively. Average and RME ILCRs for the car wash worker data using kriged to 725 foot radius were 1×10^{-6} and 2×10^{-5}, respectively. These ILCRs falls within USEPA's acceptable risk range of 10^{-4} to 10^{-6}. Approximately 50 percent of the ILCR is due to benzene.

2.7.1.2 Landscape Worker

Non-Cancer. For the landscape worker, Tier 2 average and RME theoretical HIs using data kriged to 500 foot radius were 0.66 and 0.98, respectively. Tier 2 average and RME theoretical HIs using data kriged to 725 foot radius were 0.51 and 0.76, respectively. Approximately 45 percent of the HI is due to naphthalene.

Cancer. Average and RME ILCRs for the landscape worker data using kriged to 500 foot radius were 3×10^{-6} and 3×10^{-5}, respectively. Average and RME ILCRs for the car wash worker using data kriged to 725 foot radius were 2×10^{-6} and 2×10^{-5}, respectively. These ILCRs falls within USEPA's acceptable risk range of 10^{-4} to 10^{-6}. Approximately 50 percent of the ILCR is due to benzene.

2.7.1.3 Resident

Due to the nature of the Johnson and Ettinger model, only the RME scenario was run for the residential receptor.

Non-Cancer. The Tier 2 HI based on groundwater data calculated using the Johnson and Ettinger model for the resident (a child) was 0.29 using groundwater data kriged to both the 500 and 725 foot radius. The Tier 2 HI based on soil gas data calculated using the Johnson and Ettinger model for the resident (a child) were 0.0092 for the Alameda Annex and 0.0076 for Alameda Point – Sites 25, 30 and 31. Because these theoretical HIs are less than the target hazard index of 1.0, no non-carcinogenic health effects are anticipated as a result of hypothetical exposures of a resident to chemical vapors that may originate from groundwater or soil gas beneath the site.

Cancer. The theoretical upper-bound ILCR estimate for the resident (adult) using groundwater data kriged to a 500 foot and 725 foot radius were 1×10^{-5} and 8×10^{-6}, respectively. The theoretical upper-bound ILCR estimate for the resident (adult) using soil gas data were 1×10^{-6} for the Alameda Annex and 5×10^{-8} for Alameda Point – Sites 25, 30 and 31. These ILCRs falls within or below USEPA's acceptable risk range of 10^{-4} to 10^{-6}. Approximately 90 percent of the ILCR is due to benzene.

2.7.1.4 School Site

Due to the nature of the Johnson and Ettinger model, only the RME scenario was run for each school receptor.

School Worker

Non-Cancer. The Tier 2 HI based on groundwater data calculated using the Johnson and Ettinger model for the school worker was 0.29 using groundwater data kriged to both the 500 and 725 foot radius. The Tier 2 HI based on soil gas data calculated using the Johnson and Ettinger model for the school worker were 0.0087 for the Alameda Annex and 0.0076 for Alameda Point – Sites 25, 30 and 31. Because this theoretical HIs are less than the target hazard index of 1.0, no non-carcinogenic health effects are anticipated as a result of hypothetical exposures of a school worker to chemical vapors that may originate from groundwater or soil gas beneath the site.

Cancer. The theoretical upper-bound ILCR estimate for the school worker using groundwater data kriged to a 500 foot and 725 foot radius were 7×10^{-6} and 5×10^{-6}, respectively. The theoretical upper-bound ILCR estimate for the school worker using soil gas data were 8×10^{-7} for the Alameda Annex and 5×10^{-8} for Alameda Point – Sites 25, 30 and 31. These ILCRs falls within or below USEPA's acceptable risk range of 10^{-4} to 10^{-6}. Approximately 80 percent of the ILCR is due to benzene.

Student

Non-Cancer. The Tier 2 average and RME theoretical HIs based on groundwater calculated using the Johnson and Ettinger model for the school student was 0.29 using groundwater data kriged to the 725 and 500 foot radius. The Tier 2 HI based on soil gas data calculated using the Johnson and Ettinger model for the school student were 0.0084 for the Alameda Annex and 0.0076 for Alameda Point – Sites 25, 30 and 31. Because this theoretical HIs are less than the target hazard index of 1.0, no non-carcinogenic health effects are anticipated as a result of hypothetical exposures of a school student to chemical vapors that may originate from groundwater or soil gas beneath the site.

Cancer. The theoretical upper-bound ILCR estimate for the school student using groundwater data kriged to a 500 foot and 725 foot radius was 2×10^{-6} for both. The theoretical upper-bound ILCR estimate for the school worker using soil gas data were 2×10^{-7} for the Alameda Annex and 5×10^{-8} for Alameda Point – Sites 25, 30 and 31. These ILCRs fall below or at the lowest (most conservative) end of USEPA's acceptable risk range of 10^{-4} to 10^{-6}. Approximately 45 percent to 55 percent of the ILCR is due to benzene.

2.7.2 Potential Groundwater Potable Uses

It is important to note that groundwater at the site is currently not used as a potable water supply, and that any future development at the site will include connecting the developments to the existing municipal water supply.

2.7.2.1 Car Wash Worker

Non-Cancer. For car wash worker scenario, the Tier 2 average and RME theoretical HIs associated with theoretical use of groundwater as a potable water supply using data kriged to a 725 foot radius were 8.2 and 8.7. Tier 2 average and RME theoretical HIs associated with theoretical use of groundwater as a potable water supply using data kriged to a 500 foot radius were 9.2 and 9.8.

Cancer. For the car wash worker scenarios, the average and RME theoretical ILCRs associated with theoretical use of groundwater as a potable water supply using data kriged to both a 725 and 500 foot radius were 4×10^{-4} and 2×10^{-3}, respectively. Approximately 80 percent of this ILCR is due to PAHs in the groundwater.

2.7.2.2 Landscape Worker

Non-Cancer. For landscape worker scenario, the Tier 2 average and RME theoretical HIs associated with theoretical use of groundwater as a potable water supply using data kriged to a 725 foot radius were 8.4 and 8.7. Tier 2 average and RME theoretical HIs associated with theoretical use of groundwater as a potable water supply using data kriged to a 500 foot radius were 9.5 and 9.8.

Cancer. For the landscape worker scenarios, the average and RME theoretical ILCRs associated with theoretical use of groundwater as a potable water supply using data kriged to both a 725 and 500 foot radius were 5×10^{-4} and 3×10^{-3}, respectively. Approximately 80 percent of this ILCR is due to PAHs in the groundwater.

2.7.2.3 Resident

Non-Cancer. For the resident scenario, the average and RME theoretical HIs associated with theoretical use of groundwater as a potable water supply using groundwater data kriged to a 725 foot radius or soil gas data from Alameda Annex or Alameda Point – Sites 25, 30 or 31 were 74 and 123, respectively. Average and RME theoretical HIs associated with theoretical use of groundwater as a potable water supply using data kriged to a 500 foot radius were 88 and 145, respectively.

Cancer. For the resident scenario, the average and RME theoretical ILCRs associated with theoretical use of groundwater as a potable water supply using data kriged to either a 725 or 500 foot radius and including indoor air inhalation via groundwater or soil gas from locations from Alameda Annex or Alameda Point – Sites 25, 30 or 31 were 5×10^{-3} and 2×10^{-2}, respectively.

The results of the Tier 2 assessment are summarized in Tables 10.11 through 10.20. It is important to note that these exposure scenarios could be additionally refined using probabilistic exposure assessment techniques. However, the use of the Tier 2 exposure point concentrations and refined exposure parameters has demonstrated that groundwater or soil gas, without potable use, does not pose a significant risk to any of the receptors assessed at the site.

The results of groundwater potable uses include the contribution of background levels of several inorganic constituents. Arsenic, barium, cadmium, iron, manganese, and thallium are inorganic COPCs that had total risk results that exceeded an HI of 1.0. Of these barium, iron, and thallium

are at levels that exceed reported background concentrations (Tetra Tech EM, 2001). The maximum arsenic, cadmium and manganese concentrations do not exceed background levels. The maximum barium concentration exceeds background by a factor of 3.4. The maximum iron concentration exceeds background by a factor of 5.5. The maximum thallium concentration exceeds background by a factor of 1.6.

Arsenic is the only inorganic COPC that had total risk results that exceeded the USEPA's acceptable risk range of 10^{-4} to 10^{-6}. The maximum arsenic concentration does not exceed background levels.

3.0 UNCERTAINTY ANALYSIS

Risk estimates are values that have uncertainties associated with them. These uncertainties, which arise at every step of a risk assessment, are evaluated to provide an indication of the relative degree of uncertainty associated with a risk estimate. In this section, a qualitative discussion of the uncertainties associated with the HRA for the site is presented.

Risk assessments are not intended to estimate actual risks to a receptor associated with exposure to chemicals in the environment. In fact, estimating actual risks is impossible because of the variability in the exposed or potentially exposed populations. Therefore, risk assessment is a means of estimating the probability that an adverse health effect (*e.g.*, cancer, impaired reproduction) will occur in a receptor. The multitude of conservative assumptions used in risk assessments guard against underestimation of risks.

Risk estimates are calculated by combining site data, assumptions about individual receptor's exposures to impacted media, and toxicity data. The uncertainties in this HRA can be grouped into four main categories that correspond to these steps:

- Uncertainties in environmental sampling and analysis
- Uncertainties in fate and transport modeling
- Uncertainties in assumptions concerning exposure scenarios
- Uncertainties in toxicity data and dose-response extrapolations

3.1 Environmental Sampling and Analysis

The HRA for the site is based on the sampling results obtained from recent investigations conducted by IT Corp. Errors in sampling results can arise from the field sampling, laboratory analyses, and data analyses. Errors in laboratory analysis procedures are possible, although the impacts of these sorts of errors on the risk estimates are likely to be low. The environmental sampling at the site is one source of uncertainty in the evaluation. However, the number of sampling locations and events is fairly large; therefore, the sampling and analysis data should be sufficient to characterize the impacts and the associated potential risks.

3.2 Fate and Transport Modeling

The assumptions and uncertainties inherent in each of the fate and transport models applied to the site are discussed in each of the individual model sections. To the extent practical, models have been calibrated to reflect actual site conditions. However, where site-specific data were unavailable, fate and transport models and their input parameters were selected such that modeled concentrations at a temporally or spatially remote receptor point would be overestimated. Thus, actual future concentrations of COPCs in each of the modeled media at the site are likely to be less than those predicted by the model.

A benzene soil gas investigation by Tetra Tech (1999) further shows the conservativeness of the results of this assessment. This assessment assumes that benzene in the groundwater readily volatilizes to soil pore water and soil pore gas, further moving out of soil into indoor air. The Tetra Tech soil gas summary (1999) concluded that benzene "is not volatilizing to a large extent from groundwater into soil gas in the area." This conclusion was based on low frequency of detections of benzene in soil gas even in areas with higher concentrations of benzene in groundwater. In addition, benzene when detected in soil gas was present in low soil gas concentrations that resulted in predicted residential cancer risk of equal to or less than 1×10^{-6} when placed into the Johnson and Ettinger model. Overall, the soil gas investigation indicated the limited ability of benzene to volatilize from groundwater at the site. This shows that the modeling used in this assessment would result in overestimation of soil gas at the site and thus and overestimation of indoor air concentrations and associated risks. This is demonstrated by the risks via indoor air calculated based on available soil gas data. These risks are lower than those compared to risks calculated from groundwater data.

3.3 Human Health Risk Assessment

Below is a discussion of the uncertainties inherent in each step of the risk assessment process.

3.3.1 Exposure Assessment

In this report, the exposure assessment is based on a number of assumptions with varying degrees of uncertainty (USEPA, 1992a). Uncertainties can arise from the types of exposures examined, the points of potential human exposure, the concentrations of COPCs at the points of human exposure, and the intake assumptions. These factors and the ways in which they contribute to the risk estimation are discussed below.

3.3.1.1 Types of Exposures Examined

The selection of exposure pathways is a process, often based on professional judgment that attempts to identify the most probable potentially harmful exposure scenarios. In an evaluation, risks are sometimes not calculated for all of the exposure pathways that may occur, possibly causing some underestimation of risk. In this evaluation, potential risks were estimated for exposure scenarios at the site. Risks to potential receptors were estimated for a number of different exposure pathways (*e.g.*, inhalation of volatiles). While other exposure routes could exist for a particular site use, these exposures are expected to be lower than the risks associated with the pathways considered.

3.3.1.2 Intake Assumptions Used

The risks calculated depend largely on the assumptions used to calculate the rate of COPC intake. The uncertainties associated with the parameters used in this HRA are described below.

Individuals can come into contact with chemicals via a number of different exposure routes. For the reasonable maximum exposure scenarios, standard default rates were used for these exposures. These represent upper-bound values and provide reasonable maximum activity

assumptions. The use of these standard default and upper-end values makes it likely that the risk is not underestimated, and may in fact be overestimated.

The amount of COPCs the body absorbs may be different from the amount of a COPC contacted. In this assessment, absorption of ingested and inhaled COPCs is conservatively assumed to be 100 percent. Actual chemical and site-specific values are likely less than this default value. Dermal absorption of PAHs from groundwater was also assumed to be zero, based upon an analysis that demonstrated that detected groundwater can be expected to be associated with suspended sediment. This may have underestimated potential dermal exposures.

3.3.2 Toxicological Data and Dose Response Extrapolations

The availability and quality of toxicological data is another source of uncertainty in the HRA. Uncertainties associated with animal and human studies may have influenced the toxicity criteria. Carcinogenic criteria are classified according to the amount of evidence available that suggests human carcinogenicity. USEPA assigns each carcinogen a designation of A through E, dependent upon the strength of the scientific evidence for carcinogenicity. In the establishment of the non-carcinogenic criteria, conservative multipliers, known as uncertainty and modifying factors, are used.

3.3.2.1 Uncertainties in Animal and Human Studies

Extrapolation of toxicological data from animal tests is one of the largest sources of uncertainty in a risk assessment. There may be important, but unidentified, differences in uptake, metabolism, and distribution of chemicals in the body between the test species and humans. For the most part, these uncertainties are addressed through use of conservative assumptions in establishing values for RfDs and CSFs, which results in the likelihood that the risk is overstated.

Typically, animals are administered high doses (*e.g.*, maximum tolerated dose) of a chemical in a standard diet or in air. Humans may be exposed to much lower doses in a highly variable diet, which may affect the toxicity of the chemical. In these studies, animals, usually laboratory rodents, are exposed daily to the chemical agent for various periods of time up to their 2-year lifetimes. Humans have an average 70-year lifetime and may be exposed either intermittently or regularly for an exposure period ranging from months to a full lifetime. Because of these differences, it is not surprising that extrapolation error is a large source of uncertainty in a risk assessment.

3.3.2.2 Non-Carcinogenic Toxicity Criteria

In the establishment of the non-carcinogenic criteria, conservative multipliers, known as uncertainty factors, are used. Most of the chronic non-carcinogenic toxicity criteria that were located in the IRIS database have uncertainty factors of 1,000. This means that the dose corresponding to a toxicological endpoint (*e.g.*, LOAEL) was divided by 1,000; thus increasing the toxicity by a factor of three. The purpose of the uncertainty factor is to account for the extrapolation of toxicity data from animals to humans and to insure the protection of sensitive individuals. However, in accomplishing these things, the uncertainty in the actual toxicity of the chemical in humans is greatly increased.

3.3.2.3 Carcinogenic Toxicity Criteria

Uncertainty due to extrapolation of toxicological data for potential carcinogens tested in animals to human data is more prominent for potentially carcinogenic chemicals than non-carcinogenic ones. USEPA uses the LMS model to extrapolate the toxicological data. The LMS assumes that there is no threshold for carcinogenic substances; that is, exposure to even one molecule of a carcinogen is sufficient to cause cancer. This is a highly conservative assumption because the body has several mechanisms to protect against cancer.

The use of the LMS model to extrapolate is a well-recognized source of significant uncertainty in the development of carcinogenic toxicity criteria and, subsequently, theoretical carcinogenic risk estimates. At high levels of exposure, there may indeed be a risk of cancer regardless of whether the effect occurs via a threshold mechanism or not. An animal bioassay can't determine what happens at low levels of exposure, however, which are generally typical of human exposure levels.

At low levels of exposure, the probability of cancer cannot be measured but must be extrapolated from higher dosages. To do this, animals are typically exposed to carcinogens at levels that are orders of magnitude greater than those likely to be encountered by humans in the environment. It would be difficult, if not impossible, to perform animal experiments with a large enough number of animals to directly estimate the level of risk at the low exposure levels typically encountered by humans. Thus, to estimate the risk to humans exposed at low levels, dose-response data derived from animals given high dosages are extrapolated downward using mathematical models such as the LMS, which assumes that there is no threshold of response. The dose-response curve generated by the model is known as the maximum likelihood estimate (MLE). The slope of the 95 percent lower confidence interval (*i.e.*, upper-bound limit) curve, which is a function of the variability in the input animal data, is taken as the CSF. CSFs are then used directly in cancer risk assessment.

Several other factors inherent in the LMS result in overestimated carcinogenic potency: (1) any exaggerations in the extrapolation that can be produced by some high dose responses (if they occur) are generally neglected, (2) upper confidence limits on the actual response observed in the animal study are used rather than the actual response, resulting in upper-bound low dose extrapolations, which can greatly overestimate risk, and (3) non-genotoxic chemicals (*i.e.*, threshold carcinogens) are modeled in the same manner as highly genotoxic chemicals.

Typically, animals are administered high doses, including the controversial maximum tolerated dose (MTD) of a chemical in a standard diet. Humans, on the other hand, may be exposed to much lower doses in a highly variable diet. In these studies, animals, usually laboratory rodents, are exposed daily to the chemical agent for various periods of time up to their two-year lifetime. Humans have an average 70-year lifetime and may be exposed either intermittently or regularly for an exposure period ranging from months to a full lifetime. Because of these differences, extrapolation error is a large source of uncertainty in risk assessment.

Even if studies of chemical effect in humans are available, they generally are for workplace exposures far in excess of those expected in the environment. Uncertainties can be large because the activity patterns, exposure duration and frequency, individual susceptibility, and dose may not be the same in the study populations as in the individuals exposed to environmental

concentrations. Because conservative methods are used in developing the RfDs and CSFs, the possibility of underestimating risks is low, and the risk estimates are likely overestimated through the use of the LMS approach.

3.4 Combinations of Sources of Uncertainty

Uncertainties from different sources are compounded in the HRA. For example, if a person's daily intake rate for a chemical is compared to an RfD to determine potential health risks, the uncertainties in the concentration measurements, exposure assumptions, and toxicities will all be expressed in the result. Therefore, by combining all upper-bound numbers, the uncertainty is compounded, and the resulting risk estimate is above the 90th or 95th percentile, perhaps even greater than the 99th percentile.

4.0 SUMMARY

The findings presented in this HRA are based on recent groundwater monitoring data. The methods and procedures used in this HRA are consistent with USEPA and DTSC guidance. Results of this HRA indicate that:

- The findings presented in this HHRA indicate that beneficial use of groundwater does not pose an unacceptable cancer risk to car wash and landscape workers. Under the non-potable water use scenarios, the non-carcinogenic HIs ranged from 0.30 to 0.99. Because the entire range is below the acceptable level of 1.0, adverse health effects to workers are considered unlikely.

- Potential inhalation of VOCs in indoor air by residential and school receptors does not pose an unacceptable health risk. The indoor air risks calculated from soil gas at areas where there are current residents, a school and a daycare center were below USEPA's acceptable risk range.

- Under the assumptions applied in this risk assessment, potential ingestion of groundwater would pose an unacceptable risk to future residential and worker receptors. Groundwater is not currently used as a source of drinking water, and it is not expected that it will be in future because of available municipal drinking water supply.

5.0 REFERENCES

American Society for Testing and Materials (ASTM). 1999. Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites. E1739-95e1.

California Department of Toxic Substances Control (DTSC). 1992. Supplemental Guidance for Human Health Multimedia Risk Assessments of Hazardous Waste Sites and Permitted Facilities.

California Department of Toxic Substances Control (DTSC). 1994a. *CalTOX, A Multimedia Exposure Model for Hazardous Waste Sites*. Office of Scientific Affairs. May.

California Department of Toxic Substances Control (DTSC). 1994b. Preliminary Endangerment Assessment Manual. January.

California Department of Toxic Substances Control (DTSC). 1999a. email from Mary Rose Casa to the Navy. Re: DTSC Toxicologists Comments on FISC Annex HRA Workplan. July 21, 1999.

California Department of Toxic Substances Control (DTSC). 1999b. Letter from Dr. John Christopher, Human and Ecological Risk Division (HERD), to Mary Rose Casa, Office of Military Facilities (OMF), Re: FISCO Facility/Alameda Annex: Remedial Investigation Report. September 17, 1999.

California Department of Toxic Substances Control (DTSC). 1999c. Letter from Mary Rose Casa, Office of Military Facilities (OMF), to Mr. Richard Hegarty, BRAC Environmental Coordinator, Re: Recommendations for Human Health Risk Assessment for Groundwater, Fleet and Industrial Supply Center Oakland-Alameda Facility/ Alameda Annex, Alameda, California. September 24, 1999.

California Department of Toxic Substances Control (DTSC). 1999d. Letter from Mary Rose Casa, Office of Military Facilities (OMF), to Mr Richard Hegarty, BRAC Environmental Coordinator, Re: Technical Memorandum: Supplemental Description of Methods for Use in the Human Health Risk Assessment, Fleet and Industrial Supply Center Oakland-Alameda Facility/ Alameda Annex, Alameda, California. November 29, 1999.

California Irrigation Management Information System (CIMIS). 1999. Developed by the California Department of Water Resource and the University of California at Davis: http://wwwdpla.water.ca.gov/cgi-bin/cimis/cimis/hq/main.pl.

Carey. 1988. Occupational tenure in 1987: many workers have remained in their fields. *Monthly Labor Review*. October. 3-12.

Clark, I. 1979. Practical Geostatistics. Applied Science Publishers. London.

IT, 2001. Draft Final Operable Unit 5 Remedial Investigation Report, Alameda Point, Alameda, CA.

Johnson, P. C., and R. A. Ettinger. 1991. Heuristic model for predicting the intrusion rate of contaminant vapors into buildings. *Environ. Sci. Technology*, Vol. 25:1445-1452

McKone, T.E. 1987. *Human Exposure to Volatile Organic Compounds in Household Tap Water: The Indoor Inhalation Pathway.* Environmental Science and Technology. Vol. 21. No. 12. Pages 1194-1201.

McKone, T.E. and Knezovich, J.P. 1991. *The Transfer of Trichloroethylene (TCE) from a Shower to Indoor Air: Experimental Measurements and Their Implications.* Journal of Air Waste Management, Vol. 41, Pages 832-837.

NewFields, Inc. 2000. Baseline Human Health Risk Assessment, FISCO Alameda Facility/Annex Site, Alameda, California. January.

Office of Environmental Health Hazard Assessment (OEHHA). 2004. California Cancer Potency Factors. California Environmental Protection Agency. On-line database.

Personal Communication. 1999. Personal communication of Ken Kiefer, NewFields, Inc., with Pro Equipment Co. and Custom Kraft. July 19, 1999.

PRC EM, Inc., 1996. Fleet and Industrial Supply Center, Oakland Alameda Facility/Alameda Annex Site Alameda, California, "Final Remedial Investigation Report". Tetra Tech EM, Inc. January 31.

San Francisco Bay Region, California Regional Water Quality Control Board (RWQCB). 1995. Water Quality Control Plan, San Francisco Bay Region (Region 2) (Basin Plan). November 13.

RWQCB. 1999. Letter from Mr. Gregory W. Bartow addressed to Mr. Antonio Tactay of the Navy Engineering Facility Activity, San Bruno, CA. Concurrence that Groundwater Meets the Exemption Criteria in the SWRCB Source of Drinking Water Policy Resolution 88-63 at Fleet and Industrial Supply Center Oakland, Alameda Facility/Annex, Alameda, County. June, 9.

Shaw, 2004a. Groundwater Monitoring Report for Installation Restoration Site 25 Group, Summer 2003 to Spring 2004, Alameda Point. April 16.

Shaw, 2004b. Groundwater Monitoring Report for Installation Restoration Site 25 Group, Summer 2002 to Spring 2003, Alameda Point. February 27.

Tetra Tech EM Inc. 1998a. Draft Base-Wide Groundwater Beneficial Use Report, Shallow Water Bearing Zone. Fleet And Industrial Supply Center, Oakland Alameda Facility/Alameda Annex, Alameda, California. December.

Tetra Tech EM Inc. 1998b. Final Cumulative Groundwater Monitoring report. Fleet And Industrial Supply Center, Oakland Alameda Facility/Alameda Annex, Alameda, California. November.

Tetra Tech EM Inc. 1999. Updated Alameda Point/Alameda Annex Benzene Soil Gas Investigation Summary and Summary of Crawl Space Benzene Air Sampling at Parcel 179. October 20.

Tetra Tech EM Inc. 2001. Final Technical Memorandum on the Groundwater and Benzene Soil Gas Investigation at Installation Restoration Site 02 Fleet and Industrial Supply Center Oakland Alameda Facility/Alameda Annex, Alameda, California. December 27.

U.S. Environmental Protection Agency (USEPA). 1989. Risk Assessment Guidance for Superfund: Volume I—Human Health Evaluation Manual (Part A). Interim Final. Office of Emergency and Remedial Response, Washington, D.C. EPA/540/1-89/002. December.

U.S. Environmental Protection Agency (USEPA). 1991. Risk Assessment Guidance for Superfund: Volume I—Human Health Evaluation Manual. Supplemental Guidance 'Standard Default Exposure Factors'. Office of Emergency and Remedial Response, Washington, D.C. OSWER Directive 9285.3-03. March.

U.S. Environmental Protection Agency (USEPA). 1992a. Guidelines for Exposure Assessment. Federal Register, 57(104):22888-22938. May 29.

U.S. Environmental Protection Agency (USEPA). 1992b. Supplemental Guidance to RAGS: Calculating the Concentration Term. Office of Emergency and Remedial Response, Washington, D.C. Publication 9285.7-08I. May.

U.S. Environmental Protection Agency (USEPA). 1997. Exposure Factors Handbook—Volumes I-III. Office of Research and Development, Washington DC. EPA/600/P-95/002Fa-c. August.

U.S. Environmental Protection Agency (USEPA). 2000. Users Guide for the Johnson and Ettinger (1991) Model for Subsurface Vapor Intrusion into Buildings. Office of Emergency and Remedial Response. September.

U.S. Environmental Protection Agency (USEPA). 2001a. Risk Assessment Guidance for Superfund: Volume III—Part A, Process for Conducting Probabilistic Risk Assessment. Office of Emergency and Remedial Response, Washington, DC. EPA-540R-02-002.

U.S. Environmental Protection Agency (USEPA). 2001b. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), Interim. Review Draft for Public Comment. Office of Emergency and Remedial Response. September.

U.S. Environmental Protection Agency (USEPA). 2002: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. EPA OSWER 9355.4-24. December.

U.S. Environmental Protection Agency (USEPA). 2004. Integrated Risk Information System (IRIS). On-line database, Washington, DC.

TABLES

TABLE ES.1

TIER 1 RISK SUMMARY

FISCO ALAMEDA FACILITY/ANNEX SITE

	Non-Cancer Hazard		Cancer Risk	
	Average Exposure	RME Exposure	Average Exposure	RME Exposure
Dermal Contact				
Car Wash Worker	2.7	6.2	3 E-5	3 E-4
Landscape Worker	3.7	8.0	2 E-5	2 E-4
Inhalation - Modeled from Groundwater				
Car Wash Worker	0.70	2.2	2 E-6	2 E-5
Landscape Worker	2.1	2.1	6 E-6	2 E-5
Resident	0.46	0.46	1 E-4	1 E-4
School Worker	0.46	0.46	1 E-4	1 E-4
School Student	0.46	0.46	1 E-4	1 E-4
Inhalation - Modeled from Soil Gas				
Resident	0.0091	0.0091	1 E-6	1 E-6
School Worker	0.0091	0.0091	1 E-6	1 E-6
School Student	0.0091	0.0091	1 E-6	1 E-6
Total				
Car Wash Worker	3.4	8.3	3 E-5	3 E-4
Landscape Worker	5.8	10	2 E-5	2 E-4
Modeled from Groundwater				
Resident	0.46	0.46	1 E-4	1 E-4
School Worker	0.46	0.46	1 E-4	1 E-4
School Student	0.46	0.46	1 E-4	1 E-4
Modeled from Soil Gas				
Resident	0.0091	0.0091	1 E-6	1 E-6
School Worker	0.0091	0.0091	1 E-6	1 E-6
School Student	0.0091	0.0091	1 E-6	1 E-6
Assuming Domestic Water Use				
Ingestion				
Car Wash Worker	32	32	1 E-3	5 E-3
Landscape Worker	32	32	1 E-3	5 E-3
Resident	118	235	6 E-3	3 E-2
Inhalation				
Resident	4574	6169	1 E-2	4 E-2
Total				
Car Wash Worker	35	40	1 E-3	6 E-3
Landscape Worker	37	42	1 E-3	6 E-3
Resident	4692	6404	2 E-2	6 E-2

TABLE ES.2

TIER 2 RISK SUMMARY

FISCO ALAMEDA FACILITY/ANNEX SITE

	Non-Cancer Hazard		Cancer Risk	
	Average Exposure	RME Exposure	Average Exposure	RME Exposure
Industrial Receptors				
Dermal Contact				
Car Wash Worker				
Non-Kriged COPCs	0.047	0.108	7 E-7	8 E-6
Benzene 725 ft radius	0.057	0.13	6 E-7	8 E-6
Benzene 500 ft radius	0.09	0.20	1 E-6	1 E-5
Naphthalene 725 ft radius	0.085	0.20	NA	NA
Naphthalene 500 ft radius	0.110	0.25	NA	NA
Landscape Worker				
Non-Kriged COPCs	0.047	0.108	9 E-7	1 E-5
Benzene 725 ft radius	0.057	0.13	9 E-7	1 E-5
Benzene 500 ft radius	0.09	0.20	1 E-6	2 E-5
Naphthalene 725 ft radius	0.085	0.20	NA	NA
Naphthalene 500 ft radius	0.110	0.25	NA	NA
Inhalation				
Car Wash Worker				
Non-Kriged COPCs	0.0034	0.010	3 E-8	4 E-7
Benzene 725 ft radius	0.0062	0.019	4 E-8	6 E-7
Benzene 500 ft radius	0.010	0.029	6 E-8	1 E-6
Naphthalene 725 ft radius	0.099	0.30	NA	NA
Naphthalene 500 ft radius	0.128	0.39	NA	NA
Landscape Worker				
Non-Kriged COPCs	0.010	0.0100	1 E-7	5 E-7
Benzene 725 ft radius	0.019	0.019	2 E-7	8 E-7
Benzene 500 ft radius	0.028	0.028	2 E-7	1 E-6
Naphthalene 725 ft radius	0.29	0.29	NA	NA
Naphthalene 500 ft radius	0.38	0.38	NA	NA
Total				
Car Wash Worker				
COPCs + Kriged @ 725 ft radius	0.30	0.77	1 E-6	2 E-5
COPCs + Kriged 500 ft radius	0.38	0.99	2 E-6	2 E-5
Landscape Worker				
COPCs + Kriged 725 ft radius	0.51	0.76	2 E-6	2 E-5
COPCs + Kriged 500 ft radius	0.66	0.98	3 E-6	3 E-5

TABLE ES.2

TIER 2 RISK SUMMARY

FISCO ALAMEDA FACILITY/ANNEX SITE

	Non-Cancer Hazard		Cancer Risk	
	Average Exposure	RME Exposure	Average Exposure	RME Exposure
Other Receptors				
Inhalation Modeled from Groundwater				
Resident				
Non-Kriged COPCs	0.28	0.28	9 E-7	9 E-7
Benzene 725 ft radius	0.009	0.009	7 E-6	7 E-6
Benzene 500 ft radius	0.015	0.015	1 E-5	1 E-5
School Worker				
Non-Kriged COPCs	0.28	0.28	9 E-7	9 E-7
Benzene 725 ft radius	0.007	0.007	4 E-6	4 E-6
Benzene 500 ft radius	0.010	0.010	6 E-6	6 E-6
School Student				
Non-Kriged COPCs	0.28	0.28	9 E-7	9 E-7
Benzene 725 ft radius	0.0049	0.0049	7 E-7	7 E-7
Benzene 500 ft radius	0.007	0.007	1 E-6	1 E-6
Total (Modeled from Groundwater)				
Resident				
COPCs + Kriged 725 ft radius	0.29	0.29	8 E-6	8 E-6
COPCs + Kriged 500 ft radius	0.29	0.29	1 E-5	1 E-5
School Worker				
COPCs + Kriged @ 725 ft radius	0.29	0.29	5 E-6	5 E-6
COPCs + Kriged 500 ft radius	0.29	0.29	7 E-6	7 E-6
School Student				
COPCs + Kriged @ 725 ft radius	0.29	0.29	2 E-6	2 E-6
COPCs + Kriged 500 ft radius	0.29	0.29	2 E-6	2 E-6

TABLE ES.2

TIER 2 RISK SUMMARY

FISCO ALAMEDA FACILITY/ANNEX SITE

	Non-Cancer Hazard		Cancer Risk	
	Average Exposure	RME Exposure	Average Exposure	RME Exposure
Inhalation Modeled from Soil Gas				
Resident				
Non-Benzene COPCs	0.0076	0.0076	5 E-8	5 E-8
Benzene - Alameda Annex	0.0016	0.0016	1 E-6	1 E-6
Benzene - Alameda Point - Site 25	0.0000060	0.0000060	4 E-9	4 E-9
Benzene - Alameda Point - Site 30	0.0000092	0.0000092	7 E-9	7 E-9
Benzene - Alameda Point - Site 31	0.0000046	0.0000046	3 E-9	3 E-9
School Worker				
Non-Benzene COPCs	0.0076	0.0076	5 E-8	5 E-8
Benzene - Alameda Annex	0.0011	0.0011	7 E-7	7 E-7
Benzene - Alameda Point - Site 25	0.0000042	0.0000042	3 E-9	3 E-9
Benzene - Alameda Point - Site 30	0.0000065	0.0000065	4 E-9	4 E-9
Benzene - Alameda Point - Site 31	0.0000033	0.0000033	2 E-9	2 E-9
School Student				
Non-Benzene COPCs	0.0076	0.0076	5 E-8	5 E-8
Benzene - Alameda Annex	0.00081	0.00081	1 E-7	1 E-7
Benzene - Alameda Point - Site 25	0.0000030	0.0000030	4 E-10	4 E-10
Benzene - Alameda Point - Site 30	0.0000047	0.0000047	7 E-10	7 E-10
Benzene - Alameda Point - Site 31	0.0000023	0.0000023	3 E-10	3 E-10
Total (Modeled from Soil Gas)				
Resident				
COPCs + Benzene - Alameda Annex	0.0092	0.0092	1.E-06	1.E-06
COPCs + Benzene - Alameda Point - Site 25	0.0076	0.0076	5.E-08	5.E-08
COPCs + Benzene - Alameda Point - Site 30	0.0076	0.0076	5.E-08	5.E-08
COPCs + Benzene - Alameda Point - Site 31	0.0076	0.0076	5.E-08	5.E-08
School Worker				
COPCs + Benzene - Alameda Annex	0.0087	0.0087	8.E-07	8.E-07
COPCs + Benzene - Alameda Point - Site 25	0.0076	0.0076	5.E-08	5.E-08
COPCs + Benzene - Alameda Point - Site 30	0.0076	0.0076	5.E-08	5.E-08
COPCs + Benzene - Alameda Point - Site 31	0.0076	0.0076	5.E-08	5.E-08
School Student				
COPCs + Benzene - Alameda Annex	0.0084	0.0084	2.E-07	2.E-07
COPCs + Benzene - Alameda Point - Site 25	0.0076	0.0076	5.E-08	5.E-08
COPCs + Benzene - Alameda Point - Site 30	0.0076	0.0076	5.E-08	5.E-08
COPCs + Benzene - Alameda Point - Site 31	0.0076	0.0076	5.E-08	5.E-08

TABLE ES.2

TIER 2 RISK SUMMARY

FISCO ALAMEDA FACILITY/ANNEX SITE

	Non-Cancer Hazard		Cancer Risk	
	Average Exposure	RME Exposure	Average Exposure	RME Exposure
Assuming Domestic Water Use				
Ingestion				
Car Wash Worker				
Non-Kriged COPCs	5.5	5.5	4 E-4	2 E-3
Benzene 725 ft radius	0.9	0.9	1 E-5	6 E-5
Benzene 500 ft radius	1.4	1.4	2 E-5	8 E-5
Naphthalene 725 ft radius	1.42	1.4	NA	NA
Naphthalene 500 ft radius	1.8	1.8	NA	NA
Landscape Worker				
Non-Kriged COPCs	5.5	5.5	5 E-4	2 E-3
Benzene 725 ft radius	0.9	0.9	1 E-5	7 E-5
Benzene 500 ft radius	1.4	1.4	2 E-5	1 E-4
Naphthalene 725 ft radius	1.42	1.4	NA	NA
Naphthalene 500 ft radius	1.8	1.8	NA	NA
Resident				
Non-Kriged COPCs	23	47	4 E-3	2 E-2
Benzene 725 ft radius	3	7	1 E-4	5 E-4
Benzene 500 ft radius	5	11	2 E-4	7 E-4
Naphthalene 725 ft radius	5.2	10	NA	NA
Naphthalene 500 ft radius	6.7	13	NA	NA
Inhalation				
Resident				
Non-Kriged COPCs	20	27	7 E-4	2 E-3
Benzene 725 ft radius	19	26	6 E-4	2 E-3
Benzene 500 ft radius	29	39	9 E-4	3 E-3
Naphthalene 725 ft radius	2.8	6.5	NA	NA
Naphthalene 500 ft radius	3.7	8.4	NA	NA
Total				
Car Wash Worker				
COPCs + Kriged @ 725 ft radius	8.2	8.7	4 E-4	2 E-3
COPCs + Kriged 500 ft radius	9.2	9.8	4 E-4	2 E-3
Landscape Worker				
COPCs + Kriged @ 725 ft radius	8.4	8.7	5 E-4	3 E-3
COPCs + Kriged 500 ft radius	9.5	9.8	5 E-4	3 E-3
Resident				
COPCs + Kriged @ 725 ft radius	74	123	5 E-3	2 E-2
COPCs + Kriged 500 ft radius	88	145	5 E-3	2 E-2

TABLE 1

SELECTION OF EXPOSURE PATHWAYS

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-Site/ Off-Site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Current	Soil Gas	Indoor Air	Indoor Air	Resident	Adult/Child	Air Inhalation	On-Site	Quantitative	Volatile constituents could volatilize from the subsurface into indoor air where they could be inhaled by current on-site residents
				School Worker	Adult	Air Inhalation	On-Site	Quantitative	Volatile constituents could volatilize from the subsurface into indoor air where they could be inhaled by current on-site school workers
				School Student	Child	Air Inhalation	On-Site	Quantitative	Volatile constituents could volatilize from the subsurface into indoor air where they could be inhaled by current on-site school students
	Groundwater	Indoor Air	Indoor Air	Resident	Adult/Child	Air Inhalation	On-Site	Quantitative	Volatile constituents could volatilize from the subsurface into indoor air where they could be inhaled by current on-site residents
				School Worker	Adult	Air Inhalation	On-Site	Quantitative	Volatile constituents could volatilize from the subsurface into indoor air where they could be inhaled by current on-site school workers
				School Student	Child	Air Inhalation	On-Site	Quantitative	Volatile constituents could volatilize from the subsurface into indoor air where they could be inhaled by current on-site school students
Future	Soil Gas	Indoor Air	Indoor Air	Resident	Adult/Child	Air Inhalation	On-Site	Quantitative	Volatile constituents could volatilize from the subsurface into indoor air where they could be inhaled by future on-site residents
				School Worker	Adult	Air Inhalation	On-Site	Quantitative	Volatile constituents could volatilize from the subsurface into indoor air where they could be inhaled by future on-site school workers
				School Student	Child	Air Inhalation	On-Site	Quantitative	Volatile constituents could volatilize from the subsurface into indoor air where they could be inhaled by future on-site school students
	Groundwater	Indoor Air	Indoor Air	Resident	Adult/Child	Air Inhalation	On-Site	Quantitative	Volatile constituents could volatilize from the subsurface into indoor air where they could be inhaled by future on-site residents
				School Worker	Adult	Air Inhalation	On-Site	Quantitative	Volatile constituents could volatilize from the subsurface into indoor air where they could be inhaled by future on-site school workers
				School Student	Child	Air Inhalation	On-Site	Quantitative	Volatile constituents could volatilize from the subsurface into indoor air where they could be inhaled by future on-site school students
	Groundwater - Potable Use	Potable Water	Potable Water	Resident	Adult	Ingestion	On-Site	Quantitative	Future on-site residents may ingest groundwater.
					Child	Ingestion	On-Site	Quantitative	Future on-site residents may ingest groundwater.
				Car Wash Worker	Adult	Ingestion	On-Site	Quantitative	Future on-site workers may ingest groundwater.
				Landscape Worker	Adult	Ingestion	On-Site	Quantitative	Future on-site workers may ingest groundwater.
		Indoor Air	Indoor Air	Resident	Adult	Air Inhalation	On-Site	Quantitative	Future on-site residents may inhale constituents volatilizing during household use of groundwater.
					Child	Air Inhalation	On-Site	Quantitative	Future on-site residents may inhale constituents volatilizing during household use of groundwater.
	Groundwater - Industrial Use Water	Industrial Water	Industrial Water	Car Wash Worker	Adult	Dermal	On-Site	Quantitative	Future on-site workers could have dermal exposure to groundwater.
				Landscape Worker	Adult	Dermal	On-Site	Quantitative	Future on-site workers could have dermal exposure to groundwater.
		Work Space Air	Work Space Air	Car Wash Worker	Adult	Air Inhalation	On-Site	Quantitative	Future on-site workers may inhale constituents volatilizing during use o groundwater.
				Landscape Worker	Adult	Air Inhalation	On-Site	Quantitative	Future on-site workers may inhale constituents volatilizing during use of groundwater.

TABLE 2.1
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: On-site Groundwater

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location/Sample of Maximum Concentration	Detection Frequency		Range of Detection Limits	Concentration Used for Screening	Greater Than Background (2)	Screening Value (3)	COPC Flag	Rationale (4)
	Alkalinity	134.0		3,960,000		µg/L	OS-HP-04 / 6/11/01	88/88	1.00	0 - 0	3,960,000	Yes	DL	No	NTX
	Alkalinity, bicarbonate	188.0		4,280		µg/L	PW-12 / 12/11/03	31/31	1	0 - 0	4,280	Yes	DL	No	NTX
	Alkalinity, carbonate					µg/L		0/25	0	1 - 5		No	DL	No	ND
	Alkalinity, hydroxide					µg/L		0/13	0	1 - 1		No	DL	No	ND
	Aluminum	4.3	J	1,400		µg/L	M25-01 / 7/3/03	24/55	0	100 - 2000	1,400	Yes	DL	Yes	DET
	Antimony	0.049	J	0.48	J	µg/L	M25-05 / 9/11/02	30/55	0.55	5 - 50	0	No	DL	Yes	DET
	Arsenic	0.34	J	22		µg/L	M25-05 / 4/21/03	27/55	0	5 - 50	22	No	DL	Yes	DET
	Barium	39.3	J	1,960		µg/L	P181-MW45 / 7/3/03	55/55	1	0 - 0	1,960	Yes	DL	Yes	DET
	Beryllium	0.025	J	2	J	µg/L	M25-01 / 7/3/03	11/55	0.20	2 - 4	2	No	DL	Yes	DET
	Cadmium	0.067	J	3	J	µg/L	M25-01 / 7/3/03	11/55	0	5 - 100	3	No	DL	Yes	DET
	Calcium	36		580,000		µg/L	S-16 / 6/25/02	55/55	1.00	0 - 0	580,000	Yes	DL	No	NTX
	Chloride	37		18,200		µg/L	PW-12 / 7/3/03	43/43	1	0 - 0	18,200	Yes	DL	No	NTX
	Chromium	0.86	J	22		µg/L	P181-MW45 / 6/24/02	39/55	1	10 - 10	22	Yes	DL	Yes	DET
	Cobalt	0.75	J	7.5	J	µg/L	M25-05 / 12/11/03	38/55	0.69	10 - 10	7.5	No	DL	Yes	DET
	Copper	0.63	J	11		µg/L	M25-05 / 12/20/02	35/55	0.64	10 - 10	11	No	DL	Yes	DET
	Iron	81.7	J	39,700		µg/L	P181-MW45 / 7/3/03	55/55	1	0 - 0	39,700	Yes	DL	Yes	DET
	Lead	0.030	J	0	J	µg/L	P181-MW47 / 12/19/02	30/55	0.55	10 - 10	0	No	DL	Yes	DET
	Magnesium	17.0		1,800,000		µg/L	P181-MW45 / 6/24/02	55/55	1	0 - 0	1,800,000	Yes	DL	No	NTX
	Manganese	73.7		2,470		µg/L	M25-03 / 7/3/03	55/55	1	0 - 0	2,470	No	DL	Yes	DET
	Mercury	0.1	J	0	J	µg/L	PW-12 / 12/11/03	14/55	0	0.2 - 0.4	0	Yes	DL	Yes	DET
	Molybdenum	0.4	J	37	J	µg/L	PW-12 / 12/11/03	21/55	0	20 - 400	37	Yes	DL	Yes	DET
	Nickel	1.8	J	16	J	µg/L	M25-05 / 12/20/02	41/55	0.75	20 - 20	16.0	No	DL	Yes	DET
	Nitrate	0.19		7,000		µg/L	OS-HP-14 / 6/11/01	14/88	0	0.1 - 20000	7,000	Yes	DL	Yes	DET
	Nitrite					µg/L		0/37	0	0.05 - 100		No	DL	No	ND
	Potassium	11.0		417,000		µg/L	S-16-2 / 12/19/03	55/55	1.00	0 - 0	417,000	Yes	DL	No	NTX
	Selenium	1.2	J	13		µg/L	M25-02 / 12/26/02	7/55	0.13	5 - 20	13.0	Yes	DL	Yes	DET
	Silver	0.0	J	15		µg/L	S-16 / 6/1/02	12/55	0	5 - 100	15	Yes	DL	Yes	DET
	Sodium	400		10,700,000		µg/L	PW-12 / 12/11/03	54/55	0.98	500 - 500	10,700,000	Yes	DL	No	NTX
	Sulfate	0.92	J	1,800,000		µg/L	OS-HP-20 / 6/14/01	74/88	0.84	1 - 50000	1,800,000	Yes	DL	No	NTX
	Sulfide	0.1		5,690		µg/L	OS-HP-28 / 6/12/01	48/88	0.55	0.04 - 1000	5,690	Yes	DL	No	NTX
	Thallium	0.02	J	10	J	µg/L	M25-05 / 9/23/03	18/55	0.33	2 - 50	10	Yes	DL	Yes	DET
	Vanadium	2.8	J	20		µg/L	M25-03 / 12/18/02	50/55	0.91	50 - 50	20	No	DL	Yes	DET
	Zinc	2.1	J	11	J	µg/L	M25-04 / 12/19/02	10/55	0.18	20 - 20	11	No	DL	Yes	DET

TABLE 2.1
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: On-site Groundwater

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location/Sample of Maximum Concentration	Detection Frequency		Range of Detection Limits	Concentration Used for Screening	Greater Than Background (2)	Screening Value (3)	COPC Flag	Rationale (4)
	1,1,1,2-Tetrachloroethane	2.0	J	200	J	µg/L	OU5-HP06 / 6/14/01	2/205	0.01	0.5 - 2000	200	Yes	DL	No	IFD
	1,1,1-Trichloroethane					µg/L		0/205	0.00	0.5 - 2000		Yes	DL	No	ND
	1,1,2,2-Tetrachloroethane					µg/L		0/205	0.00	0.5 - 2000		Yes	DL	No	ND
	1,1,2-Trichloroethane					µg/L		0/205	0	0.5 - 2000		Yes	DL	No	ND
	1,1-Dichloroethane					µg/L		0/205	0	0.5 - 2000		Yes	DL	No	ND
	1,1-Dichloroethene	5.0		5.0		µg/L	OS-HP-14 / 6/11/01	1/205	0.00	0.5 - 2000	5.0	Yes	DL	No	IFD
	1,1-Dichloropropene					µg/L		0/205	0	0.5 - 2000		Yes	DL	No	ND
	1,2,3-Trichlorobenzene					µg/L		0/205	0	0.5 - 2000		Yes	DL	No	ND
	1,2,3-Trichloropropane	1.00		1.0		µg/L	OS-HP-14 / 6/11/01	1/205	0.00	0.5 - 2000	1.0	Yes	DL	No	IFD
	1,2,4-Trichlorobenzene					µg/L		0/205	0	0.5 - 2000		Yes	DL	No	ND
	1,2,4-TRIMETHYLBENZENE	0.1	J	55		µg/L	OS-HP-37 / 6/13/01	114/211	0.54	0.5 - 2000	55	Yes	DL	Yes	DET
	1,2-Dibromo-3-chloropropane					µg/L		0/205	0	0.5 - 2000		Yes	DL	No	ND
	1,2-Dibromoethane					µg/L		0/205	0.00	0.5 - 2000		Yes	DL	No	ND
	1,2-Dichlorobenzene	0.2	J	14.0		µg/L	S-35 / 12/26/02	4/205	0.02	0.5 - 2000	14.0	Yes	DL	No	IFD
	1,2-Dichloroethane	0.20	J	50		µg/L	OS-HP-14 / 6/11/01	26/205	0.13	0.5 - 2000	50	Yes	DL	Yes	DET
	1,2-Dichloropropane					µg/L		0/205	0.00	0.5 - 2000		Yes	DL	No	ND
	1,3,5-Trimethylbenzene	0.1	J	29	J	µg/L	OS-HP-10 / 6/12/01	90/211	0	0.5 - 2000	29	Yes	DL	Yes	DET
	1,3-Dichlorobenzene	0.2	J	0	J	µg/L	S-35 / 12/26/02	2/205	0.01	0.5 - 2000	0	Yes	DL	No	IFD
	1,3-Dichloropropane					µg/L		0/205	0.00	0.5 - 2000		Yes	DL	No	ND
	1,4-Dichlorobenzene	1.2		2		µg/L	S-35 / 12/26/02	2/205	0	0.5 - 2000	2	Yes	DL	No	IFD
	2,2-Dichloropropane					µg/L		0/205	0.00	0.5 - 2000		Yes	DL	No	ND
	2-Butanone	2.40	J	3	J	µg/L	OS-HP-39 / 6/12/01	2/125	0.02	1 - 20000	3	Yes	DL	No	IFD
	2-Chlorotoluene	0.37	J	0	J	µg/L	M25-05 / 7/3/03	1/205	0.00	0.5 - 2000	0	Yes	DL	No	IFD
	2-Hexanone					µg/L		0/125	0.00	1 - 20000		Yes	DL	No	ND
	4-Chlorotoluene	2.2		5		µg/L	OU5-HP-12 / 6/13/01	2/205	0.01	0.5 - 2000	5	Yes	DL	No	IFD
	4-Isopropyltoluene	0.130	J	20		µg/L	OU5-HP-11 / 6/13/01	71/279	0.25	0.5 - 2000	20	Yes	DL	No	NTX
	4-Methyl-2-pentanone					µg/L		0/52	0.00	1 - 20000		Yes	DL	No	ND
	Acenaphthene	0.300	J	220		µg/L	OU5-HP01 / 6/13/01	127/195	0.65	0.94 - 500	220	Yes	DL	Yes	DET
	Acenaphthylene	0.2	J	800		µg/L	OS-HP-10 / 6/12/01	119/195	0.61	1.9 - 38	800	Yes	DL	Yes	DET
	Acetone	0.5	J	10,000		µg/L	M25-02 / 9/12/02	28/131	0.21	1 - 20000	10,000	Yes	DL	Yes	DET
	Anthracene	0.06	J	59	J	µg/L	OS-HP-20 / 6/14/01	157/195	0.81	0.19 - 1.9	59	Yes	DL	Yes	DET
	Benzene	0.10	J	6,000	J	µg/L	OS-HP-10 / 6/12/01	140/211	0.66	0.5 - 36	6,000	Yes	DL	Yes	DET

TABLE 2.1
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: On-site Groundwater

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location/Sample of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening	Greater Than Background (2)	Screening Value (3)	COPC Flag	Rationale (4)
	Benzo[a]anthracene	0.07	J	26		µg/L	OS-HP-20 / 6/14/01	146/195 0.75	0.09 - 20	26	Yes	DL	Yes	DET
	Benzo[a]pyrene	0.05	J	60	J	µg/L	OS-HP-20 / 6/14/01	105/195 0.54	0.09 - 20	60.0	Yes	DL	Yes	DET
	Benzo[b]fluoranthene	0.04	J	29		µg/L	OS-HP-20 / 6/14/01	94/195 0.48	0.1 - 20	29.0	Yes	DL	Yes	DET
	Benzo[g,h,I]perylene	0.07	J	37		µg/L	OS-HP-20 / 6/14/01	81/195 0.42	0.19 - 20	37.0	Yes	DL	Yes	DET
	Benzo[k]fluoranthene	0.03	J	14		µg/L	OS-HP-20 / 6/14/01	88/195 0.45	0.09 - 20	14.0	Yes	DL	Yes	DET
	Bromobenzene					µg/L		0/205 0.00	0.5 - 2000		Yes	DL	No	ND
	Bromochloromethane					µg/L		0/205 0.00	0.5 - 2000		Yes	DL	No	ND
	Bromodichloromethane	0.22	J	0	J	µg/L	OU5-HP-07 / 6/19/01	1/205 0.00	0.5 - 2000	0.2	Yes	DL	No	IFD
	Bromoform					µg/L		0/205 0.00	1 - 2000		Yes	DL	No	ND
	Bromomethane					µg/L		0/205 0.00	1 - 2000		Yes	DL	No	ND
	Carbon Disulfide	0.10	J	5		µg/L	M25-03 / 9/11/02	33/131 0.25	0.5 - 2500	4.8	Yes	DL	Yes	DET
	Carbon tetrachloride					µg/L		0/205 0.00	0.5 - 2000		Yes	DL	No	ND
	Chlorobenzene	0.80		85		µg/L	OS-HP-31 / 6/11/01	4/205 0.02	0.5 - 2000	85.0	Yes	DL	No	IFD
	Chloroethane					µg/L		0/205 0.00	1 - 2000		Yes	DL	No	ND
	Chloroform	0.75	J	1	J	µg/L	OS-HP-26 / 6/12/01	1/205 0.00	0.5 - 2000	0.8	Yes	DL	No	IFD
	Chloromethane	0.60	J	1	J	µg/L	S-35 / 6/6/01	2/205 0.01	1 - 2000	0.6	Yes	DL	No	IFD
	Chrysene	0.03	J	43		µg/L	OS-HP-20 / 6/14/01	143/195 0.73	0.09 - 20	43.0	Yes	DL	Yes	DET
	cis-1,2-Dichloroethene	0.20	J	5		µg/L	OS-HP-14 / 6/11/01	4/205 0.02	0.5 - 2000	5.0	Yes	DL	No	IFD
	cis-1,3-Dichloropropene					µg/L		0/93 0.00	1 - 250		Yes	DL	No	ND
	Dibenz[a,h]anthracene	0.30	J	3	J	µg/L	OU5-HP-09 / 6/14/01	12/189 0.06	0.19 - 50	3.0	Yes	DL	Yes	DET
	Dibromochloromethane	0.23	J	0	J	µg/L	OU5-HP-07 / 6/19/01	1/205 0.00	0.5 - 2000	0.2	Yes	DL	No	IFD
	Dibromomethane					µg/L		0/205 0.00	0.5 - 2000		Yes	DL	No	ND
	Dichlorodifluoromethane	20.00	J	20	J	µg/L	OS-HP-03 / 6/19/01	1/205 0.00	1 - 2000	20.0	Yes	DL	No	IFD
	Ethane					µg/L		0/37 0.00	0.003 - 0.01		Yes	DL	No	ND
	Ethene					µg/L		0/37 0.00	0.003 - 0.01		Yes	DL	No	ND
	Ethylbenzene	0.10	J	800	J	µg/L	OS-HP-10 / 6/12/01	144/211 0.68	0.5 - 36	800.0	Yes	DL	Yes	DET
	Fluoranthene	0.05	J	280	J	µg/L	OS-HP-20 / 6/14/01	187/195 0.96	0.19 - 38	280.0	Yes	DL	Yes	DET
	Fluorene	0.10	J	70	J	µg/L	OS-HP-10 / 6/12/01	99/195 0.51	0.19 - 100	70.0	Yes	DL	Yes	DET
	Hexachlorobutadiene					µg/L		0/205 0.00	0.5 - 2000		Yes	DL	No	ND
	Indeno(1,2,3-cd)pyrene	0.04	J	44	J	µg/L	OU5-HP-07 / 6/19/01	79/195 0.41	0.09 - 20	44.0	Yes	DL	Yes	DET
	Isopropyl benzene	0.16	J	7	J	µg/L	OS-HP-10 / 6/12/01	62/134 0.46	0.5 - 2000	7.4	Yes	DL	Yes	DET
	Isopropyl Ether	0.50		2	J	µg/L	PW-12 / 9/22/03	7/79 0.09	0.5 - 120	2.0	Yes	DL	No	NTX

TABLE 2.1
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: On-site Groundwater

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location/Sample of Maximum Concentration	Detection Frequency		Range of Detection Limits	Concentration Used for Screening	Greater Than Background (2)	Screening Value (3)	COPC Flag	Rationale (4)
	m,p-xylene	0.20	J	130		µg/L	M25-01 / 12/8/03	77/123	0.63	0.5 - 5000	130.0	Yes	DL	Yes	DET
	Methane	0.47		32,000		µg/L	EW-2 / 6/7/01	89/89	1.00	0 - 0	32,000.0	Yes	DL	No	NTX
	Methyl isobutyl ketone	1.30	J	4	J	µg/L	M25-03 / 9/22/03	4/73	0.05	10 - 1200	3.5	Yes	DL	Yes	DET
	Methylene chloride	0.10	J	180	J	µg/L	OS-HP-08 / 6/16/01	27/205	0.13	1 - 2000	180.0	Yes	DL	Yes	DET
	MTBE	0.20	J	19		µg/L	P181-MW46 / 5/31/01	64/211	0.30	0.5 - 5000	19.0	Yes	DL	Yes	DET
	Naphthalene	0.20	J	19,000	J	µg/L	OS-HP-13 / 6/7/01	336/406	0.83	0.4 - 140	19,000.0	Yes	DL	Yes	DET
	n-Butylbenzene	0.22	J	1,800	J	µg/L	OS-HP-30 / 6/8/01	25/205	0.12	0.5 - 2000	1,800.0	Yes	DL	Yes	DET
	n-Propylbenzene	0.10	J	11		µg/L	OU5-HP-11 / 6/13/01	73/211	0.35	0.5 - 2000	11.0	Yes	DL	Yes	DET
	o-xylene	0.22	J	81		µg/L	M25-01 / 12/8/03	77/123	0.63	0.5 - 5000	81.0	Yes	DL	Yes	DET
	Phenanthrene	0.08	J	250	J	µg/L	OS-HP-20 / 6/14/01	183/195	0.94	0.19 - 1.9	250.0	Yes	DL	Yes	DET
	Pyrene	0.02	J	200	J	µg/L	OS-HP-20 / 6/14/01	188/195	0.96	0.2 - 10	200.0	Yes	DL	Yes	DET
	sec-Butylbenzene	0.20	J	0	J	µg/L	OU5-HP-12 / 6/13/01	4/205	0.02	0.5 - 2000	0.3	Yes	DL	No	IFD
	Styrene	0.30	J	186		µg/L	OS-HP-37 / 6/13/01	75/211	0.36	0.5 - 5000	186.0	Yes	DL	Yes	DET
	tert-amyl methyl ether					µg/L		0/73	0.00	0.5 - 120		Yes	DL	No	ND
	tert-butyl alcohol	23.00	J	23	J	µg/L	M25-04 / 12/12/03	1/73	0.01	10 - 1400	23.0	Yes	DL	No	IFD
	tert-butyl ethyl ether					µg/L		0/73	0.00	0.5 - 120		Yes	DL	No	ND
	tert-Butylbenzene					µg/L		0/205	0.00	0.5 - 2000		Yes	DL	No	ND
	Tetrachloroethene	1.00		13		µg/L	M25-01 / 4/16/03	2/205	0.01	0.5 - 2000	13.0	Yes	DL	No	IFD
	Toluene	0.10	J	620	J	µg/L	OS-HP-10 / 6/12/01	147/211	0.70	0.5 - 1000	620.0	Yes	DL	Yes	DET
	trans-1,2-Dichloroethene	0.25	J	1		µg/L	OS-HP-31 / 6/11/01	3/172	0.02	0.5 - 2000	1.0	Yes	DL	No	IFD
	trans-1,3-Dichloropropene					µg/L		0/74	0.00	1 - 250		Yes	DL	No	ND
	Trichloroethene	0.10	J	4	J	µg/L	M25-05 / 4/21/03	3/205	0.01	0.5 - 2000	3.6	Yes	DL	No	IFD
	Trichlorofluoromethane	0.34	J	0	J	µg/L	P181-MW46 / 12/11/03	3/205	0.01	1 - 2000	0.4	Yes	DL	No	IFD
	Vinyl chloride	0.30	J	1	J	µg/L	OS-HP-31 / 6/11/01	3/205	0.01	0.5 - 2000	0.9	Yes	DL	No	IFD
	Xylenes (total)	0.16	J	423.0		µg/L	OS-HP-37 / 6/13/01	61/88	0.69	1 - 500	423.0	Yes	DL	Yes	DET

DL = Detection Limit

(1) Minimum/maximum detected concentration.

(2) Comparison to background was made using statistical comparison of data in each exposure area to the background data set.

(3) The detection limit was utilized as the screening value, i.e., if the chemical was detected, it was considered a COPC.

(4) Rationale Codes for Contaminant Deletion or Selection

Selection Reason: Detected (DET)
Deletion Reason: Not Detected (ND)
Infrequent Detection, <5% (IFD)
No Toxicity Information (NTX)

TABLE 2.2
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Medium: Shallow Soil Gas
Exposure Medium: Shallow Soil Gas
Exposure Point: Shallow Soil Gas

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location/Sample of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening	Greater Than Background (2)	Screening Value (3)	COPC Flag	Rationale (4)
71-55-6	1,1,1-Trichloroethane			27		ug/m^3	OS-SG-16, 2'			27	Yes	22,000	No	BSL
75-34-3	1,1-Dichloroethane			38		ug/m^3	OS-SG-09, 2'			38	Yes	5,000	No	BSL
75-35-4	1,1-Dichloroethene			1.6		ug/m^3	OU5-SG-19D, 4.5-6.5'			1.6	Yes	2,000	No	BSL
78-93-3	2-Butanone			240		ug/m^3	OS-SG-05, 2'			240	Yes	10,000	No	BSL
591-78-6	2-Hexanone			29		ug/m^3	OS-SG-06, 2'			29	Yes	NA	No	NTX
106-43-4	4-Methyl-2-Pentanone (MIBK)			19		ug/m^3	OS-SG-06, 2'			19	Yes	10,000	No	BSL
67-64-1	Acetone			9,735		ug/m^3	OU5-SG-19S, 1.5-3.5'			9,735	Yes	3.50E+04 (a)	No	BSL
71-43-2	Benzene			262		ug/m^3	OU5-SG-20S, 2-4'			262	Yes	3.1	Yes	ASL
56-23-5	Carbon tetrachloride			0.61		ug/m^3	OU5-SG-16S, 2-3.5'			0.61	Yes	2	No	BSL
108-90-7	Chlorobenzene			120		ug/m^3	OU5-SG-19D, 4.5-6.5'			120	Yes	600	No	BSL
75-00-3	Chloroethane			5.2		ug/m^3	OS-SG-06, 2'			5.2	Yes	100,000	No	BSL
67-66-3	Chloroform			92.0		ug/m^3	OS-SG-03, 2'			92	Yes	1.1	Yes	ASL
74-87-3	Chloromethane			9.3		ug/m^3	OU5-SG-20S, 2-4'			9.3	Yes	24.0	No	BSL
98-82-8	Cumene			157		ug/m^3	OU5-SG-20S, 2-4'			157	Yes	4,000	No	BSL
156-59-2	cis-1,2-Dichloroethene			ND		ug/m^3	--			ND	Yes	350.0	No	BSL
100-41-4	Ethylbenzene			868		ug/m^3	OU5-SG-20S, 2-4'			868	Yes	22	Yes	ASL
1330-20-7	m,p-Xylene			2,000		ug/m^3	OS-SG-02, 2'			2,000	Yes	1.00E+03 (a)	Yes	ASL
1330-20-7	o-Xylene			810		ug/m^3	OS-SG-02, 2'			810	Yes	1.00E+03 (a)	No	BSL
75-09-2	Methylene chloride			6.3		ug/m^3	OU5-SG-19D, 4.5-6.5'			6.3	Yes	52	No	BSL
1634-04-4	MTBE			112		ug/m^3	OU5-SG-19D, 4.5-6.5'			112	Yes	30,000	No	BSL
91-20-3	Naphthalene			2,106		ug/m^3	OU5-SG-20S, 2-4'			2,106	Yes	30	Yes	ASL
100-42-5	Styrene			21		ug/m^3	OU5-SG-20S, 2-4'			21	Yes	10,000.0	No	BSL
127-18-4	Tetrachloroethene			65		ug/m^3	OS-SG-13, 2'			65	Yes	8.1	Yes	ASL
108-88-3	Toluene			300		ug/m^3	OS-SG-12, 5'			300	Yes	4,000.0	No	BSL
79-01-6	Trichloroethene			130		ug/m^3	OS-SG-02, 2'			130	Yes	0.2	Yes	ASL
75-01-4	Vinyl acetate			76.0		ug/m^3	OS-SG-06, 2'			76	Yes	2,000.0	No	BSL
1330-20-7	Xylenes (total)			990		ug/m^3	OU5-SG-20S, 2-4'			990	Yes	1.00E+03 (a)	No	BSL

(1) Minimum/maximum detected concentration.
(2) Comparison to background was made using statistical comparison of data in each exposure area to the background data set.
(3) If the chemical was detected above the shallow soil gas criterion from USEPA (2002), it was considered a COPC.
(4) Rationale Codes for Contaminant Deletion or Selection Selection Reason: Above screening level (ASL)

TABLE 2.2
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Medium: Shallow Soil Gas
Exposure Medium: Shallow Soil Gas
Exposure Point: Shallow Soil Gas

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location/Sample of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening	Greater Than Background (2)	Screening Value (3)	COPC Flag	Rationale (4)

Deletion Reason: Not Detected (ND)
No Toxicity Information (NTX)
Below screening level (BSL)

DL = Detection Limit

(a) = toxicity critieria utilized in the derivation of the screening criteria were review for recent changes that would significantly affect the criterion. The change in the toxicity criteria for this compound was significant (extrapolated from oral, 0.35 mg/m3 to 3.5 mg/m3). The screening critierion was modified to reflect this change.
(b) = toxicity critieria utilized in the derivation of the screening criteria were review for recent changes that would significantly affect the criterion. The change in the toxicity criteria for this compound was significant (from 7 mg/m3 to 0.1 mg/m3). The screening critierion was modified to reflect this change.
shallow = less than or equal to 5 feet below ground surface

TABLE 2.3
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Medium: Deep Soil Gas
Exposure Medium: Deep Soil Gas
Exposure Point: Deep Soil Gas

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location/Sample of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening	Greater Than Background (2)	Screening Value (3)	COPC Flag	Rationale (4)
71-55-6	1,1,1-Trichloroethane			ND		ug/m^3	--			ND	Yes	220,000	No	ND
75-34-3	1,1-Dichloroethane			6.0		ug/m^3	OS-SG-09, 5.5'			6.0	Yes	50,000	No	BSL
75-35-4	1,1-Dichloroethene			3.9		ug/m^3	OU5-SG-10, 5.5'			3.9	Yes	20,000	No	BSL
78-93-3	2-Butanone			30		ug/m^3	OS-SG-16, 5.5'			30	Yes	100,000	No	BSL
591-78-6	2-Hexanone			ND		ug/m^3	--			ND	Yes	NA	No	NTX
106-43-4	4-Methyl-2-Pentanone (MIBK)			78		ug/m^3	OS-SG-16, 5.5'			78	Yes	100,000	No	BSL
67-64-1	Acetone			166		ug/m^3	OU-SG-20D, 6-8'			166	Yes	3.50E+05 (a)	No	BSL
71-43-2	Benzene			5,588		ug/m^3	OU-SG-20D, 6-8'			5,588	Yes	31	Yes	ASL
56-23-5	Carbon tetrachloride			0.36		ug/m^3	OU5-SG-20D, 6-8'			0.36	Yes	16	No	BSL
108-90-7	Chlorobenzene			ND		ug/m^3	--			ND	Yes	6,000	No	ND
75-00-3	Chloroethane			ND		ug/m^3	--			ND	Yes	1,000,000	No	ND
67-66-3	Chloroform			1.0		ug/m^3	OU5-SG-20			1.0	Yes	11.0	No	ASL
74-87-3	Chloromethane			ND		ug/m^3	--			ND	Yes	240	No	ND
98-82-8	Cumene			5.4		ug/m^3	OU5-SG-18D, 5-7'			5.4	Yes	40,000	No	BSL
156-59-2	cis-1,2-Dichloroethene			19		ug/m^3	OU5-SG-18D, 5-7'			19	Yes	3,500	No	BSL
100-41-4	Ethylbenzene			4,427		ug/m^3	OU5-SG-20D, 6-8'			4,427	Yes	220	Yes	ASL
1330-20-7	m,p-Xylene			420		ug/m^3	OS-SG-16, 5.5'			420	Yes	1.00E+04 (a)	No	ASL
1330-20-7	o-Xylene			360		ug/m^3	OS-SG-16, 5.5'			360	Yes	1.00E+04 (a)	No	BSL
75-09-2	Methylene chloride			0.59		ug/m^3	OU5-SG-18D, 5-7'			0.59	Yes	520	No	BSL
1634-04-4	MTBE			793		ug/m^3	OU5-SG-20D, 6-8'			793	Yes	300,000	No	BSL
91-20-3	Naphthalene			362		ug/m^3	OU5-SG-18D, 5-7'			362	Yes	300	Yes	ASL
100-42-5	Styrene			192		ug/m^3	OU5-SG-20D, 6-8'			192	Yes	100,000	No	BSL
127-18-4	Tetrachloroethene			86		ug/m^3	OS-SG-11, 6'			86	Yes	81.0	Yes	ASL
108-88-3	Toluene			3,029		ug/m^3	OU5-SG-20D, 6-8'			3,029	Yes	40,000	No	BSL
79-01-6	Trichloroethene			ND		ug/m^3	--			ND	Yes	2.2	No	ND
75-01-4	Vinyl acetate			ND		ug/m^3	--			ND	Yes	20,000	No	ND
1330-20-7	Xylenes (total)			4,110		ug/m^3	OU5-SG-20D, 6-8'			4,110	Yes	1.00E+04 (a)	No	BSL

(1) Minimum/maximum detected concentration.
(2) Comparison to background was made using statistical comparison of data in each exposure area to the background data set.
(3) If the chemical was detected above the deep soil gas criterion from USEPA (2002), it was considered a COPC.

TABLE 2.3
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Medium: Deep Soil Gas
Exposure Medium: Deep Soil Gas
Exposure Point: Deep Soil Gas

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location/Sample of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening	Greater Than Background (2)	Screening Value (3)	COPC Flag	Rationale (4)

(4) Rationale Codes for Contaminant Deletion or Selection

Selection Reason: Above screening level (ASL)
Deletion Reason: Not Detected (ND)
No Toxicity Information (NTX)
Below screening level (BSL)

DL = Detection Limit

(a) = toxicity critieria utilized in the derivation of the screening criteria were review for recent changes that would significantly affect the criterion. The change in the toxicity criteria for this compound was significant (extrapolated from oral, 0.35 mg/m3 to 3.5 mg/m3). The screening critierion was modified to reflect this change.
(b) = toxicity critieria utilized in the derivation of the screening criteria were review for recent changes that would significantly affect the criterion. The change in the toxicity criteria for this compound was significant (from 7 mg/m3 to 0.1 mg/m3). The screening critierion was modified to reflect this change.
deep = greater than 5 feet below ground surface.

Table 3.1

EXPOSURE POINT CONCENTRATION SUMMARY

CENTRAL / REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Tier 1 Future
Medium: Groundwater (On-Site)
Exposure Medium: Groundwater

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Normal)	Maximum Concentration	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Groundwater	Aluminum	ug/L			1400	1400	ug/L	Max	Tier 1 Default (1)
	Antimony	ug/L			0.48	0.48	ug/L	Max	Tier 1 Default (1)
	Arsenic	ug/L			22	22	ug/L	Max	Tier 1 Default (1)
	Barium	ug/L			1960	1960	ug/L	Max	Tier 1 Default (1)
	Beryllium	ug/L			2	2	ug/L	Max	Tier 1 Default (1)
	Cadmium	ug/L			3	3	ug/L	Max	Tier 1 Default (1)
	Chromium	ug/L			22	22	ug/L	Max	Tier 1 Default (1)
	Cobalt	ug/L			7	7	ug/L	Max	Tier 1 Default (1)
	Copper	ug/L			11	11	ug/L	Max	Tier 1 Default (1)
	Iron	ug/L			39700	39700	ug/L	Max	Tier 1 Default (1)
	Lead	ug/L			0.37	0.37	ug/L	Max	Tier 1 Default (1)
	Manganese	ug/L			2470	2470	ug/L	Max	Tier 1 Default (1)
	Mercury	ug/L			0.22	0.22	ug/L	Max	Tier 1 Default (1)
	Molybdenum	ug/L			37	37	ug/L	Max	Tier 1 Default (1)
	Nickel	ug/L			16	16	ug/L	Max	Tier 1 Default (1)
	Nitrate	ug/L			7000	7000	ug/L	Max	Tier 1 Default (1)
	Selenium	ug/L			13	13	ug/L	Max	Tier 1 Default (1)
	Silver	ug/L			15	15	ug/L	Max	Tier 1 Default (1)
	Thallium	ug/L			10	10	ug/L	Max	Tier 1 Default (1)
	Vanadium	ug/L			20	20	ug/L	Max	Tier 1 Default (1)
	Zinc	ug/L			11	11	ug/L	Max	Tier 1 Default (1)
	1,2,4-Trimethylbenzene	ug/L			55	55	ug/L	Max	Tier 1 Default (1)
	1,2-Dichloroethane	ug/L			50	50	ug/L	Max	Tier 1 Default (1)
	1,3,5-Trimethylbenzene	ug/L			29	29	ug/L	Max	Tier 1 Default (1)
	Acenaphthene	ug/L			220	220	ug/L	Max	Tier 1 Default (1)
	Acenaphthylene	ug/L			800	800	ug/L	Max	Tier 1 Default (1)
	Acetone	ug/L			10000	10000	ug/L	Max	Tier 1 Default (1)
	Anthracene	ug/L			59	59	ug/L	Max	Tier 1 Default (1)
	Benzene	ug/L			6000	6000	ug/L	Max	Tier 1 Default (1)
	Benzo[a]anthracene	ug/L			26	26	ug/L	Max	Tier 1 Default (1)
	Benzo[a]pyrene	ug/L			60	60	ug/L	Max	Tier 1 Default (1)
	Benzo[b]fluoranthene	ug/L			29	29	ug/L	Max	Tier 1 Default (1)
	Benzo[g,h,I]perylene	ug/L			37	37	ug/L	Max	Tier 1 Default (1)
	Benzo[k]fluoranthene	ug/L			14	14	ug/L	Max	Tier 1 Default (1)
	Carbon Disulfide	ug/L			4.8	4.8	ug/L	Max	Tier 1 Default (1)

Table 3.1

EXPOSURE POINT CONCENTRATION SUMMARY

CENTRAL / REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Tier 1 Future
Medium: Groundwater (On-Site)
Exposure Medium: Groundwater

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Normal)	Maximum Concentration	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
	Chrysene	ug/L			43	43	ug/L	Max	Tier 1 Default (1)
	Dibenz[a,h]anthracene	ug/L			3.0	3.0	ug/L	Max	Tier 1 Default (1)
	Ethylbenzene	ug/L			800	800	ug/L	Max	Tier 1 Default (1)
	Fluoranthene	ug/L			280	280	ug/L	Max	Tier 1 Default (1)
	Fluorene	ug/L			70	70	ug/L	Max	Tier 1 Default (1)
	Indeno(1,2,3-cd)pyrene	ug/L			44	44	ug/L	Max	Tier 1 Default (1)
	Isopropyl benzene	ug/L			7.4	7.4	ug/L	Max	Tier 1 Default (1)
	Methyl isobutyl ketone	ug/L			3.5	3.5	ug/L	Max	Tier 1 Default (1)
	Methylene chloride	ug/L			180	180	ug/L	Max	Tier 1 Default (1)
	MTBE	ug/L			19	19	ug/L	Max	Tier 1 Default (1)
	Naphthalene	ug/L			19000	19000	ug/L	Max	Tier 1 Default (1)
	n-Butylbenzene	ug/L			1800	1800	ug/L	Max	Tier 1 Default (1)
	n-Propylbenzene	ug/L			11	11	ug/L	Max	Tier 1 Default (1)
	Phenanthrene	ug/L			250	250	ug/L	Max	Tier 1 Default (1)
	Pyrene	ug/L			200	200	ug/L	Max	Tier 1 Default (1)
	Styrene	ug/L			186	186	ug/L	Max	Tier 1 Default (1)
	Toluene	ug/L			620	620	ug/L	Max	Tier 1 Default (1)
	Xylenes (total)	ug/L			423	423	ug/L	Max	Tier 1 Default (1)

Statistics: Max Maximum Detected Value

(1) Default Tier 1 EPCs are maximum detected concentrations.

Table 3.2

EXPOSURE POINT CONCENTRATION SUMMARY

CENTRAL / REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Tier 1 Current/Future
Medium: Groundwater (On-Site)
Exposure Medium: Indoor Air

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Normal)	Maximum Concentration	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Indoor Air	1,2,4-Trimethylbenzene	ug/m^3			0.060	0.060	ug/m^3	Modeled	
	1,2-Dichloroethane	ug/m^3			0.019	0.019	ug/m^3	Modeled	
	1,3,5-Trimethylbenzene	ug/m^3			0.032	0.032	ug/m^3	Modeled	
	Acetone	ug/m^3			0.29	0.29	ug/m^3	Modeled	
	Benzene	ug/m^3			11	11	ug/m^3	Modeled	
	Carbon disulfide	ug/m^3			0.06	0.06	ug/m^3	Modeled	
	Ethylbenzene	ug/m^3			1.6	1.6	ug/m^3	Modeled	
	Isopropyl benzene	ug/m^3			0.017	0.017	ug/m^3	Modeled	
	Methyl isobutyl ketone	ug/m^3			0.0049	0.0049	ug/m^3	Modeled	
	Methylene chloride	ug/m^3			0.16	0.16	ug/m^3	Modeled	
	MTBE	ug/m^3			0.0073	0.0073	ug/m^3	Modeled	
	Naphthalene	ug/m^3			2.1	2.1	ug/m^3	Modeled	
	n-Butylbenzene	ug/m^3			5.5	5.5	ug/m^3	Modeled	
	Styrene	ug/m^3			0.12	0.12	ug/m^3	Modeled	
	Toluene	ug/m^3			1.2	1.2	ug/m^3	Modeled	
	Xylenes (total)	ug/m^3			0.60	0.60	ug/m^3	Modeled	

Statistics: Modeled - Volatilization from groundwater to indoor air modeled using the USEPA vapor intrusion model.

Table 3.3

EXPOSURE POINT CONCENTRATION SUMMARY

CENTRAL / REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Tier 1 Current/Future
Medium: Soil Gas
Exposure Medium: Indoor Air

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Normal)	Maximum Concentration	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Indoor Air	Benzene	ug/m^3			0.16	0.16	ug/m^3	Modeled	
	Chloroform	ug/m^3			0.003	0.003	ug/m^3	Modeled	
	Ethylbenzene	ug/m^3			0.12	0.12	ug/m^3	Modeled	
	m,p-Xylene	ug/m^3			0.055	0.055	ug/m^3	Modeled	
	Naphthalene	ug/m^3			0.065	0.065	ug/m^3	Modeled	
	Tetrachloroethene (PCE)	ug/m^3			0.002	0.002	ug/m^3	Modeled	
	Trichloroethene	ug/m^3			0.004	0.004	ug/m^3	Modeled	

Statistics: Modeled - Volatilization from groundwater to indoor air modeled using the USEPA vapor intrusion model.

Table 3.4

EXPOSURE POINT CONCENTRATION SUMMARY

CENTRAL EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Tier 1 Future
Medium: Goundwater Beneficial Use
Exposure Medium: Car Wash Worker Air

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Normal)	Maximum Concentration	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Car Wash Workplace Air	1,2,4-Trimethylbenzene	ug/m^3			0.0083	0.0083	ug/m^3	Modeled	
	1,2-Dichloroethane	ug/m^3			0.010	0.010	ug/m^3	Modeled	
	1,3,5-Trimethylbenzene	ug/m^3			0.0044	0.0044	ug/m^3	Modeled	
	Acenaphthene	ug/m^3			0.029	0.029	ug/m^3	Modeled	
	Acetone	ug/m^3			1.4	1.4	ug/m^3	Modeled	
	Anthracene	ug/m^3			0.0078	0.0078	ug/m^3	Modeled	
	Benzene	ug/m^3			1.1	1.1	ug/m^3	Modeled	
	Benzo[b]fluoranthene	ug/m^3			0.0038	0.0038	ug/m^3	Modeled	
	Carbon Disulfide	ug/m^3			0.00091	0.00091	ug/m^3	Modeled	
	Chrysene	ug/m^3			0.0057	0.0057	ug/m^3	Modeled	
	Ethylbenzene	ug/m^3			0.13	0.13	ug/m^3	Modeled	
	Fluorene	ug/m^3			0.0093	0.0093	ug/m^3	Modeled	
	Isopropyl benzene	ug/m^3			0.0011	0.0011	ug/m^3	Modeled	
	Methyl isobutyl ketone	ug/m^3			0.00049	0.00049	ug/m^3	Modeled	
	Methylene chloride	ug/m^3			0.038	0.038	ug/m^3	Modeled	
	MTBE	ug/m^3			0.0035	0.0035	ug/m^3	Modeled	
	Naphthalene	ug/m^3			2.8	2.8	ug/m^3	Modeled	
	n-Butylbenzene	ug/m^3			0.29	0.29	ug/m^3	Modeled	
	n-Propylbenzene	ug/m^3			0.0018	0.0018	ug/m^3	Modeled	
	Pyrene	ug/m^3			0.026	0.026	ug/m^3	Modeled	
	Styrene	ug/m^3			0.030	0.030	ug/m^3	Modeled	
	Toluene	ug/m^3			0.11	0.11	ug/m^3	Modeled	
	Xylenes (total)	ug/m^3			0.074	0.074	ug/m^3	Modeled	

Statistics: Modeled - Volatilization from groundwater to workplace air modeled using vapor stripping model.

Table 3.5

EXPOSURE POINT CONCENTRATION SUMMARY

REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Tier 1 Future
Medium: Goundwater Beneficial Use
Exposure Medium: Car Wash Worker Air

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Normal)	Maximum Concentration	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Car Wash Workplace Air	1,2,4-Trimethylbenzene	ug/m^3			0.026	0.026	ug/m^3	Modeled	
	1,2-Dichloroethane	ug/m^3			0.030	0.030	ug/m^3	Modeled	
	1,3,5-Trimethylbenzene	ug/m^3			0.013	0.013	ug/m^3	Modeled	
	Acenaphthene	ug/m^3			0.090	0.090	ug/m^3	Modeled	
	Acetone	ug/m^3			4.2	4.2	ug/m^3	Modeled	
	Anthracene	ug/m^3			0.024	0.024	ug/m^3	Modeled	
	Benzene	ug/m^3			3.4	3.4	ug/m^3	Modeled	
	Benzo[b]fluoranthene	ug/m^3			0.012	0.012	ug/m^3	Modeled	
	Carbon Disulfide	ug/m^3			0.0028	0.0028	ug/m^3	Modeled	
	Chrysene	ug/m^3			0.017	0.017	ug/m^3	Modeled	
	Ethylbenzene	ug/m^3			0.40	0.40	ug/m^3	Modeled	
	Fluorene	ug/m^3			0.028	0.028	ug/m^3	Modeled	
	Isopropyl benzene	ug/m^3			0.0034	0.0034	ug/m^3	Modeled	
	Methyl isobutyl ketone	ug/m^3			0.0015	0.0015	ug/m^3	Modeled	
	Methylene chloride	ug/m^3			0.12	0.12	ug/m^3	Modeled	
	MTBE	ug/m^3			0.011	0.011	ug/m^3	Modeled	
	Naphthalene	ug/m^3			8.7	8.7	ug/m^3	Modeled	
	n-Butylbenzene	ug/m^3			0.89	0.89	ug/m^3	Modeled	
	n-Propylbenzene	ug/m^3			0.0054	0.0054	ug/m^3	Modeled	
	Pyrene	ug/m^3			0.081	0.081	ug/m^3	Modeled	
	Styrene	ug/m^3			0.093	0.093	ug/m^3	Modeled	
	Toluene	ug/m^3			0.33	0.33	ug/m^3	Modeled	
	Xylenes (total)	ug/m^3			0.23	0.23	ug/m^3	Modeled	

Statistics: Modeled - Volatilization from groundwater to workplace air modeled using vapor stripping model.

Table 3.6

EXPOSURE POINT CONCENTRATION SUMMARY

CENTRAL EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Tier 1 Future
Medium: Goundwater Beneficial Use
Exposure Medium: Landscape Worker Air

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Normal)	Maximum Concentration	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Landscape Workplace Air	1,2,4-Trimethylbenzene	ug/m^3			0.025	0.025	ug/m^3	Modeled	
	1,2-Dichloroethane	ug/m^3			0.029	0.029	ug/m^3	Modeled	
	1,3,5-Trimethylbenzene	ug/m^3			0.013	0.013	ug/m^3	Modeled	
	Acenaphthene	ug/m^3			0.087	0.087	ug/m^3	Modeled	
	Acetone	ug/m^3			4.1	4.1	ug/m^3	Modeled	
	Anthracene	ug/m^3			0.023	0.023	ug/m^3	Modeled	
	Benzene	ug/m^3			3.3	3.3	ug/m^3	Modeled	
	Benzo[b]fluoranthene	ug/m^3			0.011	0.011	ug/m^3	Modeled	
	Carbon Disulfide	ug/m^3			0.0027	0.0027	ug/m^3	Modeled	
	Chrysene	ug/m^3			0.017	0.017	ug/m^3	Modeled	
	Ethylbenzene	ug/m^3			0.38	0.38	ug/m^3	Modeled	
	Fluorene	ug/m^3			0.028	0.028	ug/m^3	Modeled	
	Isopropyl benzene	ug/m^3			0.0033	0.0033	ug/m^3	Modeled	
	Methyl isobutyl ketone	ug/m^3			0.0015	0.0015	ug/m^3	Modeled	
	Methylene chloride	ug/m^3			0.11	0.11	ug/m^3	Modeled	
	MTBE	ug/m^3			0.010	0.010	ug/m^3	Modeled	
	Naphthalene	ug/m^3			8.5	8.5	ug/m^3	Modeled	
	n-Butylbenzene	ug/m^3			0.86	0.86	ug/m^3	Modeled	
	n-Propylbenzene	ug/m^3			0.0053	0.0053	ug/m^3	Modeled	
	Pyrene	ug/m^3			0.079	0.079	ug/m^3	Modeled	
	Styrene	ug/m^3			0.090	0.090	ug/m^3	Modeled	
	Toluene	ug/m^3			0.32	0.32	ug/m^3	Modeled	
	Xylenes (total)	ug/m^3			0.22	0.22	ug/m^3	Modeled	

Statistics: Modeled - Volatilization from groundwater to workplace air modeled using vapor stripping model.

Table 3.7

EXPOSURE POINT CONCENTRATION SUMMARY

REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Tier 1 Future
Medium: Goundwater Beneficial Use
Exposure Medium: Landscape Worker Air

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Normal)	Maximum Concentration	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Landscape Workplace Air	1,2,4-Trimethylbenzene	ug/m^3			0.056	0.056	ug/m^3	Modeled	
	1,2-Dichloroethane	ug/m^3			0.066	0.066	ug/m^3	Modeled	
	1,3,5-Trimethylbenzene	ug/m^3			0.030	0.030	ug/m^3	Modeled	
	Acenaphthene	ug/m^3			0.20	0.20	ug/m^3	Modeled	
	Acetone	ug/m^3			9.3	9.3	ug/m^3	Modeled	
	Anthracene	ug/m^3			0.053	0.053	ug/m^3	Modeled	
	Benzene	ug/m^3			7.6	7.6	ug/m^3	Modeled	
	Benzo[b]fluoranthene	ug/m^3			0.026	0.026	ug/m^3	Modeled	
	Carbon Disulfide	ug/m^3			0.0062	0.0062	ug/m^3	Modeled	
	Chrysene	ug/m^3			0.039	0.039	ug/m^3	Modeled	
	Ethylbenzene	ug/m^3			0.87	0.87	ug/m^3	Modeled	
	Fluorene	ug/m^3			0.063	0.063	ug/m^3	Modeled	
	Isopropyl benzene	ug/m^3			0.0076	0.0076	ug/m^3	Modeled	
	Methyl isobutyl ketone	ug/m^3			0.0033	0.0033	ug/m^3	Modeled	
	Methylene chloride	ug/m^3			0.26	0.26	ug/m^3	Modeled	
	MTBE	ug/m^3			0.024	0.024	ug/m^3	Modeled	
	Naphthalene	ug/m^3			19	19	ug/m^3	Modeled	
	n-Butylbenzene	ug/m^3			2.0	2.0	ug/m^3	Modeled	
	n-Propylbenzene	ug/m^3			0.012	0.012	ug/m^3	Modeled	
	Pyrene	ug/m^3			0.18	0.18	ug/m^3	Modeled	
	Styrene	ug/m^3			0.21	0.21	ug/m^3	Modeled	
	Toluene	ug/m^3			0.72	0.72	ug/m^3	Modeled	
	Xylenes (total)	ug/m^3			0.50	0.50	ug/m^3	Modeled	

Statistics: Modeled - Volatilization from groundwater to workplace air modeled using vapor stripping model.

Table 3.8

EXPOSURE POINT CONCENTRATION SUMMARY

CENTRAL / REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Tier 2 Future
Medium: Groundwater (On-Site)
Exposure Medium: Groundwater

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Normal)	Maximum Concentration	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Groundwater	Aluminum	ug/L			1400	1400	ug/L	Max	Tier 2 Default (1)
	Antimony	ug/L			0.48	0.48	ug/L	Max	Tier 2 Default (1)
	Arsenic	ug/L			22	22	ug/L	Max	Tier 2 Default (1)
	Barium	ug/L			1960	1960	ug/L	Max	Tier 2 Default (1)
	Beryllium	ug/L			2	2	ug/L	Max	Tier 2 Default (1)
	Cadmium	ug/L			3	3	ug/L	Max	Tier 2 Default (1)
	Chromium	ug/L			22	22	ug/L	Max	Tier 2 Default (1)
	Cobalt	ug/L			7	7	ug/L	Max	Tier 2 Default (1)
	Copper	ug/L			11	11	ug/L	Max	Tier 2 Default (1)
	Iron	ug/L			39700	39700	ug/L	Max	Tier 2 Default (1)
	Lead	ug/L			0.37	0.37	ug/L	Max	Tier 2 Default (1)
	Manganese	ug/L			2470	2470	ug/L	Max	Tier 2 Default (1)
	Mercury	ug/L			0.22	0.22	ug/L	Max	Tier 2 Default (1)
	Molybdenum	ug/L			37	37	ug/L	Max	Tier 2 Default (1)
	Nickel	ug/L			16	16	ug/L	Max	Tier 2 Default (1)
	Nitrate	ug/L			7000	7000	ug/L	Max	Tier 2 Default (1)
	Selenium	ug/L			13	13	ug/L	Max	Tier 2 Default (1)
	Silver	ug/L			15	15	ug/L	Max	Tier 2 Default (1)
	Thallium	ug/L			10	10	ug/L	Max	Tier 2 Default (1)
	Vanadium	ug/L			20	20	ug/L	Max	Tier 2 Default (1)
	Zinc	ug/L			11	11	ug/L	Max	Tier 2 Default (1)
	1,2,4-Trimethylbenzene	ug/L			55	55	ug/L	Max	Tier 2 Default (1)
	1,2-Dichloroethane	ug/L			50	50	ug/L	Max	Tier 2 Default (1)
	1,3,5-Trimethylbenzene	ug/L			29	29	ug/L	Max	Tier 2 Default (1)
	Acenaphthene	ug/L			220	220	ug/L	Max	Tier 2 Default (1)
	Acenaphthylene	ug/L			800	800	ug/L	Max	Tier 2 Default (1)
	Acetone	ug/L			10000	10000	ug/L	Max	Tier 2 Default (1)
	Anthracene	ug/L			59	59	ug/L	Max	Tier 2 Default (1)
	Benzo[a]anthracene	ug/L			26	26	ug/L	Max	Tier 2 Default (1)
	Benzo[a]pyrene	ug/L			60	60	ug/L	Max	Tier 2 Default (1)
	Benzo[b]fluoranthene	ug/L			29	29	ug/L	Max	Tier 2 Default (1)
	Benzo[g,h,I]perylene	ug/L			37	37	ug/L	Max	Tier 2 Default (1)
	Benzo[k]fluoranthene	ug/L			14	14	ug/L	Max	Tier 2 Default (1)
	Carbon Disulfide	ug/L			4.8	4.8	ug/L	Max	Tier 2 Default (1)
	Chrysene	ug/L			43	43	ug/L	Max	Tier 2 Default (1)

Table 3.8

EXPOSURE POINT CONCENTRATION SUMMARY

CENTRAL / REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Tier 2 Future
Medium: Groundwater (On-Site)
Exposure Medium: Groundwater

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Normal)	Maximum Concentration	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
	Dibenz[a,h]anthracene	ug/L			3.0	3.0	ug/L	Max	Tier 2 Default (1)
	Ethylbenzene	ug/L			800	800	ug/L	Max	Tier 2 Default (1)
	Fluoranthene	ug/L			280	280	ug/L	Max	Tier 2 Default (1)
	Fluorene	ug/L			70	70	ug/L	Max	Tier 2 Default (1)
	Indeno(1,2,3-cd)pyrene	ug/L			44	44	ug/L	Max	Tier 2 Default (1)
	Isopropyl benzene	ug/L			7.4	7.4	ug/L	Max	Tier 2 Default (1)
	Methyl isobutyl ketone	ug/L			3.5	3.5	ug/L	Max	Tier 2 Default (1)
	Methylene chloride	ug/L			180	180	ug/L	Max	Tier 2 Default (1)
	MTBE	ug/L			19	19	ug/L	Max	Tier 2 Default (1)
	n-Butylbenzene	ug/L			1800	1800	ug/L	Max	Tier 2 Default (1)
	n-Propylbenzene	ug/L			11	11	ug/L	Max	Tier 2 Default (1)
	Phenanthrene	ug/L			250	250	ug/L	Max	Tier 2 Default (1)
	Pyrene	ug/L			200	200	ug/L	Max	Tier 2 Default (1)
	Styrene	ug/L			186	186	ug/L	Max	Tier 2 Default (1)
	Toluene	ug/L			620	620	ug/L	Max	Tier 2 Default (1)
	Xylenes (total)	ug/L			423	423	ug/L	Max	Tier 2 Default (1)
	Styrene	ug/L			186	186	ug/L	Max	Tier 2 Default (1)
	Toluene	ug/L			620	620	ug/L	Max	Tier 2 Default (1)
	trans-1,2-Dichloroethene	ug/L			1	0	ug/L	Max	Tier 2 Default (1)
	Vinyl chloride	ug/L			1	0	ug/L	Max	Tier 2 Default (1)
	Xylenes (total)	ug/L			423	423	ug/L	Max	Tier 2 Default (1)
	Nitrate	ug/L			7000	7000	ug/L	Max	Tier 2 Default (1)
	Sulfate	ug/L			1800000	1800000	ug/L	Max	Tier 2 Default (1)
	Sulfide	ug/L			5690	5690	ug/L	Max	Tier 2 Default (1)
	Benzene (725 ft)	ug/L			322	322	ug/L	95% UCL-G	Geostat (2)
	Benzene (500 ft)	ug/L			494	494	ug/L	95% UCL-G	Geostat (3)
	Naphthalene (725 ft)	ug/L			3231	3231	ug/L	95% UCL-G	Geostat (2)
	Naphthalene (500 ft)	ug/L			4171	4171	ug/L	95% UCL-G	Geostat (3)

Statistics: Max Maximum Detected Value

95%UCL-G Geostatistical 95% upper confidence limit on the mean

(1) Tier 2 EPCs are maximum detected concentrations, except for benzene and naphthalene (the driving chemicals). All other concentrations are the same as the Tier 1 concentrations, as these chemicals did not contribute significantly to overall carcinogenic or noncarcinogenic risks at the site.

(2) Tier 2 exposure point concentrations for benzene and naphthalene (the driving chemicals) based on geostatistical analysis of a circular area, with a radius of 725 feet, around monitoring well the well with the highest measured benzene concentration. See section 2.6.1 of the text for discussion of how these concentrations were derived.

(3) Tier 2 exposure point concentrations for benzene and naphthalene (the driving chemicals) were also calculated using on geostatistical analysis of an alternate circular area, with a radius of 500 feet, around monitoring well the well with the highest measured benzene concentration. See section 2.6.1 of the text for discussion of how these concentrations were derived.

Table 3.9

EXPOSURE POINT CONCENTRATION SUMMARY

CENTRAL / REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Tier 2 Future
Medium: Groundwater (On-Site)
Exposure Medium: Indoor Air

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Normal)	Maximum Concentration	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Indoor Air	1,2,4-Trimethylbenzene	ug/m^3			0.060	0.060	ug/m^3	Modeled	
	1,2-Dichloroethane	ug/m^3			0.019	0.019	ug/m^3	Modeled	
	1,3,5-Trimethylbenzene	ug/m^3			0.032	0.032	ug/m^3	Modeled	
	Acetone	ug/m^3			0.29	0.29	ug/m^3	Modeled	
	Carbon disulfide	ug/m^3			0.06	0.06	ug/m^3	Modeled	
	Ethylbenzene	ug/m^3			1.6	1.6	ug/m^3	Modeled	
	Isopropyl benzene	ug/m^3			0.017	0.017	ug/m^3	Modeled	
	Methyl isobutyl ketone	ug/m^3			0.0049	0.0049	ug/m^3	Modeled	
	Methylene chloride	ug/m^3			0.16	0.16	ug/m^3	Modeled	
	MTBE	ug/m^3			0.0073	0.0073	ug/m^3	Modeled	
	Naphthalene	ug/m^3			2.1	2.1	ug/m^3	Modeled	
	n-Butylbenzene	ug/m^3			5.5	5.5	ug/m^3	Modeled	
	Styrene	ug/m^3			0.12	0.12	ug/m^3	Modeled	
	Toluene	ug/m^3			1.2	1.2	ug/m^3	Modeled	
	Xylenes (total)	ug/m^3			0.60	0.60	ug/m^3	Modeled	
	Benzene (725 ft)	ug/L			0.59	0.59	ug/m^3	Modeled	
	Benzene (500 ft)	ug/L			0.91	0.91	ug/m^3	Modeled	

Statistics: Modeled - Volatilization from groundwater to indoor air modeled using the USEPA vapor intrusion model.

Table 3.10

EXPOSURE POINT CONCENTRATION SUMMARY

CENTRAL / REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Tier 2 Current/Future
Medium: Soil Gas
Exposure Medium: Indoor Air

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Normal)	Maximum Concentration	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Indoor Air	Benzene	ug/m^3			0.16	0.16	ug/m^3	Modeled	
	Chloroform	ug/m^3			0.003	0.003	ug/m^3	Modeled	
	Ethylbenzene	ug/m^3			0.12	0.12	ug/m^3	Modeled	
	m,p-Xylene	ug/m^3			0.055	0.055	ug/m^3	Modeled	
	Naphthalene	ug/m^3			0.065	0.065	ug/m^3	Modeled	
	Tetrachloroethene (PCE)	ug/m^3			0.002	0.002	ug/m^3	Modeled	
	Trichloroethene	ug/m^3			0.004	0.004	ug/m^3	Modeled	

Statistics: Modeled - Volatilization from groundwater to indoor air modeled using the USEPA vapor intrusion model.

Table 3.11

EXPOSURE POINT CONCENTRATION SUMMARY

CENTRAL EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Tier 2 Future
Medium: Goundwater Beneficial Use
Exposure Medium: Car Wash Worker Air

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Normal)	Maximum Concentration	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Car Wash Workplace Air	1,2,4-Trimethylbenzene	ug/m^3			0.0083	0.0083	ug/m^3	Modeled	
	1,2-Dichloroethane	ug/m^3			0.010	0.010	ug/m^3	Modeled	
	1,3,5-Trimethylbenzene	ug/m^3			0.0044	0.0044	ug/m^3	Modeled	
	Acenaphthene	ug/m^3			0.029	0.029	ug/m^3	Modeled	
	Acetone	ug/m^3			1.4	1.4	ug/m^3	Modeled	
	Anthracene	ug/m^3			0.0078	0.0078	ug/m^3	Modeled	
	Benzo[b]fluoranthene	ug/m^3			0.0038	0.0038	ug/m^3	Modeled	
	Carbon Disulfide	ug/m^3			0.00091	0.00091	ug/m^3	Modeled	
	Chrysene	ug/m^3			0.0057	0.0057	ug/m^3	Modeled	
	Ethylbenzene	ug/m^3			0.13	0.13	ug/m^3	Modeled	
	Fluorene	ug/m^3			0.0093	0.0093	ug/m^3	Modeled	
	Isopropyl benzene	ug/m^3			0.0011	0.0011	ug/m^3	Modeled	
	Methyl isobutyl ketone	ug/m^3			0.00049	0.00049	ug/m^3	Modeled	
	Methylene chloride	ug/m^3			0.038	0.038	ug/m^3	Modeled	
	MTBE	ug/m^3			0.0035	0.0035	ug/m^3	Modeled	
	n-Butylbenzene	ug/m^3			0.29	0.29	ug/m^3	Modeled	
	n-Propylbenzene	ug/m^3			0.0018	0.0018	ug/m^3	Modeled	
	Pyrene	ug/m^3			0.026	0.026	ug/m^3	Modeled	
	Styrene	ug/m^3			0.030	0.030	ug/m^3	Modeled	
	Toluene	ug/m^3			0.11	0.11	ug/m^3	Modeled	
	Xylenes (total)	ug/m^3			0.074	0.074	ug/m^3	Modeled	
							ug/m^4	Modeled	
	Benzene (725 ft)	ug/L			0.060	0.060	ug/m^5	Modeled	
	Benzene (500 ft)	ug/L			0.093	0.093	ug/m^6	Modeled	
	Naphthalene (725 ft)	ug/L			0.48	0.48	ug/m^7	Modeled	
	Naphthalene (500 ft)	ug/L			0.62	0.62	ug/m^8	Modeled	

Statistics: Modeled - Volatilization from groundwater to workplace air modeled using vapor stripping model.

Table 3.12

EXPOSURE POINT CONCENTRATION SUMMARY

REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Tier 2 Future
Medium: Goundwater Beneficial Use
Exposure Medium: Car Wash Worker Air

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Normal)	Maximum Concentration	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Car Wash Workplace Air	1,2,4-Trimethylbenzene	ug/m^3			0.026	0.026	ug/m^3	Modeled	
	1,2-Dichloroethane	ug/m^3			0.030	0.030	ug/m^3	Modeled	
	1,3,5-Trimethylbenzene	ug/m^3			0.013	0.013	ug/m^3	Modeled	
	Acenaphthene	ug/m^3			0.090	0.090	ug/m^3	Modeled	
	Acetone	ug/m^3			4.2	4.2	ug/m^3	Modeled	
	Anthracene	ug/m^3			0.024	0.024	ug/m^3	Modeled	
	Benzo[b]fluoranthene	ug/m^3			0.012	0.012	ug/m^3	Modeled	
	Carbon Disulfide	ug/m^3			0.0028	0.0028	ug/m^3	Modeled	
	Chrysene	ug/m^3			0.017	0.017	ug/m^3	Modeled	
	Ethylbenzene	ug/m^3			0.40	0.40	ug/m^3	Modeled	
	Fluorene	ug/m^3			0.028	0.028	ug/m^3	Modeled	
	Isopropyl benzene	ug/m^3			0.0034	0.0034	ug/m^3	Modeled	
	Methyl isobutyl ketone	ug/m^3			0.0015	0.0015	ug/m^3	Modeled	
	Methylene chloride	ug/m^3			0.12	0.12	ug/m^3	Modeled	
	MTBE	ug/m^3			0.011	0.011	ug/m^3	Modeled	
	n-Butylbenzene	ug/m^3			0.89	0.89	ug/m^3	Modeled	
	n-Propylbenzene	ug/m^3			0.0054	0.0054	ug/m^3	Modeled	
	Pyrene	ug/m^3			0.081	0.081	ug/m^3	Modeled	
	Styrene	ug/m^3			0.093	0.093	ug/m^3	Modeled	
	Toluene	ug/m^3			0.33	0.33	ug/m^3	Modeled	
	Xylenes (total)	ug/m^3			0.23	0.23	ug/m^3	Modeled	
							ug/m^4	Modeled	
	Benzene (725 ft)	ug/L			0.18	0.18	ug/m^5	Modeled	
	Benzene (500 ft)	ug/L			0.28	0.28	ug/m^6	Modeled	
	Naphthalene (725 ft)	ug/L			1.5	1.5	ug/m^7	Modeled	
	Naphthalene (500 ft)	ug/L			1.9	1.9	ug/m^8	Modeled	

Statistics: Modeled - Volatilization from groundwater to workplace air modeled using vapor stripping model.

Table 3.13

EXPOSURE POINT CONCENTRATION SUMMARY

CENTRAL EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Tier 2 Future
Medium: Goundwater Beneficial Use
Exposure Medium: Landscape Worker Air

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Normal)	Maximum Concentration	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Landscape Workplace Air	1,2,4-Trimethylbenzene	ug/m^3			0.025	0.025	ug/m^3	Modeled	
	1,2-Dichloroethane	ug/m^3			0.029	0.029	ug/m^3	Modeled	
	1,3,5-Trimethylbenzene	ug/m^3			0.013	0.013	ug/m^3	Modeled	
	Acenaphthene	ug/m^3			0.087	0.087	ug/m^3	Modeled	
	Acetone	ug/m^3			4.1	4.1	ug/m^3	Modeled	
	Anthracene	ug/m^3			0.023	0.023	ug/m^3	Modeled	
	Benzo[b]fluoranthene	ug/m^3			0.011	0.011	ug/m^3	Modeled	
	Carbon Disulfide	ug/m^3			0.0027	0.0027	ug/m^3	Modeled	
	Chrysene	ug/m^3			0.017	0.017	ug/m^3	Modeled	
	Ethylbenzene	ug/m^3			0.38	0.38	ug/m^3	Modeled	
	Fluorene	ug/m^3			0.028	0.028	ug/m^3	Modeled	
	Isopropyl benzene	ug/m^3			0.0033	0.0033	ug/m^3	Modeled	
	Methyl isobutyl ketone	ug/m^3			0.0015	0.0015	ug/m^3	Modeled	
	Methylene chloride	ug/m^3			0.11	0.11	ug/m^3	Modeled	
	MTBE	ug/m^3			0.010	0.010	ug/m^3	Modeled	
	n-Butylbenzene	ug/m^3			0.86	0.86	ug/m^3	Modeled	
	n-Propylbenzene	ug/m^3			0.0053	0.0053	ug/m^3	Modeled	
	Pyrene	ug/m^3			0.079	0.079	ug/m^3	Modeled	
	Styrene	ug/m^3			0.090	0.090	ug/m^3	Modeled	
	Toluene	ug/m^3			0.32	0.32	ug/m^3	Modeled	
	Xylenes (total)	ug/m^3			0.22	0.22	ug/m^3	Modeled	
							ug/m^4	Modeled	
	Benzene (725 ft)	ug/L			0.18	0.18	ug/m^5	Modeled	
	Benzene (500 ft)	ug/L			0.27	0.27	ug/m^6	Modeled	
	Naphthalene (725 ft)	ug/L			1.4	1.4	ug/m^7	Modeled	
	Naphthalene (500 ft)	ug/L			1.9	1.9	ug/m^8	Modeled	

Statistics: Modeled - Volatilization from groundwater to workplace air modeled using vapor stripping model.

Table 3.14

EXPOSURE POINT CONCENTRATION SUMMARY

REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Tier 2 Future
Medium: Goundwater Beneficial Use
Exposure Medium: Landscape Worker Air

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Normal)	Maximum Concentration	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Landscape Workplace Air	1,2,4-Trimethylbenzene	ug/m^3			0.056	0.056	ug/m^3	Modeled	
	1,2-Dichloroethane	ug/m^3			0.066	0.066	ug/m^3	Modeled	
	1,3,5-Trimethylbenzene	ug/m^3			0.030	0.030	ug/m^3	Modeled	
	Acenaphthene	ug/m^3			0.198	0.198	ug/m^3	Modeled	
	Acetone	ug/m^3			9.3	9.3	ug/m^3	Modeled	
	Anthracene	ug/m^3			0.053	0.053	ug/m^3	Modeled	
	Benzo[b]fluoranthene	ug/m^3			0.026	0.026	ug/m^3	Modeled	
	Carbon Disulfide	ug/m^3			0.0062	0.0062	ug/m^3	Modeled	
	Chrysene	ug/m^3			0.039	0.039	ug/m^3	Modeled	
	Ethylbenzene	ug/m^3			0.87	0.87	ug/m^3	Modeled	
	Fluorene	ug/m^3			0.063	0.063	ug/m^3	Modeled	
	Isopropyl benzene	ug/m^3			0.0076	0.0076	ug/m^3	Modeled	
	Methyl isobutyl ketone	ug/m^3			0.0033	0.0033	ug/m^3	Modeled	
	Methylene chloride	ug/m^3			0.26	0.26	ug/m^3	Modeled	
	MTBE	ug/m^3			0.024	0.024	ug/m^3	Modeled	
	n-Butylbenzene	ug/m^3			2.0	2.0	ug/m^3	Modeled	
	n-Propylbenzene	ug/m^3			0.012	0.012	ug/m^3	Modeled	
	Pyrene	ug/m^3			0.18	0.18	ug/m^3	Modeled	
	Styrene	ug/m^3			0.21	0.21	ug/m^3	Modeled	
	Toluene	ug/m^3			0.72	0.72	ug/m^3	Modeled	
	Xylenes (total)	ug/m^3			0.50	0.50	ug/m^3	Modeled	
							ug/m^4	Modeled	
	Benzene (725 ft)	ug/L			0.41	0.41	ug/m^5	Modeled	
	Benzene (500 ft)	ug/L			0.63	0.63	ug/m^6	Modeled	
	Naphthalene (725 ft)	ug/L			3.3	3.3	ug/m^7	Modeled	
	Naphthalene (500 ft)	ug/L			4.2	4.2	ug/m^8	Modeled	

Statistics: Modeled - Volatilization from groundwater to workplace air modeled using vapor stripping model.

TABLE 4.1

VALUES USED FOR DAILY INTAKE CALCULATIONS

TIER 1 CENTRAL EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Medium: Groundwater
Exposure Medium: Indoor Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Air Inhalation	Current/Future	Adult /	Indoor Air	C_{ia}	Modeled Chemical Concentration in Indoor Air	See Table 3	mg/m^3	See Table 3	Average Concentration (mg/m^3) =
	Resident	Child		EF	Exposure Frequency	350	days/year	U.S. EPA, 2001a,b	C_{ia} x EF x ED
	School Worker			ED	Exposure Duration	25	years	U.S. EPA, 2001a,b	/(AT)
	School Student			AT_{nc}	Averaging Time (noncancer)	10,950	days	Based on $ED_{r,a}$ + $ED_{r,c}$	
				AT_c	Averaging Time (cancer)	25,550	days	U.S. EPA, 1991a, 2001a,b	

U.S. EPA, 1991a: Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. OSWER: 9285.6-03.

U.S. EPA, 2001a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

U.S. EPA, 2001b: Risk Assessment Guidance for Superfund. Volume 1- Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) EPA 540/R/99/005.

TABLE 4.2

VALUES USED FOR DAILY INTAKE CALCULATIONS

TIER 1 REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Medium: Groundwater
Exposure Medium: Indoor Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Air Inhalation	Current/Future	Adult /	Indoor Air	C_{ia}	Modeled Chemical Concentration in Indoor Air	See Table 3	mg/m^3	See Table 3	Average Concentration (mg/m^3) =
	Resident	Child		EF	Exposure Frequency	350	days/year	U.S. EPA, 2001a,b	C_{ia} x EF x ED
	School Worker			ED	Exposure Duration	25	years	U.S. EPA, 2001a,b	/(AT)
	School Student			AT_{nc}	Averaging Time (noncancer)	10,950	days	Based on $ED_{r,a}$ + $ED_{r,c}$	
				AT_c	Averaging Time (cancer)	25,550	days	U.S. EPA, 1991a, 2001a,b	

U.S. EPA, 1991a: Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. OSWER: 9285.6-03.

U.S. EPA, 2001a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

U.S. EPA, 2001b: Risk Assessment Guidance for Superfund. Volume 1- Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) EPA 540/R/99/005.

TABLE 4.3

VALUES USED FOR DAILY INTAKE CALCULATIONS

TIER 1 CENTRAL EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater - Potable Use

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Future Resident	Age-Adjusted Adult	Potable Water	CW	Chemical Concentration in Water	See Table 3	ug/L	See Table 3	LADD (mg/kg-day) =
				CF1	Conversion Factor 1	0.001	mg/ug	--	CW x CF1 x [(IR$_{w,a}$ x ED$_{r,a}$ / BW$_a$)+(IR$_{w,c}$ x ED$_{r,c}$ / BW$_c$)]
				IR$_{w,a}$	Ingestion Rate	1	L/day	U.S. EPA, 1991a, 2001a	x EF$_r$ / (AT$_c$)
				EF$_r$	Exposure Frequency	350	days/year	U.S. EPA, 1991a, 2001a,b	
				ED$_{r,a}$	Exposure Duration	3	years	U.S. EPA, 1991a, 2001a,b	
				BW$_a$	Body Weight	70	kg	U.S. EPA, 1991a, 2001a	
				AT$_{nc}$	Averaging Time (noncancer)	3,285	days	Based on ED$_{r,a}$ + ED$_{r,c}$	
				AT$_c$	Averaging Time (cancer)	25,550	days	U.S. EPA, 1991a, 2001a,b	
		Child	Potable Water	CW	Chemical Concentration in Water	See Table 3	ug/L	See Table 3	ADD (mg/kg-day) =
				CF1	Conversion Factor 1	0.001	mg/ug	--	CW x CF1 x IR$_{w,c}$ x EF$_r$ x ED$_{r,c}$
				IR$_{w,c}$	Ingestion Rate	0.5	L/day	U.S. EPA, 1991a, 2001a	/(BW$_c$ x AT$_{nc}$)
				EF$_r$	Exposure Frequency	350	days/year	U.S. EPA, 1991a, 2001a,b	
				ED$_{r,c}$	Exposure Duration	6	years	U.S. EPA, 1991a, 2001a,b	
				BW$_c$	Body Weight	15	kg	U.S. EPA, 1991a, 2001a	
				AT$_{nc}$	Averaging Time (noncancer)	2,190	days	Based on ED$_{r,c}$	
				AT$_c$	Averaging Time (cancer)	25,550	days	U.S. EPA, 1991a, 2001a,b	
	Car Wash Worker Landscape Worker	Adult	Potable Water	CW	Chemical Concentration in Water	See Table 3	ug/L	See Table 3	ADD/LADD (mg/kg-day) =
				CF1	Conversion Factor 1	0.001	mg/ug	--	CW x CF1 x IR$_{w,w}$ x EF$_{r,w}$ x ED$_{r,w}$
				IR$_{w,w}$	Ingestion Rate	1	L/day	U.S. EPA, 1991a, 2001a	/(BW$_a$ x AT)
				EF$_{r,w}$	Exposure Frequency	225	days/year	U.S. EPA, 2002	
				ED$_{r,w}$	Exposure Duration	6.6	years	U.S. EPA, 1991a, 2001a,b	
				BW$_a$	Body Weight	70	kg	U.S. EPA, 1991a, 2001a	
				AT$_{nc}$	Averaging Time (noncancer)	2,409	days	Based on ED$_{r,a}$ + ED$_{r,c}$	
				AT$_c$	Averaging Time (cancer)	25,550	days	U.S. EPA, 1991a, 2001a,b	

U.S. EPA, 1991a: Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. OSWER: 9285.6-03.

U.S. EPA, 2001a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

U.S. EPA, 2001b: Risk Assessment Guidance for Superfund. Volume 1- Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) EPA 540/R/99/005.

TABLE 4.4

VALUES USED FOR DAILY INTAKE CALCULATIONS

TIER 1 REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater - Potable Use

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Future Resident	Age-Adjusted Adult	Potable Water	CW	Chemical Concentration in Water	See Table 3	ug/L	See Table 3	LADD (mg/kg-day) =
				CF1	Conversion Factor 1	0.001	mg/ug	--	CW x CF1 x [($IR_{w,a}$ x $ED_{r,a}$ / BW_a)+($IR_{w,c}$ x $ED_{r,c}$ / BW_c)]
				$IR_{w,a}$	Ingestion Rate	2	L/day	U.S. EPA, 1991a, 2001a	x EF_r / (AT_c)
				EF_r	Exposure Frequency	350	days/year	U.S. EPA, 1991a, 2001a,b	
				$ED_{r,a}$	Exposure Duration	24	years	U.S. EPA, 1991a, 2001a,b	
				BW_a	Body Weight	70	kg	U.S. EPA, 1991a, 2001a	
				AT_{nc}	Averaging Time (noncancer)	8,760	days	Based on $ED_{r,a}$ + $ED_{r,c}$	
				AT_c	Averaging Time (cancer)	25,550	days	U.S. EPA, 1991a, 2001a,b	
		Child	Potable Water	CW	Chemical Concentration in Water	See Table 3	ug/L	See Table 3	ADD (mg/kg-day) =
				CF1	Conversion Factor 1	0.001	mg/ug	--	CW x CF1 x $IR_{w,c}$ x EF_r x $ED_{r,c}$
				$IR_{w,c}$	Ingestion Rate	1	L/day	U.S. EPA, 1991a, 2001a	/(BW_c x AT_{nc})
				EF_r	Exposure Frequency	350	days/year	U.S. EPA, 1991a, 2001a,b	
				$ED_{r,c}$	Exposure Duration	6	years	U.S. EPA, 1991a, 2001a,b	
				BW_c	Body Weight	15	kg	U.S. EPA, 1991a, 2001a	
				AT_{nc}	Averaging Time (noncancer)	2,190	days	Based on $ED_{r,c}$	
				AT_c	Averaging Time (cancer)	25,550	days	U.S. EPA, 1991a, 2001a,b	
	Car Wash Worker Landscape Worker	Adult	Potable Water	CW	Chemical Concentration in Water	See Table 3	ug/L	See Table 3	ADD/LADD (mg/kg-day) =
				CF1	Conversion Factor 1	0.001	mg/ug	--	CW x CF1 x $IR_{w,w}$ x $EF_{r,w}$ x $ED_{r,w}$
				$IR_{w,w}$	Ingestion Rate	1	L/day	U.S. EPA, 1991a, 2001a	/(BW_a x AT)
				$EF_{r,w}$	Exposure Frequency	225	days/year	U.S. EPA, 2002	
				$ED_{r,w}$	Exposure Duration	25	years	U.S. EPA, 1991a, 2001a,b	
				BW_a	Body Weight	70	kg	U.S. EPA, 1991a, 2001a	
				AT_{nc}	Averaging Time (noncancer)	9,125	days	Based on $ED_{r,a}$ + $ED_{r,c}$	
				AT_c	Averaging Time (cancer)	25,550	days	U.S. EPA, 1991a, 2001a,b	

U.S. EPA, 1991a: Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. OSWER: 9285.6-03.

U.S. EPA, 2001a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

U.S. EPA, 2001b: Risk Assessment Guidance for Superfund. Volume 1- Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) EPA 540/R/99/005.

TABLE 4.5

VALUES USED FOR DAILY INTAKE CALCULATIONS

TIER 1 CENTRAL EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater - Household Vapors

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Air Inhalation	Future Resident	Age-Adjusted Adult	Indoor Air	CW	Concentration in Groundwater	See Table 3	mg/L	See Table 3	LADD (mg/kg-day) =
				VF	Volatilization Factor	0.5	L/m^3	(1)	(CW x VF) x
				$IR_{a,a}$	Inhalation Rate	15	m^3/day	U.S. EPA, 1991a, 2001a	$[(IR_{a,a} \times ED_{r,a} / BW_a)+(IR_{a,c} \times ED_{r,c} / BW_c)]$
				EF_r	Exposure Frequency	350	days/year	U.S. EPA, 1991a, 2001a,b	$\times EF_r / AT_c$
				$ED_{r,a}$	Exposure Duration	3	year	U.S. EPA, 1991a, 2001a,b	
				BW_a	Body Weight	70	kg	U.S. EPA, 1991a, 2001a	
				AT_c	Averaging Time (cancer)	25,550	days	U.S. EPA, 1991a, 2001a,b	
		Child	Indoor Air	CW	Concentration in Groundwater	See Table 3	mg/L	See Table 3	ADD (mg/kg-day) =
				VF	Volatilization Factor	0.5	L/m^3	(1)	$CW \times VF \times IR_{a,c} \times EF_r \times ED_{r,c}$
				$IR_{a,c}$	Inhalation Rate	8	m^3/day	U.S. EPA, 1991a	$/BW_c \times AT_{nc}$
				EF_r	Exposure Frequency	350	days/year	U.S. EPA, 1991a, 2001a,b	
				$ED_{r,c}$	Exposure Duration	6	year	U.S. EPA, 1991a, 2001a,b	
				BW_c	Body Weight	15	kg	U.S. EPA, 1991a, 2001a	
				AT_{nc}	Averaging Time (noncancer)	2,190	days	Based on $ED_{r,c}$	

U.S. EPA, 1991a: Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. OSWER: 9285.6-03.

U.S. EPA, 2001a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

U.S. EPA, 2001b: Risk Assessment Guidance for Superfund. Volume 1- Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) EPA 540/R/99/005.

(1) See text for supporting information.

TABLE 4.6

VALUES USED FOR DAILY INTAKE CALCULATIONS

TIER 1 REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater - Household Vapors

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Air Inhalation	Future Resident	Age-Adjusted Adult	Indoor Air	CW	Concentration in Groundwater	See Table 3	mg/L	See Table 3	LADD (mg/kg-day) =
				VF	Volatilization Factor	0.5	L/m^3	(1)	(CW x VF) x
				$IR_{a,a}$	Inhalation Rate	20	m^3/day	U.S. EPA, 1991a, 2001a	$[(IR_{a,a} \times ED_{r,a} / BW_a)+(IR_{a,c} \times ED_{r,c} / BW_c)]$
				EF_r	Exposure Frequency	350	days/year	U.S. EPA, 1991a, 2001a,b	x EF_r / AT_c
				$ED_{r,a}$	Exposure Duration	24	year	U.S. EPA, 1991a, 2001a,b	
				BW_a	Body Weight	70	kg	U.S. EPA, 1991a, 2001a	
				AT_c	Averaging Time (cancer)	25,550	days	U.S. EPA, 1991a, 2001a,b	
		Child	Indoor Air	CW	Concentration in Groundwater	See Table 3	mg/L	See Table 3	ADD (mg/kg-day) =
				VF	Volatilization Factor	0.5	L/m^3	(1)	CW x VF x $IR_{a,c}$ x EF_r x $ED_{r,c}$
				$IR_{a,c}$	Inhalation Rate	10	m^3/day	U.S. EPA, 1991a	/BW_c x AT_{nc}
				EF_r	Exposure Frequency	350	days/year	U.S. EPA, 1991a, 2001a,b	
				$ED_{r,c}$	Exposure Duration	6	year	U.S. EPA, 1991a, 2001a,b	
				BW_c	Body Weight	15	kg	U.S. EPA, 1991a, 2001a	
				AT_{nc}	Averaging Time (noncancer)	2,190	days	Based on $ED_{r,c}$	

U.S. EPA, 1991a: Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. OSWER: 9285.6-03.

U.S. EPA, 2001a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

U.S. EPA, 2001b: Risk Assessment Guidance for Superfund. Volume 1- Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) EPA 540/R/99/005.

(1) See text for supporting information.

TABLE 4.7

VALUES USED FOR DAILY INTAKE CALCULATIONS

TIER 1 CENTRAL EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Industrial Use

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Car Wash Worker	Adult	Industrial Water	CW	Chemical Concentration in Water	See Table 3	ug/L	See Table 3	ADD/LADD (mg/kg-day) =
				CF1	Conversion Factor 1	0.001	mg/ug	--	$CW \times CF1 \times CF2 \times SA_{cw} \times ET_{cw} \times EF_{cw} \times ED_{cw} \times K_p$
				CF2	Conversion Factor 2	0.001	L/cm^3	--	$/(BW_a \times AT)$
				SA_{cw}	Surface Area	1997	cm^2	U.S. EPA 1997	
				ET_{cw}	Exposure Time	2	hr/day	(1)	
				K_p	Dermal permeability coefficient	(2)	cm/hr	See Appendix	
				EF_{cw}	Exposure Frequency	225	days/year	U.S. EPA, 2002	
				ED_{cw}	Exposure Duration	6.6	years	U.S. EPA, 1991a, 2001a,b	
				BW_a	Body Weight	70	kg	U.S. EPA, 1991a, 2001a	
				AT_{nc}	Averaging Time (noncancer)	2,409	days	Based on ED_{cw}	
				AT_c	Averaging Time (cancer)	25,550	days	U.S. EPA, 1991a, 2001a,b	
	Landscape Worker	Adult	Industrial Water	CW	Chemical Concentration in Water	See Table 3	ug/L	See Table 3	ADD/LADD (mg/kg-day) =
				CF1	Conversion Factor 1	0.001	mg/ug	--	$CW \times CF1 \times CF2 \times SA_{lw} \times ET_{lw} \times EF_{lw} \times ED_{lw} \times K_p$
				CF2	Conversion Factor 2	0.001	L/cm^3	--	$/(BW_a \times AT)$
				SA_{lw}	Surface Area	1997	cm^2	U.S. EPA 1997	
				ET_{lw}	Exposure Time	2	hr/day	(1)	
				K_p	Dermal permeability coefficient	(2)	cm/hr	See Appendix	
				EF_{lw}	Exposure Frequency	225	days/year	U.S. EPA, 2002	
				ED_{lw}	Exposure Duration	6.6	years	U.S. EPA, 1991a, 2001a,b	
				BW_a	Body Weight	70	kg	U.S. EPA, 1991a, 2001a	
				AT_{nc}	Averaging Time (noncancer)	2,409	days	Based on ED_{lw}	
				AT_c	Averaging Time (cancer)	25,550	days	U.S. EPA, 1991a, 2001a,b	

U.S. EPA, 1991a: Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. OSWER: 9285.6-03.

U.S. EPA, 2001a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

U.S. EPA, 2001b: Risk Assessment Guidance for Superfund. Volume 1- Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) EPA 540/R/99/005.

U.S. EPA, 2002: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. EPA OSWER 9355.4-24.

TABLE 4.8

VALUES USED FOR DAILY INTAKE CALCULATIONS

TIER 1 REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Industrial Use

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Car Wash Worker	Adult	Industrial Water	CW	Chemical Concentration in Water	See Table 3	ug/L	See Table 3	ADD/LADD (mg/kg-day) =
				CF1	Conversion Factor 1	0.001	mg/ug	--	$CW \times CF1 \times CF2 \times SA_{cw} \times ET_{cw} \times EF_{cw} \times ED_{cw} \times K_p$
				CF2	Conversion Factor 2	0.001	L/cm^3	--	$/(BW_a \times AT)$
				SA_{cw}	Surface Area	2299	cm^2	U.S. EPA 1997	
				ET_{cw}	Exposure Time	4	hr/day	(1)	
				K_p	Dermal permeability coefficient	(2)	cm/hr	See Appendix	
				EF_{cw}	Exposure Frequency	225	days/year	U.S. EPA, 2002	
				ED_{cw}	Exposure Duration	25	years	U.S. EPA, 1991a, 2001a,b	
				BW_a	Body Weight	70	kg	U.S. EPA, 1991a, 2001a	
				AT_{nc}	Averaging Time (noncancer)	9,125	days	Based on ED_{cw}	
				AT_c	Averaging Time (cancer)	25,550	days	U.S. EPA, 1991a, 2001a,b	
	Landscape Worker	Adult	Industrial Water	CW	Chemical Concentration in Water	See Table 3	ug/L	See Table 3	ADD/LADD (mg/kg-day) =
				CF1	Conversion Factor 1	0.001	mg/ug	--	$CW \times CF1 \times CF2 \times SA_{lw} \times ET_{lw} \times EF_{lw} \times ED_{lw} \times K_p$
				CF2	Conversion Factor 2	0.001	L/cm^3	--	$/(BW_a \times AT)$
				SA_{lw}	Surface Area	2299	cm^2	U.S. EPA 1997	
				ET_{lw}	Exposure Time	4	hr/day	(1)	
				K_p	Dermal permeability coefficient	(2)	cm/hr	See Appendix	
				EF_{lw}	Exposure Frequency	225	days/year	U.S. EPA, 2002	
				ED_{lw}	Exposure Duration	25	years	U.S. EPA, 1991a, 2001a,b	
				BW_a	Body Weight	70	kg	U.S. EPA, 1991a, 2001a	
				AT_{nc}	Averaging Time (noncancer)	9,125	days	Based on ED_{lw}	
				AT_c	Averaging Time (cancer)	25,550	days	U.S. EPA, 1991a, 2001a,b	

U.S. EPA, 1991a: Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. OSWER: 9285.6-03.

U.S. EPA, 2001a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

U.S. EPA, 2001b: Risk Assessment Guidance for Superfund. Volume 1- Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) EPA 540/R/99/005.

U.S. EPA, 2002: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. EPA OSWER 9355.4-24.

TABLE 4.9

VALUES USED FOR DAILY INTAKE CALCULATIONS

TIER 1 CENTRAL EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Industrial Water - Workspace Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Air Inhalation	Car Wash Worker	Adult	Outdoor Air	CA	Concentration in Air	See Table 3	mg/m^3	See Table 3	ADD/LADD (mg/kg-day) =
				$IR_{a,cw}$	Inhalation Rate	20	m^3/day	U.S. EPA, 1991a, 2001a	$CA \times IR_{a,cw} \times EF_{cw} \times ED_{cw}$
				EF_{cw}	Exposure Frequency	225	days/year	U.S. EPA, 2002	$/(BW_a \times AT)$
				ED_{cw}	Exposure Duration	6.6	year	U.S. EPA, 1991a, 2001a,b	
				BW_a	Body Weight	70	kg	U.S. EPA, 1991a, 2001a	
				AT_{nc}	Averaging Time (noncancer)	2,409	days	Based on ED_{cw}	
				AT_c	Averaging Time (cancer)	25,550	days	U.S. EPA, 1991a, 2001a,b	
	Landscape Worker	Adult	Outdoor Air	CA	Concentration in Air	See Table 3	mg/m^3	See Table 3	ADD/LADD (mg/kg-day) =
				$IR_{a,lw}$	Inhalation Rate	20	m^3/day	U.S. EPA, 1991a	$CA \times IR_{a,lw} \times EF_{lw} \times ED_{lw}$
				EF_r	Exposure Frequency	225	days/year	U.S. EPA, 2002	$/(BW_a \times AT)$
				ED_{lw}	Exposure Duration	6.6	year	U.S. EPA, 1991a, 2001a,b	
				BW_a	Body Weight	70	kg	U.S. EPA, 1991a, 2001a	
				AT_{nc}	Averaging Time (noncancer)	2,409	days	Based on ED_{lw}	
				AT_c	Averaging Time (cancer)	25,550	days	U.S. EPA, 1991a, 2001a,b	

U.S. EPA, 1991a: Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. OSWER: 9285.6-03.

U.S. EPA, 2001a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

U.S. EPA, 2001b: Risk Assessment Guidance for Superfund. Volume 1- Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) EPA 540/R/99/005.

U.S. EPA, 2002: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. EPA OSWER 9355.4-24.

(1) See text for supporting information.

TABLE 4.10

VALUES USED FOR DAILY INTAKE CALCULATIONS

TIER 1 REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Industrial Water - Workspace Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Air Inhalation	Car Wash Worker	Adult	Outdoor Air	CA	Concentration in Air	See Table 3	mg/m^3	See Table 3	ADD/LADD (mg/kg-day) =
				$IR_{a,cw}$	Inhalation Rate	20	m^3/day	U.S. EPA, 1991a, 2001a	$CA \times IR_{a,cw} \times EF_{cw} \times ED_{cw}$
				EF_{cw}	Exposure Frequency	225	days/year	U.S. EPA, 2002	$/(BW_a \times AT)$
				ED_{cw}	Exposure Duration	25	year	U.S. EPA, 1991a, 2001a,b	
				BW_a	Body Weight	70	kg	U.S. EPA, 1991a, 2001a	
				AT_{nc}	Averaging Time (noncancer)	9,125	days	Based on ED_{cw}	
				AT_c	Averaging Time (cancer)	25,550	days	U.S. EPA, 1991a, 2001a,b	
	Landscape Worker	Adult	Outdoor Air	CA	Concentration in Air	See Table 3	mg/m^3	See Table 3	ADD/LADD (mg/kg-day) =
				$IR_{a,lw}$	Inhalation Rate	20	m^3/day	U.S. EPA, 1991a	$CA \times IR_{a,lw} \times EF_{lw} \times ED_{lw}$
				EF_r	Exposure Frequency	225	days/year	U.S. EPA, 2002	$/(BW_a \times AT)$
				ED_{lw}	Exposure Duration	25	year	U.S. EPA, 1991a, 2001a,b	
				BW_a	Body Weight	70	kg	U.S. EPA, 1991a, 2001a	
				AT_{nc}	Averaging Time (noncancer)	9,125	days	Based on ED_{lw}	
				AT_c	Averaging Time (cancer)	25,550	days	U.S. EPA, 1991a, 2001a,b	

U.S. EPA, 1991a: Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. OSWER: 9285.6-03.

U.S. EPA, 2001a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

U.S. EPA, 2001b: Risk Assessment Guidance for Superfund. Volume 1- Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) EPA 540/R/99/005.

U.S. EPA, 2002: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. EPA OSWER 9355.4-24.

(1) See text for supporting information.

TABLE 4.11

VALUES USED FOR DAILY INTAKE CALCULATIONS

TIER 2 CENTRAL EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Medium: Groundwater
Exposure Medium: Indoor Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Air Inhalation	Current/Future Resident	Adult / Child	Indoor Air	C_{ia}	Modeled Chemical Concentration in Indoor Air	See Table 3	mg/m^3	See Table 3	Average Daily Concentration (mg/m^3) =
				EF	Exposure Frequency	350	days/year	U.S. EPA, 2001a,b	C_{ia} x EF x ED
				ED	Exposure Duration	30	years	U.S. EPA, 2001a,b	/(AT)
				AT_{nc}	Averaging Time (noncancer)	10,950	days	Based on $ED_{r,c}$	
				AT_c	Averaging Time (cancer)	25,550	days	U.S. EPA, 1991a, 2001a,b	
	School Worker	Adult	Indoor Air	C_{ia}	Modeled Chemical Concentration in Indoor Air	See Table 3	mg/m^3	See Table 3	Average Daily Concentration (mg/m^3) =
				EF	Exposure Frequency	225	days/year	U.S. EPA, 2002	C_{ia} x EF x ED
				ED	Exposure Duration	25	years	U.S. EPA, 2001a,b	/(AT)
				AT_{nc}	Averaging Time (noncancer)	9,125	days	Based on ED	
				AT_c	Averaging Time (cancer)	25,550	days	U.S. EPA, 1991a, 2001a,b	
	School Student	Child	Indoor Air	C_{ia}	Modeled Chemical Concentration in Indoor Air	See Table 3	mg/m^3	See Table 3	Average Daily Concentration (mg/m^3) =
				EF	Exposure Frequency	180	days/year	Calif. Education Code #46200	C_{ia} x EF x ED
				ED	Exposure Duration	6	years	U.S. EPA, 2001a,b	/(AT)
				AT_{nc}	Averaging Time (noncancer)	2,190	days	Based on $ED_{r,c}$	
				AT_c	Averaging Time (cancer)	25,550	days	U.S. EPA, 1991a, 2001a,b	

U.S. EPA, 1991a: Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. OSWER: 9285.6-03.

U.S. EPA, 2001a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

U.S. EPA, 2001b: Risk Assessment Guidance for Superfund. Volume 1- Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) EPA 540/R/99/005.

U.S. EPA, 2002: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. EPA OSWER 9355.4-24.

California Education Code Section #46200

TABLE 4.12

VALUES USED FOR DAILY INTAKE CALCULATIONS

TIER 2 REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Medium: Groundwater
Exposure Medium: Indoor Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Air Inhalation	Current/Future Resident	Adult / Child	Indoor Air	C_{ia}	Modeled Chemical Concentration in Indoor Air	See Table 3	mg/m^3	See Table 3	Average Concentration (mg/m^3) =
				EF	Exposure Frequency	350	days/year	U.S. EPA, 2001a,b	C_{ia} x EF x ED
				ED	Exposure Duration	30	years	U.S. EPA, 2001a,b	/(AT)
				AT_{nc}	Averaging Time (noncancer)	2,190	days	Based on $ED_{r,c}$	
				AT_c	Averaging Time (cancer)	25,550	days	U.S. EPA, 1991a, 2001a,b	
	School Worker	Adult	Indoor Air	C_{ia}	Modeled Chemical Concentration in Indoor Air	See Table 3	mg/m^3	See Table 3	Average Concentration (mg/m^3) =
				EF	Exposure Frequency	225	days/year	U.S. EPA, 2002	C_{ia} x EF x ED
				ED	Exposure Duration	25	years	U.S. EPA, 2001a,b	/(AT)
				AT_{nc}	Averaging Time (noncancer)	9,125	days	Based on ED	
				AT_c	Averaging Time (cancer)	25,550	days	U.S. EPA, 1991a, 2001a,b	
	School Student	Child	Indoor Air	C_{ia}	Modeled Chemical Concentration in Indoor Air	See Table 3	mg/m^3	See Table 3	Average Concentration (mg/m^3) =
				EF	Exposure Frequency	180	days/year	Calif. Education Code #46200	C_{ia} x EF x ED
				ED	Exposure Duration	6	years	U.S. EPA, 2001a,b	/(AT)
				AT_{nc}	Averaging Time (noncancer)	2,190	days	Based on $ED_{r,a}$ + $ED_{r,c}$	
				AT_c	Averaging Time (cancer)	25,550	days	U.S. EPA, 1991a, 2001a,b	

U.S. EPA, 1991a: Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. OSWER: 9285.6-03.

U.S. EPA, 2001a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

U.S. EPA, 2001b: Risk Assessment Guidance for Superfund. Volume 1- Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) EPA 540/R/99/005.

U.S. EPA, 2002: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. EPA OSWER 9355.4-24.

California Education Code Section #46200

TABLE 4.13
VALUES USED FOR DAILY INTAKE CALCULATIONS
TIER 2 CENTRAL EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater - Potable Use

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Future Resident	Age-Adjusted Adult	Potable Water	CW	Chemical Concentration in Water	See Table 3	ug/L	See Table 3	LADD (mg/kg-day) =
				CF1	Conversion Factor 1	0.001	mg/ug	--	CW x CF1 x [($IR_{w,a}$ x $ED_{r,a}$ / BW_a)+($IR_{w,c}$ x $ED_{r,c}$ / BW_c)]
				$IR_{w,a}$	Ingestion Rate	1	L/day	U.S. EPA, 1991a, 2001a	x EF_r / (AT_c)
				EF_r	Exposure Frequency	350	days/year	U.S. EPA, 1991a, 2001a,b	
				$ED_{r,a}$	Exposure Duration	3	years	U.S. EPA, 1991a, 2001a,b	
				BW_a	Body Weight	70	kg	U.S. EPA, 1991a, 2001a	
				AT_{nc}	Averaging Time (noncancer)	3,285	days	Based on $ED_{r,a}$ + $ED_{r,c}$	
				AT_c	Averaging Time (cancer)	25,550	days	U.S. EPA, 1991a, 2001a,b	
		Child	Potable Water	CW	Chemical Concentration in Water	See Table 3	ug/L	See Table 3	ADD (mg/kg-day) =
				CF1	Conversion Factor 1	0.001	mg/ug	–	CW x CF1 x $IR_{w,c}$ x EF_r x $ED_{r,c}$
				$IR_{w,c}$	Ingestion Rate	0.5	L/day	U.S. EPA, 1991a, 2001a	/(BW_c x AT_{nc})
				EF_r	Exposure Frequency	350	days/year	U.S. EPA, 1991a, 2001a,b	
				$ED_{r,c}$	Exposure Duration	6	years	U.S. EPA, 1991a, 2001a,b	
				BW_c	Body Weight	15	kg	U.S. EPA, 1991a, 2001a	
				AT_{nc}	Averaging Time (noncancer)	2,190	days	Based on $ED_{r,c}$	
				AT_c	Averaging Time (cancer)	25,550	days	U.S. EPA, 1991a, 2001a,b	
	Car Wash Worker Landscape Worker	Adult	Potable Water	CW	Chemical Concentration in Water	See Table 3	ug/L	See Table 3	ADD/LADD (mg/kg-day) =
				CF1	Conversion Factor 1	0.001	mg/ug	–	CW x CF1 x $IR_{w,w}$ x $EF_{r,w}$ x $ED_{r,w}$
				$IR_{w,w}$	Ingestion Rate	1	L/day	U.S. EPA, 1991a, 2001a	/(BW_a x AT)
				$EF_{r,w}$	Exposure Frequency	225	days/year	U.S. EPA, 2002	
				$ED_{r,w}$	Exposure Duration, Car Wash	2.6	years	U.S. EPA, 1997, Carey, 1988	
				$ED_{r,w}$	Exposure Duration, Landscape	3.6	years	U.S. EPA, 1997, Carey, 1988	
				BW_a	Body Weight	70	kg	U.S. EPA, 1991a, 2001a	
				$AT_{nc,car}$	Averaging Time (noncancer), car	949	days	Based on ED	
				$AT_{nc,land}$	Averaging Time (noncancer), ls	1,314	days	Based on ED	
				AT_c	Averaging Time (cancer)	25,550	days	U.S. EPA, 1991a, 2001a,b	

U.S. EPA, 1991a: Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. OSWER: 9285.6-03.

U.S. EPA, 2001a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

U.S. EPA, 2001b: Risk Assessment Guidance for Superfund. Volume 1- Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) EPA 540/R/99/005.

U.S. EPA, 2002: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. EPA OSWER 9355.4-24.

Carey. 1988. Occupational tenure in 1987: many workers have remained in their fields. Monthly Labor Review. October. 3-12.

TABLE 4.14
VALUES USED FOR DAILY INTAKE CALCULATIONS
TIER 2 REASONABLE MAXIMUM EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater - Potable Use

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Future Resident	Age-Adjusted Adult	Potable Water	CW	Chemical Concentration in Water	See Table 3	ug/L	See Table 3	LADD (mg/kg-day) =
				CF1	Conversion Factor 1	0.001	mg/ug	--	CW x CF1 x [($IR_{w,a}$ x $ED_{r,a}$ / BW_a)+($IR_{w,c}$ x $ED_{r,c}$ / BW_c)]
				$IR_{w,a}$	Ingestion Rate	2	L/day	U.S. EPA, 1991a, 2001a	x EF_r / (AT_c)
				EF_r	Exposure Frequency	350	days/year	U.S. EPA, 1991a, 2001a,b	
				$ED_{r,a}$	Exposure Duration	24	years	U.S. EPA, 1991a, 2001a,b	
				BW_a	Body Weight	70	kg	U.S. EPA, 1991a, 2001a	
				AT_{nc}	Averaging Time (noncancer)	3,285	days	Based on $ED_{r,a}$ + $ED_{r,c}$	
				AT_c	Averaging Time (cancer)	25,550	days	U.S. EPA, 1991a, 2001a,b	
		Child	Potable Water	CW	Chemical Concentration in Water	See Table 3	ug/L	See Table 3	ADD (mg/kg-day) =
				CF1	Conversion Factor 1	0.001	mg/ug	--	CW x CF1 x $IR_{w,c}$ x EF_r x $ED_{r,c}$
				$IR_{w,c}$	Ingestion Rate	1	L/day	U.S. EPA, 1991a, 2001a	/(BW_c x AT_{nc})
				EF_r	Exposure Frequency	350	days/year	U.S. EPA, 1991a, 2001a,b	
				$ED_{r,c}$	Exposure Duration	6	years	U.S. EPA, 1991a, 2001a,b	
				BW_c	Body Weight	15	kg	U.S. EPA, 1991a, 2001a	
				AT_{nc}	Averaging Time (noncancer)	2,190	days	Based on $ED_{r,c}$	
				AT_c	Averaging Time (cancer)	25,550	days	U.S. EPA, 1991a, 2001a,b	
	Car Wash Worker Landscape Worker	Adult	Potable Water	CW	Chemical Concentration in Water	See Table 3	ug/L	See Table 3	ADD/LADD (mg/kg-day) =
				CF1	Conversion Factor 1	0.001	mg/ug	--	CW x CF1 x $IR_{w,w}$ x $EF_{r,w}$ x $ED_{r,w}$
				$IR_{w,w}$	Ingestion Rate	1	L/day	U.S. EPA, 1991a, 2001a	/(BW_a x AT)
				$EF_{r,w}$	Exposure Frequency	225	days/year	U.S. EPA, 2002	
				$ED_{r,w}$	Exposure Duration, Car Wash	13.6	years	U.S. EPA, 1997, Carey, 1988	
				$ED_{r,w}$	Exposure Duration, Landscape	17.6	years	U.S. EPA, 1997, Carey, 1988	
				BW_a	Body Weight	70	kg	U.S. EPA, 1991a, 2001a	
				$AT_{nc,car}$	Averaging Time (noncancer),car	4,964	days	Based on ED	
				$AT_{nc,land}$	Averaging Time (noncancer),ls	6,424	days	Based on ED	
				AT_c	Averaging Time (cancer)	25,550	days	U.S. EPA, 1991a, 2001a,b	

U.S. EPA, 1991a: Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. OSWER: 9285.6-03.

U.S. EPA, 2001a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

U.S. EPA, 2001b: Risk Assessment Guidance for Superfund. Volume 1- Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) EPA 540/R/99/005.

U.S. EPA, 2002: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. EPA OSWER 9355.4-24.

Carey. 1988. Occupational tenure in 1987: many workers have remained in their fields. Monthly Labor Review. October. 3-12.

TABLE 4.15

VALUES USED FOR DAILY INTAKE CALCULATIONS

TIER 2 CENTRAL EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater - Household Vapors

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Air Inhalation	Future Resident	Age-Adjusted Adult	Indoor Air	CW	Concentration in Groundwater	See Table 3	mg/L	See Table 3	LADD (mg/kg-day) =
				VF	Volatilization Factor	0.5	L/m^3	(1)	(CW x VF) x
				$IR_{a,a}$	Inhalation Rate	15	m^3/day	U.S. EPA, 1991a, 2001a	$[(IR_{a,a} \times ED_{r,a} / BW_a)+(IR_{a,c} \times ED_{r,c} / BW_c)]$
				EF_r	Exposure Frequency	350	days/year	U.S. EPA, 1991a, 2001a,b	$\times EF_r / AT_c$
				$ED_{r,a}$	Exposure Duration	3	year	U.S. EPA, 1991a, 2001a,b	
				BW_a	Body Weight	70	kg	U.S. EPA, 1991a, 2001a	
				AT_c	Averaging Time (cancer)	25,550	days	U.S. EPA, 1991a, 2001a,b	
		Child	Indoor Air	CW	Concentration in Groundwater	See Table 3	mg/L	See Table 3	ADD (mg/kg-day) =
				VF	Volatilization Factor	0.5	L/m^3	(1)	$CW \times VF \times IR_{a,c} \times EF_r \times ED_{r,c}$
				$IR_{a,c}$	Inhalation Rate	8	m^3/day	U.S. EPA, 1991a	$/BW_c \times AT_{nc}$
				EF_r	Exposure Frequency	350	days/year	U.S. EPA, 1991a, 2001a,b	
				$ED_{r,c}$	Exposure Duration	6	year	U.S. EPA, 1991a, 2001a,b	
				BW_c	Body Weight	15	kg	U.S. EPA, 1991a, 2001a	
				AT_{nc}	Averaging Time (noncancer)	2,190	days	Based on $ED_{r,c}$	

U.S. EPA, 1991a: Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. OSWER: 9285.6-03.

U.S. EPA, 2001a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

U.S. EPA, 2001b: Risk Assessment Guidance for Superfund. Volume 1- Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) EPA 540/R/99/005.

(1) See text for supporting information.

TABLE 4.16

VALUES USED FOR DAILY INTAKE CALCULATIONS

TIER 2 REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater - Household Vapors

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Air Inhalation	Future Resident	Age-Adjusted Adult	Indoor Air	CW	Concentration in Groundwater	See Table 3	mg/L	See Table 3	LADD (mg/kg-day) =
				VF	Volatilization Factor	0.5	L/m^3	(1)	(CW x VF) x
				$IR_{a,a}$	Inhalation Rate	20	m^3/day	U.S. EPA, 1991a, 2001a	$[(IR_{a,a} \times ED_{r,a} / BW_a)+(IR_{a,c} \times ED_{r,c} / BW_c)]$
				EF_r	Exposure Frequency	350	days/year	U.S. EPA, 1991a, 2001a,b	$\times EF_r / AT_c$
				$ED_{r,a}$	Exposure Duration	24	year	U.S. EPA, 1991a, 2001a,b	
				BW_a	Body Weight	70	kg	U.S. EPA, 1991a, 2001a	
				AT_c	Averaging Time (cancer)	25,550	days	U.S. EPA, 1991a, 2001a,b	
		Child	Indoor Air	CW	Concentration in Groundwater	See Table 3	mg/L	See Table 3	ADD (mg/kg-day) =
				VF	Volatilization Factor	0.5	L/m^3	(1)	CW x VF x $IR_{a,c} \times EF_r \times ED_{r,c}$
				$IR_{a,c}$	Inhalation Rate	10	m^3/day	U.S. EPA, 1991a	$/BW_c \times AT_{nc}$
				EF_r	Exposure Frequency	350	days/year	U.S. EPA, 1991a, 2001a,b	
				$ED_{r,c}$	Exposure Duration	6	year	U.S. EPA, 1991a, 2001a,b	
				BW_c	Body Weight	15	kg	U.S. EPA, 1991a, 2001a	
				AT_{nc}	Averaging Time (noncancer)	2,190	days	Based on $ED_{r,c}$	

U.S. EPA, 1991a: Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. OSWER: 9285.6-03.

U.S. EPA, 2001a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

U.S. EPA, 2001b: Risk Assessment Guidance for Superfund. Volume 1- Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) EPA 540/R/99/005.

(1) See text for supporting information.

TABLE 4.17

VALUES USED FOR DAILY INTAKE CALCULATIONS

TIER 2 CENTRAL EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Industrial Use

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Car Wash Worker	Adult	Industrial Water	CW	Chemical Concentration in Water	See Table 3	ug/L	See Table 3	ADD/LADD (mg/kg-day) =
				CF1	Conversion Factor 1	0.001	mg/ug	--	$CW \times CF1 \times CF2 \times SA_{cw} \times ET_{cw} \times EF_{cw} \times ED_{cw} \times K_p$
				CF2	Conversion Factor 2	0.001	L/cm^3	--	$/(BW_a \times AT)$
				SA_{cw}	Surface Area	1997	cm^2	U.S. EPA 1997	
				ET_{cw}	Exposure Time	2	hr/day	(1)	
				K_p	Dermal permeability coefficient	(2)	cm/hr	See Appendix	
				EF_{cw}	Exposure Frequency	225	days/year	U.S. EPA, 2002	
				ED_{cw}	Exposure Duration	2.6	years	U.S. EPA, 1997, Carey, 1988	
				BW_a	Body Weight	70	kg	U.S. EPA, 1991a, 2001a	
				AT_{nc}	Averaging Time (noncancer)	949	days	Based on ED_{cw}	
				AT_c	Averaging Time (cancer)	25,550	days	U.S. EPA, 1991a, 2001a,b	
	Landscape Worker	Adult	Industrial Water	CW	Chemical Concentration in Water	See Table 3	ug/L	See Table 3	ADD/LADD (mg/kg-day) =
				CF1	Conversion Factor 1	0.001	mg/ug	--	$CW \times CF1 \times CF2 \times SA_{lw} \times ET_{lw} \times EF_{lw} \times ED_{lw} \times K_p$
				CF2	Conversion Factor 2	0.001	L/cm^3	--	$/(BW_a \times AT)$
				SA_{lw}	Surface Area	1997	cm^2	U.S. EPA 1997	
				ET_{lw}	Exposure Time	2	hr/day	(1)	
				K_p	Dermal permeability coefficient	(2)	cm/hr	See Appendix	
				EF_{lw}	Exposure Frequency	225	days/year	U.S. EPA, 2002	
				ED_{lw}	Exposure Duration	3.6	years	U.S. EPA, 1997, Carey, 1988	
				BW_a	Body Weight	70	kg	U.S. EPA, 1991a, 2001a	
				AT_{nc}	Averaging Time (noncancer)	1,314	days	Based on ED_{lw}	
				AT_c	Averaging Time (cancer)	25,550	days	U.S. EPA, 1991a, 2001a,b	

Carey. 1988. Occupational tenure in 1987: many workers have remained in their fields. Monthly Labor Review. October. 3-12.

U.S. EPA, 1991a: Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. OSWER: 9285.6-03.

U.S. EPA, 2001a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

U.S. EPA, 2001b: Risk Assessment Guidance for Superfund. Volume 1- Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) EPA 540/R/99/005.

U.S. EPA, 2002: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. EPA OSWER 9355.4-24.

(1) Site specific

(2) Chemical specific. See Appendix

TABLE 4.18
VALUES USED FOR DAILY INTAKE CALCULATIONS
TIER 2 REASONABLE MAXIMUM EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Industrial Use

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Car Wash Worker	Adult	Industrial Water	CW	Chemical Concentration in Water	See Table 3	ug/L	See Table 3	ADD/LADD (mg/kg-day) =
				CF1	Conversion Factor 1	0.001	mg/ug	–	$CW \times CF1 \times CF2 \times SA_{cw} \times ET_{cw} \times EF_{cw} \times ED_{cw} \times K_p$
				CF2	Conversion Factor 2	0.001	L/cm^3	–	$/(BW_a \times AT)$
				SA_{cw}	Surface Area	2299	cm^2	U.S. EPA 1997	
				ET_{cw}	Exposure Time	4	hr/day	(1)	
				K_p	Dermal permeability coefficient	(2)	cm/hr	See Appendix	
				EF_{cw}	Exposure Frequency	225	days/year	U.S. EPA, 2002	
				ED_{cw}	Exposure Duration	13.6	years	U.S. EPA, 1991a, 2001a,b	
				BW_a	Body Weight	70	kg	U.S. EPA, 1991a, 2001a	
				AT_{nc}	Averaging Time (noncancer)	4,964	days	Based on ED_{cw}	
				AT_c	Averaging Time (cancer)	25,550	days	U.S. EPA, 1991a, 2001a,b	
	Landscape Worker	Adult	Industrial Water	CW	Chemical Concentration in Water	See Table 3	ug/L	See Table 3	ADD/LADD (mg/kg-day) =
				CF1	Conversion Factor 1	0.001	mg/ug	–	$CW \times CF1 \times CF2 \times SA_{lw} \times ET_{lw} \times EF_{lw} \times ED_{lw} \times K_p$
				CF2	Conversion Factor 2	0.001	L/cm^3	–	$/(BW_a \times AT)$
				SA_{lw}	Surface Area	2299	cm^2	U.S. EPA 1997	
				ET_{lw}	Exposure Time	4	hr/day	(1)	
				K_p	Dermal permeability coefficient	(2)	cm/hr	See Appendix	
				EF_{lw}	Exposure Frequency	225	days/year	U.S. EPA, 2002	
				ED_{lw}	Exposure Duration	17.6	years	U.S. EPA, 1991a, 2001a,b	
				BW_a	Body Weight	70	kg	U.S. EPA, 1991a, 2001a	
				AT_{nc}	Averaging Time (noncancer)	6,424	days	Based on ED_{lw}	
				AT_c	Averaging Time (cancer)	25,550	days	U.S. EPA, 1991a, 2001a,b	

Carey. 1988. Occupational tenure in 1987: many workers have remained in their fields. Monthly Labor Review. October. 3-12.

U.S. EPA, 1991a: Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. OSWER: 9285.6-03.

U.S. EPA, 2001a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

U.S. EPA, 2001b: Risk Assessment Guidance for Superfund. Volume 1- Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) EPA 540/R/99/005.

U.S. EPA, 2002: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. EPA OSWER 9355.4-24.

(1) Site specific

(2) Chemical specific. See Appendix

TABLE 4.19

VALUES USED FOR DAILY INTAKE CALCULATIONS

TIER 2 CENTRAL EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Industrial Water - Workspace Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Air Inhalation	Car Wash Worker	Adult	Outdoor Air	CA	Concentration in Air	See Table 3	mg/m^3	See Table 3	ADD/LADD (mg/kg-day) =
				$IR_{a,cw}$	Inhalation Rate	20	m^3/day	U.S. EPA, 1991a, 2001a	$CA \times IR_{a,cw} \times EF_{cw} \times ED_{cw}$
				EF_{cw}	Exposure Frequency	225	days/year	U.S. EPA, 2002	$/(BW_a \times AT)$
				ED_{cw}	Exposure Duration	2.6	year	U.S. EPA, 1997, Carey, 1988	
				BW_a	Body Weight	70	kg	U.S. EPA, 1991a, 2001a	
				AT_{nc}	Averaging Time (noncancer)	949	days	Based on ED_{cw}	
				AT_c	Averaging Time (cancer)	25,550	days	U.S. EPA, 1991a, 2001a,b	
	Landscape Worker	Adult	Outdoor Air	CA	Concentration in Air	See Table 3	mg/m^3	See Table 3	ADD/LADD (mg/kg-day) =
				$IR_{a,lw}$	Inhalation Rate	20	m^3/day	U.S. EPA, 1991a	$CA \times IR_{a,lw} \times EF_{lw} \times ED_{lw}$
				EF_r	Exposure Frequency	225	days/year	U.S. EPA, 2002	$/(BW_a \times AT)$
				ED_{lw}	Exposure Duration	3.6	year	U.S. EPA, 1997, Carey, 1988	
				BW_a	Body Weight	70	kg	U.S. EPA, 1991a, 2001a	
				AT_{nc}	Averaging Time (noncancer)	1,314	days	Based on ED_{lw}	
				AT_c	Averaging Time (cancer)	25,550	days	U.S. EPA, 1991a, 2001a,b	

Carey. 1988. Occupational tenure in 1987: many workers have remained in their fields. Monthly Labor Review. October. 3-12.

U.S. EPA, 1991a: Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. OSWER: 9285.6-03.

U.S. EPA, 2001a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

U.S. EPA, 2001b: Risk Assessment Guidance for Superfund. Volume 1- Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) EPA 540/R/99/005.

U.S. EPA, 2002: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. EPA OSWER 9355.4-24.

(1) See text for supporting information.

TABLE 4.20

VALUES USED FOR DAILY INTAKE CALCULATIONS

TIER 2 REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Industrial Water - Workspace Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Air Inhalation	Car Wash Worker	Adult	Outdoor Air	CA	Concentration in Air	See Table 3	mg/m^3	See Table 3	ADD/LADD (mg/kg-day) =
				$IR_{a,cw}$	Inhalation Rate	20	m^3/day	U.S. EPA, 1991a, 2001a	$CA \times IR_{a,cw} \times EF_{cw} \times ED_{cw}$
				EF_{cw}	Exposure Frequency	225	days/year	U.S. EPA, 2002	$/(BW_a \times AT)$
				ED_{cw}	Exposure Duration	13.6	year	U.S. EPA, 1997, Carey, 1988	
				BW_a	Body Weight	70	kg	U.S. EPA, 1991a, 2001a	
				AT_{nc}	Averaging Time (noncancer)	4,964	days	Based on ED_{cw}	
				AT_c	Averaging Time (cancer)	25,550	days	U.S. EPA, 1991a, 2001a,b	
	Landscape Worker	Adult	Outdoor Air	CA	Concentration in Air	See Table 3	mg/m^3	See Table 3	ADD/LADD (mg/kg-day) =
				$IR_{a,lw}$	Inhalation Rate	20	m^3/day	U.S. EPA, 1991a	$CA \times IR_{a,lw} \times EF_{lw} \times ED_{lw}$
				EF_r	Exposure Frequency	225	days/year	U.S. EPA, 2002	$/(BW_a \times AT)$
				ED_{lw}	Exposure Duration	17.6	year	U.S. EPA, 1997, Carey, 1988	
				BW_a	Body Weight	70	kg	U.S. EPA, 1991a, 2001a	
				AT_{nc}	Averaging Time (noncancer)	6,424	days	Based on ED_{lw}	
				AT_c	Averaging Time (cancer)	25,550	days	U.S. EPA, 1991a, 2001a,b	

Carey. 1988. Occupational tenure in 1987: many workers have remained in their fields. Monthly Labor Review. October. 3-12.

U.S. EPA, 1991a: Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. OSWER: 9285.6-03.

U.S. EPA, 2001a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

U.S. EPA, 2001b: Risk Assessment Guidance for Superfund. Volume 1- Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) EPA 540/R/99/005.

U.S. EPA, 2002: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. EPA OSWER 9355.4-24.

(1) See text for supporting information.

TABLE 5.1

NON-CANCER TOXICITY DATA -- ORAL/DERMAL

FISCO ALAMEDA FACILITY/ANNEX SITE

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD		Oral Absorption Efficiency for Dermal	Absorbed RfD for Dermal		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfD:Target Organ(s)	
		Value	Units	(1)	Value	Units			Source(s)	Date(s) (MM/DD/YYYY)
Aluminum	Chronic	1.0E+00	mg/kg-day	NA	1.0E+00	mg/kg-day			NCEA	
Antimony	Chronic	4.0E-04	mg/kg-day	NA	4.0E-04	mg/kg-day	Whole Body, Blood	1000	IRIS	08/19/02
Arsenic	Chronic	3.0E-04	mg/kg-day	NA	3.0E-04	mg/kg-day	Skin	3	IRIS	08/19/02
Barium	Chronic	7.0E-02	mg/kg-day	NA	7.0E-02	mg/kg-day	Kidney	3	IRIS	08/19/02
Beryllium	Chronic	2.0E-03	mg/kg-day	NA	2.0E-03	mg/kg-day	Small Intestine	300	IRIS	08/19/02
Cadmium	Chronic	5.0E-04	mg/kg-day	NA	5.0E-04	mg/kg-day	Kidney	10	IRIS	08/19/02
Calcium	Chronic	NA	mg/kg-day	NA	NA	mg/kg-day				
Chloride	Chronic	NA	mg/kg-day	NA	NA	mg/kg-day				
Chromium	Chronic	3.0E-03	mg/kg-day	NA	3.0E-03	mg/kg-day		900	IRIS	08/19/02
Cobalt	Chronic	2.0E-02	mg/kg-day	NA	2.0E-02	mg/kg-day			NCEA	
Copper	Chronic	4.0E-02	mg/kg-day	NA	4.0E-02	mg/kg-day	GI System		HEAST	07/01/97
Iron	Chronic	3.0E-01	mg/kg-day	NA	3.0E-01	mg/kg-day			NCEA	
Lead	Chronic	NA	mg/kg-day	NA	NA	mg/kg-day				
Magnesium	Chronic	NA	mg/kg-day	NA	NA	mg/kg-day				
Manganese	Chronic	1.4E-01	mg/kg-day	NA	1.4E-01	mg/kg-day	CNS	1	IRIS	08/19/02
Mercury	Chronic	3.0E-04	mg/kg-day	NA	3.0E-04	mg/kg-day	Immune System	1000	IRIS	05/01/95
Methane	Chronic		mg/kg-day	NA	0.0E+00	mg/kg-day				
Molybdenum	Chronic	5.0E-03	mg/kg-day	NA	5.0E-03	mg/kg-day	Blood	30	IRIS	08/19/02
Nickel	Chronic	2.0E-02	mg/kg-day	NA	2.0E-02	mg/kg-day	Body Weight	300	IRIS	08/19/02
Nitrate	Chronic	1.6E+00	mg/kg-day	NA	1.6E+00	mg/kg-day	Blood	1	IRIS	08/19/02
Potassium	Chronic	NA	mg/kg-day	NA	NA	mg/kg-day				
Selenium	Chronic	5.0E-03	mg/kg-day	NA	5.0E-03	mg/kg-day	Whole Body	3	IRIS	08/19/02
Silver	Chronic	5.0E-03	mg/kg-day	NA	5.0E-03	mg/kg-day	Skin	3	IRIS	08/19/02
Sodium	Chronic	NA	mg/kg-day	NA	NA	mg/kg-day				
Thallium	Chronic	6.6E-05	mg/kg-day	NA	6.6E-05	mg/kg-day	Liver, Blood, Hair	3000	IRIS	08/19/02
Vanadium	Chronic	7.0E-03	mg/kg-day	NA	7.0E-03	mg/kg-day	Hair	100	HEAST	07/01/97
Zinc	Chronic	3.0E-01	mg/kg-day	NA	3.0E-01	mg/kg-day	Blood	3	IRIS	08/19/02
1,1,1,2-Tetrachloroethane	Chronic	3.0E-02	mg/kg-day	NA	3.0E-02	mg/kg-day	Kidney/Liver	3000	IRIS	12/01/96

TABLE 5.1

NON-CANCER TOXICITY DATA – ORAL/DERMAL

FISCO ALAMEDA FACILITY/ANNEX SITE

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD		Oral Absorption Efficiency for Dermal	Absorbed RfD for Dermal		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfD:Target Organ(s)	
		Value	Units	(1)	Value	Units			Source(s)	Date(s) (MM/DD/YYYY)
1,2,4-Trimethylbenzene	Chronic	5.0E-02	mg/kg-day	NA	5.0E-02	mg/kg-day			NCEA	
1,2-Dichlorobenzene	Chronic	9.0E-02	mg/kg-day	NA	9.0E-02	mg/kg-day	NOAEL	1000	IRIS	03/01/01
1,2-Dichloroethane	Chronic	3.0E-02	mg/kg-day	NA	3.0E-02	mg/kg-day			NCEA	
1,3,5-Trimethylbenzene	Chronic	5.0E-02	mg/kg-day	NA	5.0E-02	mg/kg-day			NCEA	
2-Butanone	Chronic	6.0E-01	mg/kg-day	NA	6.0E-01	mg/kg-day	Reproductive	3000	IRIS	09/26/03
4-Isopropyltoluene	no IRIS data	NA		NA	NA					
Acetone	Chronic	1.0E-01	mg/kg-day	NA	1.0E-01	mg/kg-day	Liver, Kidney	1000	IRIS	08/16/02
Benzene	Chronic	3.0E-03	mg/kg-day	NA	3.0E-03	mg/kg-day			NCEA	
Bromodichloromethane	Chronic	2.0E-02	mg/kg-day	NA	2.0E-02	mg/kg-day	Kidney	1000	IRIS	03/01/91
Carbon disulfide	Chronic	1.0E-01	mg/kg-day	NA	1.0E-01	mg/kg-day	Reproductive/ Teratogenic	100	IRIS	09/01/90
Chloroform	Chronic	1.0E-02	mg/kg-day	NA	1.0E-02	mg/kg-day	Liver	100	IRIS	10/19/01
Chloromethane	no IRIS data	NA		NA	NA					
cis-1,2-Dichloroethene	Chronic	1.0E-02	mg/kg-day	NA	1.0E-02	mg/kg-day	Blood	3000	HEAST	07/01/97
Dibromochloromethane	Chronic	2.0E-02	mg/kg-day	NA	2.0E-02	mg/kg-day	Liver	1000	IRIS	03/01/91
Dichlorodifluoromethane	Chronic	2.0E-01	mg/kg-day	NA	2.0E-01	mg/kg-day	Whole Body	100	IRIS	11//01/95
Ethylbenzene	Chronic	1.0E-01	mg/kg-day	NA	1.0E-01	mg/kg-day	Liver, Kidney	1000	IRIS	06/01/91
Isopropyl benzene	Chronic	1.0E-01	mg/kg-day	NA	1.0E-01	mg/kg-day	Kidney	1000	IRIS	08/01/97
Methyl isobutyl ketone	Chronic	8.0E-02	mg/kg-day	NA	8.0E-02	mg/kg-day			HEAST	07/01/97
Methylene Chloride	Chronic	6.0E-02	mg/kg-day	NA	6.0E-02	mg/kg-day	Liver	100	IRIS	03/01/88
MTBE	Chronic	NA		NA	NA					
n-Butylbenzene	Chronic	4.0E-02	mg/kg-day	NA	4.0E-02	mg/kg-day			NCEA	
n-Propylbenzene	Chronic	4.0E-02	mg/kg-day	NA	4.0E-02	mg/kg-day			NCEA	
sec-Butylbenzene	Chronic	4.0E-02	mg/kg-day	NA	4.0E-02	mg/kg-day			NCEA	
Styrene	Chronic	2.0E-01	mg/kg-day	NA	2.0E-01	mg/kg-day	Blood, Liver	1000	IRIS	09/01/90
Tetrachloroethene	Chronic	1.0E-02	mg/kg-day	NA	1.0E-02	mg/kg-day	Liver	1000	IRIS	03/01/88
Toluene	Chronic	2.0E-01	mg/kg-day	NA	2.0E-01	mg/kg-day	Liver, Kidney, Respiratory	1000	IRIS	04/01/94
Trichloroethene	Chronic	3.0E-04	mg/kg-day	NA	3.0E-04	mg/kg-day			NCEA	
trans-1,2-Dichloroethene	Chronic	1.0E-02	mg/kg-day	NA	1.0E-02	mg/kg-day	Blood	1000	HEAST	01/01/89

TABLE 5.1

NON-CANCER TOXICITY DATA – ORAL/DERMAL

FISCO ALAMEDA FACILITY/ANNEX SITE

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD		Oral Absorption Efficiency for Dermal	Absorbed RfD for Dermal		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfD:Target Organ(s)	
		Value	Units	(1)	Value	Units			Source(s)	Date(s) (MM/DD/YYYY)
Vinyl chloride	Chronic	3.0E-03	mg/kg-day	NA	3.0E-03	mg/kg-day	Liver	30	IRIS	08/07/00
Xylenes (Total)	Chronic	2.0E-01	mg/kg-day	NA	2.0E-01	mg/kg-day	Whole Body	100	IRIS	02/21/03
Acenaphthene	Chronic	6.0E-02	mg/kg-day	0.58-0.89	6.0E-02	mg/kg-day	Liver	3000	IRIS	04/01/94
Acenaphthylene	no IRIS data	NA		0.58-0.89	NA					
Anthracene	Chronic	3.0E-01	mg/kg-day	0.58-0.89	3.0E-01	mg/kg-day	NOAEL	3000	IRIS	08/21/02
Benzo[a]anthracene	no IRIS data	NA		0.58-0.89	NA					
Benzo[a]pyrene	no IRIS data	NA		0.58-0.89	NA					
Benzo[b]fluoranthene	no IRIS data	NA		0.58-0.89	NA					
Benzo[g,h,I]perylene	no IRIS data	NA		0.58-0.89	NA					
Benzo[k]fluoranthene	no IRIS data	NA		0.58-0.89	NA					
Chrysene	no IRIS data	NA		0.58-0.89	NA					
Dibenz[a,h]anthracene	no IRIS data	NA		0.58-0.89	NA					
Fluoranthene	Chronic	4.0E-02	mg/kg-day	0.58-0.89	4.0E-02	mg/kg-day	Kidney, Liver, Blood	3000	IRIS	07/01/93
Fluorene	Chronic	4.0E-02	mg/kg-day	0.58-0.89	4.0E-02	mg/kg-day	Blood	3000	IRIS	11/01/90
Indeno(1,2,3-cd)pyrene	no IRIS data	NA		0.58-0.89	NA					
Naphthalene	Chronic	2.0E-02	mg/kg-day	0.58-0.89	2.0E-02	mg/kg-day	Whole Body	3000	IRIS	09/17/98
Phenanthrene	no IRIS data	NA		0.58-0.89	NA					
Pyrene	Chronic	3.0E-02	mg/kg-day	0.58-0.89	3.0E-02	mg/kg-day	Kidney	3000	OEHHA	07/01/93
Nitrate as Nitrogen (N)	Chronic	1.6E+00	mg/kg-day		1.6E+00	mg/kg-day	Blood	1	IRIS	10/01/91
Sulfate	no IRIS data	NA			NA					
Sulfide	no IRIS data	NA			NA					

Footnote Instructions:

(1) USEPA, 2001.

HEAST = Health Affects Assessment Summary Tables (U.S. EPA, 1997b)

IRIS = Integrated Risk Information System

TABLE 5.2

NON-CANCER TOXICITY DATA -- INHALATION

FISCO ALAMEDA FACILITY/ANNEX SITE

Chemical of Potential Concern	Chronic/ Subchronic	Inhalation RfC		Extrapolated RfD		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfC : Target Organ(s)	
		Value	Units	Value	Units			Source(s)	Date(s) (MM/DD/YYYY)
Aluminum	Chronic	4.9E-03	mg/m^3	1.4E-03	mg/kg-day			NCEA	
Antimony	NA	NA	mg/m^3	NA	mg/kg-day				
Arsenic	NA	NA	mg/m^3	NA	mg/kg-day				
Barium	Chronic	4.9E-04	mg/m^3	1.4E-04	mg/kg-day			HEAST	7/1/97
Beryllium	Chronic	2.0E-05	mg/m^3	5.7E-06	mg/kg-day	Respiratory System	10	IRIS	8/19/02
Cadmium	NA	NA	mg/m^3	NA	mg/kg-day				
Calcium	NA	NA	mg/m^3	NA	mg/kg-day				
Chloride	NA	NA	mg/m^3	NA	mg/kg-day				
Chromium	Chronic	7.7E-06	mg/m^3	2.2E-06	mg/kg-day	Respiratory System	90	IRIS	8/19/02
Cobalt	Chronic	2.0E-05	mg/m^3	5.7E-06	mg/kg-day			NCEA	
Copper	NA	NA	mg/m^3	NA	mg/kg-day				
Iron	NA	NA	mg/m^3	NA	mg/kg-day				
Lead	NA	NA	mg/m^3	NA	mg/kg-day				
Magnesium	NA	NA	mg/m^3	NA	mg/kg-day				
Manganese	Chronic	4.9E-05	mg/m^3	1.4E-05	mg/kg-day	CNS	1000	IRIS	8/19/02
Mercury	Chronic	3.0E-04	mg/m^3	8.6E-05	mg/kg-day	CNS	30	IRIS	6/1/95
Methane			mg/m^3		mg/kg-day				
Molybdenum	NA	NA	mg/m^3	NA	mg/kg-day				
Nickel	NA	NA	mg/m^3	NA	mg/kg-day				
Nitrate	NA	NA	mg/m^3	NA	mg/kg-day				
Potassium	NA	NA	mg/m^3	NA	mg/kg-day				
Selenium	NA	NA	mg/m^3	NA	mg/kg-day				
Silver	NA	NA	mg/m^3	NA	mg/kg-day				
Sodium	NA	NA	mg/m^3	NA	mg/kg-day				
Thallium	NA	NA	mg/m^3	NA	mg/kg-day				
Vanadium	NA	NA	mg/m^3	NA	mg/kg-day				

TABLE 5.2

NON-CANCER TOXICITY DATA -- INHALATION

FISCO ALAMEDA FACILITY/ANNEX SITE

Chemical of Potential Concern	Chronic/ Subchronic	Inhalation RfC		Extrapolated RfD		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfC : Target Organ(s)	
		Value	Units	Value	Units			Source(s)	Date(s) (MM/DD/YYYY)
Zinc	NA	NA	mg/m^3	NA	mg/kg-day				
1,1,1,2-Tetrachloroethane	no IRIS data	NA		NA					
1,2,4-Trimethylbenzene	no IRIS data	6.0E-03	mg/m^3	1.7E-03	mg/kg-day			NCEA	
1,2-Dichlorobenzene	no IRIS data	2.0E-01	mg/m^3	5.7E-02	mg/kg-day			HEAST	7/1/97
1,2-Dichloroethane	no IRIS data	4.9E-03	mg/m^3	1.4E-03	mg/kg-day			NCEA	
1,3,5-Trimethylbenzene	no IRIS data	6.0E-03	mg/m^3	1.7E-03	mg/kg-day			NCEA	
2-Butanone	Chronic	5.0E+00	mg/m^3	1.4E+00	mg/kg-day	Developmental	1000	IRIS	9/26/03
4-Isopropyltoluene	no IRIS data	NA		NA					
Acetone	NA	NA	mg/m^3	NA	mg/kg-day				
Benzene	no IRIS data	6.0E-03	mg/m^3	1.7E-03	mg/kg-day			NCEA	
Bromodichloromethane	no IRIS data	NA		NA					
Carbon disulfide	Chronic	7.0E-01	mg/m^3	2.0E-01	mg/kg-day	Peripheral Nervous System	30	IRIS	8/1/95
Chloroform	no IRIS data	3.0E-03	mg/m^3	8.6E-04	mg/kg-day			NCEA	
Chloromethane	Chronic	3.0E-01	mg/m^3	8.6E-02	mg/kg-day	Brain	1000	NCEA	
cis-1,2-Dichloroethene	no IRIS data	3.5E-02	mg/m^3	1.0E-02	mg/kg-day			HEAST	7/1/97
Dibromochloromethane	no IRIS data	NA		NA					
Dichlorodifluoromethane	no IRIS data	2.0E-01	mg/m^3	5.7E-02	mg/kg-day			HEAST	7/1/97
Ethylbenzene	Chronic	1.0E+00	mg/m^3	2.9E-01	mg/kg-day	Developmental	300	IRIS	6/1/91
Isopropyl benzene		4E-01	mg/m^3	1.1E-01	mg/kg-day	Kidney	1000	IRIS	8/1/97
Methyl isobutyl ketone	Chronic	8E-02	mg/m^3	2.3E-02	mg/kg-day			HEAST	7/1/97
Methylene Chloride	no IRIS data	3.0E+00	mg/m^3	8.6E-01	mg/kg-day			HEAST	7/1/97
MTBE	Chronic	3.0E+00	mg/m^3	8.6E-01	mg/kg-day	Liver, Kidney	100	IRIS	9/1/93
n-Butylbenzene	no IRIS data	NA		NA					
n-Propylbenzene	no IRIS data	NA		NA					
sec-Butylbenzene	no IRIS data	NA		NA					

TABLE 5.2

NON-CANCER TOXICITY DATA -- INHALATION

FISCO ALAMEDA FACILITY/ANNEX SITE

Chemical of Potential Concern	Chronic/ Subchronic	Inhalation RfC		Extrapolated RfD		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfC : Target Organ(s)	
		Value	Units	Value	Units			Source(s)	Date(s) (MM/DD/YYYY)
Styrene	Chronic	1.0E+00	mg/m^3	2.9E-01	mg/kg-day	CNS	30	IRIS	7/1/93
Tetrachloroethene	Chronic	6.0E-01	mg/m^3	1.7E-01	mg/kg-day	Liver, Kidney	1000	NCEA	
Toluene	Chronic	3.9E-01	mg/m^3	1.1E-01	mg/kg-day	CNS, Respiratory	300	IRIS	8/1/92
Trichloroethene	Chronic	6.0E-01	mg/m^3	1.7E-01	mg/kg-day	CNS		OEHHA	6/23/04
trans-1,2-Dichloroethene	no IRIS data	NA		NA					
Vinyl chloride	Chronic	1.0E-01	mg/m^3	2.9E-02	mg/kg-day	Liver	30	IRIS	8/7/00
Xylenes (Total)	no IRIS data	1.0E-01	mg/m^3	2.9E-02	mg/kg-day	CNS	300	IRIS	2/21/03
Acenaphthene	no IRIS data	NA		NA					
Acenaphthylene	no IRIS data	NA		NA					
Anthracene	no IRIS data	NA		NA					
Benzo[a]anthracene	NA	NA		NA					
Benzo[a]pyrene	NA	NA		NA					
Benzo[b]fluoranthene	NA	NA		NA					
Benzo[g,h,I]perylene	NA	NA		NA					
Benzo[k]fluoranthene	no IRIS data	NA		NA					
Chrysene	no IRIS data	NA		NA					
Dibenz[a,h]anthracene	no IRIS data	NA		NA					
Fluoranthene	no IRIS data	NA		NA					
Fluorene	no IRIS data	NA		NA					
Indeno(1,2,3-cd)pyrene	no IRIS data	NA		NA					
Naphthalene	Chronic	3.0E-03	mg/m^3	8.6E-04	mg/kg-day	Respiratory	3000	IRIS	9/17/98
Phenanthrene	no IRIS data	NA		NA					
Pyrene	no IRIS data	NA		NA					
Nitrate as Nitrogen (N)	no IRIS data	NA		NA					
Sulfate	not listed in IRIS	NA		NA					
Sulfide	not listed in IRIS	NA		NA					

TABLE 5.2

NON-CANCER TOXICITY DATA -- INHALATION

FISCO ALAMEDA FACILITY/ANNEX SITE

Chemical of Potential Concern	Chronic/ Subchronic	Inhalation RfC		Extrapolated RfD		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfC : Target Organ(s)	
		Value	Units	Value	Units			Source(s)	Date(s) (MM/DD/YYYY)

Footnote Instructions:

(1) Inhalation RfD =(RfC*20 m^3/day)/70 kg

TABLE 6.1

CANCER TOXICITY DATA -- ORAL/DERMAL

FISCO ALAMEDA FACILITY/ANNEX SITE

Chemical of Potential Concern	Oral Cancer Slope Factor		Oral Absorption Efficiency for Dermal	Absorbed Cancer Slope Factor for Dermal		Weight of Evidence/ Cancer Guideline Description	Oral CSF	
	Value	Units	(1)	Value	Units		Source(s)	Date(s) (MM/DD/YYYY)
Aluminum	NA	NA	NA	NA	NA			
Antimony	NA	NA	NA	NA	NA			
Arsenic	9.5E+00	(mg/kg-day)-1	9.5E-01	1.5E+00	(mg/kg-day)-1	A	OEHHA	07/28/04
Barium	NA	NA	NA	NA	NA			
Beryllium	NA	NA	NA	NA	NA	D	IRIS	08/19/02
Cadmium	3.8E-01	(mg/kg-day)-1	2.5E-02	9.5E-03	(mg/kg-day)-1	B1	OEHHA	10/10/02
Calcium	NA	NA	NA	NA	NA	D	IRIS	08/19/02
Chloride	NA	NA	NA	NA	NA			
Chromium	NA	NA	NA	NA	NA			
Cobalt	NA	NA	NA	NA	NA			
Copper	NA	NA	NA	NA	NA	D	IRIS	08/19/02
Iron	NA	NA	NA	NA	NA			
Lead	NA	NA	NA	NA	NA			
Magnesium	NA	NA	NA	NA	NA			
Manganese	NA	NA	NA	NA	NA	D	IRIS	08/19/02
Mercury	NA	NA	NA	NA	NA	D	IRIS	08/19/02
Methane	NA	NA	NA	NA	NA			
Molybdenum	NA	NA	NA	NA	NA			
Nickel	NA	NA	NA	NA	NA			
Nitrate	NA	NA	NA	NA	NA			
Potassium	NA	NA	NA	NA	NA			
Selenium	NA	NA	NA	NA	NA	D	IRIS	08/19/02
Silver	NA	NA	NA	NA	NA	D	IRIS	08/19/02
Sodium	NA	NA	NA	NA	NA			
Thallium	NA	NA	NA	NA	NA	D	IRIS	08/19/02
Vanadium	NA	NA	NA	NA	NA			
Zinc	NA	NA	NA	NA	NA	D	IRIS	08/19/02

TABLE 6.1

CANCER TOXICITY DATA -- ORAL/DERMAL

FISCO ALAMEDA FACILITY/ANNEX SITE

Chemical of Potential Concern	Oral Cancer Slope Factor		Oral Absorption Efficiency for Dermal	Absorbed Cancer Slope Factor for Dermal		Weight of Evidence/ Cancer Guideline Description	Oral CSF	
	Value	Units	(1)	Value	Units		Source(s)	Date(s) (MM/DD/YYYY)
1,1,1,2-Tetrachloroethane	2.6E-02	$(mg/kg\text{-}day)^{-1}$	NA	2.6E-02	(mg/kg-day)-1	C		01/01/91
1,2,4-Trimethylbenzene	NA	NA	NA	NA	NA			
1,2-Dichlorobenzene	NA	NA	NA	NA	NA	D		
1,2-Dichloroethane	4.7E-02	$(mg/kg\text{-}day)^{-1}$	NA	4.7E-02	(mg/kg-day)-1	B2	OEHHA	06/23/04
1,3,5-Trimethylbenzene	NA	NA	NA	NA	NA			
2-Butanone	NA	NA	NA	NA	NA	D		
4-Isopropyltoluene	NA	NA	NA	NA	NA	D		
Acetone	NA	NA	NA	NA	NA	D	IRIS	08/16/02
Benzene	1.0E-01	$(mg/kg\text{-}day)^{-1}$	NA	1.0E-01	(mg/kg-day)-1	A	OEHHA	06/23/04
Bromodichloromethane	1.3E-01	$(mg/kg\text{-}day)^{-1}$	NA	1.3E-01	(mg/kg-day)-1	B2	OEHHA	06/23/04
Carbon disulfide	NA	NA	NA	NA	NA			
Chloroform	3.1E-02	$(mg/kg\text{-}day)^{-1}$	NA	3.1E-02	(mg/kg-day)-1		OEHHA	06/23/04
Chloromethane	1.3E-02	$(mg/kg\text{-}day)^{-1}$	NA	1.3E-02	(mg/kg-day)-1	C	HEAST	07/01/97
cis-1,2-Dichloroethene	NA	NA	NA	NA	NA	D		
Dibromochloromethane	8.4E-02	$(mg/kg\text{-}day)^{-1}$	NA	8.4E-02	(mg/kg-day)-1	C	IRIS	01/01/92
Dichlorodifluoromethane	NA	NA	NA	NA	NA			
Ethylbenzene	3.9E-03	$(mg/kg\text{-}day)^{-1}$	NA	3.9E-03	(mg/kg-day)-1	D		
Isopropyl benzene	NA	NA	NA	NA	NA	D		
Methyl isobutyl ketone	NA	NA	NA	NA	NA			
Methylene Chloride	1.4E-02	$(mg/kg\text{-}day)^{-1}$	NA	1.4E-02	(mg/kg-day)-1	B2	OEHHA	06/23/04
MTBE	1.8E-03	$(mg/kg\text{-}day)^{-1}$	NA	1.8E-03	(mg/kg-day)-1		OEHHA	06/23/04
n-Butylbenzene	NA	NA	NA	NA	NA			
n-Propylbenzene	NA	NA	NA	NA	NA			
sec-Butylbenzene	NA	NA	NA	NA	NA			
Styrene	NA	NA	NA	NA	NA			
Tetrachloroethene	5.4E-01	$(mg/kg\text{-}day)^{-1}$	NA	5.4E-01	(mg/kg-day)-1			06/23/04

TABLE 6.1

CANCER TOXICITY DATA -- ORAL/DERMAL

FISCO ALAMEDA FACILITY/ANNEX SITE

Chemical of Potential Concern	Oral Cancer Slope Factor		Oral Absorption Efficiency for Dermal	Absorbed Cancer Slope Factor for Dermal		Weight of Evidence/ Cancer Guideline Description	Oral CSF	
	Value	Units	(1)	Value	Units		Source(s)	Date(s) (MM/DD/YYYY)
Toluene	NA	NA	NA	NA	NA	D		
Trichloroethene	1.3E-02	NA	NA	1.3E-02	NA		OEHHA	06/23/04
trans-1,2-Dichloroethene	NA	NA	NA	NA	NA			
Vinyl chloride	2.7E-01	$(mg/kg\text{-}day)^{-1}$	NA	2.7E-01	(mg/kg-day)-1	A	OEHHA	06/23/04
Xylenes (Total)	NA	NA	NA	NA	NA	D		
Acenaphthene	NA	NA	0.58-0.89	NA	NA			
Acenaphthylene	NA	NA	NA	NA	NA	D		
Anthracene	NA	NA	NA	NA	NA	D		
Benzo[a]anthracene	1.2E+00	$(mg/kg\text{-}day)^{-1}$	0.58-0.89	1.2E+00	(mg/kg-day)-1	B2	OEHHA	06/23/04
Benzo[a]pyrene	1.2E+01	$(mg/kg\text{-}day)^{-1}$	0.58-0.89	1.2E+01	(mg/kg-day)-1	B2	OEHHA	06/23/04
Benzo[b]fluoranthene	1.2E+00	$(mg/kg\text{-}day)^{-1}$	0.58-0.89	1.2E+00	(mg/kg-day)-1	B2	OEHHA	06/23/04
Benzo[g,h,I]perylene	NA	NA	NA	NA	NA	D		
Benzo[k]fluoranthene	1.2E+00	$(mg/kg\text{-}day)^{-1}$	0.58-0.89	1.2E+00	(mg/kg-day)-1	B2	OEHHA	06/23/04
Chrysene	1.2E-01	NA	0.58-0.89	1.2E-01	NA	B2	OEHHA	06/23/04
Dibenz[a,h]anthracene	4.1E+00	$(mg/kg\text{-}day)^{-1}$	0.58-0.89	4.1E+00	(mg/kg-day)-1	B2	OEHHA	06/23/04
Fluoranthene	NA	NA	NA	NA	NA	D		
Fluorene	NA	NA	NA	NA	NA	D		
Indeno(1,2,3-cd)pyrene	1.2E+00	$(mg/kg\text{-}day)^{-1}$	0.58-0.89	1.2E+00	(mg/kg-day)-1	B2	OEHHA	06/23/04
Naphthalene	NA	NA	0.58-0.89	NA	NA	C		09/17/98
Phenanthrene	NA	NA	NA	NA	NA	D		
Pyrene	NA	NA	NA	NA	NA	D		
Nitrate as Nitrogen (N)	NA	NA	NA	NA	NA			
Sulfate	NA	NA	NA	NA	NA			
Sulfide	NA	NA	NA	NA	NA			

Footnote Instructions:

(1) USEPA, 2001.

TABLE 6.2
CANCER TOXICITY DATA – INHALATION
FISCO ALAMEDA FACILITY/ANNEX SITE

Chemical of Potential Concern	Unit Risk		Inhalation Cancer Slope Factor		Weight of Evidence/ Cancer Guideline Description	Unit Risk : Inhalation CSF	
	Value	Units	Value	Units		Source(s)	Date(s) (MM/DD/YYYY)
Aluminum	NA		NA				
Antimony	NA		NA				
Arsenic	3.3E+00	(mg/m3)-1	1.2E+01	(mg/kg-day)-1	A	OEHHA	7/28/2004
Barium	NA		NA		D	IRIS	8/19/2002
Beryllium	2.4E+00	(mg/m3)-1	8.4E+00	(mg/kg-day)-1	B1	IRIS	8/19/2002
Cadmium	1.8E+00	(mg/m3)-1	1.5E+01	(mg/kg-day)-1	B1	OEHHA	7/28/2004
Calcium	NA		NA				
Chloride	NA		NA				
Chromium	8.4E+01	(mg/m3)-1	2.9E+02	(mg/kg-day)-1	A	IRIS	8/19/2002
Cobalt	2.8E+00	$(mg/m^3)^{-1}$	9.8E+00	(mg/kg-day)-1		NCEA	
Copper	NA		NA		D	IRIS	8/19/2002
Iron	NA		NA				
Lead	NA		NA				
Magnesium	NA		NA				
Manganese	NA		NA		D	IRIS	8/19/2002
Mercury	NA		NA		D	IRIS	8/19/2002
Methane	NA		NA				
Molybdenum	NA		NA				
Nickel	2.6E-01	(mg/m3)-1	9.1E-01	(mg/kg-day)-1	A	OEHHA	10/10/2002
Nitrate	NA		NA				
Potassium	NA		NA				
Selenium	NA		NA		D	IRIS	8/19/2002
Silver	NA		NA		D	IRIS	8/19/2002
Sodium	NA		NA				
Thallium	NA		NA		D	IRIS	8/19/2002

TABLE 6.2
CANCER TOXICITY DATA -- INHALATION
FISCO ALAMEDA FACILITY/ANNEX SITE

Chemical of Potential Concern	Unit Risk		Inhalation Cancer Slope Factor		Weight of Evidence/ Cancer Guideline Description	Unit Risk : Inhalation CSF	
	Value	Units	Value	Units		Source(s)	Date(s) (MM/DD/YYYY)
Vanadium	NA		NA				
Zinc	NA		NA		D	IRIS	8/19/2002
1,1,1,2-Tetrachloroethane	7.4E-03	$(mg/m^3)^{-1}$	2.6E-02	(mg/kg-day)-1	D		
1,2,4-Trimethylbenzene	NA		NA		D		
1,2-Dichlorobenzene	NA		NA		D		
1,2-Dichloroethane	2.1E-02	$(mg/m^3)^{-1}$	7.2E-02	(mg/kg-day)-1	B2	OEHHA	06/23/04
1,3,5-Trimethylbenzene	NA		NA				
2-Butanone	NA		NA		D		
4-Isopropyltoluene	NA		NA		D		
Acetone	NA		NA		D	IRIS	8/16/2002
Benzene	2.9E-02	$(mg/m^3)^{-1}$	1.0E-01	(mg/kg-day)-1	A	OEHHA	06/23/04
Bromodichloromethane	3.7E-02	$(mg/m^3)^{-1}$	1.3E-01	(mg/kg-day)-1	B2	OEHHA	06/23/04
Carbon disulfide	NA		NA				
Chloroform	5.4E-03	$(mg/m^3)^{-1}$	1.9E-02	(mg/kg-day)-1	B2	OEHHA	06/23/04
Chloromethane	1.8E-03	$(mg/m^3)^{-1}$	6.3E-03	(mg/kg-day)-1	D	HEAST	07/01/97
cis-1,2-Dichloroethene	NA		NA		D		
Dibromochloromethane	NA		NA		C		12/6/2002
Dichlorodifluoromethane	NA		NA				
Ethylbenzene	1.1E-03	$(mg/m^3)^{-1}$	3.9E-03	(mg/kg-day)-1	D	IRIS	03/01/03
Isopropyl benzene	NA		NA		D		
Methyl isobutyl ketone	NA		NA				
Methylene Chloride	1.0E-03	$(mg/m^3)^{-1}$	3.5E-03	(mg/kg-day)-1	B2	OEHHA	06/23/04
MTBE	2.6E-04	$(mg/m^3)^{-1}$	9.1E-04	(mg/kg-day)-1		OEHHA	06/23/04
n-Butylbenzene	NA		NA				
n-Propylbenzene	NA		NA				

TABLE 6.2

CANCER TOXICITY DATA -- INHALATION

FISCO ALAMEDA FACILITY/ANNEX SITE

Chemical of Potential Concern	Unit Risk		Inhalation Cancer Slope Factor		Weight of Evidence/ Cancer Guideline Description	Unit Risk : Inhalation CSF	
	Value	Units	Value	Units		Source(s)	Date(s) (MM/DD/YYYY)
sec-Butylbenzene	NA		NA				
Styrene	NA		NA				
Tetrachloroethene	5.9E-03	$(mg/m^3)^{-1}$	2.1E-02	(mg/kg-day)-1		OEHHA	06/23/04
Toluene	NA		NA		D		
Trichloroethene	2.0E-03	$(mg/m^3)^{-1}$	7.0E-03	(mg/kg-day)-1		OEHHA	6/23/2004
trans-1,2-Dichloroethene	NA		NA				
Vinyl chloride	7.7E-02	$(mg/m^3)^{-1}$	2.7E-01	(mg/kg-day)-1	A	OEHHA	06/23/04
Xylenes (Total)	NA		NA		D		
Acenaphthene	NA		NA				
Acenaphthylene	NA		NA		D		
Anthracene	NA		NA		D		
Benzo[a]anthracene	1.1E-01	$(mg/m^3)^{-1}$	3.9E-01	(mg/kg-day)-1	B2	OEHHA	06/23/04
Benzo[a]pyrene	1.1E+00	$(mg/m^3)^{-1}$	3.9E+00	(mg/kg-day)-1	B2	OEHHA	06/23/04
Benzo[b]fluoranthene	1.1E-01	$(mg/m^3)^{-1}$	3.9E-01	(mg/kg-day)-1	B2	OEHHA	06/23/04
Benzo[g,h,I]perylene	NA		NA		D		
Benzo[k]fluoranthene	1.1E-01	$(mg/m^3)^{-1}$	3.9E-01	(mg/kg-day)-1	B2	OEHHA	06/23/04
Chrysene	1.1E-02	$(mg/m^3)^{-1}$	3.9E-02	(mg/kg-day)-1	B2	OEHHA	06/23/04
Dibenz[a,h]anthracene	1.2E+00	$(mg/m^3)^{-1}$	4.1E+00	(mg/kg-day)-1	B2	OEHHA	06/23/04
Fluoranthene	NA		NA		D		
Fluorene	NA		NA		D		
Indeno(1,2,3-cd)pyrene	1.1E-01	$(mg/m^3)^{-1}$	3.9E-01	(mg/kg-day)-1	B2	OEHHA	06/23/04
Naphthalene	NA		NA		C		
Phenanthrene	NA		NA		D		
Pyrene	NA		NA		D		
Nitrate as Nitrogen (N)	NA		NA			NA	
Sulfate	NA		NA			NA	

(1) Inhalation RfD =(SFi*70 kg)/20 m^3/day

TABLE 7.1

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

TIER 1 CENTRAL EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Car Wash Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater Potable Use	Potable Water	Potable Water	Ingestion	Aluminum	1.4E+3	ug/L	1.2E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	1.2E-2	mg/kg-day	1.0E+0	mg/kg-day	1.2E-2
				Antimony	4.8E-1	ug/L	4.0E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	4.2E-6	mg/kg-day	4.0E-4	mg/kg-day	1.1E-2
				Arsenic	2.2E+1	ug/L	1.8E-5	mg/kg-day	9.5E+0	(mg/kg-day)-1	2E-4	1.9E-4	mg/kg-day	3.0E-4	mg/kg-day	6.5E-1
				Barium	2.0E+3	ug/L	1.6E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	1.7E-2	mg/kg-day	7.0E-2	mg/kg-day	2.5E-1
				Beryllium	1.8E+0	ug/L	1.5E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	1.6E-5	mg/kg-day	2.0E-3	mg/kg-day	8.1E-3
				Cadmium	3.2E+0	ug/L	2.7E-6	mg/kg-day	3.8E-1	(mg/kg-day)-1	1E-6	2.9E-5	mg/kg-day	5.0E-4	mg/kg-day	5.7E-2
				Chromium	2.2E+1	ug/L	1.8E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	1.9E-4	mg/kg-day	3.0E-3	mg/kg-day	6.5E-2
				Cobalt	7.5E+0	ug/L	6.2E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	6.6E-5	mg/kg-day	2.0E-2	mg/kg-day	3.3E-3
				Copper	1.1E+1	ug/L	9.1E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	9.7E-5	mg/kg-day	4.0E-2	mg/kg-day	2.4E-3
				Iron	4.0E+4	ug/L	3.3E-2	mg/kg-day	NA	(mg/kg-day)-1	NA	3.5E-1	mg/kg-day	3.0E-1	mg/kg-day	1.2E+0
				Lead	3.7E-1	ug/L	3.1E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	3.3E-6	mg/kg-day	NA	mg/kg-day	NA
				Manganese	2.5E+3	ug/L	2.1E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	2.2E-2	mg/kg-day	1.4E-1	mg/kg-day	1.6E-1
				Mercury	2.2E-1	ug/L	1.8E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	2.0E-6	mg/kg-day	3.0E-4	mg/kg-day	6.5E-3
				Molybdenum	3.7E+1	ug/L	3.1E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	3.3E-4	mg/kg-day	5.0E-3	mg/kg-day	6.6E-2
				Nickel	1.6E+1	ug/L	1.3E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	1.4E-4	mg/kg-day	2.0E-2	mg/kg-day	7.0E-3
				Nitrate	7.0E+3	ug/L	5.8E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	6.2E-2	mg/kg-day	1.6E+0	mg/kg-day	3.9E-2
				Selenium	1.3E+1	ug/L	1.1E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	1.1E-4	mg/kg-day	5.0E-3	mg/kg-day	2.3E-2
				Silver	1.5E+1	ug/L	1.2E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	1.3E-4	mg/kg-day	5.0E-3	mg/kg-day	2.6E-2
				Thallium	9.6E+0	ug/L	8.0E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	8.5E-5	mg/kg-day	6.6E-5	mg/kg-day	1.3E+0
				Vanadium	2.0E+1	ug/L	1.7E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	1.8E-4	mg/kg-day	7.0E-3	mg/kg-day	2.5E-2
				Zinc	1.1E+1	ug/L	9.1E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	9.7E-5	mg/kg-day	3.0E-1	mg/kg-day	3.2E-4
				1,2,4-Trimethylbenzene	5.5E+1	ug/L	4.6E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	4.8E-4	mg/kg-day	5.0E-2	mg/kg-day	9.7E-3
				1,2-Dichloroethane	5.0E+1	ug/L	4.2E-5	mg/kg-day	4.7E-2	(mg/kg-day)-1	2E-6	4.4E-4	mg/kg-day	3.0E-2	mg/kg-day	1.5E-2
				1,3,5-Trimethylbenzene	2.9E+1	ug/L	2.4E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	2.6E-4	mg/kg-day	5.0E-2	mg/kg-day	5.1E-3
				Acenaphthene	2.2E+2	ug/L	1.8E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	1.9E-3	mg/kg-day	6.0E-2	mg/kg-day	3.2E-2
				Acenaphthylene	8.0E+2	ug/L	6.6E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	7.0E-3	mg/kg-day	NA	mg/kg-day	NA
				Acetone	1.0E+4	ug/L	8.3E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	8.8E-2	mg/kg-day	1.0E-1	mg/kg-day	8.8E-1
				Anthracene	5.9E+1	ug/L	4.9E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	5.2E-4	mg/kg-day	3.0E-1	mg/kg-day	1.7E-3
				Benzene	6.0E+3	ug/L	5.0E-3	mg/kg-day	1.0E-1	(mg/kg-day)-1	5E-4	5.3E-2	mg/kg-day	3.0E-3	mg/kg-day	1.8E+1
				Benzo[a]anthracene	2.6E+1	ug/L	2.2E-5	mg/kg-day	1.2E+0	(mg/kg-day)-1	3E-5	2.3E-4	mg/kg-day	NA	mg/kg-day	NA
				Benzo[a]pyrene	6.0E+1	ug/L	5.0E-5	mg/kg-day	1.2E+1	(mg/kg-day)-1	6E-4	5.3E-4	mg/kg-day	NA	mg/kg-day	NA
				Benzo[b]fluoranthene	2.9E+1	ug/L	2.4E-5	mg/kg-day	1.2E+0	(mg/kg-day)-1	3E-5	2.6E-4	mg/kg-day	NA	mg/kg-day	NA
				Benzo[g,h,i]perylene	3.7E+1	ug/L	3.1E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	3.3E-4	mg/kg-day	NA	mg/kg-day	NA
				Benzo[k]fluoranthene	1.4E+1	ug/L	1.2E-5	mg/kg-day	1.2E+0	(mg/kg-day)-1	1E-5	1.2E-4	mg/kg-day	NA	mg/kg-day	NA
				Carbon Disulfide	4.8E+0	ug/L	4.0E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	4.2E-5	mg/kg-day	1.0E-1	mg/kg-day	4.2E-4
				Chrysene	4.3E+1	ug/L	3.6E-5	mg/kg-day	1.2E-1	(mg/kg-day)-1	4E-6	3.8E-4	mg/kg-day	NA	mg/kg-day	NA
				Dibenz[a,h]anthracene	3.0E+0	ug/L	2.5E-6	mg/kg-day	4.1E+0	(mg/kg-day)-1	1E-5	2.6E-5	mg/kg-day	NA	mg/kg-day	NA
				Ethylbenzene	8.0E+2	ug/L	6.6E-4	mg/kg-day	3.9E-3	(mg/kg-day)-1	3E-6	7.0E-3	mg/kg-day	1.0E-1	mg/kg-day	7.0E-2
				Fluoranthene	2.8E+2	ug/L	2.3E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	2.5E-3	mg/kg-day	4.0E-2	mg/kg-day	6.2E-2

TABLE 7.1
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
TIER 1 CENTRAL EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Car Wash Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
				Fluorene	7.0E+1	ug/L	5.8E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	6.2E-4	mg/kg-day	4.0E-2	mg/kg-day	1.5E-2
				Indeno(1,2,3-cd)pyrene	4.4E+1	ug/L	3.7E-5	mg/kg-day	1.2E+0	(mg/kg-day)-1	4E-5	3.9E-4	mg/kg-day	NA	mg/kg-day	NA
				Isopropyl benzene	7.4E+0	ug/L	6.1E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	6.5E-5	mg/kg-day	1.0E-1	mg/kg-day	6.5E-4
				Methyl isobutyl ketone	3.5E+0	ug/L	2.9E-6	mg/kg-day	0.0E+0	(mg/kg-day)-1	0E+0	3.1E-5	mg/kg-day	8.0E-2	mg/kg-day	3.9E-4
				Methylene chloride	1.8E+2	ug/L	1.5E-4	mg/kg-day	1.4E-2	(mg/kg-day)-1	2E-6	1.6E-3	mg/kg-day	6.0E-2	mg/kg-day	2.6E-2
				MTBE	1.9E+1	ug/L	1.6E-5	mg/kg-day	1.8E-3	(mg/kg-day)-1	3E-8	1.7E-4	mg/kg-day	NA	mg/kg-day	NA
				Naphthalene	1.9E+4	ug/L	1.6E-2	mg/kg-day	NA	(mg/kg-day)-1	NA	1.7E-1	mg/kg-day	2.0E-2	mg/kg-day	8.4E+0
				n-Butylbenzene	1.8E+3	ug/L	1.5E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	1.6E-2	mg/kg-day	4.0E-2	mg/kg-day	4.0E-1
				n-Propylbenzene	1.1E+1	ug/L	9.1E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	9.7E-5	mg/kg-day	4.0E-2	mg/kg-day	2.4E-3
				Phenanthrene	2.5E+2	ug/L	2.1E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	2.2E-3	mg/kg-day	NA	mg/kg-day	NA
				Pyrene	2.0E+2	ug/L	1.7E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	1.8E-3	mg/kg-day	3.0E-2	mg/kg-day	5.9E-2
				Styrene	1.9E+2	ug/L	1.5E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	1.6E-3	mg/kg-day	2.0E-1	mg/kg-day	8.2E-3
				Toluene	6.2E+2	ug/L	5.1E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	5.5E-3	mg/kg-day	2.0E-1	mg/kg-day	2.7E-2
				Xylenes (total)	4.2E+2	ug/L	3.5E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	3.7E-3	mg/kg-day	2.0E-1	mg/kg-day	1.9E-2
			Exp. Route Total								1E-3					3.1E+1
		Exposure Point Total									1E-3					3.1E+1
	Exposure Medium Total										1E-3					3.1E+1
Medium Total											1E-3					3.1E+1
Groundwater Industrial Use	Industrial Water	Industrial Water	Dermal	Aluminum	1.4E+3	ug/L	4.6E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	4.9E-5	mg/kg-day	1.0E+0	mg/kg-day	4.9E-5
				Antimony	4.8E-1	ug/L	1.6E-9	mg/kg-day	NA	(mg/kg-day)-1	NA	1.7E-8	mg/kg-day	4.0E-4	mg/kg-day	4.2E-5
				Arsenic	2.2E+1	ug/L	7.3E-8	mg/kg-day	9.5E+0	(mg/kg-day)-1	7E-7	7.7E-7	mg/kg-day	3.0E-4	mg/kg-day	2.6E-3
				Barium	2.0E+3	ug/L	6.5E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	6.9E-5	mg/kg-day	7.0E-2	mg/kg-day	9.8E-4
				Beryllium	1.8E+0	ug/L	6.1E-9	mg/kg-day	NA	(mg/kg-day)-1	NA	6.4E-8	mg/kg-day	2.0E-3	mg/kg-day	3.2E-5
				Cadmium	3.2E+0	ug/L	1.1E-8	mg/kg-day	3.8E-1	(mg/kg-day)-1	4E-9	1.1E-7	mg/kg-day	5.0E-4	mg/kg-day	2.3E-4
				Chromium	2.2E+1	ug/L	1.5E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	1.5E-6	mg/kg-day	3.0E-3	mg/kg-day	5.2E-4
				Cobalt	7.5E+0	ug/L	2.5E-8	mg/kg-day	NA	(mg/kg-day)-1	NA	2.6E-7	mg/kg-day	2.0E-2	mg/kg-day	1.3E-5
				Copper	1.1E+1	ug/L	3.6E-8	mg/kg-day	NA	(mg/kg-day)-1	NA	3.9E-7	mg/kg-day	4.0E-2	mg/kg-day	9.7E-6
				Iron	4.0E+4	ug/L	1.3E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	1.4E-3	mg/kg-day	3.0E-1	mg/kg-day	4.7E-3
				Lead	3.7E-1	ug/L	1.2E-9	mg/kg-day	NA	(mg/kg-day)-1	NA	1.3E-8	mg/kg-day	NA	mg/kg-day	NA
				Manganese	2.5E+3	ug/L	8.2E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	8.7E-5	mg/kg-day	1.4E-1	mg/kg-day	6.2E-4
				Mercury	2.2E-1	ug/L	7.4E-10	mg/kg-day	NA	(mg/kg-day)-1	NA	7.8E-9	mg/kg-day	3.0E-4	mg/kg-day	2.6E-5
				Molybdenum	3.7E+1	ug/L	1.2E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	1.3E-6	mg/kg-day	5.0E-3	mg/kg-day	2.6E-4
				Nickel	1.6E+1	ug/L	1.1E-8	mg/kg-day	NA	(mg/kg-day)-1	NA	1.1E-7	mg/kg-day	2.0E-2	mg/kg-day	5.6E-6
				Nitrate	7.0E+3	ug/L	2.3E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	2.5E-4	mg/kg-day	1.6E+0	mg/kg-day	1.5E-4
				Selenium	1.3E+1	ug/L	4.3E-8	mg/kg-day	NA	(mg/kg-day)-1	NA	4.6E-7	mg/kg-day	5.0E-3	mg/kg-day	9.1E-5
				Silver	1.5E+1	ug/L	3.0E-8	mg/kg-day	NA	(mg/kg-day)-1	NA	3.2E-7	mg/kg-day	5.0E-3	mg/kg-day	6.3E-5
				Thallium	9.6E+0	ug/L	3.2E-8	mg/kg-day	NA	(mg/kg-day)-1	NA	3.4E-7	mg/kg-day	6.6E-5	mg/kg-day	5.1E-3
				Vanadium	2.0E+1	ug/L	6.6E-8	mg/kg-day	NA	(mg/kg-day)-1	NA	7.0E-7	mg/kg-day	7.0E-3	mg/kg-day	1.0E-4
				Zinc	1.1E+1	ug/L	2.2E-8	mg/kg-day	NA	(mg/kg-day)-1	NA	2.3E-7	mg/kg-day	3.0E-1	mg/kg-day	7.7E-7

TABLE 7.1
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
TIER 1 CENTRAL EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Car Wash Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
				1,2,4-Trimethylbenzene	5.5E+1	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	5.0E-2	mg/kg-day	0.0E+0
				1,2-Dichloroethane	5.0E+1	ug/L	7.0E-6	mg/kg-day	4.7E-2	(mg/kg-day)-1	3E-7	7.4E-5	mg/kg-day	3.0E-2	mg/kg-day	2.5E-3
				1,3,5-Trimethylbenzene	2.9E+1	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	5.0E-2	mg/kg-day	0.0E+0
				Acenaphthene	2.2E+2	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	6.0E-2	mg/kg-day	0.0E+0
				Acenaphthylene	8.0E+2	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Acetone	1.0E+4	ug/L	3.6E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	3.8E-4	mg/kg-day	1.0E-1	mg/kg-day	3.8E-3
				Anthracene	5.9E+1	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	3.0E-1	mg/kg-day	0.0E+0
				Benzene	6.0E+3	ug/L	3.0E-4	mg/kg-day	1.0E-1	(mg/kg-day)-1	3E-5	3.2E-3	mg/kg-day	3.0E-3	mg/kg-day	1.1E+0
				Benzo[a]anthracene	2.6E+1	ug/L	0.0E+0	mg/kg-day	1.2E+0	(mg/kg-day)-1	0E+0	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Benzo[a]pyrene	6.0E+1	ug/L	0.0E+0	mg/kg-day	1.2E+1	(mg/kg-day)-1	0E+0	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Benzo[b]fluoranthene	2.9E+1	ug/L	0.0E+0	mg/kg-day	1.2E+0	(mg/kg-day)-1	0E+0	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Benzo[g,h,i]perylene	3.7E+1	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Benzo[k]fluoranthene	1.4E+1	ug/L	0.0E+0	mg/kg-day	1.2E+0	(mg/kg-day)-1	0E+0	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Carbon Disulfide	4.8E+0	ug/L	2.7E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	2.9E-6	mg/kg-day	1.0E-1	mg/kg-day	2.9E-5
				Chrysene	4.3E+1	ug/L	0.0E+0	mg/kg-day	1.2E-1	(mg/kg-day)-1	0E+0	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Dibenz[a,h]anthracene	3.0E+0	ug/L	0.0E+0	mg/kg-day	4.1E+0	(mg/kg-day)-1	0E+0	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Ethylbenzene	8.0E+2	ug/L	1.3E-4	mg/kg-day	3.9E-3	(mg/kg-day)-1	5E-7	1.4E-3	mg/kg-day	1.0E-1	mg/kg-day	1.4E-2
				Fluoranthene	2.8E+2	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	4.0E-2	mg/kg-day	0.0E+0
				Fluorene	7.0E+1	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	4.0E-2	mg/kg-day	0.0E+0
				Indeno(1,2,3-cd)pyrene	4.4E+1	ug/L	0.0E+0	mg/kg-day	1.2E+0	(mg/kg-day)-1	0E+0	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Isopropyl benzene	7.4E+0	ug/L	7.5E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	8.0E-6	mg/kg-day	1.0E-1	mg/kg-day	8.0E-5
				Methyl isobutyl ketone	3.5E+0	ug/L	4.6E-8	mg/kg-day	0.0E+0	(mg/kg-day)-1	0E+0	4.9E-7	mg/kg-day	8.0E-2	mg/kg-day	6.1E-6
				Methylene chloride	1.8E+2	ug/L	2.1E-6	mg/kg-day	1.4E-2	(mg/kg-day)-1	3E-8	2.2E-5	mg/kg-day	6.0E-2	mg/kg-day	3.7E-4
				MTBE	1.9E+1	ug/L	2.4E-7	mg/kg-day	1.8E-3	(mg/kg-day)-1	4E-10	2.6E-6	mg/kg-day	NA	mg/kg-day	NA
				Naphthalene	1.9E+4	ug/L	3.0E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	3.1E-2	mg/kg-day	2.0E-2	mg/kg-day	1.6E+0
				n-Butylbenzene	1.8E+3	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	4.0E-2	mg/kg-day	0.0E+0
				n-Propylbenzene	1.1E+1	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	4.0E-2	mg/kg-day	0.0E+0
				Phenanthrene	2.5E+2	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Pyrene	2.0E+2	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	3.0E-2	mg/kg-day	0.0E+0
				Styrene	1.9E+2	ug/L	2.3E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	2.4E-4	mg/kg-day	2.0E-1	mg/kg-day	1.2E-3
				Toluene	6.2E+2	ug/L	6.4E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	6.8E-4	mg/kg-day	2.0E-1	mg/kg-day	3.4E-3
				Xylenes (total)	4.2E+2	ug/L	7.4E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	7.9E-4	mg/kg-day	2.0E-1	mg/kg-day	3.9E-3
			Exp. Route Total								3E-5					2.7E+0
		Exposure Point Total									3E-5					2.7E+0
	Exposure Medium Total										3E-5					2.7E+0
	Work Space Air	Work Space Air	Inhalation	1,2,4-Trimethylbenzene	8.3E-6	mg/m3	1.4E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	1.5E-6	mg/kg-day	1.7E-3	mg/kg-day	8.6E-4
				1,2-Dichloroethane	9.8E-6	mg/m3	1.6E-7	mg/kg-day	7.2E-2	(mg/kg-day)-1	1E-8	1.7E-6	mg/kg-day	1.4E-3	mg/kg-day	1.2E-3
				1,3,5-Trimethylbenzene	4.4E-6	mg/m3	7.3E-8	mg/kg-day	NA	(mg/kg-day)-1	NA	7.7E-7	mg/kg-day	1.7E-3	mg/kg-day	4.5E-4

TABLE 7.1

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

TIER 1 CENTRAL EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Car Wash Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
				Acenaphthene	2.9E-5	mg/m3	4.9E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	5.2E-6	mg/kg-day	NA	mg/kg-day	NA
				Acetone	1.4E-3	mg/m3	2.3E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	2.4E-4	mg/kg-day	NA	mg/kg-day	NA
				Anthracene	7.8E-6	mg/m3	1.3E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	1.4E-6	mg/kg-day	NA	mg/kg-day	NA
				Benzene	1.1E-3	mg/m3	1.9E-5	mg/kg-day	1.0E-1	(mg/kg-day)-1	2E-6	2.0E-4	mg/kg-day	1.7E-3	mg/kg-day	1.2E-1
				Benzo[b]fluoranthene	3.8E-6	mg/m3	6.4E-8	mg/kg-day	3.9E-1	(mg/kg-day)-1	2E-8	6.8E-7	mg/kg-day	NA	mg/kg-day	NA
				Carbon Disulfide	9.1E-7	mg/m3	1.5E-8	mg/kg-day	NA	(mg/kg-day)-1	NA	1.6E-7	mg/kg-day	2.0E-1	mg/kg-day	8.1E-7
				Chrysene	5.7E-6	mg/m3	9.5E-8	mg/kg-day	3.9E-2	(mg/kg-day)-1	4E-9	1.0E-6	mg/kg-day	NA	mg/kg-day	NA
				Ethylbenzene	1.3E-4	mg/m3	2.1E-6	mg/kg-day	3.9E-3	(mg/kg-day)-1	8E-9	2.3E-5	mg/kg-day	2.9E-1	mg/kg-day	7.8E-5
				Fluorene	9.3E-6	mg/m3	1.5E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	1.6E-6	mg/kg-day	NA	mg/kg-day	NA
				Isopropyl benzene	1.1E-6	mg/m3	1.9E-8	mg/kg-day	NA	(mg/kg-day)-1	NA	2.0E-7	mg/kg-day	1.1E-1	mg/kg-day	1.8E-6
				Methyl isobutyl ketone	4.9E-7	mg/m3	8.1E-9	mg/kg-day	0.0E+0	(mg/kg-day)-1	0E+0	8.6E-8	mg/kg-day	2.3E-2	mg/kg-day	3.8E-6
				Methylene chloride	3.8E-5	mg/m3	6.3E-7	mg/kg-day	3.5E-3	(mg/kg-day)-1	2E-9	6.6E-6	mg/kg-day	8.6E-1	mg/kg-day	7.7E-6
				MTBE	3.5E-6	mg/m3	5.8E-8	mg/kg-day	9.1E-4	(mg/kg-day)-1	5E-11	6.1E-7	mg/kg-day	8.6E-1	mg/kg-day	7.1E-7
				Naphthalene	2.8E-3	mg/m3	4.7E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	5.0E-4	mg/kg-day	8.6E-4	mg/kg-day	5.8E-1
				n-Butylbenzene	2.9E-4	mg/m3	4.8E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	5.1E-5	mg/kg-day	NA	mg/kg-day	NA
				n-Propylbenzene	1.8E-6	mg/m3	2.9E-8	mg/kg-day	NA	(mg/kg-day)-1	NA	3.1E-7	mg/kg-day	NA	mg/kg-day	NA
				Pyrene	2.6E-5	mg/m3	4.4E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	4.7E-6	mg/kg-day	NA	mg/kg-day	NA
				Styrene	3.0E-5	mg/m3	5.0E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	5.3E-6	mg/kg-day	2.9E-1	mg/kg-day	1.8E-5
				Toluene	1.1E-4	mg/m3	1.8E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	1.9E-5	mg/kg-day	1.1E-1	mg/kg-day	1.7E-4
				Xylenes (total)	7.4E-5	mg/m3	1.2E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	1.3E-5	mg/kg-day	2.9E-2	mg/kg-day	4.5E-4
			Exp. Route Total								2E-6					7.0E-1
		Exposure Point Total									2E-6					7.0E-1
	Exposure Medium Total										2E-6					7.0E-1
Medium Total											3E-5					3.4E+0
										Total of Receptor Risks Across All Media	1E-3				Total of Receptor Risks Across All Media	3.5E+1

TABLE 7.2

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

TIER 1 REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Car Wash Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater Potable Use	Potable Water	Potable Water	Ingestion	Aluminum	1.4E+3	ug/L	4.4E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	1.2E-2	mg/kg-day	1.0E+0	mg/kg-day	1.2E-2
				Antimony	4.8E-1	ug/L	1.5E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	4.2E-6	mg/kg-day	4.0E-4	mg/kg-day	1.1E-2
				Arsenic	2.2E+1	ug/L	6.9E-5	mg/kg-day	9.5E+0	(mg/kg-day)-1	7E-4	1.9E-4	mg/kg-day	3.0E-4	mg/kg-day	6.5E-1
				Barium	2.0E+3	ug/L	6.2E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	1.7E-2	mg/kg-day	7.0E-2	mg/kg-day	2.5E-1
				Beryllium	1.8E+0	ug/L	5.8E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	1.6E-5	mg/kg-day	2.0E-3	mg/kg-day	8.1E-3
				Cadmium	3.2E+0	ug/L	1.0E-5	mg/kg-day	3.8E-1	(mg/kg-day)-1	4E-6	2.9E-5	mg/kg-day	5.0E-4	mg/kg-day	5.7E-2
				Chromium	2.2E+1	ug/L	6.9E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	1.9E-4	mg/kg-day	3.0E-3	mg/kg-day	6.5E-2
				Cobalt	7.5E+0	ug/L	2.3E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	6.6E-5	mg/kg-day	2.0E-2	mg/kg-day	3.3E-3
				Copper	1.1E+1	ug/L	3.5E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	9.7E-5	mg/kg-day	4.0E-2	mg/kg-day	2.4E-3
				Iron	4.0E+4	ug/L	1.2E-1	mg/kg-day	NA	(mg/kg-day)-1	NA	3.5E-1	mg/kg-day	3.0E-1	mg/kg-day	1.2E+0
				Lead	3.7E-1	ug/L	1.2E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	3.3E-6	mg/kg-day	NA	mg/kg-day	NA
				Manganese	2.5E+3	ug/L	7.8E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	2.2E-2	mg/kg-day	1.4E-1	mg/kg-day	1.6E-1
				Mercury	2.2E-1	ug/L	7.0E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	2.0E-6	mg/kg-day	3.0E-4	mg/kg-day	6.5E-3
				Molybdenum	3.7E+1	ug/L	1.2E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	3.3E-4	mg/kg-day	5.0E-3	mg/kg-day	6.6E-2
				Nickel	1.6E+1	ug/L	5.0E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	1.4E-4	mg/kg-day	2.0E-2	mg/kg-day	7.0E-3
				Nitrate	7.0E+3	ug/L	2.2E-2	mg/kg-day	NA	(mg/kg-day)-1	NA	6.2E-2	mg/kg-day	1.6E+0	mg/kg-day	3.9E-2
				Selenium	1.3E+1	ug/L	4.1E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	1.1E-4	mg/kg-day	5.0E-3	mg/kg-day	2.3E-2
				Silver	1.5E+1	ug/L	4.7E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	1.3E-4	mg/kg-day	5.0E-3	mg/kg-day	2.6E-2
				Thallium	9.6E+0	ug/L	3.0E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	8.5E-5	mg/kg-day	6.6E-5	mg/kg-day	1.3E+0
				Vanadium	2.0E+1	ug/L	6.3E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	1.8E-4	mg/kg-day	7.0E-3	mg/kg-day	2.5E-2
				Zinc	1.1E+1	ug/L	3.5E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	9.7E-5	mg/kg-day	3.0E-1	mg/kg-day	3.2E-4
				1,2,4-Trimethylbenzene	5.5E+1	ug/L	1.7E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	4.8E-4	mg/kg-day	5.0E-2	mg/kg-day	9.7E-3
				1,2-Dichloroethane	5.0E+1	ug/L	1.6E-4	mg/kg-day	4.7E-2	(mg/kg-day)-1	7E-6	4.4E-4	mg/kg-day	3.0E-2	mg/kg-day	1.5E-2
				1,3,5-Trimethylbenzene	2.9E+1	ug/L	9.1E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	2.6E-4	mg/kg-day	5.0E-2	mg/kg-day	5.1E-3
				Acenaphthene	2.2E+2	ug/L	6.9E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	1.9E-3	mg/kg-day	6.0E-2	mg/kg-day	3.2E-2
				Acenaphthylene	8.0E+2	ug/L	2.5E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	7.0E-3	mg/kg-day	NA	mg/kg-day	NA
				Acetone	1.0E+4	ug/L	3.1E-2	mg/kg-day	NA	(mg/kg-day)-1	NA	8.8E-2	mg/kg-day	1.0E-1	mg/kg-day	8.8E-1
				Anthracene	5.9E+1	ug/L	1.9E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	5.2E-4	mg/kg-day	3.0E-1	mg/kg-day	1.7E-3
				Benzene	6.0E+3	ug/L	1.9E-2	mg/kg-day	1.0E-1	(mg/kg-day)-1	2E-3	5.3E-2	mg/kg-day	3.0E-3	mg/kg-day	1.8E+1
				Benzo[a]anthracene	2.6E+1	ug/L	8.2E-5	mg/kg-day	1.2E+0	(mg/kg-day)-1	1E-4	2.3E-4	mg/kg-day	NA	mg/kg-day	NA
				Benzo[a]pyrene	6.0E+1	ug/L	1.9E-4	mg/kg-day	1.2E+1	(mg/kg-day)-1	2E-3	5.3E-4	mg/kg-day	NA	mg/kg-day	NA
				Benzo[b]fluoranthene	2.9E+1	ug/L	9.1E-5	mg/kg-day	1.2E+0	(mg/kg-day)-1	1E-4	2.6E-4	mg/kg-day	NA	mg/kg-day	NA
				Benzo[g,h,i]perylene	3.7E+1	ug/L	1.2E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	3.3E-4	mg/kg-day	NA	mg/kg-day	NA
				Benzo[k]fluoranthene	1.4E+1	ug/L	4.4E-5	mg/kg-day	1.2E+0	(mg/kg-day)-1	5E-5	1.2E-4	mg/kg-day	NA	mg/kg-day	NA
				Carbon Disulfide	4.8E+0	ug/L	1.5E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	4.2E-5	mg/kg-day	1.0E-1	mg/kg-day	4.2E-4
				Chrysene	4.3E+1	ug/L	1.4E-4	mg/kg-day	1.2E-1	(mg/kg-day)-1	2E-5	3.8E-4	mg/kg-day	NA	mg/kg-day	NA
				Dibenz[a,h]anthracene	3.0E+0	ug/L	9.4E-6	mg/kg-day	4.1E+0	(mg/kg-day)-1	4E-5	2.6E-5	mg/kg-day	NA	mg/kg-day	NA
				Ethylbenzene	8.0E+2	ug/L	2.5E-3	mg/kg-day	3.9E-3	(mg/kg-day)-1	1E-5	7.0E-3	mg/kg-day	1.0E-1	mg/kg-day	7.0E-2
				Fluoranthene	2.8E+2	ug/L	8.8E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	2.5E-3	mg/kg-day	4.0E-2	mg/kg-day	6.2E-2

TABLE 7.2
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
TIER 1 REASONABLE MAXIMUM EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Car Wash Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
				Fluorene	7.0E+1	ug/L	2.2E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	6.2E-4	mg/kg-day	4.0E-2	mg/kg-day	1.5E-2
				Indeno(1,2,3-cd)pyrene	4.4E+1	ug/L	1.4E-4	mg/kg-day	1.2E+0	(mg/kg-day)-1	2E-4	3.9E-4	mg/kg-day	NA	mg/kg-day	NA
				Isopropyl benzene	7.4E+0	ug/L	2.3E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	6.5E-5	mg/kg-day	1.0E-1	mg/kg-day	6.5E-4
				Methyl isobutyl ketone	3.5E+0	ug/L	1.1E-5	mg/kg-day	0.0E+0	(mg/kg-day)-1	0E+0	3.1E-5	mg/kg-day	8.0E-2	mg/kg-day	3.9E-4
				Methylene chloride	1.8E+2	ug/L	5.7E-4	mg/kg-day	1.4E-2	(mg/kg-day)-1	8E-6	1.6E-3	mg/kg-day	6.0E-2	mg/kg-day	2.6E-2
				MTBE	1.9E+1	ug/L	6.0E-5	mg/kg-day	1.8E-3	(mg/kg-day)-1	1E-7	1.7E-4	mg/kg-day	NA	mg/kg-day	NA
				Naphthalene	1.9E+4	ug/L	6.0E-2	mg/kg-day	NA	(mg/kg-day)-1	NA	1.7E-1	mg/kg-day	2.0E-2	mg/kg-day	8.4E+0
				n-Butylbenzene	1.8E+3	ug/L	5.7E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	1.6E-2	mg/kg-day	4.0E-2	mg/kg-day	4.0E-1
				n-Propylbenzene	1.1E+1	ug/L	3.5E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	9.7E-5	mg/kg-day	4.0E-2	mg/kg-day	2.4E-3
				Phenanthrene	2.5E+2	ug/L	7.9E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	2.2E-3	mg/kg-day	NA	mg/kg-day	NA
				Pyrene	2.0E+2	ug/L	6.3E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	1.8E-3	mg/kg-day	3.0E-2	mg/kg-day	5.9E-2
				Styrene	1.9E+2	ug/L	5.8E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	1.6E-3	mg/kg-day	2.0E-1	mg/kg-day	8.2E-3
				Toluene	6.2E+2	ug/L	1.9E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	5.5E-3	mg/kg-day	2.0E-1	mg/kg-day	2.7E-2
				Xylenes (total)	4.2E+2	ug/L	1.3E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	3.7E-3	mg/kg-day	2.0E-1	mg/kg-day	1.9E-2
			Exp. Route Total								5E-3					3.1E+1
		Exposure Point Total									5E-3					3.1E+1
	Exposure Medium Total										5E-3					3.1E+1
Medium Total											5E-3					3.1E+1
Groundwater Industrial Use	Industrial Water	Industrial Water	Dermal	Aluminum	1.4E+3	ug/L	4.0E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	1.1E-4	mg/kg-day	1.0E+0	mg/kg-day	1.1E-4
				Antimony	4.8E-1	ug/L	1.4E-8	mg/kg-day	NA	(mg/kg-day)-1	NA	3.9E-8	mg/kg-day	4.0E-4	mg/kg-day	9.7E-5
				Arsenic	2.2E+1	ug/L	6.4E-7	mg/kg-day	9.5E+0	(mg/kg-day)-1	6E-6	1.8E-6	mg/kg-day	3.0E-4	mg/kg-day	5.9E-3
				Barium	2.0E+3	ug/L	5.7E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	1.6E-4	mg/kg-day	7.0E-2	mg/kg-day	2.3E-3
				Beryllium	1.8E+0	ug/L	5.3E-8	mg/kg-day	NA	(mg/kg-day)-1	NA	1.5E-7	mg/kg-day	2.0E-3	mg/kg-day	7.4E-5
				Cadmium	3.2E+0	ug/L	9.4E-8	mg/kg-day	3.8E-1	(mg/kg-day)-1	4E-8	2.6E-7	mg/kg-day	5.0E-4	mg/kg-day	5.2E-4
				Chromium	2.2E+1	ug/L	1.3E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	3.6E-6	mg/kg-day	3.0E-3	mg/kg-day	1.2E-3
				Cobalt	7.5E+0	ug/L	2.2E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	6.0E-7	mg/kg-day	2.0E-2	mg/kg-day	3.0E-5
				Copper	1.1E+1	ug/L	3.2E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	8.9E-7	mg/kg-day	4.0E-2	mg/kg-day	2.2E-5
				Iron	4.0E+4	ug/L	1.1E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	3.2E-3	mg/kg-day	3.0E-1	mg/kg-day	1.1E-2
				Lead	3.7E-1	ug/L	1.1E-8	mg/kg-day	NA	(mg/kg-day)-1	NA	3.0E-8	mg/kg-day	NA	mg/kg-day	NA
				Manganese	2.5E+3	ug/L	7.1E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	2.0E-4	mg/kg-day	1.4E-1	mg/kg-day	1.4E-3
				Mercury	2.2E-1	ug/L	6.4E-9	mg/kg-day	NA	(mg/kg-day)-1	NA	1.8E-8	mg/kg-day	3.0E-4	mg/kg-day	6.0E-5
				Molybdenum	3.7E+1	ug/L	1.1E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	3.0E-6	mg/kg-day	5.0E-3	mg/kg-day	6.1E-4
				Nickel	1.6E+1	ug/L	9.3E-8	mg/kg-day	NA	(mg/kg-day)-1	NA	2.6E-7	mg/kg-day	2.0E-2	mg/kg-day	1.3E-5
				Nitrate	7.0E+3	ug/L	2.0E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	5.7E-4	mg/kg-day	1.6E+0	mg/kg-day	3.5E-4
				Selenium	1.3E+1	ug/L	3.8E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	1.1E-6	mg/kg-day	5.0E-3	mg/kg-day	2.1E-4
				Silver	1.5E+1	ug/L	2.6E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	7.3E-7	mg/kg-day	5.0E-3	mg/kg-day	1.5E-4
				Thallium	9.6E+0	ug/L	2.8E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	7.8E-7	mg/kg-day	6.6E-5	mg/kg-day	1.2E-2
				Vanadium	2.0E+1	ug/L	5.8E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	1.6E-6	mg/kg-day	7.0E-3	mg/kg-day	2.3E-4
				Zinc	1.1E+1	ug/L	1.9E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	5.3E-7	mg/kg-day	3.0E-1	mg/kg-day	1.8E-6

TABLE 7.2
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
TIER 1 REASONABLE MAXIMUM EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Car Wash Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
				1,2,4-Trimethylbenzene	5.5E+1	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	5.0E-2	mg/kg-day	0.0E+0
				1,2-Dichloroethane	5.0E+1	ug/L	6.1E-5	mg/kg-day	4.7E-2	(mg/kg-day)-1	3E-6	1.7E-4	mg/kg-day	3.0E-2	mg/kg-day	5.7E-3
				1,3,5-Trimethylbenzene	2.9E+1	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	5.0E-2	mg/kg-day	0.0E+0
				Acenaphthene	2.2E+2	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	6.0E-2	mg/kg-day	0.0E+0
				Acenaphthylene	8.0E+2	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Acetone	1.0E+4	ug/L	3.1E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	8.7E-4	mg/kg-day	1.0E-1	mg/kg-day	8.7E-3
				Anthracene	5.9E+1	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	3.0E-1	mg/kg-day	0.0E+0
				Benzene	6.0E+3	ug/L	2.6E-3	mg/kg-day	1.0E-1	(mg/kg-day)-1	3E-4	7.3E-3	mg/kg-day	3.0E-3	mg/kg-day	2.4E+0
				Benzo[a]anthracene	2.6E+1	ug/L	0.0E+0	mg/kg-day	1.2E+0	(mg/kg-day)-1	0E+0	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Benzo[a]pyrene	6.0E+1	ug/L	0.0E+0	mg/kg-day	1.2E+1	(mg/kg-day)-1	0E+0	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Benzo[b]fluoranthene	2.9E+1	ug/L	0.0E+0	mg/kg-day	1.2E+0	(mg/kg-day)-1	0E+0	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Benzo[g,h,i]perylene	3.7E+1	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Benzo[k]fluoranthene	1.4E+1	ug/L	0.0E+0	mg/kg-day	1.2E+0	(mg/kg-day)-1	0E+0	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Carbon Disulfide	4.8E+0	ug/L	2.4E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	6.6E-6	mg/kg-day	1.0E-1	mg/kg-day	6.6E-5
				Chrysene	4.3E+1	ug/L	0.0E+0	mg/kg-day	1.2E-1	(mg/kg-day)-1	0E+0	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Dibenz[a,h]anthracene	3.0E+0	ug/L	0.0E+0	mg/kg-day	4.1E+0	(mg/kg-day)-1	0E+0	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Ethylbenzene	8.0E+2	ug/L	1.1E-3	mg/kg-day	3.9E-3	(mg/kg-day)-1	4E-6	3.2E-3	mg/kg-day	1.0E-1	mg/kg-day	3.2E-2
				Fluoranthene	2.8E+2	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	4.0E-2	mg/kg-day	0.0E+0
				Fluorene	7.0E+1	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	4.0E-2	mg/kg-day	0.0E+0
				Indeno(1,2,3-cd)pyrene	4.4E+1	ug/L	0.0E+0	mg/kg-day	1.2E+0	(mg/kg-day)-1	0E+0	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Isopropyl benzene	7.4E+0	ug/L	6.6E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	1.8E-5	mg/kg-day	1.0E-1	mg/kg-day	1.8E-4
				Methyl isobutyl ketone	3.5E+0	ug/L	4.0E-7	mg/kg-day	0.0E+0	(mg/kg-day)-1	0E+0	1.1E-6	mg/kg-day	8.0E-2	mg/kg-day	1.4E-5
				Methylene chloride	1.8E+2	ug/L	1.8E-5	mg/kg-day	1.4E-2	(mg/kg-day)-1	3E-7	5.1E-5	mg/kg-day	6.0E-2	mg/kg-day	8.5E-4
				MTBE	1.9E+1	ug/L	2.1E-6	mg/kg-day	1.8E-3	(mg/kg-day)-1	4E-9	6.0E-6	mg/kg-day	NA	mg/kg-day	NA
				Naphthalene	1.9E+4	ug/L	2.6E-2	mg/kg-day	NA	(mg/kg-day)-1	NA	7.2E-2	mg/kg-day	2.0E-2	mg/kg-day	3.6E+0
				n-Butylbenzene	1.8E+3	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	4.0E-2	mg/kg-day	0.0E+0
				n-Propylbenzene	1.1E+1	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	4.0E-2	mg/kg-day	0.0E+0
				Phenanthrene	2.5E+2	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Pyrene	2.0E+2	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	3.0E-2	mg/kg-day	0.0E+0
				Styrene	1.9E+2	ug/L	2.0E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	5.6E-4	mg/kg-day	2.0E-1	mg/kg-day	2.8E-3
				Toluene	6.2E+2	ug/L	5.6E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	1.6E-3	mg/kg-day	2.0E-1	mg/kg-day	7.8E-3
				Xylenes (total)	4.2E+2	ug/L	6.5E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	1.8E-3	mg/kg-day	2.0E-1	mg/kg-day	9.1E-3
			Exp. Route Total								3E-4					6.1E+0
		Exposure Point Total									3E-4					6.1E+0
	Exposure Medium Total										3E-4					6.1E+0
	Work Space Air	Work Space Air	Inhalation	1,2,4-Trimethylbenzene	2.6E-5	mg/m3	1.6E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	4.5E-6	mg/kg-day	1.7E-3	mg/kg-day	2.6E-3
				1,2-Dichloroethane	3.0E-5	mg/m3	1.9E-6	mg/kg-day	7.2E-2	(mg/kg-day)-1	1E-7	5.3E-6	mg/kg-day	1.4E-3	mg/kg-day	3.8E-3
				1,3,5-Trimethylbenzene	1.3E-5	mg/m3	8.5E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	2.4E-6	mg/kg-day	1.7E-3	mg/kg-day	1.4E-3

TABLE 7.2

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

TIER 1 REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Car Wash Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
				Acenaphthene	9.0E-5	mg/m3	5.6E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	1.6E-5	mg/kg-day	NA	mg/kg-day	NA
				Acetone	4.2E-3	mg/m3	2.7E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	7.4E-4	mg/kg-day	NA	mg/kg-day	NA
				Anthracene	2.4E-5	mg/m3	1.5E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	4.2E-6	mg/kg-day	NA	mg/kg-day	NA
				Benzene	3.4E-3	mg/m3	2.2E-4	mg/kg-day	1.0E-1	(mg/kg-day)-1	2E-5	6.1E-4	mg/kg-day	1.7E-3	mg/kg-day	3.6E-1
				Benzo[b]fluoranthene	1.2E-5	mg/m3	7.4E-7	mg/kg-day	3.9E-1	(mg/kg-day)-1	3E-7	2.1E-6	mg/kg-day	NA	mg/kg-day	NA
				Carbon Disulfide	2.8E-6	mg/m3	1.8E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	4.9E-7	mg/kg-day	2.0E-1	mg/kg-day	2.5E-6
				Chrysene	1.7E-5	mg/m3	1.1E-6	mg/kg-day	3.9E-2	(mg/kg-day)-1	4E-8	3.1E-6	mg/kg-day	NA	mg/kg-day	NA
				Ethylbenzene	4.0E-4	mg/m3	2.5E-5	mg/kg-day	3.9E-3	(mg/kg-day)-1	1E-7	7.0E-5	mg/kg-day	2.9E-1	mg/kg-day	2.4E-4
				Fluorene	2.8E-5	mg/m3	1.8E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	5.0E-6	mg/kg-day	NA	mg/kg-day	NA
				Isopropyl benzene	3.4E-6	mg/m3	2.2E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	6.1E-7	mg/kg-day	1.1E-1	mg/kg-day	5.5E-6
				Methyl isobutyl ketone	1.5E-6	mg/m3	9.5E-8	mg/kg-day	0.0E+0	(mg/kg-day)-1	0E+0	2.6E-7	mg/kg-day	2.3E-2	mg/kg-day	1.2E-5
				Methylene chloride	1.2E-4	mg/m3	7.3E-6	mg/kg-day	3.5E-3	(mg/kg-day)-1	3E-8	2.0E-5	mg/kg-day	8.6E-1	mg/kg-day	2.4E-5
				MTBE	1.1E-5	mg/m3	6.7E-7	mg/kg-day	9.1E-4	(mg/kg-day)-1	6E-10	1.9E-6	mg/kg-day	8.6E-1	mg/kg-day	2.2E-6
				Naphthalene	8.7E-3	mg/m3	5.5E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	1.5E-3	mg/kg-day	8.6E-4	mg/kg-day	1.8E+0
				n-Butylbenzene	8.9E-4	mg/m3	5.6E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	1.6E-4	mg/kg-day	NA	mg/kg-day	NA
				n-Propylbenzene	5.4E-6	mg/m3	3.4E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	9.6E-7	mg/kg-day	NA	mg/kg-day	NA
				Pyrene	8.1E-5	mg/m3	5.1E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	1.4E-5	mg/kg-day	NA	mg/kg-day	NA
				Styrene	9.3E-5	mg/m3	5.9E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	1.6E-5	mg/kg-day	2.9E-1	mg/kg-day	5.6E-5
				Toluene	3.3E-4	mg/m3	2.1E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	5.8E-5	mg/kg-day	1.1E-1	mg/kg-day	5.2E-4
				Xylenes (total)	2.3E-4	mg/m3	1.4E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	4.0E-5	mg/kg-day	2.9E-2	mg/kg-day	1.4E-3
			Exp. Route Total								2E-5					2.2E+0
		Exposure Point Total									2E-5					2.2E+0
	Exposure Medium Total										2E-5					2.2E+0
Medium Total											3E-4					8.3E+0
										Total of Receptor Risks Across All Media	6E-3				Total of Receptor Risks Across All Media	4.0E+1

TABLE 7.3
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
TIER 1 CENTRAL EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Landscape Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater Potable Use	Potable Water	Potable Water	Ingestion	Aluminum	1.4E+3	ug/L	1.2E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	1.2E-2	mg/kg-day	1.0E+0	mg/kg-day	1.2E-2
				Antimony	4.8E-1	ug/L	4.0E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	4.2E-6	mg/kg-day	4.0E-4	mg/kg-day	1.1E-2
				Arsenic	2.2E+1	ug/L	1.8E-5	mg/kg-day	9.5E+0	(mg/kg-day)-1	2E-4	1.9E-4	mg/kg-day	3.0E-4	mg/kg-day	6.5E-1
				Barium	2.0E+3	ug/L	1.6E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	1.7E-2	mg/kg-day	7.0E-2	mg/kg-day	2.5E-1
				Beryllium	1.8E+0	ug/L	1.5E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	1.6E-5	mg/kg-day	2.0E-3	mg/kg-day	8.1E-3
				Cadmium	3.2E+0	ug/L	2.7E-6	mg/kg-day	3.8E-1	(mg/kg-day)-1	1E-6	2.9E-5	mg/kg-day	5.0E-4	mg/kg-day	5.7E-2
				Chromium	2.2E+1	ug/L	1.8E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	1.9E-4	mg/kg-day	3.0E-3	mg/kg-day	6.5E-2
				Cobalt	7.5E+0	ug/L	6.2E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	6.6E-5	mg/kg-day	2.0E-2	mg/kg-day	3.3E-3
				Copper	1.1E+1	ug/L	9.1E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	9.7E-5	mg/kg-day	4.0E-2	mg/kg-day	2.4E-3
				Iron	4.0E+4	ug/L	3.3E-2	mg/kg-day	NA	(mg/kg-day)-1	NA	3.5E-1	mg/kg-day	3.0E-1	mg/kg-day	1.2E+0
				Lead	3.7E-1	ug/L	3.1E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	3.3E-6	mg/kg-day	NA	mg/kg-day	NA
				Manganese	2.5E+3	ug/L	2.1E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	2.2E-2	mg/kg-day	1.4E-1	mg/kg-day	1.6E-1
				Mercury	2.2E-1	ug/L	1.8E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	2.0E-6	mg/kg-day	3.0E-4	mg/kg-day	6.5E-3
				Molybdenum	3.7E+1	ug/L	3.1E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	3.3E-4	mg/kg-day	5.0E-3	mg/kg-day	6.6E-2
				Nickel	1.6E+1	ug/L	1.3E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	1.4E-4	mg/kg-day	2.0E-2	mg/kg-day	7.0E-3
				Nitrate	7.0E+3	ug/L	5.8E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	6.2E-2	mg/kg-day	1.6E+0	mg/kg-day	3.9E-2
				Selenium	1.3E+1	ug/L	1.1E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	1.1E-4	mg/kg-day	5.0E-3	mg/kg-day	2.3E-2
				Silver	1.5E+1	ug/L	1.2E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	1.3E-4	mg/kg-day	5.0E-3	mg/kg-day	2.6E-2
				Thallium	9.6E+0	ug/L	8.0E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	8.5E-5	mg/kg-day	6.6E-5	mg/kg-day	1.3E+0
				Vanadium	2.0E+1	ug/L	1.7E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	1.8E-4	mg/kg-day	7.0E-3	mg/kg-day	2.5E-2
				Zinc	1.1E+1	ug/L	9.1E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	9.7E-5	mg/kg-day	3.0E-1	mg/kg-day	3.2E-4
				1,2,4-Trimethylbenzene	5.5E+1	ug/L	4.6E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	4.8E-4	mg/kg-day	5.0E-2	mg/kg-day	9.7E-3
				1,2-Dichloroethane	5.0E+1	ug/L	4.2E-5	mg/kg-day	4.7E-2	(mg/kg-day)-1	2E-6	4.4E-4	mg/kg-day	3.0E-2	mg/kg-day	1.5E-2
				1,3,5-Trimethylbenzene	2.9E+1	ug/L	2.4E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	2.6E-4	mg/kg-day	5.0E-2	mg/kg-day	5.1E-3
				Acenaphthene	2.2E+2	ug/L	1.8E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	1.9E-3	mg/kg-day	6.0E-2	mg/kg-day	3.2E-2
				Acenaphthylene	8.0E+2	ug/L	6.6E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	7.0E-3	mg/kg-day	NA	mg/kg-day	NA
				Acetone	1.0E+4	ug/L	8.3E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	8.8E-2	mg/kg-day	1.0E-1	mg/kg-day	8.8E-1
				Anthracene	5.9E+1	ug/L	4.9E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	5.2E-4	mg/kg-day	3.0E-1	mg/kg-day	1.7E-3
				Benzene	6.0E+3	ug/L	5.0E-3	mg/kg-day	1.0E-1	(mg/kg-day)-1	5E-4	5.3E-2	mg/kg-day	3.0E-3	mg/kg-day	1.8E+1
				Benzo[a]anthracene	2.6E+1	ug/L	2.2E-5	mg/kg-day	1.2E+0	(mg/kg-day)-1	3E-5	2.3E-4	mg/kg-day	NA	mg/kg-day	NA
				Benzo[a]pyrene	6.0E+1	ug/L	5.0E-5	mg/kg-day	1.2E+1	(mg/kg-day)-1	6E-4	5.3E-4	mg/kg-day	NA	mg/kg-day	NA
				Benzo[b]fluoranthene	2.9E+1	ug/L	2.4E-5	mg/kg-day	1.2E+0	(mg/kg-day)-1	3E-5	2.6E-4	mg/kg-day	NA	mg/kg-day	NA
				Benzo[g,h,i]perylene	3.7E+1	ug/L	3.1E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	3.3E-4	mg/kg-day	NA	mg/kg-day	NA
				Benzo[k]fluoranthene	1.4E+1	ug/L	1.2E-5	mg/kg-day	1.2E+0	(mg/kg-day)-1	1E-5	1.2E-4	mg/kg-day	NA	mg/kg-day	NA
				Carbon Disulfide	4.8E+0	ug/L	4.0E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	4.2E-5	mg/kg-day	1.0E-1	mg/kg-day	4.2E-4
				Chrysene	4.3E+1	ug/L	3.6E-5	mg/kg-day	1.2E-1	(mg/kg-day)-1	4E-6	3.8E-4	mg/kg-day	NA	mg/kg-day	NA
				Dibenz[a,h]anthracene	3.0E+0	ug/L	2.5E-6	mg/kg-day	4.1E+0	(mg/kg-day)-1	1E-5	2.6E-5	mg/kg-day	NA	mg/kg-day	NA
				Ethylbenzene	8.0E+2	ug/L	6.6E-4	mg/kg-day	3.9E-3	(mg/kg-day)-1	3E-6	7.0E-3	mg/kg-day	1.0E-1	mg/kg-day	7.0E-2
				Fluoranthene	2.8E+2	ug/L	2.3E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	2.5E-3	mg/kg-day	4.0E-2	mg/kg-day	6.2E-2

TABLE 7.3
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
TIER 1 CENTRAL EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Landscape Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
				Fluorene	7.0E+1	ug/L	5.8E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	6.2E-4	mg/kg-day	4.0E-2	mg/kg-day	1.5E-2
				Indeno(1,2,3-cd)pyrene	4.4E+1	ug/L	3.7E-5	mg/kg-day	1.2E+0	(mg/kg-day)-1	4E-5	3.9E-4	mg/kg-day	NA	mg/kg-day	NA
				Isopropyl benzene	7.4E+0	ug/L	6.1E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	6.5E-5	mg/kg-day	1.0E-1	mg/kg-day	6.5E-4
				Methyl isobutyl ketone	3.5E+0	ug/L	2.9E-6	mg/kg-day	0.0E+0	(mg/kg-day)-1	0E+0	3.1E-5	mg/kg-day	8.0E-2	mg/kg-day	3.9E-4
				Methylene chloride	1.8E+2	ug/L	1.5E-4	mg/kg-day	1.4E-2	(mg/kg-day)-1	2E-6	1.6E-3	mg/kg-day	6.0E-2	mg/kg-day	2.6E-2
				MTBE	1.9E+1	ug/L	1.6E-5	mg/kg-day	1.8E-3	(mg/kg-day)-1	3E-8	1.7E-4	mg/kg-day	NA	mg/kg-day	NA
				Naphthalene	1.9E+4	ug/L	1.6E-2	mg/kg-day	NA	(mg/kg-day)-1	NA	1.7E-1	mg/kg-day	2.0E-2	mg/kg-day	8.4E+0
				n-Butylbenzene	1.8E+3	ug/L	1.5E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	1.6E-2	mg/kg-day	4.0E-2	mg/kg-day	4.0E-1
				n-Propylbenzene	1.1E+1	ug/L	9.1E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	9.7E-5	mg/kg-day	4.0E-2	mg/kg-day	2.4E-3
				Phenanthrene	2.5E+2	ug/L	2.1E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	2.2E-3	mg/kg-day	NA	mg/kg-day	NA
				Pyrene	2.0E+2	ug/L	1.7E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	1.8E-3	mg/kg-day	3.0E-2	mg/kg-day	5.9E-2
				Styrene	1.9E+2	ug/L	1.5E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	1.6E-3	mg/kg-day	2.0E-1	mg/kg-day	8.2E-3
				Toluene	6.2E+2	ug/L	5.1E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	5.5E-3	mg/kg-day	2.0E-1	mg/kg-day	2.7E-2
				Xylenes (total)	4.2E+2	ug/L	3.5E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	3.7E-3	mg/kg-day	2.0E-1	mg/kg-day	1.9E-2
			Exp. Route Total								1E-3					3.1E+1
		Exposure Point Total									1E-3					3.1E+1
	Exposure Medium Total										1E-3					3.1E+1
Medium Total											1E-3					3.1E+1
Groundwater Industrial Use	Industrial Water	Industrial Water	Dermal	Aluminum	1.4E+3	ug/L	2.5E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	6.8E-5	mg/kg-day	1.0E+0	mg/kg-day	6.8E-5
				Antimony	4.8E-1	ug/L	8.7E-10	mg/kg-day	NA	(mg/kg-day)-1	NA	2.3E-8	mg/kg-day	4.0E-4	mg/kg-day	5.8E-5
				Arsenic	2.2E+1	ug/L	4.0E-8	mg/kg-day	9.5E+0	(mg/kg-day)-1	4E-7	1.1E-6	mg/kg-day	3.0E-4	mg/kg-day	3.6E-3
				Barium	2.0E+3	ug/L	3.5E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	9.5E-5	mg/kg-day	7.0E-2	mg/kg-day	1.4E-3
				Beryllium	1.8E+0	ug/L	3.3E-9	mg/kg-day	NA	(mg/kg-day)-1	NA	8.9E-8	mg/kg-day	2.0E-3	mg/kg-day	4.5E-5
				Cadmium	3.2E+0	ug/L	5.9E-9	mg/kg-day	3.8E-1	(mg/kg-day)-1	2E-9	1.6E-7	mg/kg-day	5.0E-4	mg/kg-day	3.2E-4
				Chromium	2.2E+1	ug/L	8.0E-8	mg/kg-day	NA	(mg/kg-day)-1	NA	2.1E-6	mg/kg-day	3.0E-3	mg/kg-day	7.1E-4
				Cobalt	7.5E+0	ug/L	1.3E-8	mg/kg-day	NA	(mg/kg-day)-1	NA	3.6E-7	mg/kg-day	2.0E-2	mg/kg-day	1.8E-5
				Copper	1.1E+1	ug/L	2.0E-8	mg/kg-day	NA	(mg/kg-day)-1	NA	5.4E-7	mg/kg-day	4.0E-2	mg/kg-day	1.3E-5
				Iron	4.0E+4	ug/L	7.2E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	1.9E-3	mg/kg-day	3.0E-1	mg/kg-day	6.4E-3
				Lead	3.7E-1	ug/L	6.7E-10	mg/kg-day	NA	(mg/kg-day)-1	NA	1.8E-8	mg/kg-day	NA	mg/kg-day	NA
				Manganese	2.5E+3	ug/L	4.5E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	1.2E-4	mg/kg-day	1.4E-1	mg/kg-day	8.6E-4
				Mercury	2.2E-1	ug/L	4.0E-10	mg/kg-day	NA	(mg/kg-day)-1	NA	1.1E-8	mg/kg-day	3.0E-4	mg/kg-day	3.6E-5
				Molybdenum	3.7E+1	ug/L	6.8E-8	mg/kg-day	NA	(mg/kg-day)-1	NA	1.8E-6	mg/kg-day	5.0E-3	mg/kg-day	3.6E-4
				Nickel	1.6E+1	ug/L	5.8E-9	mg/kg-day	NA	(mg/kg-day)-1	NA	1.6E-7	mg/kg-day	2.0E-2	mg/kg-day	7.8E-6
				Nitrate	7.0E+3	ug/L	1.3E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	3.4E-4	mg/kg-day	1.6E+0	mg/kg-day	2.1E-4
				Selenium	1.3E+1	ug/L	2.4E-8	mg/kg-day	NA	(mg/kg-day)-1	NA	6.3E-7	mg/kg-day	5.0E-3	mg/kg-day	1.3E-4
				Silver	1.5E+1	ug/L	1.6E-8	mg/kg-day	NA	(mg/kg-day)-1	NA	4.4E-7	mg/kg-day	5.0E-3	mg/kg-day	8.8E-5
				Thallium	9.6E+0	ug/L	1.7E-8	mg/kg-day	NA	(mg/kg-day)-1	NA	4.7E-7	mg/kg-day	6.6E-5	mg/kg-day	7.1E-3
				Vanadium	2.0E+1	ug/L	3.6E-8	mg/kg-day	NA	(mg/kg-day)-1	NA	9.7E-7	mg/kg-day	7.0E-3	mg/kg-day	1.4E-4
				Zinc	1.1E+1	ug/L	1.2E-8	mg/kg-day	NA	(mg/kg-day)-1	NA	3.2E-7	mg/kg-day	3.0E-1	mg/kg-day	1.1E-6

TABLE 7.3
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
TIER 1 CENTRAL EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Landscape Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
				1,2,4-Trimethylbenzene	5.5E+1	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	5.0E-2	mg/kg-day	0.0E+0
				1,2-Dichloroethane	5.0E+1	ug/L	3.8E-6	mg/kg-day	4.7E-2	(mg/kg-day)-1	2E-7	1.0E-4	mg/kg-day	3.0E-2	mg/kg-day	3.4E-3
				1,3,5-Trimethylbenzene	2.9E+1	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	5.0E-2	mg/kg-day	0.0E+0
				Acenaphthene	2.2E+2	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	6.0E-2	mg/kg-day	0.0E+0
				Acenaphthylene	8.0E+2	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Acetone	1.0E+4	ug/L	1.9E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	5.2E-4	mg/kg-day	1.0E-1	mg/kg-day	5.2E-3
				Anthracene	5.9E+1	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	3.0E-1	mg/kg-day	0.0E+0
				Benzene	6.0E+3	ug/L	1.6E-4	mg/kg-day	1.0E-1	(mg/kg-day)-1	2E-5	4.4E-3	mg/kg-day	3.0E-3	mg/kg-day	1.5E+0
				Benzo[a]anthracene	2.6E+1	ug/L	0.0E+0	mg/kg-day	1.2E+0	(mg/kg-day)-1	0E+0	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Benzo[a]pyrene	6.0E+1	ug/L	0.0E+0	mg/kg-day	1.2E+1	(mg/kg-day)-1	0E+0	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Benzo[b]fluoranthene	2.9E+1	ug/L	0.0E+0	mg/kg-day	1.2E+0	(mg/kg-day)-1	0E+0	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Benzo[g,h,i]perylene	3.7E+1	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Benzo[k]fluoranthene	1.4E+1	ug/L	0.0E+0	mg/kg-day	1.2E+0	(mg/kg-day)-1	0E+0	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Carbon Disulfide	4.8E+0	ug/L	1.5E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	4.0E-6	mg/kg-day	1.0E-1	mg/kg-day	4.0E-5
				Chrysene	4.3E+1	ug/L	0.0E+0	mg/kg-day	1.2E-1	(mg/kg-day)-1	0E+0	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Dibenz[a,h]anthracene	3.0E+0	ug/L	0.0E+0	mg/kg-day	4.1E+0	(mg/kg-day)-1	0E+0	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Ethylbenzene	8.0E+2	ug/L	7.1E-5	mg/kg-day	3.9E-3	(mg/kg-day)-1	3E-7	1.9E-3	mg/kg-day	1.0E-1	mg/kg-day	1.9E-2
				Fluoranthene	2.8E+2	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	4.0E-2	mg/kg-day	0.0E+0
				Fluorene	7.0E+1	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	4.0E-2	mg/kg-day	0.0E+0
				Indeno(1,2,3-cd)pyrene	4.4E+1	ug/L	0.0E+0	mg/kg-day	1.2E+0	(mg/kg-day)-1	0E+0	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Isopropyl benzene	7.4E+0	ug/L	4.1E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	1.1E-5	mg/kg-day	1.0E-1	mg/kg-day	1.1E-4
				Methyl isobutyl ketone	3.5E+0	ug/L	2.5E-8	mg/kg-day	0.0E+0	(mg/kg-day)-1	0E+0	6.8E-7	mg/kg-day	8.0E-2	mg/kg-day	8.5E-6
				Methylene chloride	1.8E+2	ug/L	1.1E-6	mg/kg-day	1.4E-2	(mg/kg-day)-1	2E-8	3.1E-5	mg/kg-day	6.0E-2	mg/kg-day	5.1E-4
				MTBE	1.9E+1	ug/L	1.3E-7	mg/kg-day	1.8E-3	(mg/kg-day)-1	2E-10	3.6E-6	mg/kg-day	NA	mg/kg-day	NA
				Naphthalene	1.9E+4	ug/L	1.6E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	4.3E-2	mg/kg-day	2.0E-2	mg/kg-day	2.2E+0
				n-Butylbenzene	1.8E+3	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	4.0E-2	mg/kg-day	0.0E+0
				n-Propylbenzene	1.1E+1	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	4.0E-2	mg/kg-day	0.0E+0
				Phenanthrene	2.5E+2	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Pyrene	2.0E+2	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	3.0E-2	mg/kg-day	0.0E+0
				Styrene	1.9E+2	ug/L	1.2E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	3.4E-4	mg/kg-day	2.0E-1	mg/kg-day	1.7E-3
				Toluene	6.2E+2	ug/L	3.5E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	9.4E-4	mg/kg-day	2.0E-1	mg/kg-day	4.7E-3
				Xylenes (total)	4.2E+2	ug/L	4.1E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	1.1E-3	mg/kg-day	2.0E-1	mg/kg-day	5.5E-3
			Exp. Route Total								2E-5					3.7E+0
		Exposure Point Total									2E-5					3.7E+0
	Exposure Medium Total										2E-5					3.7E+0
	Work Space Air	Work Space Air	Inhalation	1,2,4-Trimethylbenzene	2.5E-5	mg/m3	4.1E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	4.4E-6	mg/kg-day	1.7E-3	mg/kg-day	2.6E-3
				1,2-Dichloroethane	2.9E-5	mg/m3	4.8E-7	mg/kg-day	7.2E-2	(mg/kg-day)-1	3E-8	5.1E-6	mg/kg-day	1.4E-3	mg/kg-day	3.7E-3
				1,3,5-Trimethylbenzene	1.3E-5	mg/m3	2.2E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	2.3E-6	mg/kg-day	1.7E-3	mg/kg-day	1.4E-3

TABLE 7.3

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

TIER 1 CENTRAL EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Landscape Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
				Acenaphthene	8.7E-5	mg/m3	1.4E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	1.5E-5	mg/kg-day	NA	mg/kg-day	NA
				Acetone	4.1E-3	mg/m3	6.8E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	7.2E-4	mg/kg-day	NA	mg/kg-day	NA
				Anthracene	2.3E-5	mg/m3	3.9E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	4.1E-6	mg/kg-day	NA	mg/kg-day	NA
				Benzene	3.3E-3	mg/m3	5.5E-5	mg/kg-day	1.0E-1	(mg/kg-day)-1	6E-6	5.9E-4	mg/kg-day	1.7E-3	mg/kg-day	3.5E-1
				Benzo[b]fluoranthene	1.1E-5	mg/m3	1.9E-7	mg/kg-day	3.9E-1	(mg/kg-day)-1	7E-8	2.0E-6	mg/kg-day	NA	mg/kg-day	NA
				Carbon Disulfide	2.7E-6	mg/m3	4.5E-8	mg/kg-day	NA	(mg/kg-day)-1	NA	4.8E-7	mg/kg-day	2.0E-1	mg/kg-day	2.4E-6
				Chrysene	1.7E-5	mg/m3	2.8E-7	mg/kg-day	3.9E-2	(mg/kg-day)-1	1E-8	3.0E-6	mg/kg-day	NA	mg/kg-day	NA
				Ethylbenzene	3.8E-4	mg/m3	6.4E-6	mg/kg-day	3.9E-3	(mg/kg-day)-1	2E-8	6.7E-5	mg/kg-day	2.9E-1	mg/kg-day	2.3E-4
				Fluorene	2.8E-5	mg/m3	4.6E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	4.9E-6	mg/kg-day	NA	mg/kg-day	NA
				Isopropyl benzene	3.3E-6	mg/m3	5.5E-8	mg/kg-day	NA	(mg/kg-day)-1	NA	5.9E-7	mg/kg-day	1.1E-1	mg/kg-day	5.3E-6
				Methyl isobutyl ketone	1.5E-6	mg/m3	2.4E-8	mg/kg-day	0.0E+0	(mg/kg-day)-1	0E+0	2.6E-7	mg/kg-day	2.3E-2	mg/kg-day	1.1E-5
				Methylene chloride	1.1E-4	mg/m3	1.9E-6	mg/kg-day	3.5E-3	(mg/kg-day)-1	7E-9	2.0E-5	mg/kg-day	8.6E-1	mg/kg-day	2.3E-5
				MTBE	1.0E-5	mg/m3	1.7E-7	mg/kg-day	9.1E-4	(mg/kg-day)-1	2E-10	1.8E-6	mg/kg-day	8.6E-1	mg/kg-day	2.1E-6
				Naphthalene	8.5E-3	mg/m3	1.4E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	1.5E-3	mg/kg-day	8.6E-4	mg/kg-day	1.7E+0
				n-Butylbenzene	8.6E-4	mg/m3	1.4E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	1.5E-4	mg/kg-day	NA	mg/kg-day	NA
				n-Propylbenzene	5.3E-6	mg/m3	8.8E-8	mg/kg-day	NA	(mg/kg-day)-1	NA	9.3E-7	mg/kg-day	NA	mg/kg-day	NA
				Pyrene	7.9E-5	mg/m3	1.3E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	1.4E-5	mg/kg-day	NA	mg/kg-day	NA
				Styrene	9.0E-5	mg/m3	1.5E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	1.6E-5	mg/kg-day	2.9E-1	mg/kg-day	5.5E-5
				Toluene	3.2E-4	mg/m3	5.3E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	5.6E-5	mg/kg-day	1.1E-1	mg/kg-day	5.1E-4
				Xylenes (total)	2.2E-4	mg/m3	3.6E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	3.8E-5	mg/kg-day	2.9E-2	mg/kg-day	1.3E-3
			Exp. Route Total								6E-6					2.1E+0
		Exposure Point Total									6E-6					2.1E+0
	Exposure Medium Total										6E-6					2.1E+0
Medium Total											2E-5					5.8E+0
										Total of Receptor Risks Across All Media	1E-3				Total of Receptor Risks Across All Media	3.7E+1

TABLE 7.4

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

TIER 1 REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Landscape Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater Potable Use	Potable Water	Potable Water	Ingestion	Aluminum	1.4E+3	ug/L	4.4E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	1.2E-2	mg/kg-day	1.0E+0	mg/kg-day	1.2E-2
				Antimony	4.8E-1	ug/L	1.5E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	4.2E-6	mg/kg-day	4.0E-4	mg/kg-day	1.1E-2
				Arsenic	2.2E+1	ug/L	6.9E-5	mg/kg-day	9.5E+0	(mg/kg-day)-1	7E-4	1.9E-4	mg/kg-day	3.0E-4	mg/kg-day	6.5E-1
				Barium	2.0E+3	ug/L	6.2E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	1.7E-2	mg/kg-day	7.0E-2	mg/kg-day	2.5E-1
				Beryllium	1.8E+0	ug/L	5.8E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	1.6E-5	mg/kg-day	2.0E-3	mg/kg-day	8.1E-3
				Cadmium	3.2E+0	ug/L	1.0E-5	mg/kg-day	3.8E-1	(mg/kg-day)-1	4E-6	2.9E-5	mg/kg-day	5.0E-4	mg/kg-day	5.7E-2
				Chromium	2.2E+1	ug/L	6.9E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	1.9E-4	mg/kg-day	3.0E-3	mg/kg-day	6.5E-2
				Cobalt	7.5E+0	ug/L	2.3E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	6.6E-5	mg/kg-day	2.0E-2	mg/kg-day	3.3E-3
				Copper	1.1E+1	ug/L	3.5E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	9.7E-5	mg/kg-day	4.0E-2	mg/kg-day	2.4E-3
				Iron	4.0E+4	ug/L	1.2E-1	mg/kg-day	NA	(mg/kg-day)-1	NA	3.5E-1	mg/kg-day	3.0E-1	mg/kg-day	1.2E+0
				Lead	3.7E-1	ug/L	1.2E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	3.3E-6	mg/kg-day	NA	mg/kg-day	NA
				Manganese	2.5E+3	ug/L	7.8E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	2.2E-2	mg/kg-day	1.4E-1	mg/kg-day	1.6E-1
				Mercury	2.2E-1	ug/L	7.0E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	2.0E-6	mg/kg-day	3.0E-4	mg/kg-day	6.5E-3
				Molybdenum	3.7E+1	ug/L	1.2E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	3.3E-4	mg/kg-day	5.0E-3	mg/kg-day	6.6E-2
				Nickel	1.6E+1	ug/L	5.0E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	1.4E-4	mg/kg-day	2.0E-2	mg/kg-day	7.0E-3
				Nitrate	7.0E+3	ug/L	2.2E-2	mg/kg-day	NA	(mg/kg-day)-1	NA	6.2E-2	mg/kg-day	1.6E+0	mg/kg-day	3.9E-2
				Selenium	1.3E+1	ug/L	4.1E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	1.1E-4	mg/kg-day	5.0E-3	mg/kg-day	2.3E-2
				Silver	1.5E+1	ug/L	4.7E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	1.3E-4	mg/kg-day	5.0E-3	mg/kg-day	2.6E-2
				Thallium	9.6E+0	ug/L	3.0E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	8.5E-5	mg/kg-day	6.6E-5	mg/kg-day	1.3E+0
				Vanadium	2.0E+1	ug/L	6.3E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	1.8E-4	mg/kg-day	7.0E-3	mg/kg-day	2.5E-2
				Zinc	1.1E+1	ug/L	3.5E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	9.7E-5	mg/kg-day	3.0E-1	mg/kg-day	3.2E-4
				1,2,4-Trimethylbenzene	5.5E+1	ug/L	1.7E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	4.8E-4	mg/kg-day	5.0E-2	mg/kg-day	9.7E-3
				1,2-Dichloroethane	5.0E+1	ug/L	1.6E-4	mg/kg-day	4.7E-2	(mg/kg-day)-1	7E-6	4.4E-4	mg/kg-day	3.0E-2	mg/kg-day	1.5E-2
				1,3,5-Trimethylbenzene	2.9E+1	ug/L	9.1E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	2.6E-4	mg/kg-day	5.0E-2	mg/kg-day	5.1E-3
				Acenaphthene	2.2E+2	ug/L	6.9E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	1.9E-3	mg/kg-day	6.0E-2	mg/kg-day	3.2E-2
				Acenaphthylene	8.0E+2	ug/L	2.5E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	7.0E-3	mg/kg-day	NA	mg/kg-day	NA
				Acetone	1.0E+4	ug/L	3.1E-2	mg/kg-day	NA	(mg/kg-day)-1	NA	8.8E-2	mg/kg-day	1.0E-1	mg/kg-day	8.8E-1
				Anthracene	5.9E+1	ug/L	1.9E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	5.2E-4	mg/kg-day	3.0E-1	mg/kg-day	1.7E-3
				Benzene	6.0E+3	ug/L	1.9E-2	mg/kg-day	1.0E-1	(mg/kg-day)-1	2E-3	5.3E-2	mg/kg-day	3.0E-3	mg/kg-day	1.8E+1
				Benzo[a]anthracene	2.6E+1	ug/L	8.2E-5	mg/kg-day	1.2E+0	(mg/kg-day)-1	1E-4	2.3E-4	mg/kg-day	NA	mg/kg-day	NA
				Benzo[a]pyrene	6.0E+1	ug/L	1.9E-4	mg/kg-day	1.2E+1	(mg/kg-day)-1	2E-3	5.3E-4	mg/kg-day	NA	mg/kg-day	NA
				Benzo[b]fluoranthene	2.9E+1	ug/L	9.1E-5	mg/kg-day	1.2E+0	(mg/kg-day)-1	1E-4	2.6E-4	mg/kg-day	NA	mg/kg-day	NA
				Benzo[g,h,i]perylene	3.7E+1	ug/L	1.2E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	3.3E-4	mg/kg-day	NA	mg/kg-day	NA
				Benzo[k]fluoranthene	1.4E+1	ug/L	4.4E-5	mg/kg-day	1.2E+0	(mg/kg-day)-1	5E-5	1.2E-4	mg/kg-day	NA	mg/kg-day	NA
				Carbon Disulfide	4.8E+0	ug/L	1.5E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	4.2E-5	mg/kg-day	1.0E-1	mg/kg-day	4.2E-4
				Chrysene	4.3E+1	ug/L	1.4E-4	mg/kg-day	1.2E-1	(mg/kg-day)-1	2E-5	3.8E-4	mg/kg-day	NA	mg/kg-day	NA
				Dibenz[a,h]anthracene	3.0E+0	ug/L	9.4E-6	mg/kg-day	4.1E+0	(mg/kg-day)-1	4E-5	2.6E-5	mg/kg-day	NA	mg/kg-day	NA
				Ethylbenzene	8.0E+2	ug/L	2.5E-3	mg/kg-day	3.9E-3	(mg/kg-day)-1	1E-5	7.0E-3	mg/kg-day	1.0E-1	mg/kg-day	7.0E-2
				Fluoranthene	2.8E+2	ug/L	8.8E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	2.5E-3	mg/kg-day	4.0E-2	mg/kg-day	6.2E-2

TABLE 7.4

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

TIER 1 REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Landscape Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
				Fluorene	7.0E+1	ug/L	2.2E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	6.2E-4	mg/kg-day	4.0E-2	mg/kg-day	1.5E-2
				Indeno(1,2,3-cd)pyrene	4.4E+1	ug/L	1.4E-4	mg/kg-day	1.2E+0	(mg/kg-day)-1	2E-4	3.9E-4	mg/kg-day	NA	mg/kg-day	NA
				Isopropyl benzene	7.4E+0	ug/L	2.3E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	6.5E-5	mg/kg-day	1.0E-1	mg/kg-day	6.5E-4
				Methyl isobutyl ketone	3.5E+0	ug/L	1.1E-5	mg/kg-day	0.0E+0	(mg/kg-day)-1	0E+0	3.1E-5	mg/kg-day	8.0E-2	mg/kg-day	3.9E-4
				Methylene chloride	1.8E+2	ug/L	5.7E-4	mg/kg-day	1.4E-2	(mg/kg-day)-1	8E-6	1.6E-3	mg/kg-day	6.0E-2	mg/kg-day	2.6E-2
				MTBE	1.9E+1	ug/L	6.0E-5	mg/kg-day	1.8E-3	(mg/kg-day)-1	1E-7	1.7E-4	mg/kg-day	NA	mg/kg-day	NA
				Naphthalene	1.9E+4	ug/L	6.0E-2	mg/kg-day	NA	(mg/kg-day)-1	NA	1.7E-1	mg/kg-day	2.0E-2	mg/kg-day	8.4E+0
				n-Butylbenzene	1.8E+3	ug/L	5.7E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	1.6E-2	mg/kg-day	4.0E-2	mg/kg-day	4.0E-1
				n-Propylbenzene	1.1E+1	ug/L	3.5E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	9.7E-5	mg/kg-day	4.0E-2	mg/kg-day	2.4E-3
				Phenanthrene	2.5E+2	ug/L	7.9E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	2.2E-3	mg/kg-day	NA	mg/kg-day	NA
				Pyrene	2.0E+2	ug/L	6.3E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	1.8E-3	mg/kg-day	3.0E-2	mg/kg-day	5.9E-2
				Styrene	1.9E+2	ug/L	5.8E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	1.6E-3	mg/kg-day	2.0E-1	mg/kg-day	8.2E-3
				Toluene	6.2E+2	ug/L	1.9E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	5.5E-3	mg/kg-day	2.0E-1	mg/kg-day	2.7E-2
				Xylenes (total)	4.2E+2	ug/L	1.3E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	3.7E-3	mg/kg-day	2.0E-1	mg/kg-day	1.9E-2
			Exp. Route Total								5E-3					3.1E+1
		Exposure Point Total									5E-3					3.1E+1
	Exposure Medium Total										5E-3					3.1E+1
Medium Total											5E-3					3.1E+1
Groundwater Industrial Use	Industrial Water	Industrial Water	Dermal	Aluminum	1.4E+3	ug/L	2.9E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	1.5E-4	mg/kg-day	1.0E+0	mg/kg-day	1.5E-4
				Antimony	4.8E-1	ug/L	9.8E-9	mg/kg-day	NA	(mg/kg-day)-1	NA	5.0E-8	mg/kg-day	4.0E-4	mg/kg-day	1.3E-4
				Arsenic	2.2E+1	ug/L	4.5E-7	mg/kg-day	9.5E+0	(mg/kg-day)-1	4E-6	2.3E-6	mg/kg-day	3.0E-4	mg/kg-day	7.7E-3
				Barium	2.0E+3	ug/L	4.0E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	2.1E-4	mg/kg-day	7.0E-2	mg/kg-day	2.9E-3
				Beryllium	1.8E+0	ug/L	3.7E-8	mg/kg-day	NA	(mg/kg-day)-1	NA	1.9E-7	mg/kg-day	2.0E-3	mg/kg-day	9.6E-5
				Cadmium	3.2E+0	ug/L	6.6E-8	mg/kg-day	3.8E-1	(mg/kg-day)-1	3E-8	3.4E-7	mg/kg-day	5.0E-4	mg/kg-day	6.8E-4
				Chromium	2.2E+1	ug/L	9.0E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	4.6E-6	mg/kg-day	3.0E-3	mg/kg-day	1.5E-3
				Cobalt	7.5E+0	ug/L	1.5E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	7.8E-7	mg/kg-day	2.0E-2	mg/kg-day	3.9E-5
				Copper	1.1E+1	ug/L	2.2E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	1.2E-6	mg/kg-day	4.0E-2	mg/kg-day	2.9E-5
				Iron	4.0E+4	ug/L	8.1E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	4.2E-3	mg/kg-day	3.0E-1	mg/kg-day	1.4E-2
				Lead	3.7E-1	ug/L	7.5E-9	mg/kg-day	NA	(mg/kg-day)-1	NA	3.9E-8	mg/kg-day	NA	mg/kg-day	NA
				Manganese	2.5E+3	ug/L	5.0E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	2.6E-4	mg/kg-day	1.4E-1	mg/kg-day	1.8E-3
				Mercury	2.2E-1	ug/L	4.5E-9	mg/kg-day	NA	(mg/kg-day)-1	NA	2.3E-8	mg/kg-day	3.0E-4	mg/kg-day	7.8E-5
				Molybdenum	3.7E+1	ug/L	7.6E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	3.9E-6	mg/kg-day	5.0E-3	mg/kg-day	7.8E-4
				Nickel	1.6E+1	ug/L	6.5E-8	mg/kg-day	NA	(mg/kg-day)-1	NA	3.4E-7	mg/kg-day	2.0E-2	mg/kg-day	1.7E-5
				Nitrate	7.0E+3	ug/L	1.4E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	7.3E-4	mg/kg-day	1.6E+0	mg/kg-day	4.6E-4
				Selenium	1.3E+1	ug/L	2.6E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	1.4E-6	mg/kg-day	5.0E-3	mg/kg-day	2.7E-4
				Silver	1.5E+1	ug/L	1.8E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	9.4E-7	mg/kg-day	5.0E-3	mg/kg-day	1.9E-4
				Thallium	9.6E+0	ug/L	2.0E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	1.0E-6	mg/kg-day	6.6E-5	mg/kg-day	1.5E-2
				Vanadium	2.0E+1	ug/L	4.1E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	2.1E-6	mg/kg-day	7.0E-3	mg/kg-day	3.0E-4
				Zinc	1.1E+1	ug/L	1.3E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	6.9E-7	mg/kg-day	3.0E-1	mg/kg-day	2.3E-6

TABLE 7.4
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
TIER 1 REASONABLE MAXIMUM EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Landscape Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
				1,2,4-Trimethylbenzene	5.5E+1	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	5.0E-2	mg/kg-day	0.0E+0
				1,2-Dichloroethane	5.0E+1	ug/L	4.3E-5	mg/kg-day	4.7E-2	(mg/kg-day)-1	2E-6	2.2E-4	mg/kg-day	3.0E-2	mg/kg-day	7.3E-3
				1,3,5-Trimethylbenzene	2.9E+1	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	5.0E-2	mg/kg-day	0.0E+0
				Acenaphthene	2.2E+2	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	6.0E-2	mg/kg-day	0.0E+0
				Acenaphthylene	8.0E+2	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Acetone	1.0E+4	ug/L	2.2E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	1.1E-3	mg/kg-day	1.0E-1	mg/kg-day	1.1E-2
				Anthracene	5.9E+1	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	3.0E-1	mg/kg-day	0.0E+0
				Benzene	6.0E+3	ug/L	1.8E-3	mg/kg-day	1.0E-1	(mg/kg-day)-1	2E-4	9.4E-3	mg/kg-day	3.0E-3	mg/kg-day	3.1E+0
				Benzo[a]anthracene	2.6E+1	ug/L	0.0E+0	mg/kg-day	1.2E+0	(mg/kg-day)-1	0E+0	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Benzo[a]pyrene	6.0E+1	ug/L	0.0E+0	mg/kg-day	1.2E+1	(mg/kg-day)-1	0E+0	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Benzo[b]fluoranthene	2.9E+1	ug/L	0.0E+0	mg/kg-day	1.2E+0	(mg/kg-day)-1	0E+0	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Benzo[g,h,i]perylene	3.7E+1	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Benzo[k]fluoranthene	1.4E+1	ug/L	0.0E+0	mg/kg-day	1.2E+0	(mg/kg-day)-1	0E+0	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Carbon Disulfide	4.8E+0	ug/L	1.7E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	8.6E-6	mg/kg-day	1.0E-1	mg/kg-day	8.6E-5
				Chrysene	4.3E+1	ug/L	0.0E+0	mg/kg-day	1.2E-1	(mg/kg-day)-1	0E+0	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Dibenz[a,h]anthracene	3.0E+0	ug/L	0.0E+0	mg/kg-day	4.1E+0	(mg/kg-day)-1	0E+0	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Ethylbenzene	8.0E+2	ug/L	8.0E-4	mg/kg-day	3.9E-3	(mg/kg-day)-1	3E-6	4.1E-3	mg/kg-day	1.0E-1	mg/kg-day	4.1E-2
				Fluoranthene	2.8E+2	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	4.0E-2	mg/kg-day	0.0E+0
				Fluorene	7.0E+1	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	4.0E-2	mg/kg-day	0.0E+0
				Indeno(1,2,3-cd)pyrene	4.4E+1	ug/L	0.0E+0	mg/kg-day	1.2E+0	(mg/kg-day)-1	0E+0	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Isopropyl benzene	7.4E+0	ug/L	4.6E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	2.4E-5	mg/kg-day	1.0E-1	mg/kg-day	2.4E-4
				Methyl isobutyl ketone	3.5E+0	ug/L	2.8E-7	mg/kg-day	0.0E+0	(mg/kg-day)-1	0E+0	1.5E-6	mg/kg-day	8.0E-2	mg/kg-day	1.8E-5
				Methylene chloride	1.8E+2	ug/L	1.3E-5	mg/kg-day	1.4E-2	(mg/kg-day)-1	2E-7	6.6E-5	mg/kg-day	6.0E-2	mg/kg-day	1.1E-3
				MTBE	1.9E+1	ug/L	1.5E-6	mg/kg-day	1.8E-3	(mg/kg-day)-1	3E-9	7.7E-6	mg/kg-day	NA	mg/kg-day	NA
				Naphthalene	1.9E+4	ug/L	1.8E-2	mg/kg-day	NA	(mg/kg-day)-1	NA	9.4E-2	mg/kg-day	2.0E-2	mg/kg-day	4.7E+0
				n-Butylbenzene	1.8E+3	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	4.0E-2	mg/kg-day	0.0E+0
				n-Propylbenzene	1.1E+1	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	4.0E-2	mg/kg-day	0.0E+0
				Phenanthrene	2.5E+2	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Pyrene	2.0E+2	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	3.0E-2	mg/kg-day	0.0E+0
				Styrene	1.9E+2	ug/L	1.4E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	7.2E-4	mg/kg-day	2.0E-1	mg/kg-day	3.6E-3
				Toluene	6.2E+2	ug/L	3.9E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	2.0E-3	mg/kg-day	2.0E-1	mg/kg-day	1.0E-2
				Xylenes (total)	4.2E+2	ug/L	4.6E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	2.3E-3	mg/kg-day	2.0E-1	mg/kg-day	1.2E-2
			Exp. Route Total								2E-4					8.0E+0
		Exposure Point Total									2E-4					8.0E+0
	Exposure Medium Total										2E-4					8.0E+0
	Work Space Air	Work Space Air	Inhalation	1,2,4-Trimethylbenzene	5.6E-5	mg/m3	1.6E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	4.4E-6	mg/kg-day	1.7E-3	mg/kg-day	2.6E-3
				1,2-Dichloroethane	6.6E-5	mg/m3	1.8E-6	mg/kg-day	7.2E-2	(mg/kg-day)-1	1E-7	5.1E-6	mg/kg-day	1.4E-3	mg/kg-day	3.7E-3
				1,3,5-Trimethylbenzene	3.0E-5	mg/m3	8.2E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	2.3E-6	mg/kg-day	1.7E-3	mg/kg-day	1.4E-3

TABLE 7.4

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

TIER 1 REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Landscape Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
				Acenaphthene	2.0E-4	mg/m3	5.5E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	1.5E-5	mg/kg-day	NA	mg/kg-day	NA
				Acetone	9.3E-3	mg/m3	2.6E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	7.2E-4	mg/kg-day	NA	mg/kg-day	NA
				Anthracene	5.3E-5	mg/m3	1.5E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	4.1E-6	mg/kg-day	NA	mg/kg-day	NA
				Benzene	7.6E-3	mg/m3	2.1E-4	mg/kg-day	1.0E-1	(mg/kg-day)-1	2E-5	5.9E-4	mg/kg-day	1.7E-3	mg/kg-day	3.5E-1
				Benzo[b]fluoranthene	2.6E-5	mg/m3	7.2E-7	mg/kg-day	3.9E-1	(mg/kg-day)-1	3E-7	2.0E-6	mg/kg-day	NA	mg/kg-day	NA
				Carbon Disulfide	6.2E-6	mg/m3	1.7E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	4.8E-7	mg/kg-day	2.0E-1	mg/kg-day	2.4E-6
				Chrysene	3.9E-5	mg/m3	1.1E-6	mg/kg-day	3.9E-2	(mg/kg-day)-1	4E-8	3.0E-6	mg/kg-day	NA	mg/kg-day	NA
				Ethylbenzene	8.7E-4	mg/m3	2.4E-5	mg/kg-day	3.9E-3	(mg/kg-day)-1	9E-8	6.7E-5	mg/kg-day	2.9E-1	mg/kg-day	2.3E-4
				Fluorene	6.3E-5	mg/m3	1.7E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	4.9E-6	mg/kg-day	NA	mg/kg-day	NA
				Isopropyl benzene	7.6E-6	mg/m3	2.1E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	5.9E-7	mg/kg-day	1.1E-1	mg/kg-day	5.3E-6
				Methyl isobutyl ketone	3.3E-6	mg/m3	9.2E-8	mg/kg-day	0.0E+0	(mg/kg-day)-1	0E+0	2.6E-7	mg/kg-day	2.3E-2	mg/kg-day	1.1E-5
				Methylene chloride	2.6E-4	mg/m3	7.0E-6	mg/kg-day	3.5E-3	(mg/kg-day)-1	2E-8	2.0E-5	mg/kg-day	8.6E-1	mg/kg-day	2.3E-5
				MTBE	2.4E-5	mg/m3	6.5E-7	mg/kg-day	9.1E-4	(mg/kg-day)-1	6E-10	1.8E-6	mg/kg-day	8.6E-1	mg/kg-day	2.1E-6
				Naphthalene	1.9E-2	mg/m3	5.3E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	1.5E-3	mg/kg-day	8.6E-4	mg/kg-day	1.7E+0
				n-Butylbenzene	2.0E-3	mg/m3	5.4E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	1.5E-4	mg/kg-day	NA	mg/kg-day	NA
				n-Propylbenzene	1.2E-5	mg/m3	3.3E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	9.3E-7	mg/kg-day	NA	mg/kg-day	NA
				Pyrene	1.8E-4	mg/m3	5.0E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	1.4E-5	mg/kg-day	NA	mg/kg-day	NA
				Styrene	2.1E-4	mg/m3	5.7E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	1.6E-5	mg/kg-day	2.9E-1	mg/kg-day	5.5E-5
				Toluene	7.2E-4	mg/m3	2.0E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	5.6E-5	mg/kg-day	1.1E-1	mg/kg-day	5.1E-4
				Xylenes (total)	5.0E-4	mg/m3	1.4E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	3.8E-5	mg/kg-day	2.9E-2	mg/kg-day	1.3E-3
			Exp. Route Total								2E-5					2.1E+0
		Exposure Point Total									2E-5					2.1E+0
	Exposure Medium Total										2E-5					2.1E+0
Medium Total											2E-4					1.0E+1
										Total of Receptor Risks Across All Media	6E-3				Total of Receptor Risks Across All Media	4.1E+1

TABLE 7.5
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
TIER 1 CENTRAL EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: On-Site Resident
Receptor Age: Child / Age-Adjusted Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil Vapor	Indoor Air	Indoor Air	Air Inhalation	Benzene	9.9E-2	ug/m3					1E-6					1.6E-3
				Chloroform	2.8E-3	ug/m3					6E-9					8.9E-6
				Ethylbenzene	7.1E-2	ug/m3					3E-8					3.4E-5
				m,p-Xylene	5.5E-2	ug/m3					NA					5.2E-4
				Naphthalene	6.5E-2	ug/m3					NA					6.9E-3
				Tetrachloroethene (PCE)	1.7E-3	ug/m3					4E-9					4.7E-5
				Trichloroethene	3.6E-3	ug/m3					3E-9					5.7E-6
			Exp. Route Total								1E-6					9.1E-3
		Exposure Point Total									1E-6					9.1E-3
	Exposure Medium Total										1E-6					9.1E-3
Medium Total											1E-6					9.1E-3
Groundwater	Indoor Air	Indoor Air	Air Inhalation	1,2,4-Trimethylbenzene	6.0E-2	ug/m3					NA					7.9E-4
				1,2-Dichloroethane	1.9E-2	ug/m3					2E-7					3.5E-3
				1,3,5-Trimethylbenzene	3.2E-2	ug/m3					NA					9.7E-3
				Acetone	2.9E-1	ug/m3					NA					7.9E-4
				Benzene	1.1E+1	ug/m3					1E-4					1.8E-1
				Carbon disulfide	6.0E-2	ug/m3					NA					7.1E-5
				Ethylbenzene	1.6E+0	ug/m3					7E-7					7.5E-4
				Isopropyl benzene	1.7E-2	ug/m3					NA					4.1E-5
				Methyl isobutyl ketone	4.9E-3	ug/m3					NA					1.7E-5
				Methylene chloride	1.6E-1	ug/m3					7E-8					3.9E-4
				MTBE	7.3E-3	ug/m3					8E-10					8.7E-7
				Naphthalene	2.1E+0	ug/m3					NA					2.2E-1
				n-Butylbenzene	5.5E+0	ug/m3					NA					3.8E-2
				n-Propylbenzene	NA	ug/m3					NA					NA
				Styrene	1.2E-1	ug/m3					NA					1.3E-4
				Toluene	1.2E+0	ug/m3					NA					3.9E-3
				Xylenes (total)	6.0E-1	ug/m3					NA					8.2E-4
			Exp. Route Total								1E-4					4.6E-1
		Exposure Point Total									1E-4					4.6E-1
	Exposure Medium Total										1E-4					4.6E-1
Medium Total											1E-4					4.6E-1
Groundwater[1] Potable Use	Potable Water	Potable Water	Ingestion	Aluminum	1.4E+3	ug/L	4.7E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	4.5E-2	mg/kg-day	1.0E+0	mg/kg-day	4.5E-2
				Antimony	4.8E-1	ug/L	1.6E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	1.5E-5	mg/kg-day	4.0E-4	mg/kg-day	3.8E-2
				Arsenic	2.2E+1	ug/L	7.3E-5	mg/kg-day	9.5E+0	(mg/kg-day)-1	7E-4	7.0E-4	mg/kg-day	3.0E-4	mg/kg-day	2.3E+0
				Barium	2.0E+3	ug/L	6.5E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	6.3E-2	mg/kg-day	7.0E-2	mg/kg-day	8.9E-1

TABLE 7.5

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

TIER 1 CENTRAL EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: On-Site Resident
Receptor Age: Child / Age-Adjusted Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
				Beryllium	1.8E+0	ug/L	6.1E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	5.8E-5	mg/kg-day	2.0E-3	mg/kg-day	2.9E-2
				Cadmium	3.2E+0	ug/L	1.1E-5	mg/kg-day	3.8E-1	(mg/kg-day)-1	4E-6	1.0E-4	mg/kg-day	5.0E-4	mg/kg-day	2.1E-1
				Chromium	2.2E+1	ug/L	7.3E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	7.0E-4	mg/kg-day	3.0E-3	mg/kg-day	2.3E-1
				Cobalt	7.5E+0	ug/L	2.5E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	2.4E-4	mg/kg-day	2.0E-2	mg/kg-day	1.2E-2
				Copper	1.1E+1	ug/L	3.7E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	3.5E-4	mg/kg-day	4.0E-2	mg/kg-day	8.8E-3
				Iron	4.0E+4	ug/L	1.3E-1	mg/kg-day	NA	(mg/kg-day)-1	NA	1.3E+0	mg/kg-day	3.0E-1	mg/kg-day	4.2E+0
				Lead	3.7E-1	ug/L	1.2E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	1.2E-5	mg/kg-day	NA	mg/kg-day	NA
				Manganese	2.5E+3	ug/L	8.2E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	7.9E-2	mg/kg-day	1.4E-1	mg/kg-day	5.6E-1
				Mercury	2.2E-1	ug/L	7.4E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	7.1E-6	mg/kg-day	3.0E-4	mg/kg-day	2.4E-2
				Molybdenum	3.7E+1	ug/L	1.2E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	1.2E-3	mg/kg-day	5.0E-3	mg/kg-day	2.4E-1
				Nickel	1.6E+1	ug/L	5.3E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	5.1E-4	mg/kg-day	2.0E-2	mg/kg-day	2.6E-2
				Nitrate	7.0E+3	ug/L	2.3E-2	mg/kg-day	NA	(mg/kg-day)-1	NA	2.2E-1	mg/kg-day	1.6E+0	mg/kg-day	1.4E-1
				Selenium	1.3E+1	ug/L	4.3E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	4.2E-4	mg/kg-day	5.0E-3	mg/kg-day	8.3E-2
				Silver	1.5E+1	ug/L	5.0E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	4.8E-4	mg/kg-day	5.0E-3	mg/kg-day	9.6E-2
				Thallium	9.6E+0	ug/L	3.2E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	3.1E-4	mg/kg-day	6.6E-5	mg/kg-day	4.7E+0
				Vanadium	2.0E+1	ug/L	6.7E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	6.4E-4	mg/kg-day	7.0E-3	mg/kg-day	9.1E-2
				Zinc	1.1E+1	ug/L	3.7E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	3.5E-4	mg/kg-day	3.0E-1	mg/kg-day	1.2E-3
				1,2,4-Trimethylbenzene	5.5E+1	ug/L	1.8E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	1.8E-3	mg/kg-day	5.0E-2	mg/kg-day	3.5E-2
				1,2-Dichloroethane	5.0E+1	ug/L	1.7E-4	mg/kg-day	4.7E-2	(mg/kg-day)-1	8E-6	1.6E-3	mg/kg-day	3.0E-2	mg/kg-day	5.3E-2
				1,3,5-Trimethylbenzene	2.9E+1	ug/L	9.6E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	9.3E-4	mg/kg-day	5.0E-2	mg/kg-day	1.9E-2
				Acenaphthene	2.2E+2	ug/L	7.3E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	7.0E-3	mg/kg-day	6.0E-2	mg/kg-day	1.2E-1
				Acenaphthylene	8.0E+2	ug/L	2.7E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	2.6E-2	mg/kg-day	NA	mg/kg-day	NA
				Acetone	1.0E+4	ug/L	3.3E-2	mg/kg-day	NA	(mg/kg-day)-1	NA	3.2E-1	mg/kg-day	1.0E-1	mg/kg-day	3.2E+0
				Anthracene	5.9E+1	ug/L	2.0E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	1.9E-3	mg/kg-day	3.0E-1	mg/kg-day	6.3E-3
				Benzene	6.0E+3	ug/L	2.0E-2	mg/kg-day	1.0E-1	(mg/kg-day)-1	2E-3	1.9E-1	mg/kg-day	3.0E-3	mg/kg-day	6.4E+1
				Benzo[a]anthracene	2.6E+1	ug/L	8.6E-5	mg/kg-day	1.2E+0	(mg/kg-day)-1	1E-4	8.3E-4	mg/kg-day	NA	mg/kg-day	NA
				Benzo[a]pyrene	6.0E+1	ug/L	2.0E-4	mg/kg-day	1.2E+1	(mg/kg-day)-1	2E-3	1.9E-3	mg/kg-day	NA	mg/kg-day	NA
				Benzo[b]fluoranthene	2.9E+1	ug/L	9.6E-5	mg/kg-day	1.2E+0	(mg/kg-day)-1	1E-4	9.3E-4	mg/kg-day	NA	mg/kg-day	NA
				Benzo[g,h,i]perylene	3.7E+1	ug/L	1.2E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	1.2E-3	mg/kg-day	NA	mg/kg-day	NA
				Benzo[k]fluoranthene	1.4E+1	ug/L	4.7E-5	mg/kg-day	1.2E+0	(mg/kg-day)-1	6E-5	4.5E-4	mg/kg-day	NA	mg/kg-day	NA
				Carbon Disulfide	4.8E+0	ug/L	1.6E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	1.5E-4	mg/kg-day	1.0E-1	mg/kg-day	1.5E-3
				Chrysene	4.3E+1	ug/L	1.4E-4	mg/kg-day	1.2E-1	(mg/kg-day)-1	2E-5	1.4E-3	mg/kg-day	NA	mg/kg-day	NA
				Dibenz[a,h]anthracene	3.0E+0	ug/L	1.0E-5	mg/kg-day	4.1E+0	(mg/kg-day)-1	4E-5	9.6E-5	mg/kg-day	NA	mg/kg-day	NA
				Ethylbenzene	8.0E+2	ug/L	2.7E-3	mg/kg-day	3.9E-3	(mg/kg-day)-1	1E-5	2.6E-2	mg/kg-day	1.0E-1	mg/kg-day	2.6E-1
				Fluoranthene	2.8E+2	ug/L	9.3E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	8.9E-3	mg/kg-day	4.0E-2	mg/kg-day	2.2E-1
				Fluorene	7.0E+1	ug/L	2.3E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	2.2E-3	mg/kg-day	4.0E-2	mg/kg-day	5.6E-2
				Indeno(1,2,3-cd)pyrene	4.4E+1	ug/L	1.5E-4	mg/kg-day	1.2E+0	(mg/kg-day)-1	2E-4	1.4E-3	mg/kg-day	NA	mg/kg-day	NA
				Isopropyl benzene	7.4E+0	ug/L	2.5E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	2.4E-4	mg/kg-day	1.0E-1	mg/kg-day	2.4E-3
				Methyl isobutyl ketone	3.5E+0	ug/L	1.2E-5	mg/kg-day	0.0E+0	(mg/kg-day)-1	0E+0	1.1E-4	mg/kg-day	8.0E-2	mg/kg-day	1.4E-3
				Methylene chloride	1.8E+2	ug/L	6.0E-4	mg/kg-day	1.4E-2	(mg/kg-day)-1	8E-6	5.8E-3	mg/kg-day	6.0E-2	mg/kg-day	9.6E-2

TABLE 7.5

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

TIER 1 CENTRAL EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: On-Site Resident
Receptor Age: Child / Age-Adjusted Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
				MTBE	1.9E+1	ug/L	6.3E-5	mg/kg-day	1.8E-3	(mg/kg-day)-1	1E-7	6.1E-4	mg/kg-day	NA	mg/kg-day	NA
				Naphthalene	1.9E+4	ug/L	6.3E-2	mg/kg-day	NA	(mg/kg-day)-1	NA	6.1E-1	mg/kg-day	2.0E-2	mg/kg-day	3.0E+1
				n-Butylbenzene	1.8E+3	ug/L	6.0E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	5.8E-2	mg/kg-day	4.0E-2	mg/kg-day	1.4E+0
				n-Propylbenzene	1.1E+1	ug/L	3.7E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	3.5E-4	mg/kg-day	4.0E-2	mg/kg-day	8.8E-3
				Phenanthrene	2.5E+2	ug/L	8.3E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	8.0E-3	mg/kg-day	NA	mg/kg-day	NA
				Pyrene	2.0E+2	ug/L	6.7E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	6.4E-3	mg/kg-day	3.0E-2	mg/kg-day	2.1E-1
				Styrene	1.9E+2	ug/L	6.2E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	5.9E-3	mg/kg-day	2.0E-1	mg/kg-day	3.0E-2
				Toluene	6.2E+2	ug/L	2.1E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	2.0E-2	mg/kg-day	2.0E-1	mg/kg-day	9.9E-2
				Xylenes (total)	4.2E+2	ug/L	1.4E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	1.4E-2	mg/kg-day	2.0E-1	mg/kg-day	6.8E-2
			Exp. Route Total								6E-3					1.1E+2
		Exposure Point Total									6E-3					1.1E+2
	Exposure Medium Total										6E-3					1.1E+2
	Indoor Air	Indoor Air	Air Inhalation	1,2,4-Trimethylbenzene	5.5E+1	ug/L	1.0E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	9.8E-3	mg/kg-day	1.7E-3	mg/kg-day	5.8E+0
				1,2-Dichloroethane	5.0E+1	ug/L	9.1E-4	mg/kg-day	7.2E-2	(mg/kg-day)-1	7E-5	8.9E-3	mg/kg-day	1.4E-3	mg/kg-day	6.3E+0
				1,3,5-Trimethylbenzene	2.9E+1	ug/L	5.3E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	5.2E-3	mg/kg-day	1.7E-3	mg/kg-day	3.0E+0
				Acenaphthene	2.2E+2	ug/L	4.0E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	3.9E-2	mg/kg-day	NA	mg/kg-day	NA
				Acetone	1.0E+4	ug/L	1.8E-1	mg/kg-day	NA	(mg/kg-day)-1	NA	1.8E+0	mg/kg-day	NA	mg/kg-day	NA
				Anthracene	5.9E+1	ug/L	1.1E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	1.0E-2	mg/kg-day	NA	mg/kg-day	NA
				Benzene	6.0E+3	ug/L	1.1E-1	mg/kg-day	1.0E-1	(mg/kg-day)-1	1E-2	1.1E+0	mg/kg-day	1.7E-3	mg/kg-day	6.3E+2
				Benzo[b]fluoranthene	2.9E+1	ug/L	5.3E-4	mg/kg-day	3.9E-1	(mg/kg-day)-1	2E-4	5.2E-3	mg/kg-day	NA	mg/kg-day	NA
				Carbon Disulfide	4.8E+0	ug/L	8.7E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	8.5E-4	mg/kg-day	2.0E-1	mg/kg-day	4.3E-3
				Chrysene	4.3E+1	ug/L	7.8E-4	mg/kg-day	3.9E-2	(mg/kg-day)-1	3E-5	7.6E-3	mg/kg-day	NA	mg/kg-day	NA
				Ethylbenzene	8.0E+2	ug/L	1.5E-2	mg/kg-day	3.9E-3	(mg/kg-day)-1	6E-5	1.4E-1	mg/kg-day	2.9E-1	mg/kg-day	4.9E-1
				Fluorene	7.0E+1	ug/L	1.3E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	1.2E-2	mg/kg-day	NA	mg/kg-day	NA
				Isopropyl benzene	7.4E+0	ug/L	1.3E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	1.3E-3	mg/kg-day	1.1E-1	mg/kg-day	1.2E-2
				Methyl isobutyl ketone	3.5E+0	ug/L	6.4E-5	mg/kg-day	0.0E+0	(mg/kg-day)-1	0E+0	6.2E-4	mg/kg-day	2.3E-2	mg/kg-day	2.7E-2
				Methylene chloride	1.8E+2	ug/L	3.3E-3	mg/kg-day	3.5E-3	(mg/kg-day)-1	1E-5	3.2E-2	mg/kg-day	8.6E-1	mg/kg-day	3.7E-2
				MTBE	1.9E+1	ug/L	3.5E-4	mg/kg-day	9.1E-4	(mg/kg-day)-1	3E-7	3.4E-3	mg/kg-day	8.6E-1	mg/kg-day	3.9E-3
				Naphthalene	1.9E+4	ug/L	3.5E-1	mg/kg-day	NA	(mg/kg-day)-1	NA	3.4E+0	mg/kg-day	8.6E-4	mg/kg-day	3.9E+3
				n-Butylbenzene	1.8E+3	ug/L	3.3E-2	mg/kg-day	NA	(mg/kg-day)-1	NA	3.2E-1	mg/kg-day	NA	mg/kg-day	NA
				n-Propylbenzene	1.1E+1	ug/L	2.0E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	2.0E-3	mg/kg-day	NA	mg/kg-day	NA
				Pyrene	2.0E+2	ug/L	3.6E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	3.6E-2	mg/kg-day	NA	mg/kg-day	NA
				Styrene	1.9E+2	ug/L	3.4E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	3.3E-2	mg/kg-day	2.9E-1	mg/kg-day	1.1E-1
				Toluene	6.2E+2	ug/L	1.1E-2	mg/kg-day	NA	(mg/kg-day)-1	NA	1.1E-1	mg/kg-day	1.1E-1	mg/kg-day	1.0E+0
				Xylenes (total)	4.2E+2	ug/L	7.7E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	7.5E-2	mg/kg-day	2.9E-2	mg/kg-day	2.6E+0
			Exp. Route Total								1E-2					4.6E+3
		Exposure Point Total									1E-2					4.6E+3
	Exposure Medium Total										1E-2					4.6E+3

TABLE 7.5

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

TIER 1 CENTRAL EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: On-Site Resident
Receptor Age: Child / Age-Adjusted Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Medium Total											2E-2					4.7E+3
Current Receptor Total (Inhalation via Soil Vapor)											1E-6					9.1E-3
Current Receptor Total (Inhalation via Groundwater)											1E-4					4.6E-1
Future Receptor Total (Potable Water Use + Inhalation via Soil Vapor)											2E-2					4.7E+3
Future Receptor Total (Potable Water Use + Inhalation via Groundwater)											2E-2					4.7E+3

[1] - Groundwater potable use is a future use scenario.

TABLE 7.6
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
TIER 1 REASONABLE MAXIMUM EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: On-Site Resident
Receptor Age: Child / Age-Adjusted Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil Vapor	Indoor Air	Indoor Air	Air Inhalation	Benzene	9.9E-2	ug/m3					1E-6					1.6E-3
				Chloroform	2.8E-3	ug/m3					6E-9					8.9E-6
				Ethylbenzene	7.1E-2	ug/m3					3E-8					3.4E-5
				m,p-Xylene	5.5E-2	ug/m3					NA					5.2E-4
				Naphthalene	6.5E-2	ug/m3					NA					6.9E-3
				Tetrachloroethene (PCE)	1.7E-3	ug/m3					4E-9					4.7E-5
				Trichloroethene	3.6E-3	ug/m3					3E-9					5.7E-6
			Exp. Route Total								1E-6					9E-3
		Exposure Point Total									1E-6					9E-3
	Exposure Medium Total										1E-6					9E-3
Medium Total											1E-6					9E-3
Groundwater	Indoor Air	Indoor Air	Air Inhalation	1,2,4-Trimethylbenzene	6.0E-2	ug/m3					NA					7.9E-4
				1,2-Dichloroethane	1.9E-2	ug/m3					2E-7					3.5E-3
				1,3,5-Trimethylbenzene	3.2E-2	ug/m3					NA					9.7E-3
				Acetone	2.9E-1	ug/m3					NA					7.9E-4
				Benzene	1.1E+1	ug/m3					1E-4					1.8E-1
				Carbon disulfide	6.0E-2	ug/m3					NA					7.1E-5
				Ethylbenzene	1.6E+0	ug/m3					7E-7					7.5E-4
				Isopropyl benzene	1.7E-2	ug/m3					NA					4.1E-5
				Methyl isobutyl ketone	4.9E-3	ug/m3					NA					1.7E-5
				Methylene chloride	1.6E-1	ug/m3					7E-8					3.9E-4
				MTBE	7.3E-3	ug/m3					8E-10					8.7E-7
				Naphthalene	2.1E+0	ug/m3					NA					2.2E-1
				n-Butylbenzene	5.5E+0	ug/m3					NA					3.8E-2
				n-Propylbenzene	NA	ug/m3					NA					NA
				Styrene	1.2E-1	ug/m3					NA					1.3E-4
				Toluene	1.2E+0	ug/m3					NA					3.9E-3
				Xylenes (total)	6.0E-1	ug/m3					NA					8.2E-4
			Exp. Route Total								1E-4					4.6E-1
		Exposure Point Total									1E-4					4.6E-1
	Exposure Medium Total										1E-4					5E-1
Medium Total											1E-4					5E-1
Groundwater[1] Potable Use	Potable Water	Potable Water	Ingestion	Aluminum	1.4E+3	ug/L	2.1E-2	mg/kg-day	NA	(mg/kg-day)-1	NA	8.9E-2	mg/kg-day	1.0E+0	mg/kg-day	8.9E-2
				Antimony	4.8E-1	ug/L	7.1E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	3.1E-5	mg/kg-day	4.0E-4	mg/kg-day	7.7E-2
				Arsenic	2.2E+1	ug/L	3.3E-4	mg/kg-day	9.5E+0	(mg/kg-day)-1	3E-3	1.4E-3	mg/kg-day	3.0E-4	mg/kg-day	4.7E+0
				Barium	2.0E+3	ug/L	2.9E-2	mg/kg-day	NA	(mg/kg-day)-1	NA	1.3E-1	mg/kg-day	7.0E-2	mg/kg-day	1.8E+0

TABLE 7.6

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

TIER 1 REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: On-Site Resident
Receptor Age: Child / Age-Adjusted Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
				Beryllium	1.8E+0	ug/L	2.7E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	1.2E-4	mg/kg-day	2.0E-3	mg/kg-day	5.8E-2
				Cadmium	3.2E+0	ug/L	4.8E-5	mg/kg-day	3.8E-1	(mg/kg-day)-1	2E-5	2.1E-4	mg/kg-day	5.0E-4	mg/kg-day	4.1E-1
				Chromium	2.2E+1	ug/L	3.3E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	1.4E-3	mg/kg-day	3.0E-3	mg/kg-day	4.7E-1
				Cobalt	7.5E+0	ug/L	1.1E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	4.8E-4	mg/kg-day	2.0E-2	mg/kg-day	2.4E-2
				Copper	1.1E+1	ug/L	1.6E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	7.0E-4	mg/kg-day	4.0E-2	mg/kg-day	1.8E-2
				Iron	4.0E+4	ug/L	5.9E-1	mg/kg-day	NA	(mg/kg-day)-1	NA	2.5E+0	mg/kg-day	3.0E-1	mg/kg-day	8.5E+0
				Lead	3.7E-1	ug/L	5.5E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	2.4E-5	mg/kg-day	NA	mg/kg-day	NA
				Manganese	2.5E+3	ug/L	3.7E-2	mg/kg-day	NA	(mg/kg-day)-1	NA	1.6E-1	mg/kg-day	1.4E-1	mg/kg-day	1.1E+0
				Mercury	2.2E-1	ug/L	3.3E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	1.4E-5	mg/kg-day	3.0E-4	mg/kg-day	4.7E-2
				Molybdenum	3.7E+1	ug/L	5.6E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	2.4E-3	mg/kg-day	5.0E-3	mg/kg-day	4.8E-1
				Nickel	1.6E+1	ug/L	2.4E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	1.0E-3	mg/kg-day	2.0E-2	mg/kg-day	5.1E-2
				Nitrate	7.0E+3	ug/L	1.0E-1	mg/kg-day	NA	(mg/kg-day)-1	NA	4.5E-1	mg/kg-day	1.6E+0	mg/kg-day	2.8E-1
				Selenium	1.3E+1	ug/L	1.9E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	8.3E-4	mg/kg-day	5.0E-3	mg/kg-day	1.7E-1
				Silver	1.5E+1	ug/L	2.2E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	9.6E-4	mg/kg-day	5.0E-3	mg/kg-day	1.9E-1
				Thallium	9.6E+0	ug/L	1.4E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	6.1E-4	mg/kg-day	6.6E-5	mg/kg-day	9.3E+0
				Vanadium	2.0E+1	ug/L	3.0E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	1.3E-3	mg/kg-day	7.0E-3	mg/kg-day	1.8E-1
				Zinc	1.1E+1	ug/L	1.6E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	7.0E-4	mg/kg-day	3.0E-1	mg/kg-day	2.3E-3
				1,2,4-Trimethylbenzene	5.5E+1	ug/L	8.2E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	3.5E-3	mg/kg-day	5.0E-2	mg/kg-day	7.0E-2
				1,2-Dichloroethane	5.0E+1	ug/L	7.4E-4	mg/kg-day	4.7E-2	(mg/kg-day)-1	3E-5	3.2E-3	mg/kg-day	3.0E-2	mg/kg-day	1.1E-1
				1,3,5-Trimethylbenzene	2.9E+1	ug/L	4.3E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	1.9E-3	mg/kg-day	5.0E-2	mg/kg-day	3.7E-2
				Acenaphthene	2.2E+2	ug/L	3.3E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	1.4E-2	mg/kg-day	6.0E-2	mg/kg-day	2.3E-1
				Acenaphthylene	8.0E+2	ug/L	1.2E-2	mg/kg-day	NA	(mg/kg-day)-1	NA	5.1E-2	mg/kg-day	NA	mg/kg-day	NA
				Acetone	1.0E+4	ug/L	1.5E-1	mg/kg-day	NA	(mg/kg-day)-1	NA	6.4E-1	mg/kg-day	1.0E-1	mg/kg-day	6.4E+0
				Anthracene	5.9E+1	ug/L	8.8E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	3.8E-3	mg/kg-day	3.0E-1	mg/kg-day	1.3E-2
				Benzene	6.0E+3	ug/L	8.9E-2	mg/kg-day	1.0E-1	(mg/kg-day)-1	9E-3	3.8E-1	mg/kg-day	3.0E-3	mg/kg-day	1.3E+2
				Benzo[a]anthracene	2.6E+1	ug/L	3.9E-4	mg/kg-day	1.2E+0	(mg/kg-day)-1	5E-4	1.7E-3	mg/kg-day	NA	mg/kg-day	NA
				Benzo[a]pyrene	6.0E+1	ug/L	8.9E-4	mg/kg-day	1.2E+1	(mg/kg-day)-1	1E-2	3.8E-3	mg/kg-day	NA	mg/kg-day	NA
				Benzo[b]fluoranthene	2.9E+1	ug/L	4.3E-4	mg/kg-day	1.2E+0	(mg/kg-day)-1	5E-4	1.9E-3	mg/kg-day	NA	mg/kg-day	NA
				Benzo[g,h,i]perylene	3.7E+1	ug/L	5.5E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	2.4E-3	mg/kg-day	NA	mg/kg-day	NA
				Benzo[k]fluoranthene	1.4E+1	ug/L	2.1E-4	mg/kg-day	1.2E+0	(mg/kg-day)-1	2E-4	8.9E-4	mg/kg-day	NA	mg/kg-day	NA
				Carbon Disulfide	4.8E+0	ug/L	7.1E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	3.1E-4	mg/kg-day	1.0E-1	mg/kg-day	3.1E-3
				Chrysene	4.3E+1	ug/L	6.4E-4	mg/kg-day	1.2E-1	(mg/kg-day)-1	8E-5	2.7E-3	mg/kg-day	NA	mg/kg-day	NA
				Dibenz[a,h]anthracene	3.0E+0	ug/L	4.5E-5	mg/kg-day	4.1E+0	(mg/kg-day)-1	2E-4	1.9E-4	mg/kg-day	NA	mg/kg-day	NA
				Ethylbenzene	8.0E+2	ug/L	1.2E-2	mg/kg-day	3.9E-3	(mg/kg-day)-1	5E-5	5.1E-2	mg/kg-day	1.0E-1	mg/kg-day	5.1E-1
				Fluoranthene	2.8E+2	ug/L	4.2E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	1.8E-2	mg/kg-day	4.0E-2	mg/kg-day	4.5E-1
				Fluorene	7.0E+1	ug/L	1.0E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	4.5E-3	mg/kg-day	4.0E-2	mg/kg-day	1.1E-1
				Indeno(1,2,3-cd)pyrene	4.4E+1	ug/L	6.5E-4	mg/kg-day	1.2E+0	(mg/kg-day)-1	8E-4	2.8E-3	mg/kg-day	NA	mg/kg-day	NA
				Isopropyl benzene	7.4E+0	ug/L	1.1E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	4.7E-4	mg/kg-day	1.0E-1	mg/kg-day	4.7E-3
				Methyl isobutyl ketone	3.5E+0	ug/L	5.2E-5	mg/kg-day	0.0E+0	(mg/kg-day)-1	0E+0	2.2E-4	mg/kg-day	8.0E-2	mg/kg-day	2.8E-3
				Methylene chloride	1.8E+2	ug/L	2.7E-3	mg/kg-day	1.4E-2	(mg/kg-day)-1	4E-5	1.2E-2	mg/kg-day	6.0E-2	mg/kg-day	1.9E-1

TABLE 7.6

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

TIER 1 REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: On-Site Resident
Receptor Age: Child / Age-Adjusted Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
				MTBE	1.9E+1	ug/L	2.8E-4	mg/kg-day	1.8E-3	(mg/kg-day)-1	5E-7	1.2E-3	mg/kg-day	NA	mg/kg-day	NA
				Naphthalene	1.9E+4	ug/L	2.8E-1	mg/kg-day	NA	(mg/kg-day)-1	NA	1.2E+0	mg/kg-day	2.0E-2	mg/kg-day	6.1E+1
				n-Butylbenzene	1.8E+3	ug/L	2.7E-2	mg/kg-day	NA	(mg/kg-day)-1	NA	1.2E-1	mg/kg-day	4.0E-2	mg/kg-day	2.9E+0
				n-Propylbenzene	1.1E+1	ug/L	1.6E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	7.0E-4	mg/kg-day	4.0E-2	mg/kg-day	1.8E-2
				Phenanthrene	2.5E+2	ug/L	3.7E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	1.6E-2	mg/kg-day	NA	mg/kg-day	NA
				Pyrene	2.0E+2	ug/L	3.0E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	1.3E-2	mg/kg-day	3.0E-2	mg/kg-day	4.3E-1
				Styrene	1.9E+2	ug/L	2.8E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	1.2E-2	mg/kg-day	2.0E-1	mg/kg-day	5.9E-2
				Toluene	6.2E+2	ug/L	9.2E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	4.0E-2	mg/kg-day	2.0E-1	mg/kg-day	2.0E-1
				Xylenes (total)	4.2E+2	ug/L	6.3E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	2.7E-2	mg/kg-day	2.0E-1	mg/kg-day	1.4E-1
			Exp. Route Total								3E-2					2.3E+2
		Exposure Point Total									3E-2					2.3E+2
	Exposure Medium Total										3E-2					2.3E+2
	Indoor Air	Indoor Air	Air Inhalation	1,2,4-Trimethylbenzene	5.5E+1	ug/L	3.1E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	1.3E-2	mg/kg-day	1.7E-3	mg/kg-day	7.8E+0
				1,2-Dichloroethane	5.0E+1	ug/L	2.8E-3	mg/kg-day	7.2E-2	(mg/kg-day)-1	2E-4	1.2E-2	mg/kg-day	1.4E-3	mg/kg-day	8.6E+0
				1,3,5-Trimethylbenzene	2.9E+1	ug/L	1.6E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	7.0E-3	mg/kg-day	1.7E-3	mg/kg-day	4.1E+0
				Acenaphthene	2.2E+2	ug/L	1.2E-2	mg/kg-day	NA	(mg/kg-day)-1	NA	5.3E-2	mg/kg-day	NA	mg/kg-day	NA
				Acetone	1.0E+4	ug/L	5.6E-1	mg/kg-day	NA	(mg/kg-day)-1	NA	2.4E+0	mg/kg-day	NA	mg/kg-day	NA
				Anthracene	5.9E+1	ug/L	3.3E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	1.4E-2	mg/kg-day	NA	mg/kg-day	NA
				Benzene	6.0E+3	ug/L	3.3E-1	mg/kg-day	1.0E-1	(mg/kg-day)-1	3E-2	1.4E+0	mg/kg-day	1.7E-3	mg/kg-day	8.5E+2
				Benzo[b]fluoranthene	2.9E+1	ug/L	1.6E-3	mg/kg-day	3.9E-1	(mg/kg-day)-1	6E-4	7.0E-3	mg/kg-day	NA	mg/kg-day	NA
				Carbon Disulfide	4.8E+0	ug/L	2.7E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	1.2E-3	mg/kg-day	2.0E-1	mg/kg-day	5.8E-3
				Chrysene	4.3E+1	ug/L	2.4E-3	mg/kg-day	3.9E-2	(mg/kg-day)-1	9E-5	1.0E-2	mg/kg-day	NA	mg/kg-day	NA
				Ethylbenzene	8.0E+2	ug/L	4.5E-2	mg/kg-day	3.9E-3	(mg/kg-day)-1	2E-4	1.9E-1	mg/kg-day	2.9E-1	mg/kg-day	6.6E-1
				Fluorene	7.0E+1	ug/L	3.9E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	1.7E-2	mg/kg-day	NA	mg/kg-day	NA
				Isopropyl benzene	7.4E+0	ug/L	4.1E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	1.8E-3	mg/kg-day	1.1E-1	mg/kg-day	1.6E-2
				Methyl isobutyl ketone	3.5E+0	ug/L	2.0E-4	mg/kg-day	0.0E+0	(mg/kg-day)-1	0E+0	8.4E-4	mg/kg-day	2.3E-2	mg/kg-day	3.6E-2
				Methylene chloride	1.8E+2	ug/L	1.0E-2	mg/kg-day	3.5E-3	(mg/kg-day)-1	4E-5	4.3E-2	mg/kg-day	8.6E-1	mg/kg-day	5.0E-2
				MTBE	1.9E+1	ug/L	1.1E-3	mg/kg-day	9.1E-4	(mg/kg-day)-1	1E-6	4.6E-3	mg/kg-day	8.6E-1	mg/kg-day	5.3E-3
				Naphthalene	1.9E+4	ug/L	1.1E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	4.6E+0	mg/kg-day	8.6E-4	mg/kg-day	5.3E+3
				n-Butylbenzene	1.8E+3	ug/L	1.0E-1	mg/kg-day	NA	(mg/kg-day)-1	NA	4.3E-1	mg/kg-day	NA	mg/kg-day	NA
				n-Propylbenzene	1.1E+1	ug/L	6.1E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	2.6E-3	mg/kg-day	NA	mg/kg-day	NA
				Pyrene	2.0E+2	ug/L	1.1E-2	mg/kg-day	NA	(mg/kg-day)-1	NA	4.8E-2	mg/kg-day	NA	mg/kg-day	NA
				Styrene	1.9E+2	ug/L	1.0E-2	mg/kg-day	NA	(mg/kg-day)-1	NA	4.5E-2	mg/kg-day	2.9E-1	mg/kg-day	1.5E-1
				Toluene	6.2E+2	ug/L	3.5E-2	mg/kg-day	NA	(mg/kg-day)-1	NA	1.5E-1	mg/kg-day	1.1E-1	mg/kg-day	1.4E+0
				Xylenes (total)	4.2E+2	ug/L	2.4E-2	mg/kg-day	NA	(mg/kg-day)-1	NA	1.0E-1	mg/kg-day	2.9E-2	mg/kg-day	3.5E+0
			Exp. Route Total								3E-2					6.2E+3
		Exposure Point Total									3E-2					6.2E+3
	Exposure Medium Total										3E-2					6.2E+3

TABLE 7.6

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

TIER 1 REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: On-Site Resident
Receptor Age: Child / Age-Adjusted Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Medium Total											6E-2					6.4E+3
Current Receptor Total (Inhalation via Soil Vapor)											1E-6					9.1E-3
Current Receptor Total (Inhalation via Groundwater)											1E-4					4.6E-1
Future Receptor Total (Potable Water Use + Inhalation via Soil Vapor)											6E-2					6.4E+3
Future Receptor Total (Potable Water Use + Inhalation via Groundwater)											6E-2					6.4E+3

[1] - Groundwater potable use is a future use scenario.

TABLE 7.7

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

TIER 1 CENTRAL EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: School Student
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil Vapor	Indoor Air	Indoor Air	Air Inhalation	Benzene	9.9E-2	ug/m3					1E-6					1.6E-3
				Chloroform	2.8E-3	ug/m3					6E-9					8.9E-6
				Ethylbenzene	7.1E-2	ug/m3					3E-8					3.4E-5
				m,p-Xylene	5.5E-2	ug/m3					NA					5.2E-4
				Naphthalene	6.5E-2	ug/m3					NA					6.9E-3
				Tetrachloroethene (PCE)	1.7E-3	ug/m3					4E-9					4.7E-5
				Trichloroethene	3.6E-3	ug/m3					3E-9					5.7E-6
			Exp. Route Total								1E-6					9.1E-3
		Exposure Point Total									1E-6					9.1E-3
	Exposure Medium Total										1E-6					9.1E-3
Medium Total											1E-6					9.1E-3
Groundwater	Indoor Air	Indoor Air	Air Inhalation	1,2,4-Trimethylbenzene	6.0E-2	ug/m3					NA					7.9E-4
				1,2-Dichloroethane	1.9E-2	ug/m3					2E-7					3.5E-3
				1,3,5-Trimethylbenzene	3.2E-2	ug/m3					NA					9.7E-3
				Acetone	2.9E-1	ug/m3					NA					7.9E-4
				Benzene	1.1E+1	ug/m3					1E-4					1.8E-1
				Carbon disulfide	6.0E-2	ug/m3					NA					7.1E-5
				Ethylbenzene	1.6E+0	ug/m3					7E-7					7.5E-4
				Isopropyl benzene	1.7E-2	ug/m3					NA					4.1E-5
				Methyl isobutyl ketone	4.9E-3	ug/m3					NA					1.7E-5
				Methylene chloride	1.6E-1	ug/m3					7E-8					3.9E-4
				MTBE	7.3E-3	ug/m3					8E-10					8.7E-7
				Naphthalene	2.1E+0	ug/m3					NA					2.2E-1
				n-Butylbenzene	5.5E+0	ug/m3					NA					3.8E-2
				n-Propylbenzene	NA	ug/m3					NA					NA
				Styrene	1.2E-1	ug/m3					NA					1.3E-4
				Toluene	1.2E+0	ug/m3					NA					3.9E-3
				Xylenes (total)	6.0E-1	ug/m3					NA					8.2E-4
			Exp. Route Total								1E-4					4.6E-1
		Exposure Point Total									1E-4					4.6E-1
	Exposure Medium Total										1E-4					4.6E-1
Medium Total											1E-4					4.6E-1
Receptor Total (Inhalation via Soil Vapor)											1E-6					9.1E-3
Receptor Total (Inhalation via Groundwater)											1E-4					4.6E-1

TABLE 7.8

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

TIER 1 REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: School Student
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil Vapor	Indoor Air	Indoor Air	Air Inhalation	Benzene	9.9E-2	ug/m3					1.2E-6					1.6E-3
				Chloroform	2.8E-3	ug/m3					6.1E-9					8.9E-6
				Ethylbenzene	7.1E-2	ug/m3					3.2E-8					3.4E-5
				m,p-Xylene	5.5E-2	ug/m3					NA					5.2E-4
				Naphthalene	6.5E-2	ug/m3					NA					6.9E-3
				Tetrachloroethene (PCE)	1.7E-3	ug/m3					4.1E-9					4.7E-5
				Trichloroethene	3.6E-3	ug/m3					2.9E-9					5.7E-6
			Exp. Route Total								1E-6					9.1E-3
		Exposure Point Total									1E-6					9.1E-3
	Exposure Medium Total										1E-6					9.1E-3
Medium Total											1E-6					9.1E-3
Groundwater	Indoor Air	Indoor Air	Air Inhalation	1,2,4-Trimethylbenzene	6.0E-2	ug/m3					NA					7.9E-4
				1,2-Dichloroethane	1.9E-2	ug/m3					2E-7					3.5E-3
				1,3,5-Trimethylbenzene	3.2E-2	ug/m3					NA					9.7E-3
				Acetone	2.9E-1	ug/m3					NA					7.9E-4
				Benzene	1.1E+1	ug/m3					1E-4					1.8E-1
				Carbon disulfide	6.0E-2	ug/m3					NA					7.1E-5
				Ethylbenzene	1.6E+0	ug/m3					7E-7					7.5E-4
				Isopropyl benzene	1.7E-2	ug/m3					NA					4.1E-5
				Methyl isobutyl ketone	4.9E-3	ug/m3					NA					1.7E-5
				Methylene chloride	1.6E-1	ug/m3					7E-8					3.9E-4
				MTBE	7.3E-3	ug/m3					8E-10					8.7E-7
				Naphthalene	2.1E+0	ug/m3					NA					2.2E-1
				n-Butylbenzene	5.5E+0	ug/m3					NA					3.8E-2
				n-Propylbenzene	NA	ug/m3					NA					NA
				Styrene	1.2E-1	ug/m3					NA					1.3E-4
				Toluene	1.2E+0	ug/m3					NA					3.9E-3
				Xylenes (total)	6.0E-1	ug/m3					NA					8.2E-4
			Exp. Route Total								1E-4					4.6E-1
		Exposure Point Total									1E-4					4.6E-1
	Exposure Medium Total										1E-4					4.6E-1
Medium Total											1E-4					4.6E-1
Receptor Total (Inhalation via Soil Vapor)											1E-6					9.1E-3
Receptor Total (Inhalation via Groundwater)											1E-4					4.6E-1

TABLE 7.9

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

TIER 1 CENTRAL EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: School Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil Vapor	Indoor Air	Indoor Air	Air Inhalation	Benzene	9.9E-2	ug/m3					1.2E-6					1.6E-3
				Chloroform	2.8E-3	ug/m3					6.1E-9					8.9E-6
				Ethylbenzene	7.1E-2	ug/m3					3.2E-8					3.4E-5
				m,p-Xylene	5.5E-2	ug/m3					NA					5.2E-4
				Naphthalene	6.5E-2	ug/m3					NA					6.9E-3
				Tetrachloroethene (PCE)	1.7E-3	ug/m3					4.1E-9					4.7E-5
				Trichloroethene	3.6E-3	ug/m3					2.9E-9					5.7E-6
			Exp. Route Total								1E-6					9.1E-3
		Exposure Point Total									1E-6					9.1E-3
	Exposure Medium Total										1E-6					9.1E-3
Medium Total											1E-6					9.1E-3
Groundwater	Indoor Air	Indoor Air	Air Inhalation	1,2,4-Trimethylbenzene	6.0E-2	ug/m3					NA					7.9E-4
				1,2-Dichloroethane	1.9E-2	ug/m3					2E-7					3.5E-3
				1,3,5-Trimethylbenzene	3.2E-2	ug/m3					NA					9.7E-3
				Acetone	2.9E-1	ug/m3					NA					7.9E-4
				Benzene	1.1E+1	ug/m3					1E-4					1.8E-1
				Carbon disulfide	6.0E-2	ug/m3					NA					7.1E-5
				Ethylbenzene	1.6E+0	ug/m3					7E-7					7.5E-4
				Isopropyl benzene	1.7E-2	ug/m3					NA					4.1E-5
				Methyl isobutyl ketone	4.9E-3	ug/m3					NA					1.7E-5
				Methylene chloride	1.6E-1	ug/m3					7E-8					3.9E-4
				MTBE	7.3E-3	ug/m3					8E-10					8.7E-7
				Naphthalene	2.1E+0	ug/m3					NA					2.2E-1
				n-Butylbenzene	5.5E+0	ug/m3					NA					3.8E-2
				n-Propylbenzene	NA	ug/m3					NA					NA
				Styrene	1.2E-1	ug/m3					NA					1.3E-4
				Toluene	1.2E+0	ug/m3					NA					3.9E-3
				Xylenes (total)	6.0E-1	ug/m3					NA					8.2E-4
			Exp. Route Total								1E-4					4.6E-1
		Exposure Point Total									1E-4					4.6E-1
	Exposure Medium Total										1E-4					4.6E-1
Medium Total											1E-4					4.6E-1
Receptor Total (Inhalation via Soil Vapor)											1E-6					9.1E-3
Receptor Total (Inhalation via Groundwater)											1E-4					4.6E-1

TABLE 7.10
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
TIER 1 REASONABLE MAXIMUM EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: School Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil Vapor	Indoor Air	Indoor Air	Air Inhalation	Benzene	9.9E-2	ug/m3					1.2E-6					1.6E-3
				Chloroform	2.8E-3	ug/m3					6.1E-9					8.9E-6
				Ethylbenzene	7.1E-2	ug/m3					3.2E-8					3.4E-5
				m,p-Xylene	5.5E-2	ug/m3					NA					5.2E-4
				Naphthalene	6.5E-2	ug/m3					NA					6.9E-3
				Tetrachloroethene (PCE)	1.7E-3	ug/m3					4.1E-9					4.7E-5
				Trichloroethene	3.6E-3	ug/m3					2.9E-9					5.7E-6
			Exp. Route Total								1E-6					9.1E-3
		Exposure Point Total									1E-6					9.1E-3
	Exposure Medium Total										1E-6					9.1E-3
Medium Total											1E-6					9.1E-3
Groundwater	Indoor Air	Indoor Air	Air Inhalation	1,2,4-Trimethylbenzene	6.0E-2	ug/m3					NA					7.9E-4
				1,2-Dichloroethane	1.9E-2	ug/m3					2E-7					3.5E-3
				1,3,5-Trimethylbenzene	3.2E-2	ug/m3					NA					9.7E-3
				Acetone	2.9E-1	ug/m3					NA					7.9E-4
				Benzene	1.1E+1	ug/m3					1E-4					1.8E-1
				Carbon disulfide	6.0E-2	ug/m3					NA					7.1E-5
				Ethylbenzene	1.6E+0	ug/m3					7E-7					7.5E-4
				Isopropyl benzene	1.7E-2	ug/m3					NA					4.1E-5
				Methyl isobutyl ketone	4.9E-3	ug/m3					NA					1.7E-5
				Methylene chloride	1.6E-1	ug/m3					7E-8					3.9E-4
				MTBE	7.3E-3	ug/m3					8E-10					8.7E-7
				Naphthalene	2.1E+0	ug/m3					NA					2.2E-1
				n-Butylbenzene	5.5E+0	ug/m3					NA					3.8E-2
				n-Propylbenzene	NA	ug/m3					NA					NA
				Styrene	1.2E-1	ug/m3					NA					1.3E-4
				Toluene	1.2E+0	ug/m3					NA					3.9E-3
				Xylenes (total)	6.0E-1	ug/m3					NA					8.2E-4
			Exp. Route Total								1E-4					4.6E-1
		Exposure Point Total									1E-4					4.6E-1
	Exposure Medium Total										1E-4					4.6E-1
Medium Total											1E-4					4.6E-1
Receptor Total (Inhalation via Soil Vapor)											1E-6					9.1E-3
Receptor Total (Inhalation via Groundwater)											1E-4					4.6E-1

TABLE 7.11
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
TIER 2 CENTRAL EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Car Wash Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater Potable Use	Potable Water	Potable Water	Ingestion	Aluminum	1.4E+3	ug/L	4.6E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	1.2E-2	mg/kg-day	1.0E+0	mg/kg-day	1.2E-2
				Antimony	4.8E-1	ug/L	1.6E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	4.2E-6	mg/kg-day	4.0E-4	mg/kg-day	1.1E-2
				Arsenic	2.2E+1	ug/L	7.2E-6	mg/kg-day	9.5E+0	(mg/kg-day)-1	7E-5	1.9E-4	mg/kg-day	3.0E-4	mg/kg-day	6.5E-1
				Barium	2.0E+3	ug/L	6.4E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	1.7E-2	mg/kg-day	7.0E-2	mg/kg-day	2.5E-1
				Beryllium	1.8E+0	ug/L	6.0E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	1.6E-5	mg/kg-day	2.0E-3	mg/kg-day	8.1E-3
				Cadmium	3.2E+0	ug/L	1.1E-6	mg/kg-day	3.8E-1	(mg/kg-day)-1	4E-7	2.9E-5	mg/kg-day	5.0E-4	mg/kg-day	5.7E-2
				Chromium	2.2E+1	ug/L	7.2E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	1.9E-4	mg/kg-day	3.0E-3	mg/kg-day	6.5E-2
				Cobalt	7.5E+0	ug/L	2.4E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	6.6E-5	mg/kg-day	2.0E-2	mg/kg-day	3.3E-3
				Copper	1.1E+1	ug/L	3.6E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	9.7E-5	mg/kg-day	4.0E-2	mg/kg-day	2.4E-3
				Iron	4.0E+4	ug/L	1.3E-2	mg/kg-day	NA	(mg/kg-day)-1	NA	3.5E-1	mg/kg-day	3.0E-1	mg/kg-day	1.2E+0
				Lead	3.7E-1	ug/L	1.2E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	3.3E-6	mg/kg-day	NA	mg/kg-day	NA
				Manganese	2.5E+3	ug/L	8.1E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	2.2E-2	mg/kg-day	1.4E-1	mg/kg-day	1.6E-1
				Mercury	2.2E-1	ug/L	7.3E-8	mg/kg-day	NA	(mg/kg-day)-1	NA	2.0E-6	mg/kg-day	3.0E-4	mg/kg-day	6.5E-3
				Molybdenum	3.7E+1	ug/L	1.2E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	3.3E-4	mg/kg-day	5.0E-3	mg/kg-day	6.6E-2
				Nickel	1.6E+1	ug/L	5.2E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	1.4E-4	mg/kg-day	2.0E-2	mg/kg-day	7.0E-3
				Nitrate	7.0E+3	ug/L	2.3E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	6.2E-2	mg/kg-day	1.6E+0	mg/kg-day	3.9E-2
				Selenium	1.3E+1	ug/L	4.3E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	1.1E-4	mg/kg-day	5.0E-3	mg/kg-day	2.3E-2
				Silver	1.5E+1	ug/L	4.9E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	1.3E-4	mg/kg-day	5.0E-3	mg/kg-day	2.6E-2
				Thallium	9.6E+0	ug/L	3.1E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	8.5E-5	mg/kg-day	6.6E-5	mg/kg-day	1.3E+0
				Vanadium	2.0E+1	ug/L	6.5E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	1.8E-4	mg/kg-day	7.0E-3	mg/kg-day	2.5E-2
				Zinc	1.1E+1	ug/L	3.6E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	9.7E-5	mg/kg-day	3.0E-1	mg/kg-day	3.2E-4
				1,2,4-Trimethylbenzene	5.5E+1	ug/L	1.8E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	4.8E-4	mg/kg-day	5.0E-2	mg/kg-day	9.7E-3
				1,2-Dichloroethane	5.0E+1	ug/L	1.6E-5	mg/kg-day	4.7E-2	(mg/kg-day)-1	8E-7	4.4E-4	mg/kg-day	3.0E-2	mg/kg-day	1.5E-2
				1,3,5-Trimethylbenzene	2.9E+1	ug/L	9.5E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	2.6E-4	mg/kg-day	5.0E-2	mg/kg-day	5.1E-3
				Acenaphthene	2.2E+2	ug/L	7.2E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	1.9E-3	mg/kg-day	6.0E-2	mg/kg-day	3.2E-2
				Acenaphthylene	8.0E+2	ug/L	2.6E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	7.0E-3	mg/kg-day	NA	mg/kg-day	NA
				Acetone	1.0E+4	ug/L	3.3E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	8.8E-2	mg/kg-day	1.0E-1	mg/kg-day	8.8E-1
				Anthracene	5.9E+1	ug/L	1.9E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	5.2E-4	mg/kg-day	3.0E-1	mg/kg-day	1.7E-3
				Benzo[a]anthracene	2.6E+1	ug/L	8.5E-6	mg/kg-day	1.2E+0	(mg/kg-day)-1	1E-5	2.3E-4	mg/kg-day	NA	mg/kg-day	NA
				Benzo[a]pyrene	6.0E+1	ug/L	2.0E-5	mg/kg-day	1.2E+1	(mg/kg-day)-1	2E-4	5.3E-4	mg/kg-day	NA	mg/kg-day	NA
				Benzo[b]fluoranthene	2.9E+1	ug/L	9.5E-6	mg/kg-day	1.2E+0	(mg/kg-day)-1	1E-5	2.6E-4	mg/kg-day	NA	mg/kg-day	NA
				Benzo[g,h,I]perylene	3.7E+1	ug/L	1.2E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	3.3E-4	mg/kg-day	NA	mg/kg-day	NA
				Benzo[k]fluoranthene	1.4E+1	ug/L	4.6E-6	mg/kg-day	1.2E+0	(mg/kg-day)-1	5E-6	1.2E-4	mg/kg-day	NA	mg/kg-day	NA
				Carbon Disulfide	4.8E+0	ug/L	1.6E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	4.2E-5	mg/kg-day	1.0E-1	mg/kg-day	4.2E-4
				Chrysene	4.3E+1	ug/L	1.4E-5	mg/kg-day	1.2E-1	(mg/kg-day)-1	2E-6	3.8E-4	mg/kg-day	NA	mg/kg-day	NA
				Dibenz[a,h]anthracene	3.0E+0	ug/L	9.8E-7	mg/kg-day	4.1E+0	(mg/kg-day)-1	4E-6	2.6E-5	mg/kg-day	NA	mg/kg-day	NA
				Ethylbenzene	8.0E+2	ug/L	2.6E-4	mg/kg-day	3.9E-3	(mg/kg-day)-1	1E-6	7.0E-3	mg/kg-day	1.0E-1	mg/kg-day	7.0E-2
				Fluoranthene	2.8E+2	ug/L	9.2E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	2.5E-3	mg/kg-day	4.0E-2	mg/kg-day	6.2E-2
				Fluorene	7.0E+1	ug/L	2.3E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	6.2E-4	mg/kg-day	4.0E-2	mg/kg-day	1.5E-2

TABLE 7.11
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
TIER 2 CENTRAL EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Car Wash Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater Potable Use	Potable Water	Potable Water	Ingestion	Indeno(1,2,3-cd)pyrene	4.4E+1	ug/L	1.4E-5	mg/kg-day	1.2E+0	(mg/kg-day)-1	2E-5	3.9E-4	mg/kg-day	NA	mg/kg-day	NA
				Isopropyl benzene	7.4E+0	ug/L	2.4E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	6.5E-5	mg/kg-day	1.0E-1	mg/kg-day	6.5E-4
				Methyl isobutyl ketone	3.5E+0	ug/L	1.1E-6	mg/kg-day	0.0E+0	(mg/kg-day)-1	0E+0	3.1E-5	mg/kg-day	8.0E-2	mg/kg-day	3.9E-4
				Methylene chloride	1.8E+2	ug/L	5.9E-5	mg/kg-day	1.4E-2	(mg/kg-day)-1	8E-7	1.6E-3	mg/kg-day	6.0E-2	mg/kg-day	2.6E-2
				MTBE	1.9E+1	ug/L	6.2E-6	mg/kg-day	1.8E-3	(mg/kg-day)-1	1E-8	1.7E-4	mg/kg-day	NA	mg/kg-day	NA
				n-Butylbenzene	1.8E+3	ug/L	5.9E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	1.6E-2	mg/kg-day	4.0E-2	mg/kg-day	4.0E-1
				n-Propylbenzene	1.1E+1	ug/L	3.6E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	9.7E-5	mg/kg-day	4.0E-2	mg/kg-day	2.4E-3
				Phenanthrene	2.5E+2	ug/L	8.2E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	2.2E-3	mg/kg-day	NA	mg/kg-day	NA
				Pyrene	2.0E+2	ug/L	6.5E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	1.8E-3	mg/kg-day	3.0E-2	mg/kg-day	5.9E-2
				Styrene	1.9E+2	ug/L	6.1E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	1.6E-3	mg/kg-day	2.0E-1	mg/kg-day	8.2E-3
				Toluene	6.2E+2	ug/L	2.0E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	5.5E-3	mg/kg-day	2.0E-1	mg/kg-day	2.7E-2
				Xylenes (total)	4.2E+2	ug/L	1.4E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	3.7E-3	mg/kg-day	2.0E-1	mg/kg-day	1.9E-2
				Benzene (500 ft)	4.9E+2	ug/L	1.6E-4	mg/kg-day	1.0E-1	(mg/kg-day)-1	2E-5	4.3E-3	mg/kg-day	3.0E-3	mg/kg-day	1.4E+0
				Benzene (725 ft)	3.2E+2	ug/L	1.1E-4	mg/kg-day	1.0E-1	(mg/kg-day)-1	1E-5	2.8E-3	mg/kg-day	3.0E-3	mg/kg-day	9.4E-1
				Naphthalene (500 ft)	4.2E+3	ug/L	1.4E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	3.7E-2	mg/kg-day	2.0E-2	mg/kg-day	1.8E+0
				Naphthalene (725 ft)	3.2E+3	ug/L	1.1E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	2.8E-2	mg/kg-day	2.0E-2	mg/kg-day	1.4E+0
			Exp. Route Total	krig - 500 ft							4E-4					8.8E+0
			Exp. Route Total	krig - 725 ft							4E-4					7.8E+0
		Exposure Point Total	krig - 500 ft								4E-4					8.8E+0
		Exposure Point Total	krig - 725 ft								4E-4					7.8E+0
	Exposure Medium Total	krig - 500 ft									4E-4					9E+0
	Exposure Medium Total	krig - 725 ft									4E-4					7.8E+0
Medium Total	krig - 500 ft										4E-4					8.8E+0
Medium Total	krig - 725 ft										4E-4					7.8E+0
Groundwater Industrial Use	Industrial Water	Industrial Water	Dermal	Aluminum	1.4E+3	ug/L	1.8E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	4.9E-5	mg/kg-day	1.0E+0	mg/kg-day	4.9E-5
				Antimony	4.8E-1	ug/L	6.3E-10	mg/kg-day	NA	(mg/kg-day)-1	NA	1.7E-8	mg/kg-day	4.0E-4	mg/kg-day	4.2E-5
				Arsenic	2.2E+1	ug/L	2.9E-8	mg/kg-day	9.5E+0	(mg/kg-day)-1	3E-7	7.7E-7	mg/kg-day	3.0E-4	mg/kg-day	2.6E-3
				Barium	2.0E+3	ug/L	2.6E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	6.9E-5	mg/kg-day	7.0E-2	mg/kg-day	9.8E-4
				Beryllium	1.8E+0	ug/L	2.4E-9	mg/kg-day	NA	(mg/kg-day)-1	NA	6.4E-8	mg/kg-day	2.0E-3	mg/kg-day	3.2E-5
				Cadmium	3.2E+0	ug/L	4.2E-9	mg/kg-day	3.8E-1	(mg/kg-day)-1	2E-9	1.1E-7	mg/kg-day	5.0E-4	mg/kg-day	2.3E-4
				Chromium	2.2E+1	ug/L	5.7E-8	mg/kg-day	NA	(mg/kg-day)-1	NA	1.5E-6	mg/kg-day	3.0E-3	mg/kg-day	5.2E-4
				Cobalt	7.5E+0	ug/L	9.7E-9	mg/kg-day	NA	(mg/kg-day)-1	NA	2.6E-7	mg/kg-day	2.0E-2	mg/kg-day	1.3E-5
				Copper	1.1E+1	ug/L	1.4E-8	mg/kg-day	NA	(mg/kg-day)-1	NA	3.9E-7	mg/kg-day	4.0E-2	mg/kg-day	9.7E-6
				Iron	4.0E+4	ug/L	5.2E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	1.4E-3	mg/kg-day	3.0E-1	mg/kg-day	4.7E-3
				Lead	3.7E-1	ug/L	4.8E-10	mg/kg-day	NA	(mg/kg-day)-1	NA	1.3E-8	mg/kg-day	NA	mg/kg-day	NA
				Manganese	2.5E+3	ug/L	3.2E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	8.7E-5	mg/kg-day	1.4E-1	mg/kg-day	6.2E-4
				Mercury	2.2E-1	ug/L	2.9E-10	mg/kg-day	NA	(mg/kg-day)-1	NA	7.8E-9	mg/kg-day	3.0E-4	mg/kg-day	2.6E-5
				Molybdenum	3.7E+1	ug/L	4.9E-8	mg/kg-day	NA	(mg/kg-day)-1	NA	1.3E-6	mg/kg-day	5.0E-3	mg/kg-day	2.6E-4

TABLE 7.11
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
TIER 2 CENTRAL EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Car Wash Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
				Nickel	1.6E+1	ug/L	4.2E-9	mg/kg-day	NA	(mg/kg-day)-1	NA	1.1E-7	mg/kg-day	2.0E-2	mg/kg-day	5.6E-6
Groundwater	Industrial Water	Industrial Water	Dermal	Nitrate	7.0E+3	ug/L	9.1E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	2.5E-4	mg/kg-day	1.6E+0	mg/kg-day	1.5E-4
Industrial Use				Selenium	1.3E+1	ug/L	1.7E-8	mg/kg-day	NA	(mg/kg-day)-1	NA	4.6E-7	mg/kg-day	5.0E-3	mg/kg-day	9.1E-5
				Silver	1.5E+1	ug/L	1.2E-8	mg/kg-day	NA	(mg/kg-day)-1	NA	3.2E-7	mg/kg-day	5.0E-3	mg/kg-day	6.3E-5
				Thallium	9.6E+0	ug/L	1.3E-8	mg/kg-day	NA	(mg/kg-day)-1	NA	3.4E-7	mg/kg-day	6.6E-5	mg/kg-day	5.1E-3
				Vanadium	2.0E+1	ug/L	2.6E-8	mg/kg-day	NA	(mg/kg-day)-1	NA	7.0E-7	mg/kg-day	7.0E-3	mg/kg-day	1.0E-4
				Zinc	1.1E+1	ug/L	8.6E-9	mg/kg-day	NA	(mg/kg-day)-1	NA	2.3E-7	mg/kg-day	3.0E-1	mg/kg-day	7.7E-7
				1,2,4-Trimethylbenzene	5.5E+1	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	5.0E-2	mg/kg-day	0.0E+0
				1,2-Dichloroethane	5.0E+1	ug/L	2.7E-6	mg/kg-day	4.7E-2	(mg/kg-day)-1	1E-7	7.4E-5	mg/kg-day	3.0E-2	mg/kg-day	2.5E-3
				1,3,5-Trimethylbenzene	2.9E+1	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	5.0E-2	mg/kg-day	0.0E+0
				Acenaphthene	2.2E+2	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	6.0E-2	mg/kg-day	0.0E+0
				Acenaphthylene	8.0E+2	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Acetone	1.0E+4	ug/L	1.4E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	3.8E-4	mg/kg-day	1.0E-1	mg/kg-day	3.8E-3
				Anthracene	5.9E+1	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	3.0E-1	mg/kg-day	0.0E+0
				Benzo[a]anthracene	2.6E+1	ug/L	0.0E+0	mg/kg-day	1.2E+0	(mg/kg-day)-1	0E+0	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Benzo[a]pyrene	6.0E+1	ug/L	0.0E+0	mg/kg-day	1.2E+1	(mg/kg-day)-1	0E+0	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Benzo[b]fluoranthene	2.9E+1	ug/L	0.0E+0	mg/kg-day	1.2E+0	(mg/kg-day)-1	0E+0	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Benzo[g,h,i]perylene	3.7E+1	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Benzo[k]fluoranthene	1.4E+1	ug/L	0.0E+0	mg/kg-day	1.2E+0	(mg/kg-day)-1	0E+0	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Carbon Disulfide	4.8E+0	ug/L	1.1E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	2.9E-6	mg/kg-day	1.0E-1	mg/kg-day	2.9E-5
				Chrysene	4.3E+1	ug/L	0.0E+0	mg/kg-day	1.2E-1	(mg/kg-day)-1	0E+0	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Dibenz[a,h]anthracene	3.0E+0	ug/L	0.0E+0	mg/kg-day	4.1E+0	(mg/kg-day)-1	0E+0	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Ethylbenzene	8.0E+2	ug/L	5.1E-5	mg/kg-day	3.9E-3	(mg/kg-day)-1	2E-7	1.4E-3	mg/kg-day	1.0E-1	mg/kg-day	1.4E-2
				Fluoranthene	2.8E+2	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	4.0E-2	mg/kg-day	0.0E+0
				Fluorene	7.0E+1	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	4.0E-2	mg/kg-day	0.0E+0
				Indeno(1,2,3-cd)pyrene	4.4E+1	ug/L	0.0E+0	mg/kg-day	1.2E+0	(mg/kg-day)-1	0E+0	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Isopropyl benzene	7.4E+0	ug/L	3.0E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	8.0E-6	mg/kg-day	1.0E-1	mg/kg-day	8.0E-5
				Methyl isobutyl ketone	3.5E+0	ug/L	1.8E-8	mg/kg-day	0.0E+0	(mg/kg-day)-1	0E+0	4.9E-7	mg/kg-day	8.0E-2	mg/kg-day	6.1E-6
				Methylene chloride	1.8E+2	ug/L	8.2E-7	mg/kg-day	1.4E-2	(mg/kg-day)-1	1E-8	2.2E-5	mg/kg-day	6.0E-2	mg/kg-day	3.7E-4
				MTBE	1.9E+1	ug/L	9.6E-8	mg/kg-day	1.8E-3	(mg/kg-day)-1	2E-10	2.6E-6	mg/kg-day	NA	mg/kg-day	NA
				n-Butylbenzene	1.8E+3	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	4.0E-2	mg/kg-day	0.0E+0
				n-Propylbenzene	1.1E+1	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	4.0E-2	mg/kg-day	0.0E+0
				Phenanthrene	2.5E+2	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Pyrene	2.0E+2	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	3.0E-2	mg/kg-day	0.0E+0
				Styrene	1.9E+2	ug/L	9.0E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	2.4E-4	mg/kg-day	2.0E-1	mg/kg-day	1.2E-3
				Toluene	6.2E+2	ug/L	2.5E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	6.8E-4	mg/kg-day	2.0E-1	mg/kg-day	3.4E-3
				Xylenes (total)	4.2E+2	ug/L	2.9E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	7.9E-4	mg/kg-day	2.0E-1	mg/kg-day	3.9E-3
				Benzene (500 ft)	4.9E+2	ug/L	9.7E-6	mg/kg-day	1.0E-1	(mg/kg-day)-1	1E-6	2.6E-4	mg/kg-day	3.0E-3	mg/kg-day	8.7E-2
				Benzene (725 ft)	3.2E+2	ug/L	6.3E-6	mg/kg-day	1.0E-1	(mg/kg-day)-1	6E-7	1.7E-4	mg/kg-day	3.0E-3	mg/kg-day	5.7E-2

TABLE 7.11
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
TIER 2 CENTRAL EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Car Wash Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater Industrial Use	Industrial Water	Industrial Water	Dermal	Naphthalene (500 ft)	4.2E+3	ug/L	8.2E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	2.2E-3	mg/kg-day	2.0E-2	mg/kg-day	1.1E-1
				Naphthalene (725 ft)	3.2E+3	ug/L	6.3E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	1.7E-3	mg/kg-day	2.0E-2	mg/kg-day	8.5E-2
			Exp. Route Total	krig - 500 ft							2E-6					2.4E-1
			Exp. Route Total	krig - 725 ft							1E-6					1.9E-1
		Exposure Point Total	krig - 500 ft								2E-6					2.4E-1
		Exposure Point Total	krig - 725 ft								1E-6					1.9E-1
	Exposure Medium Total	krig - 500 ft									2E-6					2.4E-1
	Exposure Medium Total	krig - 725 ft									1E-6					1.9E-1
	Work Space Air	Work Space Air	Inhalation	1,2,4-Trimethylbenzene	8.3E-6	mg/m3	5.4E-8	mg/kg-day	NA	(mg/kg-day)-1	NA	1.5E-6	mg/kg-day	1.7E-3	mg/kg-day	8.6E-4
				1,2-Dichloroethane	9.8E-6	mg/m3	6.4E-8	mg/kg-day	7.2E-2	(mg/kg-day)-1	5E-9	1.7E-6	mg/kg-day	1.4E-3	mg/kg-day	1.2E-3
				1,3,5-Trimethylbenzene	4.4E-6	mg/m3	2.9E-8	mg/kg-day	NA	(mg/kg-day)-1	NA	7.7E-7	mg/kg-day	1.7E-3	mg/kg-day	4.5E-4
				Acenaphthene	2.9E-5	mg/m3	1.9E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	5.2E-6	mg/kg-day	NA	mg/kg-day	NA
				Acetone	1.4E-3	mg/m3	9.0E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	2.4E-4	mg/kg-day	NA	mg/kg-day	NA
				Anthracene	7.8E-6	mg/m3	5.1E-8	mg/kg-day	NA	(mg/kg-day)-1	NA	1.4E-6	mg/kg-day	NA	mg/kg-day	NA
				Benzene	0.0E+0	mg/m3	0.0E+0	mg/kg-day	1.0E-1	(mg/kg-day)-1	0E+0	0.0E+0	mg/kg-day	1.7E-3	mg/kg-day	0.0E+0
				Benzo[b]fluoranthene	3.8E-6	mg/m3	2.5E-8	mg/kg-day	3.9E-1	(mg/kg-day)-1	1E-8	6.8E-7	mg/kg-day	NA	mg/kg-day	NA
				Carbon Disulfide	9.1E-7	mg/m3	6.0E-9	mg/kg-day	NA	(mg/kg-day)-1	NA	1.6E-7	mg/kg-day	2.0E-1	mg/kg-day	8.1E-7
				Chrysene	5.7E-6	mg/m3	3.7E-8	mg/kg-day	3.9E-2	(mg/kg-day)-1	1E-9	1.0E-6	mg/kg-day	NA	mg/kg-day	NA
				Ethylbenzene	1.3E-4	mg/m3	8.4E-7	mg/kg-day	3.9E-3	(mg/kg-day)-1	3E-9	2.3E-5	mg/kg-day	2.9E-1	mg/kg-day	7.8E-5
				Fluorene	9.3E-6	mg/m3	6.1E-8	mg/kg-day	NA	(mg/kg-day)-1	NA	1.6E-6	mg/kg-day	NA	mg/kg-day	NA
				Isopropyl benzene	1.1E-6	mg/m3	7.3E-9	mg/kg-day	NA	(mg/kg-day)-1	NA	2.0E-7	mg/kg-day	1.1E-1	mg/kg-day	1.8E-6
				Methyl isobutyl ketone	4.9E-7	mg/m3	3.2E-9	mg/kg-day	0.0E+0	(mg/kg-day)-1	0E+0	8.6E-8	mg/kg-day	2.3E-2	mg/kg-day	3.8E-6
				Methylene chloride	3.8E-5	mg/m3	2.5E-7	mg/kg-day	3.5E-3	(mg/kg-day)-1	9E-10	6.6E-6	mg/kg-day	8.6E-1	mg/kg-day	7.7E-6
				MTBE	3.5E-6	mg/m3	2.3E-8	mg/kg-day	9.1E-4	(mg/kg-day)-1	2E-11	6.1E-7	mg/kg-day	8.6E-1	mg/kg-day	7.1E-7
				Naphthalene	0.0E+0	mg/m3	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	8.6E-4	mg/kg-day	0.0E+0
				n-Butylbenzene	2.9E-4	mg/m3	1.9E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	5.1E-5	mg/kg-day	NA	mg/kg-day	NA
				n-Propylbenzene	1.8E-6	mg/m3	1.2E-8	mg/kg-day	NA	(mg/kg-day)-1	NA	3.1E-7	mg/kg-day	NA	mg/kg-day	NA
				Pyrene	2.6E-5	mg/m3	1.7E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	4.7E-6	mg/kg-day	NA	mg/kg-day	NA
				Styrene	3.0E-5	mg/m3	2.0E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	5.3E-6	mg/kg-day	2.9E-1	mg/kg-day	1.8E-5
				Toluene	1.1E-4	mg/m3	7.0E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	1.9E-5	mg/kg-day	1.1E-1	mg/kg-day	1.7E-4
				Xylenes (total)	7.4E-5	mg/m3	4.8E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	1.3E-5	mg/kg-day	2.9E-2	mg/kg-day	4.5E-4
				Benzene (500 ft)	9.3E-5	mg/m3	6.1E-7	mg/kg-day	1.0E-1	(mg/kg-day)-1	6E-8	1.6E-5	mg/kg-day	1.7E-3	mg/kg-day	9.6E-3
				Benzene (725 ft)	6.0E-5	mg/m3	3.9E-7	mg/kg-day	1.0E-1	(mg/kg-day)-1	4E-8	1.1E-5	mg/kg-day	1.7E-3	mg/kg-day	6.2E-3
				Naphthalene (500 ft)	6.2E-4	mg/m3	4.1E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	1.1E-4	mg/kg-day	8.6E-4	mg/kg-day	1.3E-1
				Naphthalene (725 ft)	4.8E-4	mg/m3	3.2E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	8.5E-5	mg/kg-day	8.6E-4	mg/kg-day	9.9E-2

TABLE 7.11

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

TIER 2 CENTRAL EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Car Wash Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Work Space Air	Work Space Air	Exp. Route Total	krig - 500 ft							8E-8					1.4E-1
Industrial Use			Exp. Route Total	krig - 725 ft							6E-8					1.1E-1
		Exposure Point Total	krig - 500 ft								8E-8					1.4E-1
		Exposure Point Total	krig - 725 ft								6E-8					1.1E-1
	Exposure Medium Total	krig - 500 ft									8E-8					1.4E-1
	Exposure Medium Total	krig - 725 ft									6E-8					1.1E-1
Medium Total	krig - 500 ft										2E-6					3.8E-1
Medium Total	krig - 725 ft										1E-6					2.9E-1
Total of Receptor Risks Across All Media											4E-4	Total of Receptor Risks Across All Media				9.1E+0
Total of Receptor Risks Across All Media											4E-4	Total of Receptor Risks Across All Media				8.1E+0

TABLE 7.12
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
TIER 2 REASONABLE MAXIMUM EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Car Wash Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater Potable Use	Potable Water	Potable Water	Ingestion	Aluminum	1.4E+3	ug/L	2.4E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	1.2E-2	mg/kg-day	1.0E+0	mg/kg-day	1.2E-2
				Antimony	4.8E-1	ug/L	8.2E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	4.2E-6	mg/kg-day	4.0E-4	mg/kg-day	1.1E-2
				Arsenic	2.2E+1	ug/L	3.8E-5	mg/kg-day	9.5E+0	(mg/kg-day)-1	4E-4	1.9E-4	mg/kg-day	3.0E-4	mg/kg-day	6.5E-1
				Barium	2.0E+3	ug/L	3.4E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	1.7E-2	mg/kg-day	7.0E-2	mg/kg-day	2.5E-1
				Beryllium	1.8E+0	ug/L	3.1E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	1.6E-5	mg/kg-day	2.0E-3	mg/kg-day	8.1E-3
				Cadmium	3.2E+0	ug/L	5.5E-6	mg/kg-day	3.8E-1	(mg/kg-day)-1	2E-6	2.9E-5	mg/kg-day	5.0E-4	mg/kg-day	5.7E-2
				Chromium	2.2E+1	ug/L	3.8E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	1.9E-4	mg/kg-day	3.0E-3	mg/kg-day	6.5E-2
				Cobalt	7.5E+0	ug/L	1.3E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	6.6E-5	mg/kg-day	2.0E-2	mg/kg-day	3.3E-3
				Copper	1.1E+1	ug/L	1.9E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	9.7E-5	mg/kg-day	4.0E-2	mg/kg-day	2.4E-3
				Iron	4.0E+4	ug/L	6.8E-2	mg/kg-day	NA	(mg/kg-day)-1	NA	3.5E-1	mg/kg-day	3.0E-1	mg/kg-day	1.2E+0
				Lead	3.7E-1	ug/L	6.3E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	3.3E-6	mg/kg-day	NA	mg/kg-day	NA
				Manganese	2.5E+3	ug/L	4.2E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	2.2E-2	mg/kg-day	1.4E-1	mg/kg-day	1.6E-1
				Mercury	2.2E-1	ug/L	3.8E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	2.0E-6	mg/kg-day	3.0E-4	mg/kg-day	6.5E-3
				Molybdenum	3.7E+1	ug/L	6.4E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	3.3E-4	mg/kg-day	5.0E-3	mg/kg-day	6.6E-2
				Nickel	1.6E+1	ug/L	2.7E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	1.4E-4	mg/kg-day	2.0E-2	mg/kg-day	7.0E-3
				Nitrate	7.0E+3	ug/L	1.2E-2	mg/kg-day	NA	(mg/kg-day)-1	NA	6.2E-2	mg/kg-day	1.6E+0	mg/kg-day	3.9E-2
				Selenium	1.3E+1	ug/L	2.2E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	1.1E-4	mg/kg-day	5.0E-3	mg/kg-day	2.3E-2
				Silver	1.5E+1	ug/L	2.6E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	1.3E-4	mg/kg-day	5.0E-3	mg/kg-day	2.6E-2
				Thallium	9.6E+0	ug/L	1.6E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	8.5E-5	mg/kg-day	6.6E-5	mg/kg-day	1.3E+0
				Vanadium	2.0E+1	ug/L	3.4E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	1.8E-4	mg/kg-day	7.0E-3	mg/kg-day	2.5E-2
				Zinc	1.1E+1	ug/L	1.9E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	9.7E-5	mg/kg-day	3.0E-1	mg/kg-day	3.2E-4
				1,2,4-Trimethylbenzene	5.5E+1	ug/L	9.4E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	4.8E-4	mg/kg-day	5.0E-2	mg/kg-day	9.7E-3
				1,2-Dichloroethane	5.0E+1	ug/L	8.6E-5	mg/kg-day	4.7E-2	(mg/kg-day)-1	4E-6	4.4E-4	mg/kg-day	3.0E-2	mg/kg-day	1.5E-2
				1,3,5-Trimethylbenzene	2.9E+1	ug/L	5.0E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	2.6E-4	mg/kg-day	5.0E-2	mg/kg-day	5.1E-3
				Acenaphthene	2.2E+2	ug/L	3.8E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	1.9E-3	mg/kg-day	6.0E-2	mg/kg-day	3.2E-2
				Acenaphthylene	8.0E+2	ug/L	1.4E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	7.0E-3	mg/kg-day	NA	mg/kg-day	NA
				Acetone	1.0E+4	ug/L	1.7E-2	mg/kg-day	NA	(mg/kg-day)-1	NA	8.8E-2	mg/kg-day	1.0E-1	mg/kg-day	8.8E-1
				Anthracene	5.9E+1	ug/L	1.0E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	5.2E-4	mg/kg-day	3.0E-1	mg/kg-day	1.7E-3
				Benzo[a]anthracene	2.6E+1	ug/L	4.4E-5	mg/kg-day	1.2E+0	(mg/kg-day)-1	5E-5	2.3E-4	mg/kg-day	NA	mg/kg-day	NA
				Benzo[a]pyrene	6.0E+1	ug/L	1.0E-4	mg/kg-day	1.2E+1	(mg/kg-day)-1	1E-3	5.3E-4	mg/kg-day	NA	mg/kg-day	NA
				Benzo[b]fluoranthene	2.9E+1	ug/L	5.0E-5	mg/kg-day	1.2E+0	(mg/kg-day)-1	6E-5	2.6E-4	mg/kg-day	NA	mg/kg-day	NA
				Benzo[g,h,i]perylene	3.7E+1	ug/L	6.3E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	3.3E-4	mg/kg-day	NA	mg/kg-day	NA
				Benzo[k]fluoranthene	1.4E+1	ug/L	2.4E-5	mg/kg-day	1.2E+0	(mg/kg-day)-1	3E-5	1.2E-4	mg/kg-day	NA	mg/kg-day	NA
				Carbon Disulfide	4.8E+0	ug/L	8.2E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	4.2E-5	mg/kg-day	1.0E-1	mg/kg-day	4.2E-4
				Chrysene	4.3E+1	ug/L	7.4E-5	mg/kg-day	1.2E-1	(mg/kg-day)-1	9E-6	3.8E-4	mg/kg-day	NA	mg/kg-day	NA
				Dibenz[a,h]anthracene	3.0E+0	ug/L	5.1E-6	mg/kg-day	4.1E+0	(mg/kg-day)-1	2E-5	2.6E-5	mg/kg-day	NA	mg/kg-day	NA
				Ethylbenzene	8.0E+2	ug/L	1.4E-3	mg/kg-day	3.9E-3	(mg/kg-day)-1	5E-6	7.0E-3	mg/kg-day	1.0E-1	mg/kg-day	7.0E-2
				Fluoranthene	2.8E+2	ug/L	4.8E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	2.5E-3	mg/kg-day	4.0E-2	mg/kg-day	6.2E-2
				Fluorene	7.0E+1	ug/L	1.2E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	6.2E-4	mg/kg-day	4.0E-2	mg/kg-day	1.5E-2

TABLE 7.12
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
TIER 2 REASONABLE MAXIMUM EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Car Wash Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater Potable Use	Potable Water	Potable Water	Ingestion	Indeno(1,2,3-cd)pyrene	4.4E+1	ug/L	7.5E-5	mg/kg-day	1.2E+0	(mg/kg-day)-1	9E-5	3.9E-4	mg/kg-day	NA	mg/kg-day	NA
				Isopropyl benzene	7.4E+0	ug/L	1.3E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	6.5E-5	mg/kg-day	1.0E-1	mg/kg-day	6.5E-4
				Methyl isobutyl ketone	3.5E+0	ug/L	6.0E-6	mg/kg-day	0.0E+0	(mg/kg-day)-1	0E+0	3.1E-5	mg/kg-day	8.0E-2	mg/kg-day	3.9E-4
				Methylene chloride	1.8E+2	ug/L	3.1E-4	mg/kg-day	1.4E-2	(mg/kg-day)-1	4E-6	1.6E-3	mg/kg-day	6.0E-2	mg/kg-day	2.6E-2
				MTBE	1.9E+1	ug/L	3.3E-5	mg/kg-day	1.8E-3	(mg/kg-day)-1	6E-8	1.7E-4	mg/kg-day	NA	mg/kg-day	NA
				n-Butylbenzene	1.8E+3	ug/L	3.1E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	1.6E-2	mg/kg-day	4.0E-2	mg/kg-day	4.0E-1
				n-Propylbenzene	1.1E+1	ug/L	1.9E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	9.7E-5	mg/kg-day	4.0E-2	mg/kg-day	2.4E-3
				Phenanthrene	2.5E+2	ug/L	4.3E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	2.2E-3	mg/kg-day	NA	mg/kg-day	NA
				Pyrene	2.0E+2	ug/L	3.4E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	1.8E-3	mg/kg-day	3.0E-2	mg/kg-day	5.9E-2
				Styrene	1.9E+2	ug/L	3.2E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	1.6E-3	mg/kg-day	2.0E-1	mg/kg-day	8.2E-3
				Toluene	6.2E+2	ug/L	1.1E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	5.5E-3	mg/kg-day	2.0E-1	mg/kg-day	2.7E-2
				Xylenes (total)	4.2E+2	ug/L	7.2E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	3.7E-3	mg/kg-day	2.0E-1	mg/kg-day	1.9E-2
				Benzene (500 ft)	4.9E+2	ug/L	8.4E-4	mg/kg-day	1.0E-1	(mg/kg-day)-1	8E-5	4.3E-3	mg/kg-day	3.0E-3	mg/kg-day	1.4E+0
				Benzene (725 ft)	3.2E+2	ug/L	5.5E-4	mg/kg-day	1.0E-1	(mg/kg-day)-1	6E-5	2.8E-3	mg/kg-day	3.0E-3	mg/kg-day	9.4E-1
				Naphthalene (500 ft)	4.2E+3	ug/L	7.1E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	3.7E-2	mg/kg-day	2.0E-2	mg/kg-day	1.8E+0
				Naphthalene (725 ft)	3.2E+3	ug/L	5.5E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	2.8E-2	mg/kg-day	2.0E-2	mg/kg-day	1.4E+0
			Exp. Route Total	krig - 500 ft							2E-3					8.8E+0
			Exp. Route Total	krig - 725 ft							2E-3					7.8E+0
		Exposure Point Total	krig - 500 ft								2E-3					8.8E+0
		Exposure Point Total	krig - 725 ft								2E-3					7.8E+0
	Exposure Medium Total	krig - 500 ft									2E-3					8.8E+0
	Exposure Medium Total	krig - 725 ft									2E-3					7.8E+0
Medium Total	krig - 500 ft										2E-3					8.8E+0
Medium Total	krig - 725 ft										2E-3					7.8E+0
Groundwater Industrial Use	Industrial Water	Industrial Water	Dermal	Aluminum	1.4E+3	ug/L	2.2E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	1.1E-4	mg/kg-day	1.0E+0	mg/kg-day	1.1E-4
				Antimony	4.8E-1	ug/L	7.6E-9	mg/kg-day	NA	(mg/kg-day)-1	NA	3.9E-8	mg/kg-day	4.0E-4	mg/kg-day	9.7E-5
				Arsenic	2.2E+1	ug/L	3.5E-7	mg/kg-day	9.5E+0	(mg/kg-day)-1	3E-6	1.8E-6	mg/kg-day	3.0E-4	mg/kg-day	5.9E-3
				Barium	2.0E+3	ug/L	3.1E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	1.6E-4	mg/kg-day	7.0E-2	mg/kg-day	2.3E-3
				Beryllium	1.8E+0	ug/L	2.9E-8	mg/kg-day	NA	(mg/kg-day)-1	NA	1.5E-7	mg/kg-day	2.0E-3	mg/kg-day	7.4E-5
				Cadmium	3.2E+0	ug/L	5.1E-8	mg/kg-day	3.8E-1	(mg/kg-day)-1	2E-8	2.6E-7	mg/kg-day	5.0E-4	mg/kg-day	5.2E-4
				Chromium	2.2E+1	ug/L	6.9E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	3.6E-6	mg/kg-day	3.0E-3	mg/kg-day	1.2E-3
				Cobalt	7.5E+0	ug/L	1.2E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	6.0E-7	mg/kg-day	2.0E-2	mg/kg-day	3.0E-5
				Copper	1.1E+1	ug/L	1.7E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	8.9E-7	mg/kg-day	4.0E-2	mg/kg-day	2.2E-5
				Iron	4.0E+4	ug/L	6.2E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	3.2E-3	mg/kg-day	3.0E-1	mg/kg-day	1.1E-2
				Lead	3.7E-1	ug/L	5.8E-9	mg/kg-day	NA	(mg/kg-day)-1	NA	3.0E-8	mg/kg-day	NA	mg/kg-day	NA
				Manganese	2.5E+3	ug/L	3.9E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	2.0E-4	mg/kg-day	1.4E-1	mg/kg-day	1.4E-3
				Mercury	2.2E-1	ug/L	3.5E-9	mg/kg-day	NA	(mg/kg-day)-1	NA	1.8E-8	mg/kg-day	3.0E-4	mg/kg-day	6.0E-5
				Molybdenum	3.7E+1	ug/L	5.9E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	3.0E-6	mg/kg-day	5.0E-3	mg/kg-day	6.1E-4

TABLE 7.12

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

TIER 2 REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Car Wash Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater Industrial Use	Industrial Water	Industrial Water	Dermal	Nickel	1.6E+1	ug/L	5.0E-8	mg/kg-day	NA	(mg/kg-day)-1	NA	2.6E-7	mg/kg-day	2.0E-2	mg/kg-day	1.3E-5
				Nitrate	7.0E+3	ug/L	1.1E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	5.7E-4	mg/kg-day	1.6E+0	mg/kg-day	3.5E-4
				Selenium	1.3E+1	ug/L	2.0E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	1.1E-6	mg/kg-day	5.0E-3	mg/kg-day	2.1E-4
				Silver	1.5E+1	ug/L	1.4E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	7.3E-7	mg/kg-day	5.0E-3	mg/kg-day	1.5E-4
				Thallium	9.6E+0	ug/L	1.5E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	7.8E-7	mg/kg-day	6.6E-5	mg/kg-day	1.2E-2
				Vanadium	2.0E+1	ug/L	3.1E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	1.6E-6	mg/kg-day	7.0E-3	mg/kg-day	2.3E-4
				Zinc	1.1E+1	ug/L	1.0E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	5.3E-7	mg/kg-day	3.0E-1	mg/kg-day	1.8E-6
				1,2,4-Trimethylbenzene	5.5E+1	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	5.0E-2	mg/kg-day	0.0E+0
				1,2-Dichloroethane	5.0E+1	ug/L	3.3E-5	mg/kg-day	4.7E-2	(mg/kg-day)-1	2E-6	1.7E-4	mg/kg-day	3.0E-2	mg/kg-day	5.7E-3
				1,3,5-Trimethylbenzene	2.9E+1	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	5.0E-2	mg/kg-day	0.0E+0
				Acenaphthene	2.2E+2	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	6.0E-2	mg/kg-day	0.0E+0
				Acenaphthylene	8.0E+2	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Acetone	1.0E+4	ug/L	1.7E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	8.7E-4	mg/kg-day	1.0E-1	mg/kg-day	8.7E-3
				Anthracene	5.9E+1	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	3.0E-1	mg/kg-day	0.0E+0
				Benzo[a]anthracene	2.6E+1	ug/L	0.0E+0	mg/kg-day	1.2E+0	(mg/kg-day)-1	0E+0	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Benzo[a]pyrene	6.0E+1	ug/L	0.0E+0	mg/kg-day	1.2E+1	(mg/kg-day)-1	0E+0	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Benzo[b]fluoranthene	2.9E+1	ug/L	0.0E+0	mg/kg-day	1.2E+0	(mg/kg-day)-1	0E+0	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Benzo[g,h,I]perylene	3.7E+1	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Benzo[k]fluoranthene	1.4E+1	ug/L	0.0E+0	mg/kg-day	1.2E+0	(mg/kg-day)-1	0E+0	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Carbon Disulfide	4.8E+0	ug/L	1.3E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	6.6E-6	mg/kg-day	1.0E-1	mg/kg-day	6.6E-5
				Chrysene	4.3E+1	ug/L	0.0E+0	mg/kg-day	1.2E-1	(mg/kg-day)-1	0E+0	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Dibenz[a,h]anthracene	3.0E+0	ug/L	0.0E+0	mg/kg-day	4.1E+0	(mg/kg-day)-1	0E+0	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Ethylbenzene	8.0E+2	ug/L	6.2E-4	mg/kg-day	3.9E-3	(mg/kg-day)-1	2E-6	3.2E-3	mg/kg-day	1.0E-1	mg/kg-day	3.2E-2
				Fluoranthene	2.8E+2	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	4.0E-2	mg/kg-day	0.0E+0
				Fluorene	7.0E+1	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	4.0E-2	mg/kg-day	0.0E+0
				Indeno(1,2,3-cd)pyrene	4.4E+1	ug/L	0.0E+0	mg/kg-day	1.2E+0	(mg/kg-day)-1	0E+0	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Isopropyl benzene	7.4E+0	ug/L	3.6E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	1.8E-5	mg/kg-day	1.0E-1	mg/kg-day	1.8E-4
				Methyl isobutyl ketone	3.5E+0	ug/L	2.2E-7	mg/kg-day	0.0E+0	(mg/kg-day)-1	0E+0	1.1E-6	mg/kg-day	8.0E-2	mg/kg-day	1.4E-5
				Methylene chloride	1.8E+2	ug/L	9.9E-6	mg/kg-day	1.4E-2	(mg/kg-day)-1	1E-7	5.1E-5	mg/kg-day	6.0E-2	mg/kg-day	8.5E-4
				MTBE	1.9E+1	ug/L	1.2E-6	mg/kg-day	1.8E-3	(mg/kg-day)-1	2E-9	6.0E-6	mg/kg-day	NA	mg/kg-day	NA
				n-Butylbenzene	1.8E+3	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	4.0E-2	mg/kg-day	0.0E+0
				n-Propylbenzene	1.1E+1	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	4.0E-2	mg/kg-day	0.0E+0
				Phenanthrene	2.5E+2	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Pyrene	2.0E+2	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	3.0E-2	mg/kg-day	0.0E+0
				Styrene	1.9E+2	ug/L	1.1E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	5.6E-4	mg/kg-day	2.0E-1	mg/kg-day	2.8E-3
				Toluene	6.2E+2	ug/L	3.0E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	1.6E-3	mg/kg-day	2.0E-1	mg/kg-day	7.8E-3
				Xylenes (total)	4.2E+2	ug/L	3.5E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	1.8E-3	mg/kg-day	2.0E-1	mg/kg-day	9.1E-3
				Benzene (500 ft)	4.9E+2	ug/L	1.2E-4	mg/kg-day	1.0E-1	(mg/kg-day)-1	1E-5	6.0E-4	mg/kg-day	3.0E-3	mg/kg-day	2.0E-1
				Benzene (725 ft)	3.2E+2	ug/L	7.6E-5	mg/kg-day	1.0E-1	(mg/kg-day)-1	8E-6	3.9E-4	mg/kg-day	3.0E-3	mg/kg-day	1.3E-1

TABLE 7.12
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
TIER 2 REASONABLE MAXIMUM EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Car Wash Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater Industrial Use	Industrial Water	Industrial Water	Dermal	Naphthalene (500 ft)	4.2E+3	ug/L	9.8E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	5.1E-3	mg/kg-day	2.0E-2	mg/kg-day	2.5E-1
				Naphthalene (725 ft)	3.2E+3	ug/L	7.6E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	3.9E-3	mg/kg-day	2.0E-2	mg/kg-day	2.0E-1
			Exp. Route Total	krig - 500 ft							2E-5					5.6E-1
			Exp. Route Total	krig - 725 ft							1E-5					4.3E-1
		Exposure Point Total	krig - 500 ft								2E-5					5.6E-1
		Exposure Point Total	krig - 725 ft								1E-5					4.3E-1
	Exposure Medium Total	krig - 500 ft									2E-5					5.6E-1
	Exposure Medium Total	krig - 725 ft									1E-5					4.3E-1
	Work Space Air	Work Space Air	Inhalation	1,2,4-Trimethylbenzene	2.6E-5	mg/m3	8.7E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	4.5E-6	mg/kg-day	1.7E-3	mg/kg-day	2.6E-3
				1,2-Dichloroethane	3.0E-5	mg/m3	1.0E-6	mg/kg-day	7.2E-2	(mg/kg-day)-1	7E-8	5.3E-6	mg/kg-day	1.4E-3	mg/kg-day	3.8E-3
				1,3,5-Trimethylbenzene	1.3E-5	mg/m3	4.6E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	2.4E-6	mg/kg-day	1.7E-3	mg/kg-day	1.4E-3
				Acenaphthene	9.0E-5	mg/m3	3.1E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	1.6E-5	mg/kg-day	NA	mg/kg-day	NA
				Acetone	4.2E-3	mg/m3	1.4E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	7.4E-4	mg/kg-day	NA	mg/kg-day	NA
				Anthracene	2.4E-5	mg/m3	8.2E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	4.2E-6	mg/kg-day	NA	mg/kg-day	NA
				Benzo[b]fluoranthene	1.2E-5	mg/m3	4.0E-7	mg/kg-day	3.9E-1	(mg/kg-day)-1	2E-7	2.1E-6	mg/kg-day	NA	mg/kg-day	NA
				Carbon Disulfide	2.8E-6	mg/m3	9.6E-8	mg/kg-day	NA	(mg/kg-day)-1	NA	4.9E-7	mg/kg-day	2.0E-1	mg/kg-day	2.5E-6
				Chrysene	1.7E-5	mg/m3	6.0E-7	mg/kg-day	3.9E-2	(mg/kg-day)-1	2E-8	3.1E-6	mg/kg-day	NA	mg/kg-day	NA
				Ethylbenzene	4.0E-4	mg/m3	1.4E-5	mg/kg-day	3.9E-3	(mg/kg-day)-1	5E-8	7.0E-5	mg/kg-day	2.9E-1	mg/kg-day	2.4E-4
				Fluorene	2.8E-5	mg/m3	9.7E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	5.0E-6	mg/kg-day	NA	mg/kg-day	NA
				Isopropyl benzene	3.4E-6	mg/m3	1.2E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	6.1E-7	mg/kg-day	1.1E-1	mg/kg-day	5.5E-6
				Methyl isobutyl ketone	1.5E-6	mg/m3	5.1E-8	mg/kg-day	0.0E+0	(mg/kg-day)-1	0E+0	2.6E-7	mg/kg-day	2.3E-2	mg/kg-day	1.2E-5
				Methylene chloride	1.2E-4	mg/m3	4.0E-6	mg/kg-day	3.5E-3	(mg/kg-day)-1	1E-8	2.0E-5	mg/kg-day	8.6E-1	mg/kg-day	2.4E-5
				MTBE	1.1E-5	mg/m3	3.7E-7	mg/kg-day	9.1E-4	(mg/kg-day)-1	3E-10	1.9E-6	mg/kg-day	8.6E-1	mg/kg-day	2.2E-6
				n-Butylbenzene	8.9E-4	mg/m3	3.0E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	1.6E-4	mg/kg-day	NA	mg/kg-day	NA
				n-Propylbenzene	5.4E-6	mg/m3	1.9E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	9.6E-7	mg/kg-day	NA	mg/kg-day	NA
				Pyrene	8.1E-5	mg/m3	2.8E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	1.4E-5	mg/kg-day	NA	mg/kg-day	NA
				Styrene	9.3E-5	mg/m3	3.2E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	1.6E-5	mg/kg-day	2.9E-1	mg/kg-day	5.6E-5
				Toluene	3.3E-4	mg/m3	1.1E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	5.8E-5	mg/kg-day	1.1E-1	mg/kg-day	5.2E-4
				Xylenes (total)	2.3E-4	mg/m3	7.7E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	4.0E-5	mg/kg-day	2.9E-2	mg/kg-day	1.4E-3
				Benzene (500 ft)	2.8E-4	mg/m3	9.7E-6	mg/kg-day	1.0E-1	(mg/kg-day)-1	1E-6	5.0E-5	mg/kg-day	1.7E-3	mg/kg-day	2.9E-2
				Benzene (725 ft)	1.8E-4	mg/m3	6.3E-6	mg/kg-day	1.0E-1	(mg/kg-day)-1	6E-7	3.3E-5	mg/kg-day	1.7E-3	mg/kg-day	1.9E-2
				Naphthalene (500 ft)	1.9E-3	mg/m3	6.6E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	3.4E-4	mg/kg-day	8.6E-4	mg/kg-day	3.9E-1
				Naphthalene (725 ft)	1.5E-3	mg/m3	5.1E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	2.6E-4	mg/kg-day	8.6E-4	mg/kg-day	3.0E-1

TABLE 7.12

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

TIER 2 REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Car Wash Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Work Space Air	Work Space Air	Exp. Route Total	krig - 500 ft							1E-6					4.3E-1
Industrial Use			Exp. Route Total	krig - 725 ft							1E-6					3.3E-1
		Exposure Point Total	krig - 500 ft								1E-6					4.3E-1
		Exposure Point Total	krig - 725 ft								1E-6					3.3E-1
	Exposure Medium Total	krig - 500 ft									1E-6					4.3E-1
	Exposure Medium Total	krig - 725 ft									1E-6					3.3E-1
Medium Total	krig - 500 ft										2E-5					9.9E-1
Medium Total	krig - 725 ft										2E-5					7.6E-1
Total of Receptor Risks Across All Media											2E-3	Total of Receptor Risks Across All Media				9.8E+0
Total of Receptor Risks Across All Media											2E-3	Total of Receptor Risks Across All Media				8.6E+0

TABLE 7.13
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
TIER 2 CENTRAL EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Landscape Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater Potable Use	Potable Water	Potable Water	Ingestion	Aluminum	1.4E+3	ug/L	6.3E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	1.2E-2	mg/kg-day	1.0E+0	mg/kg-day	1.2E-2
				Antimony	4.8E-1	ug/L	2.2E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	4.2E-6	mg/kg-day	4.0E-4	mg/kg-day	1.1E-2
				Arsenic	2.2E+1	ug/L	1.0E-5	mg/kg-day	9.5E+0	(mg/kg-day)-1	9E-5	1.9E-4	mg/kg-day	3.0E-4	mg/kg-day	6.5E-1
				Barium	2.0E+3	ug/L	8.9E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	1.7E-2	mg/kg-day	7.0E-2	mg/kg-day	2.5E-1
				Beryllium	1.8E+0	ug/L	8.3E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	1.6E-5	mg/kg-day	2.0E-3	mg/kg-day	8.1E-3
				Cadmium	3.2E+0	ug/L	1.5E-6	mg/kg-day	3.8E-1	(mg/kg-day)-1	6E-7	2.9E-5	mg/kg-day	5.0E-4	mg/kg-day	5.7E-2
				Chromium	2.2E+1	ug/L	1.0E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	1.9E-4	mg/kg-day	3.0E-3	mg/kg-day	6.5E-2
				Cobalt	7.5E+0	ug/L	3.4E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	6.6E-5	mg/kg-day	2.0E-2	mg/kg-day	3.3E-3
				Copper	1.1E+1	ug/L	5.0E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	9.7E-5	mg/kg-day	4.0E-2	mg/kg-day	2.4E-3
				Iron	4.0E+4	ug/L	1.8E-2	mg/kg-day	NA	(mg/kg-day)-1	NA	3.5E-1	mg/kg-day	3.0E-1	mg/kg-day	1.2E+0
				Lead	3.7E-1	ug/L	1.7E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	3.3E-6	mg/kg-day	NA	mg/kg-day	NA
				Manganese	2.5E+3	ug/L	1.1E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	2.2E-2	mg/kg-day	1.4E-1	mg/kg-day	1.6E-1
				Mercury	2.2E-1	ug/L	1.0E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	2.0E-6	mg/kg-day	3.0E-4	mg/kg-day	6.5E-3
				Molybdenum	3.7E+1	ug/L	1.7E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	3.3E-4	mg/kg-day	5.0E-3	mg/kg-day	6.6E-2
				Nickel	1.6E+1	ug/L	7.2E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	1.4E-4	mg/kg-day	2.0E-2	mg/kg-day	7.0E-3
				Nitrate	7.0E+3	ug/L	3.2E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	6.2E-2	mg/kg-day	1.6E+0	mg/kg-day	3.9E-2
				Selenium	1.3E+1	ug/L	5.9E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	1.1E-4	mg/kg-day	5.0E-3	mg/kg-day	2.3E-2
				Silver	1.5E+1	ug/L	6.8E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	1.3E-4	mg/kg-day	5.0E-3	mg/kg-day	2.6E-2
				Thallium	9.6E+0	ug/L	4.4E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	8.5E-5	mg/kg-day	6.6E-5	mg/kg-day	1.3E+0
				Vanadium	2.0E+1	ug/L	9.1E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	1.8E-4	mg/kg-day	7.0E-3	mg/kg-day	2.5E-2
				Zinc	1.1E+1	ug/L	5.0E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	9.7E-5	mg/kg-day	3.0E-1	mg/kg-day	3.2E-4
				1,2,4-Trimethylbenzene	5.5E+1	ug/L	2.5E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	4.8E-4	mg/kg-day	5.0E-2	mg/kg-day	9.7E-3
				1,2-Dichloroethane	5.0E+1	ug/L	2.3E-5	mg/kg-day	4.7E-2	(mg/kg-day)-1	1E-6	4.4E-4	mg/kg-day	3.0E-2	mg/kg-day	1.5E-2
				1,3,5-Trimethylbenzene	2.9E+1	ug/L	1.3E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	2.6E-4	mg/kg-day	5.0E-2	mg/kg-day	5.1E-3
				Acenaphthene	2.2E+2	ug/L	1.0E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	1.9E-3	mg/kg-day	6.0E-2	mg/kg-day	3.2E-2
				Acenaphthylene	8.0E+2	ug/L	3.6E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	7.0E-3	mg/kg-day	NA	mg/kg-day	NA
				Acetone	1.0E+4	ug/L	4.5E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	8.8E-2	mg/kg-day	1.0E-1	mg/kg-day	8.8E-1
				Anthracene	5.9E+1	ug/L	2.7E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	5.2E-4	mg/kg-day	3.0E-1	mg/kg-day	1.7E-3
				Benzo[a]anthracene	2.6E+1	ug/L	1.2E-5	mg/kg-day	1.2E+0	(mg/kg-day)-1	1E-5	2.3E-4	mg/kg-day	NA	mg/kg-day	NA
				Benzo[a]pyrene	6.0E+1	ug/L	2.7E-5	mg/kg-day	1.2E+1	(mg/kg-day)-1	3E-4	5.3E-4	mg/kg-day	NA	mg/kg-day	NA
				Benzo[b]fluoranthene	2.9E+1	ug/L	1.3E-5	mg/kg-day	1.2E+0	(mg/kg-day)-1	2E-5	2.6E-4	mg/kg-day	NA	mg/kg-day	NA
				Benzo[g,h,i]perylene	3.7E+1	ug/L	1.7E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	3.3E-4	mg/kg-day	NA	mg/kg-day	NA
				Benzo[k]fluoranthene	1.4E+1	ug/L	6.3E-6	mg/kg-day	1.2E+0	(mg/kg-day)-1	8E-6	1.2E-4	mg/kg-day	NA	mg/kg-day	NA
				Carbon Disulfide	4.8E+0	ug/L	2.2E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	4.2E-5	mg/kg-day	1.0E-1	mg/kg-day	4.2E-4
				Chrysene	4.3E+1	ug/L	1.9E-5	mg/kg-day	1.2E-1	(mg/kg-day)-1	2E-6	3.8E-4	mg/kg-day	NA	mg/kg-day	NA
				Dibenz[a,h]anthracene	3.0E+0	ug/L	1.4E-6	mg/kg-day	4.1E+0	(mg/kg-day)-1	6E-6	2.6E-5	mg/kg-day	NA	mg/kg-day	NA
				Ethylbenzene	8.0E+2	ug/L	3.6E-4	mg/kg-day	3.9E-3	(mg/kg-day)-1	1E-6	7.0E-3	mg/kg-day	1.0E-1	mg/kg-day	7.0E-2
				Fluoranthene	2.8E+2	ug/L	1.3E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	2.5E-3	mg/kg-day	4.0E-2	mg/kg-day	6.2E-2
				Fluorene	7.0E+1	ug/L	3.2E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	6.2E-4	mg/kg-day	4.0E-2	mg/kg-day	1.5E-2

TABLE 7.13
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
TIER 2 CENTRAL EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Landscape Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater Potable Use	Potable Water	Potable Water	Ingestion	Indeno(1,2,3-cd)pyrene	4.4E+1	ug/L	2.0E-5	mg/kg-day	1.2E+0	(mg/kg-day)-1	2E-5	3.9E-4	mg/kg-day	NA	mg/kg-day	NA
				Isopropyl benzene	7.4E+0	ug/L	3.4E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	6.5E-5	mg/kg-day	1.0E-1	mg/kg-day	6.5E-4
				Methyl isobutyl ketone	3.5E+0	ug/L	1.6E-6	mg/kg-day	0.0E+0	(mg/kg-day)-1	0E+0	3.1E-5	mg/kg-day	8.0E-2	mg/kg-day	3.9E-4
				Methylene chloride	1.8E+2	ug/L	8.2E-5	mg/kg-day	1.4E-2	(mg/kg-day)-1	1E-6	1.6E-3	mg/kg-day	6.0E-2	mg/kg-day	2.6E-2
				MTBE	1.9E+1	ug/L	8.6E-6	mg/kg-day	1.8E-3	(mg/kg-day)-1	2E-8	1.7E-4	mg/kg-day	NA	mg/kg-day	NA
				n-Butylbenzene	1.8E+3	ug/L	8.2E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	1.6E-2	mg/kg-day	4.0E-2	mg/kg-day	4.0E-1
				n-Propylbenzene	1.1E+1	ug/L	5.0E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	9.7E-5	mg/kg-day	4.0E-2	mg/kg-day	2.4E-3
				Phenanthrene	2.5E+2	ug/L	1.1E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	2.2E-3	mg/kg-day	NA	mg/kg-day	NA
				Pyrene	2.0E+2	ug/L	9.1E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	1.8E-3	mg/kg-day	3.0E-2	mg/kg-day	5.9E-2
				Styrene	1.9E+2	ug/L	8.4E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	1.6E-3	mg/kg-day	2.0E-1	mg/kg-day	8.2E-3
				Toluene	6.2E+2	ug/L	2.8E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	5.5E-3	mg/kg-day	2.0E-1	mg/kg-day	2.7E-2
				Xylenes (total)	4.2E+2	ug/L	1.9E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	3.7E-3	mg/kg-day	2.0E-1	mg/kg-day	1.9E-2
				Benzene (500 ft)	4.9E+2	ug/L	2.2E-4	mg/kg-day	1.0E-1	(mg/kg-day)-1	2E-5	4.3E-3	mg/kg-day	3.0E-3	mg/kg-day	1.4E+0
				Benzene (725 ft)	3.2E+2	ug/L	1.5E-4	mg/kg-day	1.0E-1	(mg/kg-day)-1	1E-5	2.8E-3	mg/kg-day	3.0E-3	mg/kg-day	9.4E-1
				Naphthalene (500 ft)	4.2E+3	ug/L	1.9E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	3.7E-2	mg/kg-day	2.0E-2	mg/kg-day	1.8E+0
				Naphthalene (725 ft)	3.2E+3	ug/L	1.5E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	2.8E-2	mg/kg-day	2.0E-2	mg/kg-day	1.4E+0
			Exp. Route Total	krig - 500 ft							5E-4					8.8E+0
			Exp. Route Total	krig - 725 ft							5E-4					7.8E+0
		Exposure Point Total	krig - 500 ft								5E-4					8.8E+0
		Exposure Point Total	krig - 725 ft								5E-4					7.8E+0
	Exposure Medium Total	krig - 500 ft									5E-4					8.8E+0
	Exposure Medium Total	krig - 725 ft									5E-4					7.8E+0
Medium Total	krig - 500 ft										5E-4					8.8E+0
Medium Total	krig - 725 ft										5E-4					7.8E+0
Groundwater Industrial Use	Industrial Water	Industrial Water	Dermal	Aluminum	1.4E+3	ug/L	2.5E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	4.9E-5	mg/kg-day	1.0E+0	mg/kg-day	4.9E-5
				Antimony	4.8E-1	ug/L	8.7E-10	mg/kg-day	NA	(mg/kg-day)-1	NA	1.7E-8	mg/kg-day	4.0E-4	mg/kg-day	4.2E-5
				Arsenic	2.2E+1	ug/L	4.0E-8	mg/kg-day	9.5E+0	(mg/kg-day)-1	4E-7	7.7E-7	mg/kg-day	3.0E-4	mg/kg-day	2.6E-3
				Barium	2.0E+3	ug/L	3.5E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	6.9E-5	mg/kg-day	7.0E-2	mg/kg-day	9.8E-4
				Beryllium	1.8E+0	ug/L	3.3E-9	mg/kg-day	NA	(mg/kg-day)-1	NA	6.4E-8	mg/kg-day	2.0E-3	mg/kg-day	3.2E-5
				Cadmium	3.2E+0	ug/L	5.9E-9	mg/kg-day	3.8E-1	(mg/kg-day)-1	2E-9	1.1E-7	mg/kg-day	5.0E-4	mg/kg-day	2.3E-4
				Chromium	2.2E+1	ug/L	8.0E-8	mg/kg-day	NA	(mg/kg-day)-1	NA	1.5E-6	mg/kg-day	3.0E-3	mg/kg-day	5.2E-4
				Cobalt	7.5E+0	ug/L	1.3E-8	mg/kg-day	NA	(mg/kg-day)-1	NA	2.6E-7	mg/kg-day	2.0E-2	mg/kg-day	1.3E-5
				Copper	1.1E+1	ug/L	2.0E-8	mg/kg-day	NA	(mg/kg-day)-1	NA	3.9E-7	mg/kg-day	4.0E-2	mg/kg-day	9.7E-6
				Iron	4.0E+4	ug/L	7.2E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	1.4E-3	mg/kg-day	3.0E-1	mg/kg-day	4.7E-3
				Lead	3.7E-1	ug/L	6.7E-10	mg/kg-day	NA	(mg/kg-day)-1	NA	1.3E-8	mg/kg-day	NA	mg/kg-day	NA
				Manganese	2.5E+3	ug/L	4.5E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	8.7E-5	mg/kg-day	1.4E-1	mg/kg-day	6.2E-4
				Mercury	2.2E-1	ug/L	4.0E-10	mg/kg-day	NA	(mg/kg-day)-1	NA	7.8E-9	mg/kg-day	3.0E-4	mg/kg-day	2.6E-5
				Molybdenum	3.7E+1	ug/L	6.8E-8	mg/kg-day	NA	(mg/kg-day)-1	NA	1.3E-6	mg/kg-day	5.0E-3	mg/kg-day	2.6E-4

TABLE 7.13
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
TIER 2 CENTRAL EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Landscape Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
				Nickel	1.6E+1	ug/L	5.8E-9	mg/kg-day	NA	(mg/kg-day)-1	NA	1.1E-7	mg/kg-day	2.0E-2	mg/kg-day	5.6E-6
Groundwater	Industrial Water	Industrial Water	Dermal	Nitrate	7.0E+3	ug/L	1.3E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	2.5E-4	mg/kg-day	1.6E+0	mg/kg-day	1.5E-4
Industrial Use				Selenium	1.3E+1	ug/L	2.4E-8	mg/kg-day	NA	(mg/kg-day)-1	NA	4.6E-7	mg/kg-day	5.0E-3	mg/kg-day	9.1E-5
				Silver	1.5E+1	ug/L	1.6E-8	mg/kg-day	NA	(mg/kg-day)-1	NA	3.2E-7	mg/kg-day	5.0E-3	mg/kg-day	6.3E-5
				Thallium	9.6E+0	ug/L	1.7E-8	mg/kg-day	NA	(mg/kg-day)-1	NA	3.4E-7	mg/kg-day	6.6E-5	mg/kg-day	5.1E-3
				Vanadium	2.0E+1	ug/L	3.6E-8	mg/kg-day	NA	(mg/kg-day)-1	NA	7.0E-7	mg/kg-day	7.0E-3	mg/kg-day	1.0E-4
				Zinc	1.1E+1	ug/L	1.2E-8	mg/kg-day	NA	(mg/kg-day)-1	NA	2.3E-7	mg/kg-day	3.0E-1	mg/kg-day	7.7E-7
				1,2,4-Trimethylbenzene	5.5E+1	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	5.0E-2	mg/kg-day	0.0E+0
				1,2-Dichloroethane	5.0E+1	ug/L	3.8E-6	mg/kg-day	4.7E-2	(mg/kg-day)-1	2E-7	7.4E-5	mg/kg-day	3.0E-2	mg/kg-day	2.5E-3
				1,3,5-Trimethylbenzene	2.9E+1	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	5.0E-2	mg/kg-day	0.0E+0
				Acenaphthene	2.2E+2	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	6.0E-2	mg/kg-day	0.0E+0
				Acenaphthylene	8.0E+2	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Acetone	1.0E+4	ug/L	1.9E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	3.8E-4	mg/kg-day	1.0E-1	mg/kg-day	3.8E-3
				Anthracene	5.9E+1	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	3.0E-1	mg/kg-day	0.0E+0
				Benzo[a]anthracene	2.6E+1	ug/L	0.0E+0	mg/kg-day	1.2E+0	(mg/kg-day)-1	0E+0	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Benzo[a]pyrene	6.0E+1	ug/L	0.0E+0	mg/kg-day	1.2E+1	(mg/kg-day)-1	0E+0	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Benzo[b]fluoranthene	2.9E+1	ug/L	0.0E+0	mg/kg-day	1.2E+0	(mg/kg-day)-1	0E+0	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Benzo[g,h,i]perylene	3.7E+1	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Benzo[k]fluoranthene	1.4E+1	ug/L	0.0E+0	mg/kg-day	1.2E+0	(mg/kg-day)-1	0E+0	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Carbon Disulfide	4.8E+0	ug/L	1.5E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	2.9E-6	mg/kg-day	1.0E-1	mg/kg-day	2.9E-5
				Chrysene	4.3E+1	ug/L	0.0E+0	mg/kg-day	1.2E-1	(mg/kg-day)-1	0E+0	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Dibenz[a,h]anthracene	3.0E+0	ug/L	0.0E+0	mg/kg-day	4.1E+0	(mg/kg-day)-1	0E+0	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Ethylbenzene	8.0E+2	ug/L	7.1E-5	mg/kg-day	3.9E-3	(mg/kg-day)-1	3E-7	1.4E-3	mg/kg-day	1.0E-1	mg/kg-day	1.4E-2
				Fluoranthene	2.8E+2	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	4.0E-2	mg/kg-day	0.0E+0
				Fluorene	7.0E+1	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	4.0E-2	mg/kg-day	0.0E+0
				Indeno(1,2,3-cd)pyrene	4.4E+1	ug/L	0.0E+0	mg/kg-day	1.2E+0	(mg/kg-day)-1	0E+0	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Isopropyl benzene	7.4E+0	ug/L	4.1E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	8.0E-6	mg/kg-day	1.0E-1	mg/kg-day	8.0E-5
				Methyl isobutyl ketone	3.5E+0	ug/L	2.5E-8	mg/kg-day	0.0E+0	(mg/kg-day)-1	0E+0	4.9E-7	mg/kg-day	8.0E-2	mg/kg-day	6.1E-6
				Methylene chloride	1.8E+2	ug/L	1.1E-6	mg/kg-day	1.4E-2	(mg/kg-day)-1	2E-8	2.2E-5	mg/kg-day	6.0E-2	mg/kg-day	3.7E-4
				MTBE	1.9E+1	ug/L	1.3E-7	mg/kg-day	1.8E-3	(mg/kg-day)-1	2E-10	2.6E-6	mg/kg-day	NA	mg/kg-day	NA
				n-Butylbenzene	1.8E+3	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	4.0E-2	mg/kg-day	0.0E+0
				n-Propylbenzene	1.1E+1	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	4.0E-2	mg/kg-day	0.0E+0
				Phenanthrene	2.5E+2	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Pyrene	2.0E+2	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	3.0E-2	mg/kg-day	0.0E+0
				Styrene	1.9E+2	ug/L	1.2E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	2.4E-4	mg/kg-day	2.0E-1	mg/kg-day	1.2E-3
				Toluene	6.2E+2	ug/L	3.5E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	6.8E-4	mg/kg-day	2.0E-1	mg/kg-day	3.4E-3
				Xylenes (total)	4.2E+2	ug/L	4.1E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	7.9E-4	mg/kg-day	2.0E-1	mg/kg-day	3.9E-3
				Benzene (500 ft)	4.9E+2	ug/L	1.3E-5	mg/kg-day	1.0E-1	(mg/kg-day)-1	1E-6	2.6E-4	mg/kg-day	3.0E-3	mg/kg-day	8.7E-2
				Benzene (725 ft)	3.2E+2	ug/L	8.7E-6	mg/kg-day	1.0E-1	(mg/kg-day)-1	9E-7	1.7E-4	mg/kg-day	3.0E-3	mg/kg-day	5.7E-2

TABLE 7.13
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
TIER 2 CENTRAL EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Landscape Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater Industrial Use	Industrial Water	Industrial Water	Dermal	Naphthalene (500 ft)	4.2E+3	ug/L	1.1E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	2.2E-3	mg/kg-day	2.0E-2	mg/kg-day	1.1E-1
				Naphthalene (725 ft)	3.2E+3	ug/L	8.8E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	1.7E-3	mg/kg-day	2.0E-2	mg/kg-day	8.5E-2
			Exp. Route Total	krig - 500 ft							2E-6					2.4E-1
			Exp. Route Total	krig - 725 ft							2E-6					1.9E-1
		Exposure Point Total	krig - 500 ft								2E-6					2.4E-1
		Exposure Point Total	krig - 725 ft								2E-6					1.9E-1
	Exposure Medium Total	krig - 500 ft									2E-6					2.4E-1
	Exposure Medium Total	krig - 725 ft									2E-6					1.9E-1
	Work Space Air	Work Space Air	Inhalation	1,2,4-Trimethylbenzene	2.5E-5	mg/m3	2.2E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	4.4E-6	mg/kg-day	1.7E-3	mg/kg-day	2.6E-3
				1,2-Dichloroethane	2.9E-5	mg/m3	2.6E-7	mg/kg-day	7.2E-2	(mg/kg-day)-1	2E-8	5.1E-6	mg/kg-day	1.4E-3	mg/kg-day	3.7E-3
				1,3,5-Trimethylbenzene	1.3E-5	mg/m3	1.2E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	2.3E-6	mg/kg-day	1.7E-3	mg/kg-day	1.4E-3
				Acenaphthene	8.7E-5	mg/m3	7.9E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	1.5E-5	mg/kg-day	NA	mg/kg-day	NA
				Acetone	4.1E-3	mg/m3	3.7E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	7.2E-4	mg/kg-day	NA	mg/kg-day	NA
				Anthracene	2.3E-5	mg/m3	2.1E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	4.1E-6	mg/kg-day	NA	mg/kg-day	NA
				Benzo[b]fluoranthene	1.1E-5	mg/m3	1.0E-7	mg/kg-day	3.9E-1	(mg/kg-day)-1	4E-8	2.0E-6	mg/kg-day	NA	mg/kg-day	NA
				Carbon Disulfide	2.7E-6	mg/m3	2.5E-8	mg/kg-day	NA	(mg/kg-day)-1	NA	4.8E-7	mg/kg-day	2.0E-1	mg/kg-day	2.4E-6
				Chrysene	1.7E-5	mg/m3	1.5E-7	mg/kg-day	3.9E-2	(mg/kg-day)-1	6E-9	3.0E-6	mg/kg-day	NA	mg/kg-day	NA
				Ethylbenzene	3.8E-4	mg/m3	3.5E-6	mg/kg-day	3.9E-3	(mg/kg-day)-1	1E-8	6.7E-5	mg/kg-day	2.9E-1	mg/kg-day	2.3E-4
				Fluorene	2.8E-5	mg/m3	2.5E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	4.9E-6	mg/kg-day	NA	mg/kg-day	NA
				Isopropyl benzene	3.3E-6	mg/m3	3.0E-8	mg/kg-day	NA	(mg/kg-day)-1	NA	5.9E-7	mg/kg-day	1.1E-1	mg/kg-day	5.3E-6
				Methyl isobutyl ketone	1.5E-6	mg/m3	1.3E-8	mg/kg-day	0.0E+0	(mg/kg-day)-1	0E+0	2.6E-7	mg/kg-day	2.3E-2	mg/kg-day	1.1E-5
				Methylene chloride	1.1E-4	mg/m3	1.0E-6	mg/kg-day	3.5E-3	(mg/kg-day)-1	4E-9	2.0E-5	mg/kg-day	8.6E-1	mg/kg-day	2.3E-5
				MTBE	1.0E-5	mg/m3	9.4E-8	mg/kg-day	9.1E-4	(mg/kg-day)-1	9E-11	1.8E-6	mg/kg-day	8.6E-1	mg/kg-day	2.1E-6
				n-Butylbenzene	8.6E-4	mg/m3	7.8E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	1.5E-4	mg/kg-day	NA	mg/kg-day	NA
				n-Propylbenzene	5.3E-6	mg/m3	4.8E-8	mg/kg-day	NA	(mg/kg-day)-1	NA	9.3E-7	mg/kg-day	NA	mg/kg-day	NA
				Pyrene	7.9E-5	mg/m3	7.1E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	1.4E-5	mg/kg-day	NA	mg/kg-day	NA
				Styrene	9.0E-5	mg/m3	8.2E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	1.6E-5	mg/kg-day	2.9E-1	mg/kg-day	5.5E-5
				Toluene	3.2E-4	mg/m3	2.9E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	5.6E-5	mg/kg-day	1.1E-1	mg/kg-day	5.1E-4
				Xylenes (total)	2.2E-4	mg/m3	2.0E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	3.8E-5	mg/kg-day	2.9E-2	mg/kg-day	1.3E-3
				Benzene (500 ft)	2.7E-4	mg/m3	2.5E-6	mg/kg-day	1.0E-1	(mg/kg-day)-1	2E-7	4.8E-5	mg/kg-day	1.7E-3	mg/kg-day	2.8E-2
				Benzene (725 ft)	1.8E-4	mg/m3	1.6E-6	mg/kg-day	1.0E-1	(mg/kg-day)-1	2E-7	3.2E-5	mg/kg-day	1.7E-3	mg/kg-day	1.9E-2
				Naphthalene (500 ft)	1.9E-3	mg/m3	1.7E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	3.3E-4	mg/kg-day	8.6E-4	mg/kg-day	3.8E-1
				Naphthalene (725 ft)	1.4E-3	mg/m3	1.3E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	2.5E-4	mg/kg-day	8.6E-4	mg/kg-day	2.9E-1

TABLE 7.13

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

TIER 2 CENTRAL EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Landscape Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Work Space Air	Work Space Air	Exp. Route Total	krig - 500 ft							3E-7					4.2E-1
Industrial Use			Exp. Route Total	krig - 725 ft							2E-7					3.2E-1
		Exposure Point Total	krig - 500 ft								3E-7					4.2E-1
		Exposure Point Total	krig - 725 ft								2E-7					3.2E-1
	Exposure Medium Total	krig - 500 ft									3E-7					4.2E-1
	Exposure Medium Total	krig - 725 ft									2E-7					3.2E-1
Medium Total	krig - 500 ft										3E-6					6.6E-1
Medium Total	krig - 725 ft										2E-6					5.1E-1
Total of Receptor Risks Across All Media											5E-4	Total of Receptor Risks Across All Media				9.4E+0
Total of Receptor Risks Across All Media											5E-4	Total of Receptor Risks Across All Media				8.4E+0

TABLE 7.14

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

TIER 2 REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Landscape Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater Potable Use	Potable Water	Potable Water	Ingestion	Aluminum	1.4E+3	ug/L	3.1E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	1.2E-2	mg/kg-day	1.0E+0	mg/kg-day	1.2E-2
				Antimony	4.8E-1	ug/L	1.1E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	4.2E-6	mg/kg-day	4.0E-4	mg/kg-day	1.1E-2
				Arsenic	2.2E+1	ug/L	4.9E-5	mg/kg-day	9.5E+0	(mg/kg-day)-1	5E-4	1.9E-4	mg/kg-day	3.0E-4	mg/kg-day	6.5E-1
				Barium	2.0E+3	ug/L	4.3E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	1.7E-2	mg/kg-day	7.0E-2	mg/kg-day	2.5E-1
				Beryllium	1.8E+0	ug/L	4.1E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	1.6E-5	mg/kg-day	2.0E-3	mg/kg-day	8.1E-3
				Cadmium	3.2E+0	ug/L	7.2E-6	mg/kg-day	3.8E-1	(mg/kg-day)-1	3E-6	2.9E-5	mg/kg-day	5.0E-4	mg/kg-day	5.7E-2
				Chromium	2.2E+1	ug/L	4.9E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	1.9E-4	mg/kg-day	3.0E-3	mg/kg-day	6.5E-2
				Cobalt	7.5E+0	ug/L	1.7E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	6.6E-5	mg/kg-day	2.0E-2	mg/kg-day	3.3E-3
				Copper	1.1E+1	ug/L	2.4E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	9.7E-5	mg/kg-day	4.0E-2	mg/kg-day	2.4E-3
				Iron	4.0E+4	ug/L	8.8E-2	mg/kg-day	NA	(mg/kg-day)-1	NA	3.5E-1	mg/kg-day	3.0E-1	mg/kg-day	1.2E+0
				Lead	3.7E-1	ug/L	8.2E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	3.3E-6	mg/kg-day	NA	mg/kg-day	NA
				Manganese	2.5E+3	ug/L	5.5E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	2.2E-2	mg/kg-day	1.4E-1	mg/kg-day	1.6E-1
				Mercury	2.2E-1	ug/L	4.9E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	2.0E-6	mg/kg-day	3.0E-4	mg/kg-day	6.5E-3
				Molybdenum	3.7E+1	ug/L	8.3E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	3.3E-4	mg/kg-day	5.0E-3	mg/kg-day	6.6E-2
				Nickel	1.6E+1	ug/L	3.5E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	1.4E-4	mg/kg-day	2.0E-2	mg/kg-day	7.0E-3
				Nitrate	7.0E+3	ug/L	1.5E-2	mg/kg-day	NA	(mg/kg-day)-1	NA	6.2E-2	mg/kg-day	1.6E+0	mg/kg-day	3.9E-2
				Selenium	1.3E+1	ug/L	2.9E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	1.1E-4	mg/kg-day	5.0E-3	mg/kg-day	2.3E-2
				Silver	1.5E+1	ug/L	3.3E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	1.3E-4	mg/kg-day	5.0E-3	mg/kg-day	2.6E-2
				Thallium	9.6E+0	ug/L	2.1E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	8.5E-5	mg/kg-day	6.6E-5	mg/kg-day	1.3E+0
				Vanadium	2.0E+1	ug/L	4.4E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	1.8E-4	mg/kg-day	7.0E-3	mg/kg-day	2.5E-2
				Zinc	1.1E+1	ug/L	2.4E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	9.7E-5	mg/kg-day	3.0E-1	mg/kg-day	3.2E-4
				1,2,4-Trimethylbenzene	5.5E+1	ug/L	1.2E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	4.8E-4	mg/kg-day	5.0E-2	mg/kg-day	9.7E-3
				1,2-Dichloroethane	5.0E+1	ug/L	1.1E-4	mg/kg-day	4.7E-2	(mg/kg-day)-1	5E-6	4.4E-4	mg/kg-day	3.0E-2	mg/kg-day	1.5E-2
				1,3,5-Trimethylbenzene	2.9E+1	ug/L	6.4E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	2.6E-4	mg/kg-day	5.0E-2	mg/kg-day	5.1E-3
				Acenaphthene	2.2E+2	ug/L	4.9E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	1.9E-3	mg/kg-day	6.0E-2	mg/kg-day	3.2E-2
				Acenaphthylene	8.0E+2	ug/L	1.8E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	7.0E-3	mg/kg-day	NA	mg/kg-day	NA
				Acetone	1.0E+4	ug/L	2.2E-2	mg/kg-day	NA	(mg/kg-day)-1	NA	8.8E-2	mg/kg-day	1.0E-1	mg/kg-day	8.8E-1
				Anthracene	5.9E+1	ug/L	1.3E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	5.2E-4	mg/kg-day	3.0E-1	mg/kg-day	1.7E-3
				Benzo[a]anthracene	2.6E+1	ug/L	5.8E-5	mg/kg-day	1.2E+0	(mg/kg-day)-1	7E-5	2.3E-4	mg/kg-day	NA	mg/kg-day	NA
				Benzo[a]pyrene	6.0E+1	ug/L	1.3E-4	mg/kg-day	1.2E+1	(mg/kg-day)-1	2E-3	5.3E-4	mg/kg-day	NA	mg/kg-day	NA
				Benzo[b]fluoranthene	2.9E+1	ug/L	6.4E-5	mg/kg-day	1.2E+0	(mg/kg-day)-1	8E-5	2.6E-4	mg/kg-day	NA	mg/kg-day	NA
				Benzo[g,h,i]perylene	3.7E+1	ug/L	8.2E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	3.3E-4	mg/kg-day	NA	mg/kg-day	NA
				Benzo[k]fluoranthene	1.4E+1	ug/L	3.1E-5	mg/kg-day	1.2E+0	(mg/kg-day)-1	4E-5	1.2E-4	mg/kg-day	NA	mg/kg-day	NA
				Carbon Disulfide	4.8E+0	ug/L	1.1E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	4.2E-5	mg/kg-day	1.0E-1	mg/kg-day	4.2E-4
				Chrysene	4.3E+1	ug/L	9.5E-5	mg/kg-day	1.2E-1	(mg/kg-day)-1	1E-5	3.8E-4	mg/kg-day	NA	mg/kg-day	NA
				Dibenz[a,h]anthracene	3.0E+0	ug/L	6.6E-6	mg/kg-day	4.1E+0	(mg/kg-day)-1	3E-5	2.6E-5	mg/kg-day	NA	mg/kg-day	NA
				Ethylbenzene	8.0E+2	ug/L	1.8E-3	mg/kg-day	3.9E-3	(mg/kg-day)-1	7E-6	7.0E-3	mg/kg-day	1.0E-1	mg/kg-day	7.0E-2
				Fluoranthene	2.8E+2	ug/L	6.2E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	2.5E-3	mg/kg-day	4.0E-2	mg/kg-day	6.2E-2
				Fluorene	7.0E+1	ug/L	1.5E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	6.2E-4	mg/kg-day	4.0E-2	mg/kg-day	1.5E-2

TABLE 7.14
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
TIER 2 REASONABLE MAXIMUM EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Landscape Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater Potable Use	Potable Water	Potable Water	Ingestion	Indeno(1,2,3-cd)pyrene	4.4E+1	ug/L	9.7E-5	mg/kg-day	1.2E+0	(mg/kg-day)-1	1E-4	3.9E-4	mg/kg-day	NA	mg/kg-day	NA
				Isopropyl benzene	7.4E+0	ug/L	1.6E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	6.5E-5	mg/kg-day	1.0E-1	mg/kg-day	6.5E-4
				Methyl isobutyl ketone	3.5E+0	ug/L	7.7E-6	mg/kg-day	0.0E+0	(mg/kg-day)-1	0E+0	3.1E-5	mg/kg-day	8.0E-2	mg/kg-day	3.9E-4
				Methylene chloride	1.8E+2	ug/L	4.0E-4	mg/kg-day	1.4E-2	(mg/kg-day)-1	6E-6	1.6E-3	mg/kg-day	6.0E-2	mg/kg-day	2.6E-2
				MTBE	1.9E+1	ug/L	4.2E-5	mg/kg-day	1.8E-3	(mg/kg-day)-1	8E-8	1.7E-4	mg/kg-day	NA	mg/kg-day	NA
				n-Butylbenzene	1.8E+3	ug/L	4.0E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	1.6E-2	mg/kg-day	4.0E-2	mg/kg-day	4.0E-1
				n-Propylbenzene	1.1E+1	ug/L	2.4E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	9.7E-5	mg/kg-day	4.0E-2	mg/kg-day	2.4E-3
				Phenanthrene	2.5E+2	ug/L	5.5E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	2.2E-3	mg/kg-day	NA	mg/kg-day	NA
				Pyrene	2.0E+2	ug/L	4.4E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	1.8E-3	mg/kg-day	3.0E-2	mg/kg-day	5.9E-2
				Styrene	1.9E+2	ug/L	4.1E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	1.6E-3	mg/kg-day	2.0E-1	mg/kg-day	8.2E-3
				Toluene	6.2E+2	ug/L	1.4E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	5.5E-3	mg/kg-day	2.0E-1	mg/kg-day	2.7E-2
				Xylenes (total)	4.2E+2	ug/L	9.4E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	3.7E-3	mg/kg-day	2.0E-1	mg/kg-day	1.9E-2
				Benzene (500 ft)	4.9E+2	ug/L	1.1E-3	mg/kg-day	1.0E-1	(mg/kg-day)-1	1E-4	4.3E-3	mg/kg-day	3.0E-3	mg/kg-day	1.4E+0
				Benzene (725 ft)	3.2E+2	ug/L	7.1E-4	mg/kg-day	1.0E-1	(mg/kg-day)-1	7E-5	2.8E-3	mg/kg-day	3.0E-3	mg/kg-day	9.4E-1
				Naphthalene (500 ft)	4.2E+3	ug/L	9.2E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	3.7E-2	mg/kg-day	2.0E-2	mg/kg-day	1.8E+0
				Naphthalene (725 ft)	3.2E+3	ug/L	7.2E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	2.8E-2	mg/kg-day	2.0E-2	mg/kg-day	1.4E+0
			Exp. Route Total	krig - 500 ft							3E-3					8.8E+0
			Exp. Route Total	krig - 725 ft							2E-3					7.8E+0
		Exposure Point Total	krig - 500 ft								3E-3					8.8E+0
		Exposure Point Total	krig - 725 ft								2E-3					7.8E+0
	Exposure Medium Total	krig - 500 ft									3E-3					8.8E+0
	Exposure Medium Total	krig - 725 ft									2E-3					7.8E+0
Medium Total	krig - 500 ft										3E-3					8.8E+0
Medium Total	krig - 725 ft										2E-3					7.8E+0
Groundwater Industrial Use	Industrial Water	Industrial Water	Dermal	Aluminum	1.4E+3	ug/L	2.9E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	1.1E-4	mg/kg-day	1.0E+0	mg/kg-day	1.1E-4
				Antimony	4.8E-1	ug/L	9.8E-9	mg/kg-day	NA	(mg/kg-day)-1	NA	3.9E-8	mg/kg-day	4.0E-4	mg/kg-day	9.7E-5
				Arsenic	2.2E+1	ug/L	4.5E-7	mg/kg-day	9.5E+0	(mg/kg-day)-1	4E-6	1.8E-6	mg/kg-day	3.0E-4	mg/kg-day	5.9E-3
				Barium	2.0E+3	ug/L	4.0E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	1.6E-4	mg/kg-day	7.0E-2	mg/kg-day	2.3E-3
				Beryllium	1.8E+0	ug/L	3.7E-8	mg/kg-day	NA	(mg/kg-day)-1	NA	1.5E-7	mg/kg-day	2.0E-3	mg/kg-day	7.4E-5
				Cadmium	3.2E+0	ug/L	6.6E-8	mg/kg-day	3.8E-1	(mg/kg-day)-1	3E-8	2.6E-7	mg/kg-day	5.0E-4	mg/kg-day	5.2E-4
				Chromium	2.2E+1	ug/L	9.0E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	3.6E-6	mg/kg-day	3.0E-3	mg/kg-day	1.2E-3
				Cobalt	7.5E+0	ug/L	1.5E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	6.0E-7	mg/kg-day	2.0E-2	mg/kg-day	3.0E-5
				Copper	1.1E+1	ug/L	2.2E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	8.9E-7	mg/kg-day	4.0E-2	mg/kg-day	2.2E-5
				Iron	4.0E+4	ug/L	8.1E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	3.2E-3	mg/kg-day	3.0E-1	mg/kg-day	1.1E-2
				Lead	3.7E-1	ug/L	7.5E-9	mg/kg-day	NA	(mg/kg-day)-1	NA	3.0E-8	mg/kg-day	NA	mg/kg-day	NA
				Manganese	2.5E+3	ug/L	5.0E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	2.0E-4	mg/kg-day	1.4E-1	mg/kg-day	1.4E-3
				Mercury	2.2E-1	ug/L	4.5E-9	mg/kg-day	NA	(mg/kg-day)-1	NA	1.8E-8	mg/kg-day	3.0E-4	mg/kg-day	6.0E-5
				Molybdenum	3.7E+1	ug/L	7.6E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	3.0E-6	mg/kg-day	5.0E-3	mg/kg-day	6.1E-4

TABLE 7.14
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
TIER 2 REASONABLE MAXIMUM EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Landscape Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater Industrial Use	Industrial Water	Industrial Water	Dermal	Nickel	1.6E+1	ug/L	6.5E-8	mg/kg-day	NA	(mg/kg-day)-1	NA	2.6E-7	mg/kg-day	2.0E-2	mg/kg-day	1.3E-5
				Nitrate	7.0E+3	ug/L	1.4E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	5.7E-4	mg/kg-day	1.6E+0	mg/kg-day	3.5E-4
				Selenium	1.3E+1	ug/L	2.6E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	1.1E-6	mg/kg-day	5.0E-3	mg/kg-day	2.1E-4
				Silver	1.5E+1	ug/L	1.8E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	7.3E-7	mg/kg-day	5.0E-3	mg/kg-day	1.5E-4
				Thallium	9.6E+0	ug/L	2.0E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	7.8E-7	mg/kg-day	6.6E-5	mg/kg-day	1.2E-2
				Vanadium	2.0E+1	ug/L	4.1E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	1.6E-6	mg/kg-day	7.0E-3	mg/kg-day	2.3E-4
				Zinc	1.1E+1	ug/L	1.3E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	5.3E-7	mg/kg-day	3.0E-1	mg/kg-day	1.8E-6
				1,2,4-Trimethylbenzene	5.5E+1	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	5.0E-2	mg/kg-day	0.0E+0
				1,2-Dichloroethane	5.0E+1	ug/L	4.3E-5	mg/kg-day	4.7E-2	(mg/kg-day)-1	2E-6	1.7E-4	mg/kg-day	3.0E-2	mg/kg-day	5.7E-3
				1,3,5-Trimethylbenzene	2.9E+1	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	5.0E-2	mg/kg-day	0.0E+0
				Acenaphthene	2.2E+2	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	6.0E-2	mg/kg-day	0.0E+0
				Acenaphthylene	8.0E+2	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Acetone	1.0E+4	ug/L	2.2E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	8.7E-4	mg/kg-day	1.0E-1	mg/kg-day	8.7E-3
				Anthracene	5.9E+1	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	3.0E-1	mg/kg-day	0.0E+0
				Benzo[a]anthracene	2.6E+1	ug/L	0.0E+0	mg/kg-day	1.2E+0	(mg/kg-day)-1	0E+0	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Benzo[a]pyrene	6.0E+1	ug/L	0.0E+0	mg/kg-day	1.2E+1	(mg/kg-day)-1	0E+0	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Benzo[b]fluoranthene	2.9E+1	ug/L	0.0E+0	mg/kg-day	1.2E+0	(mg/kg-day)-1	0E+0	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Benzo[g,h,I]perylene	3.7E+1	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Benzo[k]fluoranthene	1.4E+1	ug/L	0.0E+0	mg/kg-day	1.2E+0	(mg/kg-day)-1	0E+0	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Carbon Disulfide	4.8E+0	ug/L	1.7E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	6.6E-6	mg/kg-day	1.0E-1	mg/kg-day	6.6E-5
				Chrysene	4.3E+1	ug/L	0.0E+0	mg/kg-day	1.2E-1	(mg/kg-day)-1	0E+0	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Dibenz[a,h]anthracene	3.0E+0	ug/L	0.0E+0	mg/kg-day	4.1E+0	(mg/kg-day)-1	0E+0	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Ethylbenzene	8.0E+2	ug/L	8.0E-4	mg/kg-day	3.9E-3	(mg/kg-day)-1	3E-6	3.2E-3	mg/kg-day	1.0E-1	mg/kg-day	3.2E-2
				Fluoranthene	2.8E+2	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	4.0E-2	mg/kg-day	0.0E+0
				Fluorene	7.0E+1	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	4.0E-2	mg/kg-day	0.0E+0
				Indeno(1,2,3-cd)pyrene	4.4E+1	ug/L	0.0E+0	mg/kg-day	1.2E+0	(mg/kg-day)-1	0E+0	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Isopropyl benzene	7.4E+0	ug/L	4.6E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	1.8E-5	mg/kg-day	1.0E-1	mg/kg-day	1.8E-4
				Methyl isobutyl ketone	3.5E+0	ug/L	2.8E-7	mg/kg-day	0.0E+0	(mg/kg-day)-1	0E+0	1.1E-6	mg/kg-day	8.0E-2	mg/kg-day	1.4E-5
				Methylene chloride	1.8E+2	ug/L	1.3E-5	mg/kg-day	1.4E-2	(mg/kg-day)-1	2E-7	5.1E-5	mg/kg-day	6.0E-2	mg/kg-day	8.5E-4
				MTBE	1.9E+1	ug/L	1.5E-6	mg/kg-day	1.8E-3	(mg/kg-day)-1	3E-9	6.0E-6	mg/kg-day	NA	mg/kg-day	NA
				n-Butylbenzene	1.8E+3	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	4.0E-2	mg/kg-day	0.0E+0
				n-Propylbenzene	1.1E+1	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	4.0E-2	mg/kg-day	0.0E+0
				Phenanthrene	2.5E+2	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	NA	mg/kg-day	NA
				Pyrene	2.0E+2	ug/L	0.0E+0	mg/kg-day	NA	(mg/kg-day)-1	NA	0.0E+0	mg/kg-day	3.0E-2	mg/kg-day	0.0E+0
				Styrene	1.9E+2	ug/L	1.4E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	5.6E-4	mg/kg-day	2.0E-1	mg/kg-day	2.8E-3
				Toluene	6.2E+2	ug/L	3.9E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	1.6E-3	mg/kg-day	2.0E-1	mg/kg-day	7.8E-3
				Xylenes (total)	4.2E+2	ug/L	4.6E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	1.8E-3	mg/kg-day	2.0E-1	mg/kg-day	9.1E-3
				Benzene (500 ft)	4.9E+2	ug/L	1.5E-4	mg/kg-day	1.0E-1	(mg/kg-day)-1	2E-5	6.0E-4	mg/kg-day	3.0E-3	mg/kg-day	2.0E-1
				Benzene (725 ft)	3.2E+2	ug/L	9.8E-5	mg/kg-day	1.0E-1	(mg/kg-day)-1	1E-5	3.9E-4	mg/kg-day	3.0E-3	mg/kg-day	1.3E-1

TABLE 7.14
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
TIER 2 REASONABLE MAXIMUM EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Landscape Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater Industrial Use	Industrial Water	Industrial Water	Dermal	Naphthalene (500 ft)	4.2E+3	ug/L	1.3E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	5.1E-3	mg/kg-day	2.0E-2	mg/kg-day	2.5E-1
				Naphthalene (725 ft)	3.2E+3	ug/L	9.9E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	3.9E-3	mg/kg-day	2.0E-2	mg/kg-day	2.0E-1
			Exp. Route Total	krig - 500 ft							2E-5					5.6E-1
			Exp. Route Total	krig - 725 ft							2E-5					4.3E-1
		Exposure Point Total	krig - 500 ft								2E-5					5.6E-1
		Exposure Point Total	krig - 725 ft								2E-5					4.3E-1
	Exposure Medium Total	krig - 500 ft									2E-5					5.6E-1
	Exposure Medium Total	krig - 725 ft									2E-5					4.3E-1
	Work Space Air	Work Space Air	Inhalation	1,2,4-Trimethylbenzene	5.6E-5	mg/m3	1.1E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	4.4E-6	mg/kg-day	1.7E-3	mg/kg-day	2.6E-3
				1,2-Dichloroethane	6.6E-5	mg/m3	1.3E-6	mg/kg-day	7.2E-2	(mg/kg-day)-1	9E-8	5.1E-6	mg/kg-day	1.4E-3	mg/kg-day	3.7E-3
				1,3,5-Trimethylbenzene	3.0E-5	mg/m3	5.8E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	2.3E-6	mg/kg-day	1.7E-3	mg/kg-day	1.4E-3
				Acenaphthene	2.0E-4	mg/m3	3.9E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	1.5E-5	mg/kg-day	NA	mg/kg-day	NA
				Acetone	9.3E-3	mg/m3	1.8E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	7.2E-4	mg/kg-day	NA	mg/kg-day	NA
				Anthracene	5.3E-5	mg/m3	1.0E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	4.1E-6	mg/kg-day	NA	mg/kg-day	NA
				Benzo[b]fluoranthene	2.6E-5	mg/m3	5.1E-7	mg/kg-day	3.9E-1	(mg/kg-day)-1	2E-7	2.0E-6	mg/kg-day	NA	mg/kg-day	NA
				Carbon Disulfide	6.2E-6	mg/m3	1.2E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	4.8E-7	mg/kg-day	2.0E-1	mg/kg-day	2.4E-6
				Chrysene	3.9E-5	mg/m3	7.5E-7	mg/kg-day	3.9E-2	(mg/kg-day)-1	3E-8	3.0E-6	mg/kg-day	NA	mg/kg-day	NA
				Ethylbenzene	8.7E-4	mg/m3	1.7E-5	mg/kg-day	3.9E-3	(mg/kg-day)-1	7E-8	6.7E-5	mg/kg-day	2.9E-1	mg/kg-day	2.3E-4
				Fluorene	6.3E-5	mg/m3	1.2E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	4.9E-6	mg/kg-day	NA	mg/kg-day	NA
				Isopropyl benzene	7.6E-6	mg/m3	1.5E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	5.9E-7	mg/kg-day	1.1E-1	mg/kg-day	5.3E-6
				Methyl isobutyl ketone	3.3E-6	mg/m3	6.4E-8	mg/kg-day	0.0E+0	(mg/kg-day)-1	0E+0	2.6E-7	mg/kg-day	2.3E-2	mg/kg-day	1.1E-5
				Methylene chloride	2.6E-4	mg/m3	5.0E-6	mg/kg-day	3.5E-3	(mg/kg-day)-1	2E-8	2.0E-5	mg/kg-day	8.6E-1	mg/kg-day	2.3E-5
				MTBE	2.4E-5	mg/m3	4.6E-7	mg/kg-day	9.1E-4	(mg/kg-day)-1	4E-10	1.8E-6	mg/kg-day	8.6E-1	mg/kg-day	2.1E-6
				n-Butylbenzene	2.0E-3	mg/m3	3.8E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	1.5E-4	mg/kg-day	NA	mg/kg-day	NA
				n-Propylbenzene	1.2E-5	mg/m3	2.3E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	9.3E-7	mg/kg-day	NA	mg/kg-day	NA
				Pyrene	1.8E-4	mg/m3	3.5E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	1.4E-5	mg/kg-day	NA	mg/kg-day	NA
				Styrene	2.1E-4	mg/m3	4.0E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	1.6E-5	mg/kg-day	2.9E-1	mg/kg-day	5.5E-5
				Toluene	7.2E-4	mg/m3	1.4E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	5.6E-5	mg/kg-day	1.1E-1	mg/kg-day	5.1E-4
				Xylenes (total)	5.0E-4	mg/m3	9.7E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	3.8E-5	mg/kg-day	2.9E-2	mg/kg-day	1.3E-3
				Benzene (500 ft)	6.3E-4	mg/m3	1.2E-5	mg/kg-day	1.0E-1	(mg/kg-day)-1	1E-6	4.8E-5	mg/kg-day	1.7E-3	mg/kg-day	2.8E-2
				Benzene (725 ft)	4.1E-4	mg/m3	7.9E-6	mg/kg-day	1.0E-1	(mg/kg-day)-1	8E-7	3.2E-5	mg/kg-day	1.7E-3	mg/kg-day	1.9E-2
				Naphthalene (500 ft)	4.2E-3	mg/m3	8.2E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	3.3E-4	mg/kg-day	8.6E-4	mg/kg-day	3.8E-1
				Naphthalene (725 ft)	3.3E-3	mg/m3	6.4E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	2.5E-4	mg/kg-day	8.6E-4	mg/kg-day	2.9E-1

TABLE 7.14

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

TIER 2 REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Landscape Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Work Space Air	Work Space Air	Exp. Route Total	krig - 500 ft							2E-6					4.2E-1
Industrial Use			Exp. Route Total	krig - 725 ft							1E-6					3.2E-1
		Exposure Point Total	krig - 500 ft								2E-6					4.2E-1
		Exposure Point Total	krig - 725 ft								1E-6					3.2E-1
	Exposure Medium Total	krig - 500 ft									2E-6					4.2E-1
	Exposure Medium Total	krig - 725 ft									1E-6					3.2E-1
Medium Total	krig - 500 ft										3E-5					9.7E-1
Medium Total	krig - 725 ft										2E-5					7.5E-1
Total of Receptor Risks Across All Media											3E-3	Total of Receptor Risks Across All Media				9.7E+0
Total of Receptor Risks Across All Media											3E-3	Total of Receptor Risks Across All Media				8.6E+0

TABLE 7.15
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
TIER 2 CENTRAL EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: On-Site Resident
Receptor Age: Child / Age-Adjusted Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil Vapor	Indoor Air	Indoor Air	Air Inhalation	Chloroform	2.8E-3	ug/m3					6E-9					8.9E-6
				Ethylbenzene	7.1E-2	ug/m3					3E-8					3.4E-5
				m,p-Xylene	5.5E-2	ug/m3					NA					5.2E-4
				Naphthalene	6.5E-2	ug/m3					NA					6.9E-3
				Tetrachloroethene (PCE)	1.7E-3	ug/m3					4E-9					4.7E-5
				Trichloroethene	3.6E-3	ug/m3					3E-9					5.7E-6
		Alameda Annex		Benzene (Alameda Annex)	9.9E-2	ug/m3					1E-6					1.6E-3
		Alameda Point - Site 25		Benzene (Alameda Point - Site 25)	3.7E-4	ug/m3					4E-9					6.0E-6
		Alameda Point - Site 30		Benzene (Alameda Point - Site 30)	5.7E-4	ug/m3					7E-9					9.2E-6
		Alameda Point - Site 31		Benzene (Alameda Point - Site 31)	2.9E-4	ug/m3					3E-9					4.6E-6
			Exp. Route Total	(Alameda Annex)							1E-6					9.1E-3
			Exp. Route Total	(Alameda Point - Site 25)							5E-8					7.6E-3
			Exp. Route Total	(Alameda Point - Site 30)							5E-8					7.6E-3
			Exp. Route Total	(Alameda Point - Site 31)							5E-8					7.6E-3
		Exposure Point Total	(Alameda Annex)								1E-6					9.1E-3
		Exposure Point Total	(Alameda Point - Site 25)								5E-8					7.6E-3
		Exposure Point Total	(Alameda Point - Site 30)								5E-8					7.6E-3
		Exposure Point Total	(Alameda Point - Site 31)								5E-8					7.6E-3
	Exposure Medium Total	(Alameda Annex)									1E-6					9.1E-3
	Exposure Medium Total	(Alameda Point - Site 25)									5E-8					7.6E-3
	Exposure Medium Total	(Alameda Point - Site 30)									5E-8					7.6E-3
	Exposure Medium Total	(Alameda Point - Site 31)									5E-8					7.6E-3
Medium Total	(Alameda Annex)										1E-6					9.1E-3
Medium Total	(Alameda Point - Site 25)										5E-8					7.6E-3
Medium Total	(Alameda Point - Site 30)										5E-8					7.6E-3
Medium Total	(Alameda Point - Site 31)										5E-8					7.6E-3
Groundwater	Indoor Air	Indoor Air	Air Inhalation	1,2,4-Trimethylbenzene	6.0E-2	ug/m3					NA					7.9E-4
				1,2-Dichloroethane	1.9E-2	ug/m3					2E-7					3.5E-3
				1,3,5-Trimethylbenzene	3.2E-2	ug/m3					NA					9.7E-3
				Acetone	2.9E-1	ug/m3					NA					7.9E-4
				Carbon disulfide	6.0E-2	ug/m3					NA					7.1E-5
				Ethylbenzene	1.6E+0	ug/m3					7E-7					7.5E-4
				Isopropyl benzene	1.7E-2	ug/m3					NA					4.1E-5
				Methyl isobutyl ketone	4.9E-3	ug/m3					NA					1.7E-5
				Methylene chloride	1.6E-1	ug/m3					7E-8					3.9E-4
				MTBE	7.3E-3	ug/m3					8E-10					8.7E-7

TABLE 7.15

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

TIER 2 CENTRAL EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: On-Site Resident
Receptor Age: Child / Age-Adjusted Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Indoor Air	Indoor Air	Air Inhalation	Naphthalene	2.1E+0	ug/m3					NA					2.2E-1
				n-Butylbenzene	5.5E+0	ug/m3					NA					3.8E-2
				n-Propylbenzene	NA	ug/m3					NA					NA
				Styrene	1.2E-1	ug/m3					NA					1.3E-4
				Toluene	1.2E+0	ug/m3					NA					3.9E-3
				Xylenes (total)	6.0E-1	ug/m3					NA					8.2E-4
				Benzene (500 ft)	9.1E-1	ug/m3					1E-5					1.5E-2
				Benzene (725 ft)	5.9E-1	ug/m3					7E-6					9.5E-3
			Exp. Route Total	krig - 500 ft							1E-5					2.9E-1
			Exp. Route Total	krig - 725 ft							8E-6					2.9E-1
		Exposure Point Total	krig - 500 ft								1E-5					2.9E-1
		Exposure Point Total	krig - 725 ft								8E-6					2.9E-1
	Exposure Medium Total	krig - 500 ft									1E-5					2.9E-1
	Exposure Medium Total	krig - 725 ft									8E-6					2.9E-1
Medium Total	krig - 500 ft										1E-5					2.9E-1
Medium Total	krig - 725 ft										8E-6					2.9E-1
Groundwater[1] Potable Use	Potable Water	Potable Water	Ingestion	Aluminum	1.4E+3	ug/L	4.7E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	4.5E-2	mg/kg-day	1.0E+0	mg/kg-day	4.5E-2
				Antimony	4.8E-1	ug/L	1.6E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	1.5E-5	mg/kg-day	4.0E-4	mg/kg-day	3.8E-2
				Arsenic	2.2E+1	ug/L	7.3E-5	mg/kg-day	9.5E+0	(mg/kg-day)-1	7E-4	7.0E-4	mg/kg-day	3.0E-4	mg/kg-day	2.3E+0
				Barium	2.0E+3	ug/L	6.5E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	6.3E-2	mg/kg-day	7.0E-2	mg/kg-day	8.9E-1
				Beryllium	1.8E+0	ug/L	6.1E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	5.8E-5	mg/kg-day	2.0E-3	mg/kg-day	2.9E-2
				Cadmium	3.2E+0	ug/L	1.1E-5	mg/kg-day	3.8E-1	(mg/kg-day)-1	4E-6	1.0E-4	mg/kg-day	5.0E-4	mg/kg-day	2.1E-1
				Chromium	2.2E+1	ug/L	7.3E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	7.0E-4	mg/kg-day	3.0E-3	mg/kg-day	2.3E-1
				Cobalt	7.5E+0	ug/L	2.5E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	2.4E-4	mg/kg-day	2.0E-2	mg/kg-day	1.2E-2
				Copper	1.1E+1	ug/L	3.7E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	3.5E-4	mg/kg-day	4.0E-2	mg/kg-day	8.8E-3
				Iron	4.0E+4	ug/L	1.3E-1	mg/kg-day	NA	(mg/kg-day)-1	NA	1.3E+0	mg/kg-day	3.0E-1	mg/kg-day	4.2E+0
				Lead	3.7E-1	ug/L	1.2E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	1.2E-5	mg/kg-day	NA	mg/kg-day	NA
				Manganese	2.5E+3	ug/L	8.2E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	7.9E-2	mg/kg-day	1.4E-1	mg/kg-day	5.6E-1
				Mercury	2.2E-1	ug/L	7.4E-7	mg/kg-day	NA	(mg/kg-day)-1	NA	7.1E-6	mg/kg-day	3.0E-4	mg/kg-day	2.4E-2
				Molybdenum	3.7E+1	ug/L	1.2E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	1.2E-3	mg/kg-day	5.0E-3	mg/kg-day	2.4E-1
				Nickel	1.6E+1	ug/L	5.3E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	5.1E-4	mg/kg-day	2.0E-2	mg/kg-day	2.6E-2
				Nitrate	7.0E+3	ug/L	2.3E-2	mg/kg-day	NA	(mg/kg-day)-1	NA	2.2E-1	mg/kg-day	1.6E+0	mg/kg-day	1.4E-1
				Selenium	1.3E+1	ug/L	4.3E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	4.2E-4	mg/kg-day	5.0E-3	mg/kg-day	8.3E-2
				Silver	1.5E+1	ug/L	5.0E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	4.8E-4	mg/kg-day	5.0E-3	mg/kg-day	9.6E-2
				Thallium	9.6E+0	ug/L	3.2E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	3.1E-4	mg/kg-day	6.6E-5	mg/kg-day	4.7E+0
				Vanadium	2.0E+1	ug/L	6.7E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	6.4E-4	mg/kg-day	7.0E-3	mg/kg-day	9.1E-2
				Zinc	1.1E+1	ug/L	3.7E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	3.5E-4	mg/kg-day	3.0E-1	mg/kg-day	1.2E-3

TABLE 7.15
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
TIER 2 CENTRAL EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: On-Site Resident
Receptor Age: Child / Age-Adjusted Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater[1] Potable Use	Potable Water	Potable Water	Ingestion	1,2,4-Trimethylbenzene	5.5E+1	ug/L	1.8E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	1.8E-3	mg/kg-day	5.0E-2	mg/kg-day	3.5E-2
				1,2-Dichloroethane	5.0E+1	ug/L	1.7E-4	mg/kg-day	4.7E-2	(mg/kg-day)-1	8E-6	1.6E-3	mg/kg-day	3.0E-2	mg/kg-day	5.3E-2
				1,3,5-Trimethylbenzene	2.9E+1	ug/L	9.6E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	9.3E-4	mg/kg-day	5.0E-2	mg/kg-day	1.9E-2
				Acenaphthene	2.2E+2	ug/L	7.3E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	7.0E-3	mg/kg-day	6.0E-2	mg/kg-day	1.2E-1
				Acenaphthylene	8.0E+2	ug/L	2.7E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	2.6E-2	mg/kg-day	NA	mg/kg-day	NA
				Acetone	1.0E+4	ug/L	3.3E-2	mg/kg-day	NA	(mg/kg-day)-1	NA	3.2E-1	mg/kg-day	1.0E-1	mg/kg-day	3.2E+0
				Anthracene	5.9E+1	ug/L	2.0E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	1.9E-3	mg/kg-day	3.0E-1	mg/kg-day	6.3E-3
				Benzo[a]anthracene	2.6E+1	ug/L	8.6E-5	mg/kg-day	1.2E+0	(mg/kg-day)-1	1E-4	8.3E-4	mg/kg-day	NA	mg/kg-day	NA
				Benzo[a]pyrene	6.0E+1	ug/L	2.0E-4	mg/kg-day	1.2E+1	(mg/kg-day)-1	2E-3	1.9E-3	mg/kg-day	NA	mg/kg-day	NA
				Benzo[b]fluoranthene	2.9E+1	ug/L	9.6E-5	mg/kg-day	1.2E+0	(mg/kg-day)-1	1E-4	9.3E-4	mg/kg-day	NA	mg/kg-day	NA
				Benzo[g,h,i]perylene	3.7E+1	ug/L	1.2E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	1.2E-3	mg/kg-day	NA	mg/kg-day	NA
				Benzo[k]fluoranthene	1.4E+1	ug/L	4.7E-5	mg/kg-day	1.2E+0	(mg/kg-day)-1	6E-5	4.5E-4	mg/kg-day	NA	mg/kg-day	NA
				Carbon Disulfide	4.8E+0	ug/L	1.6E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	1.5E-4	mg/kg-day	1.0E-1	mg/kg-day	1.5E-3
				Chrysene	4.3E+1	ug/L	1.4E-4	mg/kg-day	1.2E-1	(mg/kg-day)-1	2E-5	1.4E-3	mg/kg-day	NA	mg/kg-day	NA
				Dibenz[a,h]anthracene	3.0E+0	ug/L	1.0E-5	mg/kg-day	4.1E+0	(mg/kg-day)-1	4E-5	9.6E-5	mg/kg-day	NA	mg/kg-day	NA
				Ethylbenzene	8.0E+2	ug/L	2.7E-3	mg/kg-day	3.9E-3	(mg/kg-day)-1	1E-5	2.6E-2	mg/kg-day	1.0E-1	mg/kg-day	2.6E-1
				Fluoranthene	2.8E+2	ug/L	9.3E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	8.9E-3	mg/kg-day	4.0E-2	mg/kg-day	2.2E-1
				Fluorene	7.0E+1	ug/L	2.3E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	2.2E-3	mg/kg-day	4.0E-2	mg/kg-day	5.6E-2
				Indeno(1,2,3-cd)pyrene	4.4E+1	ug/L	1.5E-4	mg/kg-day	1.2E+0	(mg/kg-day)-1	2E-4	1.4E-3	mg/kg-day	NA	mg/kg-day	NA
				Isopropyl benzene	7.4E+0	ug/L	2.5E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	2.4E-4	mg/kg-day	1.0E-1	mg/kg-day	2.4E-3
				Methyl isobutyl ketone	3.5E+0	ug/L	1.2E-5	mg/kg-day	0.0E+0	(mg/kg-day)-1	0E+0	1.1E-4	mg/kg-day	8.0E-2	mg/kg-day	1.4E-3
				Methylene chloride	1.8E+2	ug/L	6.0E-4	mg/kg-day	1.4E-2	(mg/kg-day)-1	8E-6	5.8E-3	mg/kg-day	6.0E-2	mg/kg-day	9.6E-2
				MTBE	1.9E+1	ug/L	6.3E-5	mg/kg-day	1.8E-3	(mg/kg-day)-1	1E-7	6.1E-4	mg/kg-day	NA	mg/kg-day	NA
				n-Butylbenzene	1.8E+3	ug/L	6.0E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	5.8E-2	mg/kg-day	4.0E-2	mg/kg-day	1.4E+0
				n-Propylbenzene	1.1E+1	ug/L	3.7E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	3.5E-4	mg/kg-day	4.0E-2	mg/kg-day	8.8E-3
				Phenanthrene	2.5E+2	ug/L	8.3E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	8.0E-3	mg/kg-day	NA	mg/kg-day	NA
				Pyrene	2.0E+2	ug/L	6.7E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	6.4E-3	mg/kg-day	3.0E-2	mg/kg-day	2.1E-1
				Styrene	1.9E+2	ug/L	6.2E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	5.9E-3	mg/kg-day	2.0E-1	mg/kg-day	3.0E-2
				Toluene	6.2E+2	ug/L	2.1E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	2.0E-2	mg/kg-day	2.0E-1	mg/kg-day	9.9E-2
				Xylenes (total)	4.2E+2	ug/L	1.4E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	1.4E-2	mg/kg-day	2.0E-1	mg/kg-day	6.8E-2
				Benzene (500 ft)	4.9E+2	ug/L	1.6E-3	mg/kg-day	1.0E-1	(mg/kg-day)-1	2E-4	1.6E-2	mg/kg-day	3.0E-3	mg/kg-day	5.3E+0
				Benzene (725 ft)	3.2E+2	ug/L	1.1E-3	mg/kg-day	1.0E-1	(mg/kg-day)-1	1E-4	1.0E-2	mg/kg-day	3.0E-3	mg/kg-day	3.4E+0
				Naphthalene (500 ft)	4.2E+3	ug/L	1.4E-2	mg/kg-day	NA	(mg/kg-day)-1	NA	1.3E-1	mg/kg-day	2.0E-2	mg/kg-day	6.7E+0
				Naphthalene (725 ft)	3.2E+3	ug/L	1.1E-2	mg/kg-day	NA	(mg/kg-day)-1	NA	1.0E-1	mg/kg-day	2.0E-2	mg/kg-day	5.2E+0
			Exp. Route Total	krig - 500 ft							4E-3					3.2E+1
			Exp. Route Total	krig - 725 ft							4E-3					2.8E+1
		Exposure Point Total	krig - 500 ft								4E-3					3.2E+1
		Exposure Point Total	krig - 725 ft								4E-3					2.8E+1

TABLE 7.15
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
TIER 2 CENTRAL EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: On-Site Resident
Receptor Age: Child / Age-Adjusted Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
	Exposure Medium Total	krig - 500 ft									4E-3					2.8E+1
	Exposure Medium Total	krig - 725 ft									4E-3					3.2E+1
Groundwater[1] Potable Use	Indoor Air	Indoor Air	Air Inhalation	1,2,4-Trimethylbenzene	5.5E+1	ug/L	1.0E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	9.8E-3	mg/kg-day	1.7E-3	mg/kg-day	5.8E+0
				1,2-Dichloroethane	5.0E+1	ug/L	9.1E-4	mg/kg-day	7.2E-2	(mg/kg-day)-1	7E-5	8.9E-3	mg/kg-day	1.4E-3	mg/kg-day	6.3E+0
				1,3,5-Trimethylbenzene	2.9E+1	ug/L	5.3E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	5.2E-3	mg/kg-day	1.7E-3	mg/kg-day	3.0E+0
				Acenaphthene	2.2E+2	ug/L	4.0E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	3.9E-2	mg/kg-day	NA	mg/kg-day	NA
				Acetone	1.0E+4	ug/L	1.8E-1	mg/kg-day	NA	(mg/kg-day)-1	NA	1.8E+0	mg/kg-day	NA	mg/kg-day	NA
				Anthracene	5.9E+1	ug/L	1.1E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	1.0E-2	mg/kg-day	NA	mg/kg-day	NA
				Benzo[b]fluoranthene	2.9E+1	ug/L	5.3E-4	mg/kg-day	3.9E-1	(mg/kg-day)-1	2E-4	5.2E-3	mg/kg-day	NA	mg/kg-day	NA
				Carbon Disulfide	4.8E+0	ug/L	8.7E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	8.5E-4	mg/kg-day	2.0E-1	mg/kg-day	4.3E-3
				Chrysene	4.3E+1	ug/L	7.8E-4	mg/kg-day	3.9E-2	(mg/kg-day)-1	3E-5	7.6E-3	mg/kg-day	NA	mg/kg-day	NA
				Ethylbenzene	8.0E+2	ug/L	1.5E-2	mg/kg-day	3.9E-3	(mg/kg-day)-1	6E-5	1.4E-1	mg/kg-day	2.9E-1	mg/kg-day	4.9E-1
				Fluorene	7.0E+1	ug/L	1.3E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	1.2E-2	mg/kg-day	NA	mg/kg-day	NA
				Isopropyl benzene	7.4E+0	ug/L	1.3E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	1.3E-3	mg/kg-day	1.1E-1	mg/kg-day	1.2E-2
				Methyl isobutyl ketone	3.5E+0	ug/L	6.4E-5	mg/kg-day	0.0E+0	(mg/kg-day)-1	0E+0	6.2E-4	mg/kg-day	2.3E-2	mg/kg-day	2.7E-2
				Methylene chloride	1.8E+2	ug/L	3.3E-3	mg/kg-day	3.5E-3	(mg/kg-day)-1	1E-5	3.2E-2	mg/kg-day	8.6E-1	mg/kg-day	3.7E-2
				MTBE	1.9E+1	ug/L	3.5E-4	mg/kg-day	9.1E-4	(mg/kg-day)-1	3E-7	3.4E-3	mg/kg-day	8.6E-1	mg/kg-day	3.9E-3
				n-Butylbenzene	1.8E+3	ug/L	3.3E-2	mg/kg-day	NA	(mg/kg-day)-1	NA	3.2E-1	mg/kg-day	NA	mg/kg-day	NA
				n-Propylbenzene	1.1E+1	ug/L	2.0E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	2.0E-3	mg/kg-day	NA	mg/kg-day	NA
				Pyrene	2.0E+2	ug/L	3.6E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	3.6E-2	mg/kg-day	NA	mg/kg-day	NA
				Styrene	1.9E+2	ug/L	3.4E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	3.3E-2	mg/kg-day	2.9E-1	mg/kg-day	1.1E-1
				Toluene	6.2E+2	ug/L	1.1E-2	mg/kg-day	NA	(mg/kg-day)-1	NA	1.1E-1	mg/kg-day	1.1E-1	mg/kg-day	1.0E+0
				Xylenes (total)	4.2E+2	ug/L	7.7E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	7.5E-2	mg/kg-day	2.9E-2	mg/kg-day	2.6E+0
				Benzene (500 ft)	4.9E+2	ug/L	9.0E-3	mg/kg-day	1.0E-1	(mg/kg-day)-1	9E-4	8.8E-2	mg/kg-day	3.0E-3	mg/kg-day	2.9E+1
				Benzene (725 ft)	3.2E+2	ug/L	5.9E-3	mg/kg-day	1.0E-1	(mg/kg-day)-1	6E-4	5.7E-2	mg/kg-day	3.0E-3	mg/kg-day	1.9E+1
				Naphthalene (500 ft)	4.2E+3	ug/L	2.7E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	7.3E-2	mg/kg-day	2.0E-2	mg/kg-day	3.7E+0
				Naphthalene (725 ft)	3.2E+3	ug/L	2.1E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	5.7E-2	mg/kg-day	2.0E-2	mg/kg-day	2.8E+0
			Exp. Route Total	krig - 500 ft							1E-3					5.2E+1
			Exp. Route Total	krig - 725 ft							1E-3					4.1E+1
		Exposure Point Total	krig - 500 ft								1E-3					5.2E+1
		Exposure Point Total	krig - 725 ft								1E-3					4.1E+1
	Exposure Medium Total	krig - 500 ft									1E-3					5.2E+1
	Exposure Medium Total	krig - 725 ft									1E-3					4.1E+1
Medium Total	krig - 500 ft										5E-3					8.1E+1
Medium Total	krig - 725 ft										5E-3					7.3E+1
Current Receptor Total (Inhalation via Soil Vapor) Alameda Annex											1E-6					9.1E-3
Current Receptor Total (Inhalation via Soil Vapor) Alameda Point - Site 25											5E-8					7.6E-3

TABLE 7.15

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

TIER 2 CENTRAL EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: On-Site Resident
Receptor Age: Child / Age-Adjusted Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Current Receptor Total (Inhalation via Soil Vapor) Alameda Point - Site 30											5E-8					7.6E-3
Current Receptor Total (Inhalation via Soil Vapor) Alameda Point - Site 31											5E-8					7.6E-3
Current Receptor Total (Inhalation via Groundwater) krig - 500 ft											1E-5					2.9E-1
Current Receptor Total (Inhalation via Groundwater) krig - 725 ft											8E-6					2.9E-1
Future Receptor Total (Potable Water Use (krig - 500 ft) + Inhalation via Soil Vapor (Alameda Annex))											5E-3					8.1E+1
Future Receptor Total (Potable Water Use (krig - 500 ft) + Inhalation via Soil Vapor (Alameda Point - Site 25))											5E-3					8.1E+1
Future Receptor Total (Potable Water Use (krig - 500 ft) + Inhalation via Soil Vapor (Alameda Point - Site 30))											5E-3					8.1E+1
Future Receptor Total (Potable Water Use (krig - 500 ft) + Inhalation via Soil Vapor (Alameda Point - Site 31))											5E-3					8.1E+1
Future Receptor Total (Potable Water Use (krig - 725 ft) + Inhalation via Soil Vapor (Alameda Annex))											5E-3					7.3E+1
Future Receptor Total (Potable Water Use (krig - 725 ft) + Inhalation via Soil Vapor (Alameda Point - Site 25))											5E-3					7.3E+1
Future Receptor Total (Potable Water Use (krig - 725 ft) + Inhalation via Soil Vapor (Alameda Point - Site 30))											5E-3					7.3E+1
Future Receptor Total (Potable Water Use (krig - 725 ft) + Inhalation via Soil Vapor (Alameda Point - Site 31))											5E-3					7.3E+1
Future Receptor Total (Potable Water Use + Inhalation via Groundwater) krig - 500 ft											5E-3					8.1E+1
Future Receptor Total (Potable Water Use + Inhalation via Groundwater) krig - 725 ft											5E-3					7.3E+1

[1] - Groundwater potable use is a future use scenario.

TABLE 7.16

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

TIER 2 REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: On-Site Resident
Receptor Age: Child / Age-Adjusted Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil Vapor	Indoor Air	Indoor Air	Air Inhalation	Chloroform	2.8E-3	ug/m3					6E-9					8.9E-6
				Ethylbenzene	7.1E-2	ug/m3					3E-8					3.4E-5
				m,p-Xylene	5.5E-2	ug/m3					NA					5.2E-4
				Naphthalene	6.5E-2	ug/m3					NA					6.9E-3
				Tetrachloroethene (PCE)	1.7E-3	ug/m3					4E-9					4.7E-5
				Trichloroethene	3.6E-3	ug/m3					3E-9					5.7E-6
		Alameda Annex		Benzene (Alameda Annex)	9.9E-2	ug/m3					1E-6					1.6E-3
		Alameda Point - Site 25		Benzene (Alameda Point - Site 25)	3.7E-4	ug/m3					4E-9					6.0E-6
		Alameda Point - Site 30		Benzene (Alameda Point - Site 30)	5.7E-4	ug/m3					7E-9					9.2E-6
		Alameda Point - Site 31		Benzene (Alameda Point - Site 31)	2.9E-4	ug/m3					3E-9					4.6E-6
			Exp. Route Total	(Alameda Annex)							1E-6					9.1E-3
			Exp. Route Total	(Alameda Point - Site 25)							5E-8					7.6E-3
			Exp. Route Total	(Alameda Point - Site 30)							5E-8					7.6E-3
			Exp. Route Total	(Alameda Point - Site 31)							5E-8					7.6E-3
		Exposure Point Total	(Alameda Annex)								1E-6					9.1E-3
		Exposure Point Total	(Alameda Point - Site 25)								5E-8					7.6E-3
		Exposure Point Total	(Alameda Point - Site 30)								5E-8					7.6E-3
		Exposure Point Total	(Alameda Point - Site 31)								5E-8					7.6E-3
	Exposure Medium Total	(Alameda Annex)									1E-6					9.1E-3
	Exposure Medium Total	(Alameda Point - Site 25)									5E-8					7.6E-3
	Exposure Medium Total	(Alameda Point - Site 30)									5E-8					7.6E-3
	Exposure Medium Total	(Alameda Point - Site 31)									5E-8					7.6E-3
Medium Total	(Alameda Annex)										1E-6					9.1E-3
Medium Total	(Alameda Point - Site 25)										5E-8					7.6E-3
Medium Total	(Alameda Point - Site 30)										5E-8					7.6E-3
Medium Total	(Alameda Point - Site 31)										5E-8					7.6E-3
Groundwater	Indoor Air	Indoor Air	Air Inhalation	1,2,4-Trimethylbenzene	6.0E-2	ug/m3					NA					7.9E-4
				1,2-Dichloroethane	1.9E-2	ug/m3					2E-7					3.5E-3
				1,3,5-Trimethylbenzene	3.2E-2	ug/m3					NA					9.7E-3
				Acetone	2.9E-1	ug/m3					NA					7.9E-4
				Carbon disulfide	6.0E-2	ug/m3					NA					7.1E-5
				Ethylbenzene	1.6E+0	ug/m3					7E-7					7.5E-4
				Isopropyl benzene	1.7E-2	ug/m3					NA					4.1E-5
				Methyl isobutyl ketone	4.9E-3	ug/m3					NA					1.7E-5
				Methylene chloride	1.6E-1	ug/m3					7E-8					3.9E-4
				MTBE	7.3E-3	ug/m3					8E-10					8.7E-7

TABLE 7.16
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
TIER 2 REASONABLE MAXIMUM EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: On-Site Resident
Receptor Age: Child / Age-Adjusted Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Indoor Air	Indoor Air	Air Inhalation	Naphthalene	2.1E+0	ug/m3					NA					2.2E-1
				n-Butylbenzene	5.5E+0	ug/m3					NA					3.8E-2
				n-Propylbenzene	NA	ug/m3					NA					NA
				Styrene	1.2E-1	ug/m3					NA					1.3E-4
				Toluene	1.2E+0	ug/m3					NA					3.9E-3
				Xylenes (total)	6.0E-1	ug/m3					NA					8.2E-4
				Benzene (500 ft)	9.1E-1	ug/m3					1E-5					1.5E-2
				Benzene (725 ft)	5.9E-1	ug/m3					7E-6					9.5E-3
			Exp. Route Total	krig - 500 ft							1E-5					2.9E-1
			Exp. Route Total	krig - 725 ft							8E-6					2.9E-1
		Exposure Point Total	krig - 500 ft								1E-5					2.9E-1
		Exposure Point Total	krig - 725 ft								8E-6					2.9E-1
	Exposure Medium Total	krig - 500 ft									1E-5					2.9E-1
	Exposure Medium Total	krig - 725 ft									8E-6					2.9E-1
Medium Total	krig - 500 ft										1E-5					2.9E-1
Medium Total	krig - 725 ft										8E-6					2.9E-1
Groundwater[1] Potable Use	Potable Water	Potable Water	Ingestion	Aluminum	1.4E+3	ug/L	2.1E-2	mg/kg-day	NA	(mg/kg-day)-1	NA	8.9E-2	mg/kg-day	1.0E+0	mg/kg-day	8.9E-2
				Antimony	4.8E-1	ug/L	7.1E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	3.1E-5	mg/kg-day	4.0E-4	mg/kg-day	7.7E-2
				Arsenic	2.2E+1	ug/L	3.3E-4	mg/kg-day	9.5E+0	(mg/kg-day)-1	3E-3	1.4E-3	mg/kg-day	3.0E-4	mg/kg-day	4.7E+0
				Barium	2.0E+3	ug/L	2.9E-2	mg/kg-day	NA	(mg/kg-day)-1	NA	1.3E-1	mg/kg-day	7.0E-2	mg/kg-day	1.8E+0
				Beryllium	1.8E+0	ug/L	2.7E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	1.2E-4	mg/kg-day	2.0E-3	mg/kg-day	5.8E-2
				Cadmium	3.2E+0	ug/L	4.8E-5	mg/kg-day	3.8E-1	(mg/kg-day)-1	2E-5	2.1E-4	mg/kg-day	5.0E-4	mg/kg-day	4.1E-1
				Chromium	2.2E+1	ug/L	3.3E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	1.4E-3	mg/kg-day	3.0E-3	mg/kg-day	4.7E-1
				Cobalt	7.5E+0	ug/L	1.1E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	4.8E-4	mg/kg-day	2.0E-2	mg/kg-day	2.4E-2
				Copper	1.1E+1	ug/L	1.6E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	7.0E-4	mg/kg-day	4.0E-2	mg/kg-day	1.8E-2
				Iron	4.0E+4	ug/L	5.9E-1	mg/kg-day	NA	(mg/kg-day)-1	NA	2.5E+0	mg/kg-day	3.0E-1	mg/kg-day	8.5E+0
				Lead	3.7E-1	ug/L	5.5E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	2.4E-5	mg/kg-day	NA	mg/kg-day	NA
				Manganese	2.5E+3	ug/L	3.7E-2	mg/kg-day	NA	(mg/kg-day)-1	NA	1.6E-1	mg/kg-day	1.4E-1	mg/kg-day	1.1E+0
				Mercury	2.2E-1	ug/L	3.3E-6	mg/kg-day	NA	(mg/kg-day)-1	NA	1.4E-5	mg/kg-day	3.0E-4	mg/kg-day	4.7E-2
				Molybdenum	3.7E+1	ug/L	5.6E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	2.4E-3	mg/kg-day	5.0E-3	mg/kg-day	4.8E-1
				Nickel	1.6E+1	ug/L	2.4E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	1.0E-3	mg/kg-day	2.0E-2	mg/kg-day	5.1E-2
				Nitrate	7.0E+3	ug/L	1.0E-1	mg/kg-day	NA	(mg/kg-day)-1	NA	4.5E-1	mg/kg-day	1.6E+0	mg/kg-day	2.8E-1
				Selenium	1.3E+1	ug/L	1.9E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	8.3E-4	mg/kg-day	5.0E-3	mg/kg-day	1.7E-1
				Silver	1.5E+1	ug/L	2.2E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	9.6E-4	mg/kg-day	5.0E-3	mg/kg-day	1.9E-1
				Thallium	9.6E+0	ug/L	1.4E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	6.1E-4	mg/kg-day	6.6E-5	mg/kg-day	9.3E+0
				Vanadium	2.0E+1	ug/L	3.0E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	1.3E-3	mg/kg-day	7.0E-3	mg/kg-day	1.8E-1
				Zinc	1.1E+1	ug/L	1.6E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	7.0E-4	mg/kg-day	3.0E-1	mg/kg-day	2.3E-3

TABLE 7.16

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

TIER 2 REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: On-Site Resident
Receptor Age: Child / Age-Adjusted Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater[1] Potable Use	Potable Water	Potable Water	Ingestion	1,2,4-Trimethylbenzene	5.5E+1	ug/L	8.2E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	3.5E-3	mg/kg-day	5.0E-2	mg/kg-day	7.0E-2
				1,2-Dichloroethane	5.0E+1	ug/L	7.4E-4	mg/kg-day	4.7E-2	(mg/kg-day)-1	3E-5	3.2E-3	mg/kg-day	3.0E-2	mg/kg-day	1.1E-1
				1,3,5-Trimethylbenzene	2.9E+1	ug/L	4.3E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	1.9E-3	mg/kg-day	5.0E-2	mg/kg-day	3.7E-2
				Acenaphthene	2.2E+2	ug/L	3.3E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	1.4E-2	mg/kg-day	6.0E-2	mg/kg-day	2.3E-1
				Acenaphthylene	8.0E+2	ug/L	1.2E-2	mg/kg-day	NA	(mg/kg-day)-1	NA	5.1E-2	mg/kg-day	NA	mg/kg-day	NA
				Acetone	1.0E+4	ug/L	1.5E-1	mg/kg-day	NA	(mg/kg-day)-1	NA	6.4E-1	mg/kg-day	1.0E-1	mg/kg-day	6.4E+0
				Anthracene	5.9E+1	ug/L	8.8E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	3.8E-3	mg/kg-day	3.0E-1	mg/kg-day	1.3E-2
				Benzo[a]anthracene	2.6E+1	ug/L	3.9E-4	mg/kg-day	1.2E+0	(mg/kg-day)-1	5E-4	1.7E-3	mg/kg-day	NA	mg/kg-day	NA
				Benzo[a]pyrene	6.0E+1	ug/L	8.9E-4	mg/kg-day	1.2E+1	(mg/kg-day)-1	1E-2	3.8E-3	mg/kg-day	NA	mg/kg-day	NA
				Benzo[b]fluoranthene	2.9E+1	ug/L	4.3E-4	mg/kg-day	1.2E+0	(mg/kg-day)-1	5E-4	1.9E-3	mg/kg-day	NA	mg/kg-day	NA
				Benzo[g,h,i]perylene	3.7E+1	ug/L	5.5E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	2.4E-3	mg/kg-day	NA	mg/kg-day	NA
				Benzo[k]fluoranthene	1.4E+1	ug/L	2.1E-4	mg/kg-day	1.2E+0	(mg/kg-day)-1	2E-4	8.9E-4	mg/kg-day	NA	mg/kg-day	NA
				Carbon Disulfide	4.8E+0	ug/L	7.1E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	3.1E-4	mg/kg-day	1.0E-1	mg/kg-day	3.1E-3
				Chrysene	4.3E+1	ug/L	6.4E-4	mg/kg-day	1.2E-1	(mg/kg-day)-1	8E-5	2.7E-3	mg/kg-day	NA	mg/kg-day	NA
				Dibenz[a,h]anthracene	3.0E+0	ug/L	4.5E-5	mg/kg-day	4.1E+0	(mg/kg-day)-1	2E-4	1.9E-4	mg/kg-day	NA	mg/kg-day	NA
				Ethylbenzene	8.0E+2	ug/L	1.2E-2	mg/kg-day	3.9E-3	(mg/kg-day)-1	5E-5	5.1E-2	mg/kg-day	1.0E-1	mg/kg-day	5.1E-1
				Fluoranthene	2.8E+2	ug/L	4.2E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	1.8E-2	mg/kg-day	4.0E-2	mg/kg-day	4.5E-1
				Fluorene	7.0E+1	ug/L	1.0E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	4.5E-3	mg/kg-day	4.0E-2	mg/kg-day	1.1E-1
				Indeno(1,2,3-cd)pyrene	4.4E+1	ug/L	6.5E-4	mg/kg-day	1.2E+0	(mg/kg-day)-1	8E-4	2.8E-3	mg/kg-day	NA	mg/kg-day	NA
				Isopropyl benzene	7.4E+0	ug/L	1.1E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	4.7E-4	mg/kg-day	1.0E-1	mg/kg-day	4.7E-3
				Methyl isobutyl ketone	3.5E+0	ug/L	5.2E-5	mg/kg-day	0.0E+0	(mg/kg-day)-1	0E+0	2.2E-4	mg/kg-day	8.0E-2	mg/kg-day	2.8E-3
				Methylene chloride	1.8E+2	ug/L	2.7E-3	mg/kg-day	1.4E-2	(mg/kg-day)-1	4E-5	1.2E-2	mg/kg-day	6.0E-2	mg/kg-day	1.9E-1
				MTBE	1.9E+1	ug/L	2.8E-4	mg/kg-day	1.8E-3	(mg/kg-day)-1	5E-7	1.2E-3	mg/kg-day	NA	mg/kg-day	NA
				n-Butylbenzene	1.8E+3	ug/L	2.7E-2	mg/kg-day	NA	(mg/kg-day)-1	NA	1.2E-1	mg/kg-day	4.0E-2	mg/kg-day	2.9E+0
				n-Propylbenzene	1.1E+1	ug/L	1.6E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	7.0E-4	mg/kg-day	4.0E-2	mg/kg-day	1.8E-2
				Phenanthrene	2.5E+2	ug/L	3.7E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	1.6E-2	mg/kg-day	NA	mg/kg-day	NA
				Pyrene	2.0E+2	ug/L	3.0E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	1.3E-2	mg/kg-day	3.0E-2	mg/kg-day	4.3E-1
				Styrene	1.9E+2	ug/L	2.8E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	1.2E-2	mg/kg-day	2.0E-1	mg/kg-day	5.9E-2
				Toluene	6.2E+2	ug/L	9.2E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	4.0E-2	mg/kg-day	2.0E-1	mg/kg-day	2.0E-1
				Xylenes (total)	4.2E+2	ug/L	6.3E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	2.7E-2	mg/kg-day	2.0E-1	mg/kg-day	1.4E-1
				Benzene (500 ft)	4.9E+2	ug/L	7.3E-3	mg/kg-day	1.0E-1	(mg/kg-day)-1	7E-4	3.2E-2	mg/kg-day	3.0E-3	mg/kg-day	1.1E+1
				Benzene (725 ft)	3.2E+2	ug/L	4.8E-3	mg/kg-day	1.0E-1	(mg/kg-day)-1	5E-4	2.1E-2	mg/kg-day	3.0E-3	mg/kg-day	6.9E+0
				Naphthalene (500 ft)	4.2E+3	ug/L	6.2E-2	mg/kg-day	NA	(mg/kg-day)-1	NA	2.7E-1	mg/kg-day	2.0E-2	mg/kg-day	1.3E+1
				Naphthalene (725 ft)	3.2E+3	ug/L	4.8E-2	mg/kg-day	NA	(mg/kg-day)-1	NA	2.1E-1	mg/kg-day	2.0E-2	mg/kg-day	1.0E+1
			Exp. Route Total	krig - 500 ft							2E-2					6.4E+1
			Exp. Route Total	krig - 725 ft							2E-2					5.7E+1
		Exposure Point Total	krig - 500 ft								2E-2					6.4E+1
		Exposure Point Total	krig - 725 ft								2E-2					5.7E+1

TABLE 7.16
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
TIER 2 REASONABLE MAXIMUM EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: On-Site Resident
Receptor Age: Child / Age-Adjusted Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
	Exposure Medium Total	krig - 500 ft									2E-2					5.7E+1
	Exposure Medium Total	krig - 725 ft									2E-2					6.4E+1
Groundwater[1] Potable Use	Indoor Air	Indoor Air	Air Inhalation	1,2,4-Trimethylbenzene	5.5E+1	ug/L	3.1E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	1.3E-2	mg/kg-day	1.7E-3	mg/kg-day	7.8E+0
				1,2-Dichloroethane	5.0E+1	ug/L	9.1E-4	mg/kg-day	7.2E-2	(mg/kg-day)-1	7E-5	8.9E-3	mg/kg-day	1.4E-3	mg/kg-day	6.3E+0
				1,3,5-Trimethylbenzene	2.9E+1	ug/L	5.3E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	5.2E-3	mg/kg-day	1.7E-3	mg/kg-day	3.0E+0
				Acenaphthene	2.2E+2	ug/L	4.0E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	3.9E-2	mg/kg-day	NA	mg/kg-day	NA
				Acetone	1.0E+4	ug/L	1.8E-1	mg/kg-day	NA	(mg/kg-day)-1	NA	1.8E+0	mg/kg-day	NA	mg/kg-day	NA
				Anthracene	5.9E+1	ug/L	1.1E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	1.0E-2	mg/kg-day	NA	mg/kg-day	NA
				Benzo[b]fluoranthene	2.9E+1	ug/L	5.3E-4	mg/kg-day	3.9E-1	(mg/kg-day)-1	2E-4	5.2E-3	mg/kg-day	NA	mg/kg-day	NA
				Carbon Disulfide	4.8E+0	ug/L	8.7E-5	mg/kg-day	NA	(mg/kg-day)-1	NA	8.5E-4	mg/kg-day	2.0E-1	mg/kg-day	4.3E-3
				Chrysene	4.3E+1	ug/L	7.8E-4	mg/kg-day	3.9E-2	(mg/kg-day)-1	3E-5	7.6E-3	mg/kg-day	NA	mg/kg-day	NA
				Ethylbenzene	8.0E+2	ug/L	1.5E-2	mg/kg-day	3.9E-3	(mg/kg-day)-1	6E-5	1.4E-1	mg/kg-day	2.9E-1	mg/kg-day	4.9E-1
				Fluorene	7.0E+1	ug/L	1.3E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	1.2E-2	mg/kg-day	NA	mg/kg-day	NA
				Isopropyl benzene	7.4E+0	ug/L	1.3E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	1.3E-3	mg/kg-day	1.1E-1	mg/kg-day	1.2E-2
				Methyl isobutyl ketone	3.5E+0	ug/L	6.4E-5	mg/kg-day	0.0E+0	(mg/kg-day)-1	0E+0	6.2E-4	mg/kg-day	2.3E-2	mg/kg-day	2.7E-2
				Methylene chloride	1.8E+2	ug/L	3.3E-3	mg/kg-day	3.5E-3	(mg/kg-day)-1	1E-5	3.2E-2	mg/kg-day	8.6E-1	mg/kg-day	3.7E-2
				MTBE	1.9E+1	ug/L	3.5E-4	mg/kg-day	9.1E-4	(mg/kg-day)-1	3E-7	3.4E-3	mg/kg-day	8.6E-1	mg/kg-day	3.9E-3
				n-Butylbenzene	1.8E+3	ug/L	3.3E-2	mg/kg-day	NA	(mg/kg-day)-1	NA	3.2E-1	mg/kg-day	NA	mg/kg-day	NA
				n-Propylbenzene	1.1E+1	ug/L	2.0E-4	mg/kg-day	NA	(mg/kg-day)-1	NA	2.0E-3	mg/kg-day	NA	mg/kg-day	NA
				Pyrene	2.0E+2	ug/L	3.6E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	3.6E-2	mg/kg-day	NA	mg/kg-day	NA
				Styrene	1.9E+2	ug/L	3.4E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	3.3E-2	mg/kg-day	2.9E-1	mg/kg-day	1.1E-1
				Toluene	6.2E+2	ug/L	1.1E-2	mg/kg-day	NA	(mg/kg-day)-1	NA	1.1E-1	mg/kg-day	1.1E-1	mg/kg-day	1.0E+0
				Xylenes (total)	4.2E+2	ug/L	7.7E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	7.5E-2	mg/kg-day	2.9E-2	mg/kg-day	2.6E+0
				Benzene (500 ft)	4.9E+2	ug/L	9.0E-3	mg/kg-day	1.0E-1	(mg/kg-day)-1	9E-4	8.8E-2	mg/kg-day	3.0E-3	mg/kg-day	2.9E+1
				Benzene (725 ft)	3.2E+2	ug/L	5.9E-3	mg/kg-day	1.0E-1	(mg/kg-day)-1	6E-4	5.7E-2	mg/kg-day	3.0E-3	mg/kg-day	1.9E+1
				Naphthalene (500 ft)	4.2E+3	ug/L	2.7E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	7.3E-2	mg/kg-day	2.0E-2	mg/kg-day	3.7E+0
				Naphthalene (725 ft)	3.2E+3	ug/L	2.1E-3	mg/kg-day	NA	(mg/kg-day)-1	NA	5.7E-2	mg/kg-day	2.0E-2	mg/kg-day	2.8E+0
			Exp. Route Total	krig - 500 ft							1E-3					5.4E+1
			Exp. Route Total	krig - 725 ft							1E-3					4.3E+1
		Exposure Point Total	krig - 500 ft								1E-3					5E+1
		Exposure Point Total	krig - 725 ft								1E-3					4E+1
	Exposure Medium Total	krig - 500 ft									1E-3					5E+1
	Exposure Medium Total	krig - 725 ft									1E-3					4E+1
Medium Total	krig - 500 ft										2E-2					1E+2
Medium Total	krig - 725 ft										2E-2					1E+2
Current Receptor Total (Inhalation via Soil Vapor) Alameda Annex											1E-6					9.1E-3
Current Receptor Total (Inhalation via Soil Vapor) Alameda Point - Site 25											5E-8					7.6E-3

TABLE 7.16

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

TIER 2 REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: On-Site Resident
Receptor Age: Child / Age-Adjusted Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Current Receptor Total (Inhalation via Soil Vapor) Alameda Point - Site 30											5E-8					7.6E-3
Current Receptor Total (Inhalation via Soil Vapor) Alameda Point - Site 31											5E-8					7.6E-3
Current Receptor Total (Inhalation via Groundwater) krig - 500 ft											1E-5					2.9E-1
Current Receptor Total (Inhalation via Groundwater) krig - 725 ft											8E-6					2.9E-1
Future Receptor Total (Potable Water Use (krig - 500 ft) + Inhalation via Soil Vapor (Alameda Annex))											2E-2					1.1E+2
Future Receptor Total (Potable Water Use (krig - 500 ft) + Inhalation via Soil Vapor (Alameda Point - Site 25))											2E-2					1.1E+2
Future Receptor Total (Potable Water Use (krig - 500 ft) + Inhalation via Soil Vapor (Alameda Point - Site 30))											2E-2					1.1E+2
Future Receptor Total (Potable Water Use (krig - 500 ft) + Inhalation via Soil Vapor (Alameda Point - Site 31))											2E-2					1.1E+2
Future Receptor Total (Potable Water Use (krig - 725 ft) + Inhalation via Soil Vapor (Alameda Annex))											2E-2					1.1E+2
Future Receptor Total (Potable Water Use (krig - 725 ft) + Inhalation via Soil Vapor (Alameda Point - Site 25))											2E-2					1.1E+2
Future Receptor Total (Potable Water Use (krig - 725 ft) + Inhalation via Soil Vapor (Alameda Point - Site 30))											2E-2					1.1E+2
Future Receptor Total (Potable Water Use (krig - 725 ft) + Inhalation via Soil Vapor (Alameda Point - Site 31))											2E-2					1.1E+2
Future Receptor Total (Potable Water Use + Inhalation via Groundwater) krig - 500 ft											2E-2					1.1E+2
Future Receptor Total (Potable Water Use + Inhalation via Groundwater) krig - 725 ft											2E-2					1.1E+2

[1] - Groundwater potable use is a future use scenario.

TABLE 7.17
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
TIER 2 CENTRAL EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: School Student
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil Vapor	Indoor Air	Indoor Air	Air Inhalation	Chloroform	2.8E-3	ug/m3					6E-9					8.9E-6
				Ethylbenzene	7.1E-2	ug/m3					3E-8					3.4E-5
				m,p-Xylene	5.5E-2	ug/m3					NA					5.2E-4
				Naphthalene	6.5E-2	ug/m3					NA					6.9E-3
				Tetrachloroethene (PCE)	1.7E-3	ug/m3					4E-9					4.7E-5
				Trichloroethene	3.6E-3	ug/m3					3E-9					5.7E-6
		Alameda Annex		Benzene (Alameda Annex)	9.9E-2	ug/m3					1E-7					8.1E-4
		Alameda Point - Site 25		Benzene (Alameda Point - Site 25)	3.7E-4	ug/m3					4E-10					3.0E-6
		Alameda Point - Site 30		Benzene (Alameda Point - Site 30)	5.7E-4	ug/m3					7E-10					4.7E-6
		Alameda Point - Site 31		Benzene (Alameda Point - Site 31)	2.9E-4	ug/m3					3E-10					2.3E-6
			Exp. Route Total	(Alameda Annex)							2E-7					8.4E-3
			Exp. Route Total	(Alameda Point - Site 25)							5E-8					7.6E-3
			Exp. Route Total	(Alameda Point - Site 30)							5E-8					7.6E-3
			Exp. Route Total	(Alameda Point - Site 31)							5E-8					7.6E-3
		Exposure Point Total	(Alameda Annex)								2E-7					8.4E-3
		Exposure Point Total	(Alameda Point - Site 25)								5E-8					7.6E-3
		Exposure Point Total	(Alameda Point - Site 30)								5E-8					7.6E-3
		Exposure Point Total	(Alameda Point - Site 31)								5E-8					7.6E-3
	Exposure Medium Total	(Alameda Annex)									2E-7					8.4E-3
	Exposure Medium Total	(Alameda Point - Site 25)									5E-8					7.6E-3
	Exposure Medium Total	(Alameda Point - Site 30)									5E-8					7.6E-3
	Exposure Medium Total	(Alameda Point - Site 31)									5E-8					7.6E-3
Medium Total	(Alameda Annex)										2E-7					8.4E-3
Medium Total	(Alameda Point - Site 25)										5E-8					7.6E-3
Medium Total	(Alameda Point - Site 30)										5E-8					7.6E-3
Medium Total	(Alameda Point - Site 31)										5E-8					7.6E-3
Groundwater	Indoor Air	Indoor Air	Air Inhalation	1,2,4-Trimethylbenzene	6.0E-2	ug/m3					NA					7.9E-4
				1,2-Dichloroethane	1.9E-2	ug/m3					2E-7					3.5E-3
				1,3,5-Trimethylbenzene	3.2E-2	ug/m3					NA					9.7E-3
				Acetone	2.9E-1	ug/m3					NA					7.9E-4
				Carbon disulfide	6.0E-2	ug/m3					NA					7.1E-5
				Ethylbenzene	1.6E+0	ug/m3					7E-7					7.5E-4
				Isopropyl benzene	1.7E-2	ug/m3					NA					4.1E-5
				Methyl isobutyl ketone	4.9E-3	ug/m3					NA					1.7E-5
				Methylene chloride	1.6E-1	ug/m3					7E-8					3.9E-4
				MTBE	7.3E-3	ug/m3					8E-10					8.7E-7

TABLE 7.17

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

TIER 2 CENTRAL EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: School Student
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Indoor Air	Indoor Air	Air Inhalation	Naphthalene	2.1E+0	ug/m3					NA					2.2E-1
				n-Butylbenzene	5.5E+0	ug/m3					NA					3.8E-2
				n-Propylbenzene	NA	ug/m3					NA					NA
				Styrene	1.2E-1	ug/m3					NA					1.3E-4
				Toluene	1.2E+0	ug/m3					NA					3.9E-3
				Xylenes (total)	6.0E-1	ug/m3					NA					8.2E-4
				Benzene (500 ft)	9.1E-1	ug/m3					1E-6					7.5E-3
				Benzene (725 ft)	5.9E-1	ug/m3					7E-7					4.9E-3
			Exp. Route Total	krig - 500 ft							2E-6					2.9E-1
			Exp. Route Total	krig - 725 ft							2E-6					2.9E-1
		Exposure Point Total	krig - 500 ft								2E-6					2.9E-1
		Exposure Point Total	krig - 725 ft								2E-6					2.9E-1
	Exposure Medium Total	krig - 500 ft									2E-6					2.9E-1
	Exposure Medium Total	krig - 725 ft									2E-6					2.9E-1
Medium Total	krig - 500 ft										2E-6					2.9E-1
Medium Total	krig - 725 ft										2E-6					2.9E-1
Receptor Total (Inhalation via Soil Vapor) Alameda Annex											2E-7					8.4E-3
Receptor Total (Inhalation via Soil Vapor) Alameda Point - Site 25											5E-8					7.6E-3
Receptor Total (Inhalation via Soil Vapor) Alameda Point - Site 30											5E-8					7.6E-3
Receptor Total (Inhalation via Soil Vapor) Alameda Point - Site 31											5E-8					7.6E-3
Receptor Total (Inhalation via Groundwater) krig - 500 ft											2E-6					2.9E-1
Receptor Total (Inhalation via Groundwater) krig - 725 ft											2E-6					2.9E-1

TABLE 7.18
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
TIER 2 REASONABLE MAXIMUM EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: School Student
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil Vapor	Indoor Air	Indoor Air	Air Inhalation	Chloroform	2.8E-3	ug/m3					6E-9					8.9E-6
				Ethylbenzene	7.1E-2	ug/m3					3E-8					3.4E-5
				m,p-Xylene	5.5E-2	ug/m3					NA					5.2E-4
				Naphthalene	6.5E-2	ug/m3					NA					6.9E-3
				Tetrachloroethene (PCE)	1.7E-3	ug/m3					4E-9					4.7E-5
				Trichloroethene	3.6E-3	ug/m3					3E-9					5.7E-6
		Alameda Annex		Benzene (Alameda Annex)	9.9E-2	ug/m3					1E-7					8.1E-4
		Alameda Point - Site 25		Benzene (Alameda Point - Site 25)	3.7E-4	ug/m3					4E-10					3.0E-6
		Alameda Point - Site 30		Benzene (Alameda Point - Site 30)	5.7E-4	ug/m3					7E-10					4.7E-6
		Alameda Point - Site 31		Benzene (Alameda Point - Site 31)	2.9E-4	ug/m3					3E-10					2.3E-6
			Exp. Route Total	(Alameda Annex)							2E-7					8.4E-3
			Exp. Route Total	(Alameda Point - Site 25)							5E-8					7.6E-3
			Exp. Route Total	(Alameda Point - Site 30)							5E-8					7.6E-3
			Exp. Route Total	(Alameda Point - Site 31)							5E-8					7.6E-3
		Exposure Point Total	(Alameda Annex)								2E-7					8.4E-3
		Exposure Point Total	(Alameda Point - Site 25)								5E-8					7.6E-3
		Exposure Point Total	(Alameda Point - Site 30)								5E-8					7.6E-3
		Exposure Point Total	(Alameda Point - Site 31)								5E-8					7.6E-3
	Exposure Medium Total	(Alameda Annex)									2E-7					8.4E-3
	Exposure Medium Total	(Alameda Point - Site 25)									5E-8					7.6E-3
	Exposure Medium Total	(Alameda Point - Site 30)									5E-8					7.6E-3
	Exposure Medium Total	(Alameda Point - Site 31)									5E-8					7.6E-3
Medium Total	(Alameda Annex)										2E-7					8.4E-3
Medium Total	(Alameda Point - Site 25)										5E-8					7.6E-3
Medium Total	(Alameda Point - Site 30)										5E-8					7.6E-3
Medium Total	(Alameda Point - Site 31)										5E-8					7.6E-3
Groundwater	Indoor Air	Indoor Air	Air Inhalation	1,2,4-Trimethylbenzene	6.0E-2	ug/m3					NA					7.9E-4
				1,2-Dichloroethane	1.9E-2	ug/m3					2E-7					3.5E-3
				1,3,5-Trimethylbenzene	3.2E-2	ug/m3					NA					9.7E-3
				Acetone	2.9E-1	ug/m3					NA					7.9E-4
				Carbon disulfide	6.0E-2	ug/m3					NA					7.1E-5
				Ethylbenzene	1.6E+0	ug/m3					7E-7					7.5E-4
				Isopropyl benzene	1.7E-2	ug/m3					NA					4.1E-5
				Methyl isobutyl ketone	4.9E-3	ug/m3					NA					1.7E-5
				Methylene chloride	1.6E-1	ug/m3					7E-8					3.9E-4
				MTBE	7.3E-3	ug/m3					8E-10					8.7E-7

TABLE 7.18

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

TIER 2 REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: School Student
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Indoor Air	Indoor Air	Air Inhalation	Naphthalene	2.1E+0	ug/m3					NA					2.2E-1
				n-Butylbenzene	5.5E+0	ug/m3					NA					3.8E-2
				n-Propylbenzene	NA	ug/m3					NA					NA
				Styrene	1.2E-1	ug/m3					NA					1.3E-4
				Toluene	1.2E+0	ug/m3					NA					3.9E-3
				Xylenes (total)	6.0E-1	ug/m3					NA					8.2E-4
				Benzene (500 ft)	9.1E-1	ug/m3					1E-6					7.5E-3
				Benzene (725 ft)	5.9E-1	ug/m3					7E-7					4.9E-3
			Exp. Route Total	krig - 500 ft							2E-6					2.9E-1
			Exp. Route Total	krig - 725 ft							2E-6					2.9E-1
		Exposure Point Total	krig - 500 ft								2E-6					2.9E-1
		Exposure Point Total	krig - 725 ft								2E-6					2.9E-1
	Exposure Medium Total	krig - 500 ft									2E-6					2.9E-1
	Exposure Medium Total	krig - 725 ft									2E-6					2.9E-1
Medium Total	krig - 500 ft										2E-6					2.9E-1
Medium Total	krig - 725 ft										2E-6					2.9E-1
Receptor Total (Inhalation via Soil Vapor) Alameda Annex											2E-7					8.4E-3
Receptor Total (Inhalation via Soil Vapor) Alameda Point - Site 25											5E-8					7.6E-3
Receptor Total (Inhalation via Soil Vapor) Alameda Point - Site 30											5E-8					7.6E-3
Receptor Total (Inhalation via Soil Vapor) Alameda Point - Site 31											5E-8					7.6E-3
Receptor Total (Inhalation via Groundwater) krig - 500 ft											2E-6					2.9E-1
Receptor Total (Inhalation via Groundwater) krig - 725 ft											2E-6					2.9E-1

TABLE 7.19
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
TIER 2 CENTRAL EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: School Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil Vapor	Indoor Air	Indoor Air	Air Inhalation	Chloroform	2.8E-3	ug/m3					6E-9					8.9E-6
				Ethylbenzene	7.1E-2	ug/m3					3E-8					3.4E-5
				m,p-Xylene	5.5E-2	ug/m3					NA					5.2E-4
				Naphthalene	6.5E-2	ug/m3					NA					6.9E-3
				Tetrachloroethene (PCE)	1.7E-3	ug/m3					4E-9					4.7E-5
				Trichloroethene	3.6E-3	ug/m3					3E-9					5.7E-6
		Alameda Annex		Benzene (Alameda Annex)	9.9E-2	ug/m3					7E-7					1.1E-3
		Alameda Point - Site 25		Benzene (Alameda Point - Site 25)	3.7E-4	ug/m3					3E-9					4.2E-6
		Alameda Point - Site 30		Benzene (Alameda Point - Site 30)	5.7E-4	ug/m3					4E-9					6.5E-6
		Alameda Point - Site 31		Benzene (Alameda Point - Site 31)	2.9E-4	ug/m3					2E-9					3.3E-6
			Exp. Route Total	(Alameda Annex)							8E-7					8.7E-3
			Exp. Route Total	(Alameda Point - Site 25)							5E-8					7.6E-3
			Exp. Route Total	(Alameda Point - Site 30)							5E-8					7.6E-3
			Exp. Route Total	(Alameda Point - Site 31)							5E-8					7.6E-3
		Exposure Point Total	(Alameda Annex)								8E-7					8.7E-3
		Exposure Point Total	(Alameda Point - Site 25)								5E-8					7.6E-3
		Exposure Point Total	(Alameda Point - Site 30)								5E-8					7.6E-3
		Exposure Point Total	(Alameda Point - Site 31)								5E-8					7.6E-3
	Exposure Medium Total	(Alameda Annex)									8E-7					8.7E-3
	Exposure Medium Total	(Alameda Point - Site 25)									5E-8					7.6E-3
	Exposure Medium Total	(Alameda Point - Site 30)									5E-8					7.6E-3
	Exposure Medium Total	(Alameda Point - Site 31)									5E-8					7.6E-3
Medium Total	(Alameda Annex)										8E-7					8.7E-3
Medium Total	(Alameda Point - Site 25)										5E-8					7.6E-3
Medium Total	(Alameda Point - Site 30)										5E-8					7.6E-3
Medium Total	(Alameda Point - Site 31)										5E-8					7.6E-3
Groundwater	Indoor Air	Indoor Air	Air Inhalation	1,2,4-Trimethylbenzene	6.0E-2	ug/m3					NA					7.9E-4
				1,2-Dichloroethane	1.9E-2	ug/m3					2E-7					3.5E-3
				1,3,5-Trimethylbenzene	3.2E-2	ug/m3					NA					9.7E-3
				Acetone	2.9E-1	ug/m3					NA					7.9E-4
				Carbon disulfide	6.0E-2	ug/m3					NA					7.1E-5
				Ethylbenzene	1.6E+0	ug/m3					7E-7					7.5E-4
				Isopropyl benzene	1.7E-2	ug/m3					NA					4.1E-5
				Methyl isobutyl ketone	4.9E-3	ug/m3					NA					1.7E-5
				Methylene chloride	1.6E-1	ug/m3					7E-8					3.9E-4
				MTBE	7.3E-3	ug/m3					8E-10					8.7E-7

TABLE 7.19

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

TIER 2 CENTRAL EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: School Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Indoor Air	Indoor Air	Air Inhalation	Naphthalene	2.1E+0	ug/m3					NA					2.2E-1
				n-Butylbenzene	5.5E+0	ug/m3					NA					3.8E-2
				n-Propylbenzene	NA	ug/m3					NA					NA
				Styrene	1.2E-1	ug/m3					NA					1.3E-4
				Toluene	1.2E+0	ug/m3					NA					3.9E-3
				Xylenes (total)	6.0E-1	ug/m3					NA					8.2E-4
				Benzene (500 ft)	9.1E-1	ug/m3					6E-6					1.0E-2
				Benzene (725 ft)	5.9E-1	ug/m3					4E-6					6.8E-3
			Exp. Route Total	krig - 500 ft							7E-6					2.9E-1
			Exp. Route Total	krig - 725 ft							5E-6					2.9E-1
		Exposure Point Total	krig - 500 ft								7E-6					2.9E-1
		Exposure Point Total	krig - 725 ft								5E-6					2.9E-1
	Exposure Medium Total	krig - 500 ft									7E-6					3E-1
	Exposure Medium Total	krig - 725 ft									5E-6					3E-1
Medium Total	krig - 500 ft										5E-6					3E-1
Medium Total	krig - 725 ft										7E-6					3E-1
Receptor Total (Inhalation via Soil Vapor) Alameda Annex											8E-7					8.7E-3
Receptor Total (Inhalation via Soil Vapor) Alameda Point - Site 25											5E-8					7.6E-3
Receptor Total (Inhalation via Soil Vapor) Alameda Point - Site 30											5E-8					7.6E-3
Receptor Total (Inhalation via Soil Vapor) Alameda Point - Site 31											5E-8					7.6E-3
Receptor Total (Inhalation via Groundwater) krig - 500 ft											5E-6					2.9E-1
Receptor Total (Inhalation via Groundwater) krig - 725 ft											7E-6					2.9E-1

TABLE 7.20

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

TIER 2 REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: School Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil Vapor	Indoor Air	Indoor Air	Air Inhalation	Chloroform	2.8E-3	ug/m3					6E-9					8.9E-6
				Ethylbenzene	7.1E-2	ug/m3					3E-8					3.4E-5
				m,p-Xylene	5.5E-2	ug/m3					NA					5.2E-4
				Naphthalene	6.5E-2	ug/m3					NA					6.9E-3
				Tetrachloroethene (PCE)	1.7E-3	ug/m3					4E-9					4.7E-5
				Trichloroethene	3.6E-3	ug/m3					3E-9					5.7E-6
		Alameda Annex		Benzene (Alameda Annex)	9.9E-2	ug/m3					7E-7					1.1E-3
		Alameda Point - Site 25		Benzene (Alameda Point - Site 25)	3.7E-4	ug/m3					3E-9					4.2E-6
		Alameda Point - Site 30		Benzene (Alameda Point - Site 30)	5.7E-4	ug/m3					4E-9					6.5E-6
		Alameda Point - Site 31		Benzene (Alameda Point - Site 31)	2.9E-4	ug/m3					2E-9					3.3E-6
			Exp. Route Total	(Alameda Annex)							8E-7					8.7E-3
			Exp. Route Total	(Alameda Point - Site 25)							5E-8					7.6E-3
			Exp. Route Total	(Alameda Point - Site 30)							5E-8					7.6E-3
			Exp. Route Total	(Alameda Point - Site 31)							5E-8					7.6E-3
		Exposure Point Total	(Alameda Annex)								8E-7					8.7E-3
		Exposure Point Total	(Alameda Point - Site 25)								5E-8					7.6E-3
		Exposure Point Total	(Alameda Point - Site 30)								5E-8					7.6E-3
		Exposure Point Total	(Alameda Point - Site 31)								5E-8					7.6E-3
	Exposure Medium Total	(Alameda Annex)									8E-7					8.7E-3
	Exposure Medium Total	(Alameda Point - Site 25)									5E-8					7.6E-3
	Exposure Medium Total	(Alameda Point - Site 30)									5E-8					7.6E-3
	Exposure Medium Total	(Alameda Point - Site 31)									5E-8					7.6E-3
Medium Total	(Alameda Annex)										8E-7					8.7E-3
Medium Total	(Alameda Point - Site 25)										5E-8					7.6E-3
Medium Total	(Alameda Point - Site 30)										5E-8					7.6E-3
Medium Total	(Alameda Point - Site 31)										5E-8					7.6E-3
Groundwater	Indoor Air	Indoor Air	Air Inhalation	1,2,4-Trimethylbenzene	6.0E-2	ug/m3					NA					7.9E-4
				1,2-Dichloroethane	1.9E-2	ug/m3					2E-7					3.5E-3
				1,3,5-Trimethylbenzene	3.2E-2	ug/m3					NA					9.7E-3
				Acetone	2.9E-1	ug/m3					NA					7.9E-4
				Carbon disulfide	6.0E-2	ug/m3					NA					7.1E-5
				Ethylbenzene	1.6E+0	ug/m3					7E-7					7.5E-4
				Isopropyl benzene	1.7E-2	ug/m3					NA					4.1E-5
				Methyl isobutyl ketone	4.9E-3	ug/m3					NA					1.7E-5
				Methylene chloride	1.6E-1	ug/m3					7E-8					3.9E-4
				MTBE	7.3E-3	ug/m3					8E-10					8.7E-7

TABLE 7.20

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

TIER 2 REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: School Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Indoor Air	Indoor Air	Air Inhalation	Naphthalene	2.1E+0	ug/m3					NA					2.2E-1
				n-Butylbenzene	5.5E+0	ug/m3					NA					3.8E-2
				n-Propylbenzene	NA	ug/m3					NA					NA
				Styrene	1.2E-1	ug/m3					NA					1.3E-4
				Toluene	1.2E+0	ug/m3					NA					3.9E-3
				Xylenes (total)	6.0E-1	ug/m3					NA					8.2E-4
				Benzene (500 ft)	9.1E-1	ug/m3					6E-6					1.0E-2
				Benzene (725 ft)	5.9E-1	ug/m3					4E-6					6.8E-3
			Exp. Route Total	krig - 500 ft							7E-6					2.9E-1
			Exp. Route Total	krig - 725 ft							5E-6					2.9E-1
		Exposure Point Total	krig - 500 ft								7E-6					2.9E-1
		Exposure Point Total	krig - 725 ft								5E-6					2.9E-1
	Exposure Medium Total	krig - 500 ft									7E-6					2.9E-1
	Exposure Medium Total	krig - 725 ft									5E-6					2.9E-1
Medium Total	krig - 500 ft										7E-6					2.9E-1
Medium Total	krig - 725 ft										5E-6					2.9E-1
Receptor Total (Inhalation via Soil Vapor) Alameda Annex											8E-7					8.7E-3
Receptor Total (Inhalation via Soil Vapor) Alameda Point - Site 25											5E-8					7.6E-3
Receptor Total (Inhalation via Soil Vapor) Alameda Point - Site 30											5E-8					7.6E-3
Receptor Total (Inhalation via Soil Vapor) Alameda Point - Site 31											5E-8					7.6E-3
Receptor Total (Inhalation via Groundwater) krig - 500 ft											7E-6					2.9E-1
Receptor Total (Inhalation via Groundwater) krig - 725 ft											5E-6					2.9E-1

TABLE 8

CALCULATION OF RADIATION CANCER RISKS

CENTRAL / REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: All
Receptor Age: All

Medium	Exposure Medium	Exposure Point	Exposure Route	Radionuclide of Potential Concern	EPC		Risk Calculation Approach	Cancer Risk Calculations				
								Intake/Activity		CSF		Cancer Risk
					Value	Units		Value	Units	Value	Units	
NOT APPLICABLE												

TABLE 9.1

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

TIER 1 CENTRAL EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Car Wash Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater Potable Use	Potable Water	Potable Water	Aluminum	NA			0E+0		1.2E-2			1.2E-2
			Antimony	NA			0E+0	Whole Body, Blood	1.1E-2			1.1E-2
			Arsenic	2E-4			2E-4	Skin	6.5E-1			6.5E-1
			Barium	NA			0E+0	Kidney	2.5E-1			2.5E-1
			Beryllium	NA			0E+0	Small Intestine	8.1E-3			8.1E-3
			Cadmium	1E-6			1E-6	Kidney	5.7E-2			5.7E-2
			Chromium	NA			0E+0		6.5E-2			6.5E-2
			Cobalt	NA			0E+0		3.3E-3			3.3E-3
			Copper	NA			0E+0	GI System	2.4E-3			2.4E-3
			Iron	NA			0E+0		1.2E+0			1.2E+0
			Lead	NA			0E+0		NA			0.0E+0
			Manganese	NA			0E+0	CNS	1.6E-1			1.6E-1
			Mercury	NA			0E+0	Immune System	6.5E-3			6.5E-3
			Molybdenum	NA			0E+0	Blood	6.6E-2			6.6E-2
			Nickel	NA			0E+0	Body Weight	7.0E-3			7.0E-3
			Nitrate	NA			0E+0	Blood	3.9E-2			3.9E-2
			Selenium	NA			0E+0	Whole Body	2.3E-2			2.3E-2
			Silver	NA			0E+0	Skin	2.6E-2			2.6E-2
			Thallium	NA			0E+0	Liver, Blood, Hair	1.3E+0			1.3E+0
			Vanadium	NA			0E+0	Hair	2.5E-2			2.5E-2
			Zinc	NA			0E+0	Blood	3.2E-4			3.2E-4
			1,2,4-Trimethylbenzene	NA			0E+0		9.7E-3			9.7E-3
			1,2-Dichloroethane	2E-6			2E-6		1.5E-2			1.5E-2
			1,3,5-Trimethylbenzene	NA			0E+0		5.1E-3			5.1E-3
			Acenaphthene	NA			0E+0	Liver	3.2E-2			3.2E-2
			Acenaphthylene	NA			0E+0		NA			0.0E+0
			Acetone	NA			0E+0	Liver, Kidney	8.8E-1			8.8E-1

TABLE 9.1

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

TIER 1 CENTRAL EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Car Wash Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
			Anthracene	NA			0E+0	NOAEL	1.7E-3			1.7E-3
			Benzene	5E-4			5E-4		1.8E+1			1.8E+1
			Benzo[a]anthracene	3E-5			3E-5		NA			0.0E+0
			Benzo[a]pyrene	6E-4			6E-4		NA			0.0E+0
			Benzo[b]fluoranthene	3E-5			3E-5		NA			0.0E+0
			Benzo[g,h,i]perylene	NA			0E+0		NA			0.0E+0
			Benzo[k]fluoranthene	1E-5			1E-5		NA			0.0E+0
			Carbon Disulfide	NA			0E+0	Reproductive/ Teratogenic	4.2E-4			4.2E-4
			Chrysene	4E-6			4E-6		NA			0.0E+0
			Dibenz[a,h]anthracene	1E-5			1E-5		NA			0.0E+0
			Ethylbenzene	3E-6			3E-6	Liver, Kidney	7.0E-2			7.0E-2
			Fluoranthene	NA			0E+0	Kidney, Liver, Blood	6.2E-2			6.2E-2
			Fluorene	NA			0E+0	Blood	1.5E-2			1.5E-2
			Indeno(1,2,3-cd)pyrene	4E-5			4E-5		NA			0.0E+0
			Isopropyl benzene	NA			0E+0	Kidney	6.5E-4			6.5E-4
			Methyl isobutyl ketone	0E+0			0E+0		3.9E-4			3.9E-4
			Methylene chloride	2E-6			2E-6	Liver	2.6E-2			2.6E-2
			MTBE	3E-8			3E-8		NA			0.0E+0
			Naphthalene	NA			0E+0	Whole Body	8.4E+0			8.4E+0
			n-Butylbenzene	NA			0E+0		4.0E-1			4.0E-1
			n-Propylbenzene	NA			0E+0		2.4E-3			2.4E-3
			Phenanthrene	NA			0E+0		NA			0.0E+0
			Pyrene	NA			0E+0	Kidney	5.9E-2			5.9E-2
			Styrene	NA			0E+0	Blood, Liver	8.2E-3			8.2E-3
			Toluene	NA			0E+0	Liver, Kidney, Respiratory	2.7E-2			2.7E-2
			Xylenes (total)	NA			0E+0	Whole Body	1.9E-2			1.9E-2
			Chemical Total	1E-3			1E-3		3.1E+1			3.1E+1
		Exposure Point Total					1E-3					3.1E+1

TABLE 9.1
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
TIER 1 CENTRAL EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Car Wash Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
	Exposure Medium Total						1E-3					3.1E+1
Medium Total							1E-3					3.1E+1
Groundwater Industrial Use	Industrial Water	Industrial Water	Aluminum			NA	0E+0				4.9E-5	4.9E-5
			Antimony			NA	0E+0	Whole Body, Blood			4.2E-5	4.2E-5
			Arsenic			7E-7	7E-7	Skin			2.6E-3	2.6E-3
			Barium			NA	0E+0	Kidney			9.8E-4	9.8E-4
			Beryllium			NA	0E+0	Small Intestine			3.2E-5	3.2E-5
			Cadmium			4E-9	4E-9	Kidney			2.3E-4	2.3E-4
			Chromium			NA	0E+0				5.2E-4	5.2E-4
			Cobalt			NA	0E+0				1.3E-5	1.3E-5
			Copper			NA	0E+0	GI System			9.7E-6	9.7E-6
			Iron			NA	0E+0				4.7E-3	4.7E-3
			Lead			NA	0E+0				NA	0.0E+0
			Manganese			NA	0E+0	CNS			6.2E-4	6.2E-4
			Mercury			NA	0E+0	Immune System			2.6E-5	2.6E-5
			Molybdenum			NA	0E+0	Blood			2.6E-4	2.6E-4
			Nickel			NA	0E+0	Body Weight			5.6E-6	5.6E-6
			Nitrate			NA	0E+0	Blood			1.5E-4	1.5E-4
			Selenium			NA	0E+0	Whole Body			9.1E-5	9.1E-5
			Silver			NA	0E+0	Skin			6.3E-5	6.3E-5
			Thallium			NA	0E+0	Liver, Blood, Hair			5.1E-3	5.1E-3
			Vanadium			NA	0E+0	Hair			1.0E-4	1.0E-4
			Zinc			NA	0E+0	Blood			7.7E-7	7.7E-7
			1,2,4-Trimethylbenzene			NA	0E+0				0.0E+0	0.0E+0
			1,2-Dichloroethane			3E-7	3E-7				2.5E-3	2.5E-3
			1,3,5-Trimethylbenzene			NA	0E+0				0.0E+0	0.0E+0

TABLE 9.1
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
TIER 1 CENTRAL EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Car Wash Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
			Acenaphthene			NA	0E+0	Liver			0.0E+0	0.0E+0
			Acenaphthylene			NA	0E+0				NA	0.0E+0
			Acetone			NA	0E+0	Liver, Kidney			3.8E-3	3.8E-3
			Anthracene			NA	0E+0	NOAEL			0.0E+0	0.0E+0
			Benzene			3E-5	3E-5				1.1E+0	1.1E+0
			Benzo[a]anthracene			0E+0	0E+0				NA	0.0E+0
			Benzo[a]pyrene			0E+0	0E+0				NA	0.0E+0
			Benzo[b]fluoranthene			0E+0	0E+0				NA	0.0E+0
			Benzo[g,h,I]perylene			NA	0E+0				NA	0.0E+0
			Benzo[k]fluoranthene			0E+0	0E+0				NA	0.0E+0
			Carbon Disulfide			NA	0E+0	Reproductive/ Teratogenic			2.9E-5	2.9E-5
			Chrysene			0E+0	0E+0				NA	0.0E+0
			Dibenz[a,h]anthracene			0E+0	0E+0				NA	0.0E+0
			Ethylbenzene			5E-7	5E-7	Liver, Kidney			1.4E-2	1.4E-2
			Fluoranthene			NA	0E+0	Kidney, Liver, Blood			0.0E+0	0.0E+0
			Fluorene			NA	0E+0	Blood			0.0E+0	0.0E+0
			Indeno(1,2,3-cd)pyrene			0E+0	0E+0				NA	0.0E+0
			Isopropyl benzene			NA	0E+0	Kidney			8.0E-5	8.0E-5
			Methyl isobutyl ketone			0E+0	0E+0				6.1E-6	6.1E-6
			Methylene chloride			3E-8	3E-8	Liver			3.7E-4	3.7E-4
			MTBE			4E-10	4E-10				NA	0.0E+0
			Naphthalene			NA	0E+0	Whole Body			1.6E+0	1.6E+0
			n-Butylbenzene			NA	0E+0				0.0E+0	0.0E+0
			n-Propylbenzene			NA	0E+0				0.0E+0	0.0E+0
			Phenanthrene			NA	0E+0				NA	0.0E+0
			Pyrene			NA	0E+0	Kidney			0.0E+0	0.0E+0
			Styrene			NA	0E+0	Blood, Liver			1.2E-3	1.2E-3
			Toluene			NA	0E+0	Liver, Kidney, Respiratory			3.4E-3	3.4E-3
			Xylenes (total)			NA	0E+0	Whole Body			3.9E-3	3.9E-3

TABLE 9.1

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

TIER 1 CENTRAL EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Car Wash Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
			Chemical Total			3E-5	3E-5				2.7E+0	2.7E+0
		Exposure Point Total					3E-5					2.7E+0
	Exposure Medium Total						3E-5					2.7E+0
	Work Space Air	Work Space Air	1,2,4-Trimethylbenzene		NA		0E+0			9E-4		8.6E-4
			1,2-Dichloroethane		1E-8		1E-8			1E-3		1.2E-3
			1,3,5-Trimethylbenzene		NA		0E+0			5E-4		4.5E-4
			Acenaphthene		NA		0E+0			NA		0.0E+0
			Acetone		NA		0E+0			NA		0.0E+0
			Anthracene		NA		0E+0			NA		0.0E+0
			Benzene		2E-6		2E-6			1E-1		1.2E-1
			Benzo[b]fluoranthene		2E-8		2E-8			NA		0.0E+0
			Carbon Disulfide		NA		0E+0	Peripheral Nervous System		8E-7		8.1E-7
			Chrysene		4E-9		4E-9			NA		0.0E+0
			Ethylbenzene		8E-9		8E-9	Developmental		8E-5		7.8E-5
			Fluorene		NA		0E+0			NA		0.0E+0
			Isopropyl benzene		NA		0E+0	Kidney		2E-6		1.8E-6
			Methyl isobutyl ketone		0E+0		0E+0			4E-6		3.8E-6
			Methylene chloride		2E-9		2E-9			8E-6		7.7E-6
			MTBE		5E-11		5E-11	Liver, Kidney		7E-7		7.1E-7
			Naphthalene		NA		0E+0	Respiratory		6E-1		5.8E-1
			n-Butylbenzene		NA		0E+0			NA		0.0E+0
			n-Propylbenzene		NA		0E+0			NA		0.0E+0
			Pyrene		NA		0E+0			NA		0.0E+0
			Styrene		NA		0E+0	CNS		2E-5		1.8E-5
			Toluene		NA		0E+0	CNS, Respiratory		2E-4		1.7E-4
			Xylenes (total)		NA		0E+0	CNS		5E-4		4.5E-4

TABLE 9.1

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

TIER 1 CENTRAL EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Car Wash Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
			Chemical Total		2E-6		2E-6			7.0E-1		7.0E-1
		Exposure Point Total					2E-6					7.0E-1
	Exposure Medium Total						2E-6					7.0E-1
Medium Total							3E-5					3.4E+0
Receptor Total							1E-3					3.5E+1

TABLE 9.2

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

TIER 1 REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Car Wash Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater Potable Use	Potable Water	Potable Water	Aluminum	NA			0E+0		1.2E-2			1.2E-2
			Antimony	NA			0E+0	Whole Body, Blood	1.1E-2			1.1E-2
			Arsenic	7E-4			7E-4	Skin	6.5E-1			6.5E-1
			Barium	NA			0E+0	Kidney	2.5E-1			2.5E-1
			Beryllium	NA			0E+0	Small Intestine	8.1E-3			8.1E-3
			Cadmium	4E-6			4E-6	Kidney	5.7E-2			5.7E-2
			Chromium	NA			0E+0		6.5E-2			6.5E-2
			Cobalt	NA			0E+0		3.3E-3			3.3E-3
			Copper	NA			0E+0	GI System	2.4E-3			2.4E-3
			Iron	NA			0E+0		1.2E+0			1.2E+0
			Lead	NA			0E+0		NA			0.0E+0
			Manganese	NA			0E+0	CNS	1.6E-1			1.6E-1
			Mercury	NA			0E+0	Immune System	6.5E-3			6.5E-3
			Molybdenum	NA			0E+0	Blood	6.6E-2			6.6E-2
			Nickel	NA			0E+0	Body Weight	7.0E-3			7.0E-3
			Nitrate	NA			0E+0	Blood	3.9E-2			3.9E-2
			Selenium	NA			0E+0	Whole Body	2.3E-2			2.3E-2
			Silver	NA			0E+0	Skin	2.6E-2			2.6E-2
			Thallium	NA			0E+0	Liver, Blood, Hair	1.3E+0			1.3E+0
			Vanadium	NA			0E+0	Hair	2.5E-2			2.5E-2
			Zinc	NA			0E+0	Blood	3.2E-4			3.2E-4
			1,2,4-Trimethylbenzene	NA			0E+0		9.7E-3			9.7E-3
			1,2-Dichloroethane	7E-6			7E-6		1.5E-2			1.5E-2
			1,3,5-Trimethylbenzene	NA			0E+0		5.1E-3			5.1E-3
			Acenaphthene	NA			0E+0	Liver	3.2E-2			3.2E-2
			Acenaphthylene	NA			0E+0		NA			0.0E+0
			Acetone	NA			0E+0	Liver, Kidney	8.8E-1			8.8E-1

TABLE 9.2

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

TIER 1 REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Car Wash Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
			Anthracene	NA			0E+0	NOAEL	1.7E-3			1.7E-3
			Benzene	2E-3			2E-3		1.8E+1			1.8E+1
			Benzo[a]anthracene	1E-4			1E-4		NA			0.0E+0
			Benzo[a]pyrene	2E-3			2E-3		NA			0.0E+0
			Benzo[b]fluoranthene	1E-4			1E-4		NA			0.0E+0
			Benzo[g,h,I]perylene	NA			0E+0		NA			0.0E+0
			Benzo[k]fluoranthene	5E-5			5E-5		NA			0.0E+0
			Carbon Disulfide	NA			0E+0	Reproductive/ Teratogenic	4.2E-4			4.2E-4
			Chrysene	2E-5			2E-5		NA			0.0E+0
			Dibenz[a,h]anthracene	4E-5			4E-5		NA			0.0E+0
			Ethylbenzene	1E-5			1E-5	Liver, Kidney	7.0E-2			7.0E-2
			Fluoranthene	NA			0E+0	Kidney, Liver, Blood	6.2E-2			6.2E-2
			Fluorene	NA			0E+0	Blood	1.5E-2			1.5E-2
			Indeno(1,2,3-cd)pyrene	2E-4			2E-4		NA			0.0E+0
			Isopropyl benzene	NA			0E+0	Kidney	6.5E-4			6.5E-4
			Methyl isobutyl ketone	0E+0			0E+0		3.9E-4			3.9E-4
			Methylene chloride	8E-6			8E-6	Liver	2.6E-2			2.6E-2
			MTBE	1E-7			1E-7		NA			0.0E+0
			Naphthalene	NA			0E+0	Whole Body	8.4E+0			8.4E+0
			n-Butylbenzene	NA			0E+0		4.0E-1			4.0E-1
			n-Propylbenzene	NA			0E+0		2.4E-3			2.4E-3
			Phenanthrene	NA			0E+0		NA			0.0E+0
			Pyrene	NA			0E+0	Kidney	5.9E-2			5.9E-2
			Styrene	NA			0E+0	Blood, Liver	8.2E-3			8.2E-3
			Toluene	NA			0E+0	Liver, Kidney, Respiratory	2.7E-2			2.7E-2
			Xylenes (total)	NA			0E+0	Whole Body	1.9E-2			1.9E-2
			Chemical Total	5E-3			5E-3		3.1E+1			3.1E+1
		Exposure Point Total					5E-3					3.1E+1

TABLE 9.2

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

TIER 1 REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Car Wash Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
	Exposure Medium Total						5E-3					3.1E+1
Medium Total							5E-3					3.1E+1
Groundwater Industrial Use	Industrial Water	Industrial Water	Aluminum			NA	0E+0				1.1E-4	1.1E-4
			Antimony			NA	0E+0	Whole Body, Blood			9.7E-5	9.7E-5
			Arsenic			6E-6	6E-6	Skin			5.9E-3	5.9E-3
			Barium			NA	0E+0	Kidney			2.3E-3	2.3E-3
			Beryllium			NA	0E+0	Small Intestine			7.4E-5	7.4E-5
			Cadmium			4E-8	4E-8	Kidney			5.2E-4	5.2E-4
			Chromium			NA	0E+0				1.2E-3	1.2E-3
			Cobalt			NA	0E+0				3.0E-5	3.0E-5
			Copper			NA	0E+0	GI System			2.2E-5	2.2E-5
			Iron			NA	0E+0				1.1E-2	1.1E-2
			Lead			NA	0E+0				NA	0.0E+0
			Manganese			NA	0E+0	CNS			1.4E-3	1.4E-3
			Mercury			NA	0E+0	Immune System			6.0E-5	6.0E-5
			Molybdenum			NA	0E+0	Blood			6.1E-4	6.1E-4
			Nickel			NA	0E+0	Body Weight			1.3E-5	1.3E-5
			Nitrate			NA	0E+0	Blood			3.5E-4	3.5E-4
			Selenium			NA	0E+0	Whole Body			2.1E-4	2.1E-4
			Silver			NA	0E+0	Skin			1.5E-4	1.5E-4
			Thallium			NA	0E+0	Liver, Blood, Hair			1.2E-2	1.2E-2
			Vanadium			NA	0E+0	Hair			2.3E-4	2.3E-4
			Zinc			NA	0E+0	Blood			1.8E-6	1.8E-6
			1,2,4-Trimethylbenzene			NA	0E+0				0.0E+0	0.0E+0
			1,2-Dichloroethane			3E-6	3E-6				5.7E-3	5.7E-3
			1,3,5-Trimethylbenzene			NA	0E+0				0.0E+0	0.0E+0

TABLE 9.2
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
TIER 1 REASONABLE MAXIMUM EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Car Wash Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
			Acenaphthene			NA	0E+0	Liver			0.0E+0	0.0E+0
			Acenaphthylene			NA	0E+0				NA	0.0E+0
			Acetone			NA	0E+0	Liver, Kidney			8.7E-3	8.7E-3
			Anthracene			NA	0E+0	NOAEL			0.0E+0	0.0E+0
			Benzene			3E-4	3E-4				2.4E+0	2.4E+0
			Benzo[a]anthracene			0E+0	0E+0				NA	0.0E+0
			Benzo[a]pyrene			0E+0	0E+0				NA	0.0E+0
			Benzo[b]fluoranthene			0E+0	0E+0				NA	0.0E+0
			Benzo[g,h,I]perylene			NA	0E+0				NA	0.0E+0
			Benzo[k]fluoranthene			0E+0	0E+0				NA	0.0E+0
			Carbon Disulfide			NA	0E+0	Reproductive/ Teratogenic			6.6E-5	6.6E-5
			Chrysene			0E+0	0E+0				NA	0.0E+0
			Dibenz[a,h]anthracene			0E+0	0E+0				NA	0.0E+0
			Ethylbenzene			4E-6	4E-6	Liver, Kidney			3.2E-2	3.2E-2
			Fluoranthene			NA	0E+0	Kidney, Liver, Blood			0.0E+0	0.0E+0
			Fluorene			NA	0E+0	Blood			0.0E+0	0.0E+0
			Indeno(1,2,3-cd)pyrene			0E+0	0E+0				NA	0.0E+0
			Isopropyl benzene			NA	0E+0	Kidney			1.8E-4	1.8E-4
			Methyl isobutyl ketone			0E+0	0E+0				1.4E-5	1.4E-5
			Methylene chloride			3E-7	3E-7	Liver			8.5E-4	8.5E-4
			MTBE			4E-9	4E-9				NA	0.0E+0
			Naphthalene			NA	0E+0	Whole Body			3.6E+0	3.6E+0
			n-Butylbenzene			NA	0E+0				0.0E+0	0.0E+0
			n-Propylbenzene			NA	0E+0				0.0E+0	0.0E+0
			Phenanthrene			NA	0E+0				NA	0.0E+0
			Pyrene			NA	0E+0	Kidney			0.0E+0	0.0E+0
			Styrene			NA	0E+0	Blood, Liver			2.8E-3	2.8E-3
			Toluene			NA	0E+0	Liver, Kidney, Respiratory			7.8E-3	7.8E-3
			Xylenes (total)			NA	0E+0	Whole Body			9.1E-3	9.1E-3

TABLE 9.2

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

TIER 1 REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Car Wash Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
			Chemical Total			3E-4	3E-4				6.1E+0	6.1E+0
		Exposure Point Total					3E-4					6.1E+0
	Exposure Medium Total						3E-4					6.1E+0
	Work Space Air	Work Space Air	1,2,4-Trimethylbenzene		NA		0E+0			3E-3		2.6E-3
			1,2-Dichloroethane		1E-7		1E-7			4E-3		3.8E-3
			1,3,5-Trimethylbenzene		NA		0E+0			1E-3		1.4E-3
			Acenaphthene		NA		0E+0			NA		0.0E+0
			Acetone		NA		0E+0			NA		0.0E+0
			Anthracene		NA		0E+0			NA		0.0E+0
			Benzene		2E-5		2E-5			4E-1		3.6E-1
			Benzo[b]fluoranthene		3E-7		3E-7			NA		0.0E+0
			Carbon Disulfide		NA		0E+0	Peripheral Nervous System		2E-6		2.5E-6
			Chrysene		4E-8		4E-8			NA		0.0E+0
			Ethylbenzene		1E-7		1E-7	Developmental		2E-4		2.4E-4
			Fluorene		NA		0E+0			NA		0.0E+0
			Isopropyl benzene		NA		0E+0	Kidney		6E-6		5.5E-6
			Methyl isobutyl ketone		0E+0		0E+0			1E-5		1.2E-5
			Methylene chloride		3E-8		3E-8			2E-5		2.4E-5
			MTBE		6E-10		6E-10	Liver, Kidney		2E-6		2.2E-6
			Naphthalene		NA		0E+0	Respiratory		2E+0		1.8E+0
			n-Butylbenzene		NA		0E+0			NA		0.0E+0
			n-Propylbenzene		NA		0E+0			NA		0.0E+0
			Pyrene		NA		0E+0			NA		0.0E+0
			Styrene		NA		0E+0	CNS		6E-5		5.6E-5
			Toluene		NA		0E+0	CNS, Respiratory		5E-4		5.2E-4
			Xylenes (total)		NA		0E+0	CNS		1E-3		1.4E-3

TABLE 9.2

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

TIER 1 REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Car Wash Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
			Chemical Total		2E-5		2E-5			2.2E+0		2.2E+0
		Exposure Point Total					2E-5					2.2E+0
	Exposure Medium Total						2E-5					2.2E+0
Medium Total							3E-4					8.3E+0
Receptor Total							6E-3					4.0E+1

TABLE 9.3

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

TIER 1 CENTRAL EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Landscape Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater Potable Use	Potable Water	Potable Water	Aluminum	NA			0E+0		1.2E-2			1.2E-2
			Antimony	NA			0E+0	Whole Body, Blood	1.1E-2			1.1E-2
			Arsenic	2E-4			2E-4	Skin	6.5E-1			6.5E-1
			Barium	NA			0E+0	Kidney	2.5E-1			2.5E-1
			Beryllium	NA			0E+0	Small Intestine	8.1E-3			8.1E-3
			Cadmium	1E-6			1E-6	Kidney	5.7E-2			5.7E-2
			Chromium	NA			0E+0		6.5E-2			6.5E-2
			Cobalt	NA			0E+0		3.3E-3			3.3E-3
			Copper	NA			0E+0	GI System	2.4E-3			2.4E-3
			Iron	NA			0E+0		1.2E+0			1.2E+0
			Lead	NA			0E+0		NA			0.0E+0
			Manganese	NA			0E+0	CNS	1.6E-1			1.6E-1
			Mercury	NA			0E+0	Immune System	6.5E-3			6.5E-3
			Molybdenum	NA			0E+0	Blood	6.6E-2			6.6E-2
			Nickel	NA			0E+0	Body Weight	7.0E-3			7.0E-3
			Nitrate	NA			0E+0	Blood	3.9E-2			3.9E-2
			Selenium	NA			0E+0	Whole Body	2.3E-2			2.3E-2
			Silver	NA			0E+0	Skin	2.6E-2			2.6E-2
			Thallium	NA			0E+0	Liver, Blood, Hair	1.3E+0			1.3E+0
			Vanadium	NA			0E+0	Hair	2.5E-2			2.5E-2
			Zinc	NA			0E+0	Blood	3.2E-4			3.2E-4
			1,2,4-Trimethylbenzene	NA			0E+0		9.7E-3			9.7E-3
			1,2-Dichloroethane	2E-6			2E-6		1.5E-2			1.5E-2
			1,3,5-Trimethylbenzene	NA			0E+0		5.1E-3			5.1E-3
			Acenaphthene	NA			0E+0	Liver	3.2E-2			3.2E-2
			Acenaphthylene	NA			0E+0		NA			0.0E+0
			Acetone	NA			0E+0	Liver, Kidney	8.8E-1			8.8E-1

TABLE 9.3

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

TIER 1 CENTRAL EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Landscape Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
			Anthracene	NA			0E+0	NOAEL	1.7E-3			1.7E-3
			Benzene	5E-4			5E-4		1.8E+1			1.8E+1
			Benzo[a]anthracene	3E-5			3E-5		NA			0.0E+0
			Benzo[a]pyrene	6E-4			6E-4		NA			0.0E+0
			Benzo[b]fluoranthene	3E-5			3E-5		NA			0.0E+0
			Benzo[g,h,l]perylene	NA			0E+0		NA			0.0E+0
			Benzo[k]fluoranthene	1E-5			1E-5		NA			0.0E+0
			Carbon Disulfide	NA			0E+0	Reproductive/ Teratogenic	4.2E-4			4.2E-4
			Chrysene	4E-6			4E-6		NA			0.0E+0
			Dibenz[a,h]anthracene	1E-5			1E-5		NA			0.0E+0
			Ethylbenzene	3E-6			3E-6	Liver, Kidney	7.0E-2			7.0E-2
			Fluoranthene	NA			0E+0	Kidney, Liver, Blood	6.2E-2			6.2E-2
			Fluorene	NA			0E+0	Blood	1.5E-2			1.5E-2
			Indeno(1,2,3-cd)pyrene	4E-5			4E-5		NA			0.0E+0
			Isopropyl benzene	NA			0E+0	Kidney	6.5E-4			6.5E-4
			Methyl isobutyl ketone	0E+0			0E+0		3.9E-4			3.9E-4
			Methylene chloride	2E-6			2E-6	Liver	2.6E-2			2.6E-2
			MTBE	3E-8			3E-8		NA			0.0E+0
			Naphthalene	NA			0E+0	Whole Body	8.4E+0			8.4E+0
			n-Butylbenzene	NA			0E+0		4.0E-1			4.0E-1
			n-Propylbenzene	NA			0E+0		2.4E-3			2.4E-3
			Phenanthrene	NA			0E+0		NA			0.0E+0
			Pyrene	NA			0E+0	Kidney	5.9E-2			5.9E-2
			Styrene	NA			0E+0	Blood, Liver	8.2E-3			8.2E-3
			Toluene	NA			0E+0	Liver, Kidney, Respiratory	2.7E-2			2.7E-2
			Xylenes (total)	NA			0E+0	Whole Body	1.9E-2			1.9E-2
			Chemical Total	1E-3			1E-3		3.1E+1			3.1E+1
		Exposure Point Total					1E-3					3.1E+1

TABLE 9.3
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
TIER 1 CENTRAL EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Landscape Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
	Exposure Medium Total						1E-3					3.1E+1
Medium Total							1E-3					3.1E+1
Groundwater Industrial Use	Industrial Water	Industrial Water	Aluminum			NA	0E+0				6.8E-5	6.8E-5
			Antimony			NA	0E+0	Whole Body, Blood			5.8E-5	5.8E-5
			Arsenic			4E-7	4E-7	Skin			3.6E-3	3.6E-3
			Barium			NA	0E+0	Kidney			1.4E-3	1.4E-3
			Beryllium			NA	0E+0	Small Intestine			4.5E-5	4.5E-5
			Cadmium			2E-9	2E-9	Kidney			3.2E-4	3.2E-4
			Chromium			NA	0E+0				7.1E-4	7.1E-4
			Cobalt			NA	0E+0				1.8E-5	1.8E-5
			Copper			NA	0E+0	GI System			1.3E-5	1.3E-5
			Iron			NA	0E+0				6.4E-3	6.4E-3
			Lead			NA	0E+0				NA	0.0E+0
			Manganese			NA	0E+0	CNS			8.6E-4	8.6E-4
			Mercury			NA	0E+0	Immune System			3.6E-5	3.6E-5
			Molybdenum			NA	0E+0	Blood			3.6E-4	3.6E-4
			Nickel			NA	0E+0	Body Weight			7.8E-6	7.8E-6
			Nitrate			NA	0E+0	Blood			2.1E-4	2.1E-4
			Selenium			NA	0E+0	Whole Body			1.3E-4	1.3E-4
			Silver			NA	0E+0	Skin			8.8E-5	8.8E-5
			Thallium			NA	0E+0	Liver, Blood, Hair			7.1E-3	7.1E-3
			Vanadium			NA	0E+0	Hair			1.4E-4	1.4E-4
			Zinc			NA	0E+0	Blood			1.1E-6	1.1E-6
			1,2,4-Trimethylbenzene			NA	0E+0				0.0E+0	0.0E+0
			1,2-Dichloroethane			2E-7	2E-7				3.4E-3	3.4E-3
			1,3,5-Trimethylbenzene			NA	0E+0				0.0E+0	0.0E+0

TABLE 9.3
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
TIER 1 CENTRAL EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Landscape Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
			Acenaphthene			NA	0E+0	Liver			0.0E+0	0.0E+0
			Acenaphthylene			NA	0E+0				NA	0.0E+0
			Acetone			NA	0E+0	Liver, Kidney			5.2E-3	5.2E-3
			Anthracene			NA	0E+0	NOAEL			0.0E+0	0.0E+0
			Benzene			2E-5	2E-5				1.5E+0	1.5E+0
			Benzo[a]anthracene			0E+0	0E+0				NA	0.0E+0
			Benzo[a]pyrene			0E+0	0E+0				NA	0.0E+0
			Benzo[b]fluoranthene			0E+0	0E+0				NA	0.0E+0
			Benzo[g,h,i]perylene			NA	0E+0				NA	0.0E+0
			Benzo[k]fluoranthene			0E+0	0E+0				NA	0.0E+0
			Carbon Disulfide			NA	0E+0	Reproductive/ Teratogenic			4.0E-5	4.0E-5
			Chrysene			0E+0	0E+0				NA	0.0E+0
			Dibenz[a,h]anthracene			0E+0	0E+0				NA	0.0E+0
			Ethylbenzene			3E-7	3E-7	Liver, Kidney			1.9E-2	1.9E-2
			Fluoranthene			NA	0E+0	Kidney, Liver, Blood			0.0E+0	0.0E+0
			Fluorene			NA	0E+0	Blood			0.0E+0	0.0E+0
			Indeno(1,2,3-cd)pyrene			0E+0	0E+0				NA	0.0E+0
			Isopropyl benzene			NA	0E+0	Kidney			1.1E-4	1.1E-4
			Methyl isobutyl ketone			0E+0	0E+0				8.5E-6	8.5E-6
			Methylene chloride			2E-8	2E-8	Liver			5.1E-4	5.1E-4
			MTBE			2E-10	2E-10				NA	0.0E+0
			Naphthalene			NA	0E+0	Whole Body			2.2E+0	2.2E+0
			n-Butylbenzene			NA	0E+0				0.0E+0	0.0E+0
			n-Propylbenzene			NA	0E+0				0.0E+0	0.0E+0
			Phenanthrene			NA	0E+0				NA	0.0E+0
			Pyrene			NA	0E+0	Kidney			0.0E+0	0.0E+0
			Styrene			NA	0E+0	Blood, Liver			1.7E-3	1.7E-3
			Toluene			NA	0E+0	Liver, Kidney, Respiratory			4.7E-3	4.7E-3
			Xylenes (total)			NA	0E+0	Whole Body			5.5E-3	5.5E-3

TABLE 9.3

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

TIER 1 CENTRAL EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Landscape Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
			Chemical Total			2E-5	2E-5				3.7E+0	3.7E+0
		Exposure Point Total					2E-5					3.7E+0
	Exposure Medium Total						2E-5					3.7E+0
	Work Space Air	Work Space Air	1,2,4-Trimethylbenzene		NA		0E+0			3E-3		2.6E-3
			1,2-Dichloroethane		3E-8		3E-8			4E-3		3.7E-3
			1,3,5-Trimethylbenzene		NA		0E+0			1E-3		1.4E-3
			Acenaphthene		NA		0E+0			NA		0.0E+0
			Acetone		NA		0E+0			NA		0.0E+0
			Anthracene		NA		0E+0			NA		0.0E+0
			Benzene		6E-6		6E-6			3E-1		3.5E-1
			Benzo[b]fluoranthene		7E-8		7E-8			NA		0.0E+0
			Carbon Disulfide		NA		0E+0	eripheral Nervous System		2E-6		2.4E-6
			Chrysene		1E-8		1E-8			NA		0.0E+0
			Ethylbenzene		2E-8		2E-8	Developmental		2E-4		2.3E-4
			Fluorene		NA		0E+0			NA		0.0E+0
			Isopropyl benzene		NA		0E+0	Kidney		5E-6		5.3E-6
			Methyl isobutyl ketone		0E+0		0E+0			1E-5		1.1E-5
			Methylene chloride		7E-9		7E-9			2E-5		2.3E-5
			MTBE		2E-10		2E-10	Liver, Kidney		2E-6		2.1E-6
			Naphthalene		NA		0E+0	Respiratory		2E+0		1.7E+0
			n-Butylbenzene		NA		0E+0			NA		0.0E+0
			n-Propylbenzene		NA		0E+0			NA		0.0E+0
			Pyrene		NA		0E+0			NA		0.0E+0
			Styrene		NA		0E+0	CNS		5E-5		5.5E-5
			Toluene		NA		0E+0	CNS, Respiratory		5E-4		5.1E-4
			Xylenes (total)		NA		0E+0	CNS		1E-3		1.3E-3

TABLE 9.3

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

TIER 1 CENTRAL EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Landscape Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
			Chemical Total		6E-6		6E-6			2.1E+0		2.1E+0
		Exposure Point Total					6E-6					2.1E+0
	Exposure Medium Total						6E-6					2.1E+0
Medium Total							2E-5					5.8E+0
Receptor Total							1E-3					3.7E+1

TABLE 9.4

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

TIER 1 REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Landscape Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater Potable Use	Potable Water	Potable Water	Aluminum	NA			0E+0		1.2E-2			1.2E-2
			Antimony	NA			0E+0	Whole Body, Blood	1.1E-2			1.1E-2
			Arsenic	7E-4			7E-4	Skin	6.5E-1			6.5E-1
			Barium	NA			0E+0	Kidney	2.5E-1			2.5E-1
			Beryllium	NA			0E+0	Small Intestine	8.1E-3			8.1E-3
			Cadmium	4E-6			4E-6	Kidney	5.7E-2			5.7E-2
			Chromium	NA			0E+0		6.5E-2			6.5E-2
			Cobalt	NA			0E+0		3.3E-3			3.3E-3
			Copper	NA			0E+0	GI System	2.4E-3			2.4E-3
			Iron	NA			0E+0		1.2E+0			1.2E+0
			Lead	NA			0E+0		NA			0.0E+0
			Manganese	NA			0E+0	CNS	1.6E-1			1.6E-1
			Mercury	NA			0E+0	Immune System	6.5E-3			6.5E-3
			Molybdenum	NA			0E+0	Blood	6.6E-2			6.6E-2
			Nickel	NA			0E+0	Body Weight	7.0E-3			7.0E-3
			Nitrate	NA			0E+0	Blood	3.9E-2			3.9E-2
			Selenium	NA			0E+0	Whole Body	2.3E-2			2.3E-2
			Silver	NA			0E+0	Skin	2.6E-2			2.6E-2
			Thallium	NA			0E+0	Liver, Blood, Hair	1.3E+0			1.3E+0
			Vanadium	NA			0E+0	Hair	2.5E-2			2.5E-2
			Zinc	NA			0E+0	Blood	3.2E-4			3.2E-4
			1,2,4-Trimethylbenzene	NA			0E+0		9.7E-3			9.7E-3
			1,2-Dichloroethane	7E-6			7E-6		1.5E-2			1.5E-2
			1,3,5-Trimethylbenzene	NA			0E+0		5.1E-3			5.1E-3
			Acenaphthene	NA			0E+0	Liver	3.2E-2			3.2E-2
			Acenaphthylene	NA			0E+0		NA			0.0E+0
			Acetone	NA			0E+0	Liver, Kidney	8.8E-1			8.8E-1

TABLE 9.4

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

TIER 1 REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Landscape Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
			Anthracene	NA			0E+0	NOAEL	1.7E-3			1.7E-3
			Benzene	2E-3			2E-3		1.8E+1			1.8E+1
			Benzo[a]anthracene	1E-4			1E-4		NA			0.0E+0
			Benzo[a]pyrene	2E-3			2E-3		NA			0.0E+0
			Benzo[b]fluoranthene	1E-4			1E-4		NA			0.0E+0
			Benzo[g,h,l]perylene	NA			0E+0		NA			0.0E+0
			Benzo[k]fluoranthene	5E-5			5E-5		NA			0.0E+0
			Carbon Disulfide	NA			0E+0	Reproductive/ Teratogenic	4.2E-4			4.2E-4
			Chrysene	2E-5			2E-5		NA			0.0E+0
			Dibenz[a,h]anthracene	4E-5			4E-5		NA			0.0E+0
			Ethylbenzene	1E-5			1E-5	Liver, Kidney	7.0E-2			7.0E-2
			Fluoranthene	NA			0E+0	Kidney, Liver, Blood	6.2E-2			6.2E-2
			Fluorene	NA			0E+0	Blood	1.5E-2			1.5E-2
			Indeno(1,2,3-cd)pyrene	2E-4			2E-4		NA			0.0E+0
			Isopropyl benzene	NA			0E+0	Kidney	6.5E-4			6.5E-4
			Methyl isobutyl ketone	0E+0			0E+0		3.9E-4			3.9E-4
			Methylene chloride	8E-6			8E-6	Liver	2.6E-2			2.6E-2
			MTBE	1E-7			1E-7		NA			0.0E+0
			Naphthalene	NA			0E+0	Whole Body	8.4E+0			8.4E+0
			n-Butylbenzene	NA			0E+0		4.0E-1			4.0E-1
			n-Propylbenzene	NA			0E+0		2.4E-3			2.4E-3
			Phenanthrene	NA			0E+0		NA			0.0E+0
			Pyrene	NA			0E+0	Kidney	5.9E-2			5.9E-2
			Styrene	NA			0E+0	Blood, Liver	8.2E-3			8.2E-3
			Toluene	NA			0E+0	Liver, Kidney, Respiratory	2.7E-2			2.7E-2
			Xylenes (total)	NA			0E+0	Whole Body	1.9E-2			1.9E-2
			Chemical Total	5E-3			5E-3		3.1E+1			3.1E+1
		Exposure Point Total					5E-3					3.1E+1

TABLE 9.4

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

TIER 1 REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Landscape Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
	Exposure Medium Total						5E-3					3.1E+1
Medium Total							5E-3					3.1E+1
Groundwater Industrial Use	Industrial Water	Industrial Water	Aluminum			NA	0E+0				1.5E-4	1.5E-4
			Antimony			NA	0E+0	Whole Body, Blood			1.3E-4	1.3E-4
			Arsenic			4E-6	4E-6	Skin			7.7E-3	7.7E-3
			Barium			NA	0E+0	Kidney			2.9E-3	2.9E-3
			Beryllium			NA	0E+0	Small Intestine			9.6E-5	9.6E-5
			Cadmium			3E-8	3E-8	Kidney			6.8E-4	6.8E-4
			Chromium			NA	0E+0				1.5E-3	1.5E-3
			Cobalt			NA	0E+0				3.9E-5	3.9E-5
			Copper			NA	0E+0	GI System			2.9E-5	2.9E-5
			Iron			NA	0E+0				1.4E-2	1.4E-2
			Lead			NA	0E+0				NA	0.0E+0
			Manganese			NA	0E+0	CNS			1.8E-3	1.8E-3
			Mercury			NA	0E+0	Immune System			7.8E-5	7.8E-5
			Molybdenum			NA	0E+0	Blood			7.8E-4	7.8E-4
			Nickel			NA	0E+0	Body Weight			1.7E-5	1.7E-5
			Nitrate			NA	0E+0	Blood			4.6E-4	4.6E-4
			Selenium			NA	0E+0	Whole Body			2.7E-4	2.7E-4
			Silver			NA	0E+0	Skin			1.9E-4	1.9E-4
			Thallium			NA	0E+0	Liver, Blood, Hair			1.5E-2	1.5E-2
			Vanadium			NA	0E+0	Hair			3.0E-4	3.0E-4
			Zinc			NA	0E+0	Blood			2.3E-6	2.3E-6
			1,2,4-Trimethylbenzene			NA	0E+0				0.0E+0	0.0E+0
			1,2-Dichloroethane			2E-6	2E-6				7.3E-3	7.3E-3
			1,3,5-Trimethylbenzene			NA	0E+0				0.0E+0	0.0E+0

TABLE 9.4
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
TIER 1 REASONABLE MAXIMUM EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Landscape Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
			Acenaphthene			NA	0E+0	Liver			0.0E+0	0.0E+0
			Acenaphthylene			NA	0E+0				NA	0.0E+0
			Acetone			NA	0E+0	Liver, Kidney			1.1E-2	1.1E-2
			Anthracene			NA	0E+0	NOAEL			0.0E+0	0.0E+0
			Benzene			2E-4	2E-4				3.1E+0	3.1E+0
			Benzo[a]anthracene			0E+0	0E+0				NA	0.0E+0
			Benzo[a]pyrene			0E+0	0E+0				NA	0.0E+0
			Benzo[b]fluoranthene			0E+0	0E+0				NA	0.0E+0
			Benzo[g,h,l]perylene			NA	0E+0				NA	0.0E+0
			Benzo[k]fluoranthene			0E+0	0E+0				NA	0.0E+0
			Carbon Disulfide			NA	0E+0	Reproductive/ Teratogenic			8.6E-5	8.6E-5
			Chrysene			0E+0	0E+0				NA	0.0E+0
			Dibenz[a,h]anthracene			0E+0	0E+0				NA	0.0E+0
			Ethylbenzene			3E-6	3E-6	Liver, Kidney			4.1E-2	4.1E-2
			Fluoranthene			NA	0E+0	Kidney, Liver, Blood			0.0E+0	0.0E+0
			Fluorene			NA	0E+0	Blood			0.0E+0	0.0E+0
			Indeno(1,2,3-cd)pyrene			0E+0	0E+0				NA	0.0E+0
			Isopropyl benzene			NA	0E+0	Kidney			2.4E-4	2.4E-4
			Methyl isobutyl ketone			0E+0	0E+0				1.8E-5	1.8E-5
			Methylene chloride			2E-7	2E-7	Liver			1.1E-3	1.1E-3
			MTBE			3E-9	3E-9				NA	0.0E+0
			Naphthalene			NA	0E+0	Whole Body			4.7E+0	4.7E+0
			n-Butylbenzene			NA	0E+0				0.0E+0	0.0E+0
			n-Propylbenzene			NA	0E+0				0.0E+0	0.0E+0
			Phenanthrene			NA	0E+0				NA	0.0E+0
			Pyrene			NA	0E+0	Kidney			0.0E+0	0.0E+0
			Styrene			NA	0E+0	Blood, Liver			3.6E-3	3.6E-3
			Toluene			NA	0E+0	Liver, Kidney, Respiratory			1.0E-2	1.0E-2
			Xylenes (total)			NA	0E+0	Whole Body			1.2E-2	1.2E-2

TABLE 9.4

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

TIER 1 REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Landscape Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
			Chemical Total			2E-4	2E-4				8.0E+0	8.0E+0
		Exposure Point Total					2E-4					8.0E+0
	Exposure Medium Total						2E-4					8.0E+0
	Work Space Air	Work Space Air	1,2,4-Trimethylbenzene		NA		0E+0			3E-3		2.6E-3
			1,2-Dichloroethane		1E-7		1E-7			4E-3		3.7E-3
			1,3,5-Trimethylbenzene		NA		0E+0			1E-3		1.4E-3
			Acenaphthene		NA		0E+0			NA		0.0E+0
			Acetone		NA		0E+0			NA		0.0E+0
			Anthracene		NA		0E+0			NA		0.0E+0
			Benzene		2E-5		2E-5			3E-1		3.5E-1
			Benzo[b]fluoranthene		3E-7		3E-7			NA		0.0E+0
			Carbon Disulfide		NA		0E+0	eripheral Nervous System		2E-6		2.4E-6
			Chrysene		4E-8		4E-8			NA		0.0E+0
			Ethylbenzene		9E-8		9E-8	Developmental		2E-4		2.3E-4
			Fluorene		NA		0E+0			NA		0.0E+0
			Isopropyl benzene		NA		0E+0	Kidney		5E-6		5.3E-6
			Methyl isobutyl ketone		0E+0		0E+0			1E-5		1.1E-5
			Methylene chloride		2E-8		2E-8			2E-5		2.3E-5
			MTBE		6E-10		6E-10	Liver, Kidney		2E-6		2.1E-6
			Naphthalene		NA		0E+0	Respiratory		2E+0		1.7E+0
			n-Butylbenzene		NA		0E+0			NA		0.0E+0
			n-Propylbenzene		NA		0E+0			NA		0.0E+0
			Pyrene		NA		0E+0			NA		0.0E+0
			Styrene		NA		0E+0	CNS		5E-5		5.5E-5
			Toluene		NA		0E+0	CNS, Respiratory		5E-4		5.1E-4
			Xylenes (total)		NA		0E+0	CNS		1E-3		1.3E-3

TABLE 9.4

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

TIER 1 REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Landscape Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
			Chemical Total		2E-5		2E-5			2.1E+0		2.1E+0
		Exposure Point Total					2E-5					2.1E+0
	Exposure Medium Total						2E-5					2.1E+0
Medium Total							2E-4					1.0E+1
Receptor Total							6E-3					4.1E+1

TABLE 9.5

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

TIER 1 CENTRAL EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: On-Site Resident
Receptor Age: Child / Age-Adjusted Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil Vapor	Indoor Air	Indoor Air	Benzene		1E-6		1E-6			2E-3		1.6E-3
			Chloroform		6E-9		6E-9			9E-6		8.9E-6
			Ethylbenzene		3E-8		3E-8	Developmental		3E-5		3.4E-5
			m,p-Xylene		NA		0E+0	CNS		5E-4		5.2E-4
			Naphthalene		NA		0E+0	Respiratory		7E-3		6.9E-3
			Tetrachloroethene (PCE)		4E-9		4E-9	Liver, Kidney		5E-5		4.7E-5
			Trichloroethene		3E-9		3E-9	CNS		6E-6		5.7E-6
			Chemical Total		1E-6		1E-6			9.1E-3		9.1E-3
		Exposure Point Total					1E-6					9.1E-3
	Exposure Medium Total						1E-6					9.1E-3
Medium Total							1E-6					9.1E-3
Groundwater	Indoor Air	Indoor Air	1,2,4-Trimethylbenzene		NA		0E+0			8E-4		7.9E-4
			1,2-Dichloroethane		2E-7		2E-7			4E-3		3.5E-3
			1,3,5-Trimethylbenzene		NA		0E+0			1E-2		9.7E-3
			Acetone		NA		0E+0			8E-4		7.9E-4
			Benzene		1E-4		1E-4			2E-1		1.8E-1
			Carbon disulfide		NA		0E+0	eripheral Nervous System		7E-5		7.1E-5
			Ethylbenzene		7E-7		7E-7	Developmental		7E-4		7.5E-4
			Isopropyl benzene		NA		0E+0	Kidney		4E-5		4.1E-5
			Methyl isobutyl ketone		NA		0E+0			2E-5		1.7E-5
			Methylene chloride		7E-8		7E-8			4E-4		3.9E-4
			MTBE		8E-10		8E-10	Liver, Kidney		9E-7		8.7E-7
			Naphthalene		NA		0E+0	Respiratory		2E-1		2.2E-1
			n-Butylbenzene		NA		0E+0			4E-2		3.8E-2
			n-Propylbenzene		NA		0E+0			NA		0.0E+0
			Styrene		NA		0E+0	CNS		1E-4		1.3E-4

TABLE 9.5
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
TIER 1 CENTRAL EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: On-Site Resident
Receptor Age: Child / Age-Adjusted Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
			Toluene		NA		0E+0	CNS, Respiratory		4E-3		3.9E-3
			Xylenes (total)		NA		0E+0	CNS		8E-4		8.2E-4
			Chemical Total		1E-4		1E-4			4.6E-1		4.6E-1
		Exposure Point Total					1E-4					4.6E-1
	Exposure Medium Total						1E-4					4.6E-1
Medium Total							1E-4					4.6E-1
Groundwater[1] Potable Use	Potable Water	Potable Water	Aluminum	NA			0E+0		4.5E-2			4.5E-2
			Antimony	NA			0E+0	Whole Body, Blood	3.8E-2			3.8E-2
			Arsenic	7E-4			7E-4	Skin	2.3E+0			2.3E+0
			Barium	NA			0E+0	Kidney	8.9E-1			8.9E-1
			Beryllium	NA			0E+0	Small Intestine	2.9E-2			2.9E-2
			Cadmium	4E-6			4E-6	Kidney	2.1E-1			2.1E-1
			Chromium	NA			0E+0		2.3E-1			2.3E-1
			Cobalt	NA			0E+0		1.2E-2			1.2E-2
			Copper	NA			0E+0	GI System	8.8E-3			8.8E-3
			Iron	NA			0E+0		4.2E+0			4.2E+0
			Lead	NA			0E+0		NA			0.0E+0
			Manganese	NA			0E+0	CNS	5.6E-1			5.6E-1
			Mercury	NA			0E+0	Immune System	2.4E-2			2.4E-2
			Molybdenum	NA			0E+0	Blood	2.4E-1			2.4E-1
			Nickel	NA			0E+0	Body Weight	2.6E-2			2.6E-2
			Nitrate	NA			0E+0	Blood	1.4E-1			1.4E-1
			Selenium	NA			0E+0	Whole Body	8.3E-2			8.3E-2
			Silver	NA			0E+0	Skin	9.6E-2			9.6E-2
			Thallium	NA			0E+0	Liver, Blood, Hair	4.7E+0			4.7E+0
			Vanadium	NA			0E+0	Hair	9.1E-2			9.1E-2

TABLE 9.5
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
TIER 1 CENTRAL EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: On-Site Resident
Receptor Age: Child / Age-Adjusted Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
			Zinc	NA			0E+0	Blood	1.2E-3			1.2E-3
			1,2,4-Trimethylbenzene	NA			0E+0		3.5E-2			3.5E-2
			1,2-Dichloroethane	8E-6			8E-6		5.3E-2			5.3E-2
			1,3,5-Trimethylbenzene	NA			0E+0		1.9E-2			1.9E-2
			Acenaphthene	NA			0E+0	Liver	1.2E-1			1.2E-1
			Acenaphthylene	NA			0E+0		NA			0.0E+0
			Acetone	NA			0E+0	Liver, Kidney	3.2E+0			3.2E+0
			Anthracene	NA			0E+0	NOAEL	6.3E-3			6.3E-3
			Benzene	2E-3			2E-3		6.4E+1			6.4E+1
			Benzo[a]anthracene	1E-4			1E-4		NA			0.0E+0
			Benzo[a]pyrene	2E-3			2E-3		NA			0.0E+0
			Benzo[b]fluoranthene	1E-4			1E-4		NA			0.0E+0
			Benzo[g,h,i]perylene	NA			0E+0		NA			0.0E+0
			Benzo[k]fluoranthene	6E-5			6E-5		NA			0.0E+0
			Carbon Disulfide	NA			0E+0	Reproductive/ Teratogenic	1.5E-3			1.5E-3
			Chrysene	2E-5			2E-5		NA			0.0E+0
			Dibenz[a,h]anthracene	4E-5			4E-5		NA			0.0E+0
			Ethylbenzene	1E-5			1E-5	Liver, Kidney	2.6E-1			2.6E-1
			Fluoranthene	NA			0E+0	Kidney, Liver, Blood	2.2E-1			2.2E-1
			Fluorene	NA			0E+0	Blood	5.6E-2			5.6E-2
			Indeno(1,2,3-cd)pyrene	2E-4			2E-4		NA			0.0E+0
			Isopropyl benzene	NA			0E+0	Kidney	2.4E-3			2.4E-3
			Methyl isobutyl ketone	0E+0			0E+0		1.4E-3			1.4E-3
			Methylene chloride	8E-6			8E-6	Liver	9.6E-2			9.6E-2
			MTBE	1E-7			1E-7		NA			0.0E+0
			Naphthalene	NA			0E+0	Whole Body	3.0E+1			3.0E+1
			n-Butylbenzene	NA			0E+0		1.4E+0			1.4E+0
			n-Propylbenzene	NA			0E+0		8.8E-3			8.8E-3

TABLE 9.5

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

TIER 1 CENTRAL EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: On-Site Resident
Receptor Age: Child / Age-Adjusted Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
			Phenanthrene	NA			0E+0		NA			0.0E+0
			Pyrene	NA			0E+0	Kidney	2.1E-1			2.1E-1
			Styrene	NA			0E+0	Blood, Liver	3.0E-2			3.0E-2
			Toluene	NA			0E+0	Liver, Kidney, Respiratory	9.9E-2			9.9E-2
			Xylenes (total)	NA			0E+0	Whole Body	6.8E-2			6.8E-2
			Chemical Total	6E-3			6E-3		1.1E+2			1.1E+2
		Exposure Point Total					6E-3					1.1E+2
	Exposure Medium Total						6E-3					1.1E+2
	Indoor Air	Indoor Air	1,2,4-Trimethylbenzene		NA		0E+0			6E+0		5.8E+0
			1,2-Dichloroethane		7E-5		7E-5			6E+0		6.3E+0
			1,3,5-Trimethylbenzene		NA		0E+0			3E+0		3.0E+0
			Acenaphthene		NA		0E+0			NA		0.0E+0
			Acetone		NA		0E+0			NA		0.0E+0
			Anthracene		NA		0E+0			NA		0.0E+0
			Benzene		1E-2		1E-2			6E+2		6.3E+2
			Benzo[b]fluoranthene		2E-4		2E-4			NA		0.0E+0
			Carbon Disulfide		NA		0E+0	Peripheral Nervous System		4E-3		4.3E-3
			Chrysene		3E-5		3E-5			NA		0.0E+0
			Ethylbenzene		6E-5		6E-5	Developmental		5E-1		4.9E-1
			Fluorene		NA		0E+0			NA		0.0E+0
			Isopropyl benzene		NA		0E+0	Kidney		1E-2		1.2E-2
			Methyl isobutyl ketone		0E+0		0E+0			3E-2		2.7E-2
			Methylene chloride		1E-5		1E-5			4E-2		3.7E-2
			MTBE		3E-7		3E-7	Liver, Kidney		4E-3		3.9E-3
			Naphthalene		NA		0E+0	Respiratory		4E+3		3.9E+3
			n-Butylbenzene		NA		0E+0			NA		0.0E+0
			n-Propylbenzene		NA		0E+0			NA		0.0E+0

TABLE 9.5

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

TIER 1 CENTRAL EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: On-Site Resident
Receptor Age: Child / Age-Adjusted Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
			Pyrene		NA		0E+0			NA		0.0E+0
			Styrene		NA		0E+0	CNS		1E-1		1.1E-1
			Toluene		NA		0E+0	CNS, Respiratory		1E+0		1.0E+0
			Xylenes (total)		NA		0E+0	CNS		3E+0		2.6E+0
			Chemical Total		1E-2		1E-2			4.6E+3		4.6E+3
		Exposure Point Total					1E-2					4.6E+3
	Exposure Medium Total						1E-2					4.6E+3
Medium Total							2E-2					4.7E+3
Current Receptor Total (Inhalation via Soil Vapor)							1E-6					9.1E-3
Current Receptor Total (Inhalation via Groundwater)							1E-4					4.6E-1
Future Receptor Total (Potable Water Use + Inhalation via Soil Vapor)							2E-2					4.7E+3
Future Receptor Total (Potable Water Use + Inhalation via Groundwater)							2E-2					4.7E+3

[1] - Groundwater potable use is a future use scenario.

TABLE 9.6
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
TIER 1 REASONABLE MAXIMUM EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: On-Site Resident
Receptor Age: Child / Age-Adjusted Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil Vapor	Indoor Air	Indoor Air	Benzene		1E-6		1E-6			2E-3		1.6E-3
			Chloroform		6E-9		6E-9			9E-6		8.9E-6
			Ethylbenzene		3E-8		3E-8	Developmental		3E-5		3.4E-5
			m,p-Xylene		NA		0E+0	CNS		5E-4		5.2E-4
			Naphthalene		NA		0E+0	Respiratory		7E-3		6.9E-3
			Tetrachloroethene (PCE)		4E-9		4E-9	Liver, Kidney		5E-5		4.7E-5
			Trichloroethene		3E-9		3E-9	CNS		6E-6		5.7E-6
			Chemical Total		1E-6		1E-6			9.1E-3		9.1E-3
		Exposure Point Total					1E-6					9.1E-3
	Exposure Medium Total						1E-6					9.1E-3
Medium Total							1E-6					9.1E-3
Groundwater	Indoor Air	Indoor Air	1,2,4-Trimethylbenzene		NA		0E+0			8E-4		7.9E-4
			1,2-Dichloroethane		2E-7		2E-7			4E-3		3.5E-3
			1,3,5-Trimethylbenzene		NA		0E+0			1E-2		9.7E-3
			Acetone		NA		0E+0			8E-4		7.9E-4
			Benzene		1E-4		1E-4			2E-1		1.8E-1
			Carbon disulfide		NA		0E+0	Peripheral Nervous System		7E-5		7.1E-5
			Ethylbenzene		7E-7		7E-7	Developmental		7E-4		7.5E-4
			Isopropyl benzene		NA		0E+0	Kidney		4E-5		4.1E-5
			Methyl isobutyl ketone		NA		0E+0			2E-5		1.7E-5
			Methylene chloride		7E-8		7E-8			4E-4		3.9E-4
			MTBE		8E-10		8E-10	Liver, Kidney		9E-7		8.7E-7
			Naphthalene		NA		0E+0	Respiratory		2E-1		2.2E-1
			n-Butylbenzene		NA		0E+0			4E-2		3.8E-2
			n-Propylbenzene		NA		0E+0			NA		0.0E+0
			Styrene		NA		0E+0	CNS		1E-4		1.3E-4

TABLE 9.6

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

TIER 1 REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: On-Site Resident
Receptor Age: Child / Age-Adjusted Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
			Toluene		NA		0E+0	CNS, Respiratory		4E-3		3.9E-3
			Xylenes (total)		NA		0E+0	CNS		8E-4		8.2E-4
			Chemical Total		1E-4		1E-4			4.6E-1		4.6E-1
		Exposure Point Total					1E-4					4.6E-1
	Exposure Medium Total						1E-4					4.6E-1
Medium Total							1E-4					4.6E-1
Groundwater[1] Potable Use	Potable Water	Potable Water	Aluminum	NA			0E+0		8.9E-2			8.9E-2
			Antimony	NA			0E+0	Whole Body, Blood	7.7E-2			7.7E-2
			Arsenic	3E-3			3E-3	Skin	4.7E+0			4.7E+0
			Barium	NA			0E+0	Kidney	1.8E+0			1.8E+0
			Beryllium	NA			0E+0	Small Intestine	5.8E-2			5.8E-2
			Cadmium	2E-5			2E-5	Kidney	4.1E-1			4.1E-1
			Chromium	NA			0E+0		4.7E-1			4.7E-1
			Cobalt	NA			0E+0		2.4E-2			2.4E-2
			Copper	NA			0E+0	GI System	1.8E-2			1.8E-2
			Iron	NA			0E+0		8.5E+0			8.5E+0
			Lead	NA			0E+0		NA			0.0E+0
			Manganese	NA			0E+0	CNS	1.1E+0			1.1E+0
			Mercury	NA			0E+0	Immune System	4.7E-2			4.7E-2
			Molybdenum	NA			0E+0	Blood	4.8E-1			4.8E-1
			Nickel	NA			0E+0	Body Weight	5.1E-2			5.1E-2
			Nitrate	NA			0E+0	Blood	2.8E-1			2.8E-1
			Selenium	NA			0E+0	Whole Body	1.7E-1			1.7E-1
			Silver	NA			0E+0	Skin	1.9E-1			1.9E-1
			Thallium	NA			0E+0	Liver, Blood, Hair	9.3E+0			9.3E+0
			Vanadium	NA			0E+0	Hair	1.8E-1			1.8E-1

TABLE 9.6
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
TIER 1 REASONABLE MAXIMUM EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: On-Site Resident
Receptor Age: Child / Age-Adjusted Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
			Zinc	NA			0E+0	Blood	2.3E-3			2.3E-3
			1,2,4-Trimethylbenzene	NA			0E+0		7.0E-2			7.0E-2
			1,2-Dichloroethane	3E-5			3E-5		1.1E-1			1.1E-1
			1,3,5-Trimethylbenzene	NA			0E+0		3.7E-2			3.7E-2
			Acenaphthene	NA			0E+0	Liver	2.3E-1			2.3E-1
			Acenaphthylene	NA			0E+0		NA			0.0E+0
			Acetone	NA			0E+0	Liver, Kidney	6.4E+0			6.4E+0
			Anthracene	NA			0E+0	NOAEL	1.3E-2			1.3E-2
			Benzene	9E-3			9E-3		1.3E+2			1.3E+2
			Benzo[a]anthracene	5E-4			5E-4		NA			0.0E+0
			Benzo[a]pyrene	1E-2			1E-2		NA			0.0E+0
			Benzo[b]fluoranthene	5E-4			5E-4		NA			0.0E+0
			Benzo[g,h,I]perylene	NA			0E+0		NA			0.0E+0
			Benzo[k]fluoranthene	2E-4			2E-4		NA			0.0E+0
			Carbon Disulfide	NA			0E+0	Reproductive/ Teratogenic	3.1E-3			3.1E-3
			Chrysene	8E-5			8E-5		NA			0.0E+0
			Dibenz[a,h]anthracene	2E-4			2E-4		NA			0.0E+0
			Ethylbenzene	5E-5			5E-5	Liver, Kidney	5.1E-1			5.1E-1
			Fluoranthene	NA			0E+0	Kidney, Liver, Blood	4.5E-1			4.5E-1
			Fluorene	NA			0E+0	Blood	1.1E-1			1.1E-1
			Indeno(1,2,3-cd)pyrene	8E-4			8E-4		NA			0.0E+0
			Isopropyl benzene	NA			0E+0	Kidney	4.7E-3			4.7E-3
			Methyl isobutyl ketone	0E+0			0E+0		2.8E-3			2.8E-3
			Methylene chloride	4E-5			4E-5	Liver	1.9E-1			1.9E-1
			MTBE	5E-7			5E-7		NA			0.0E+0
			Naphthalene	NA			0E+0	Whole Body	6.1E+1			6.1E+1
			n-Butylbenzene	NA			0E+0		2.9E+0			2.9E+0
			n-Propylbenzene	NA			0E+0		1.8E-2			1.8E-2

TABLE 9.6

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

TIER 1 REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: On-Site Resident
Receptor Age: Child / Age-Adjusted Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
			Phenanthrene	NA			0E+0		NA			0.0E+0
			Pyrene	NA			0E+0	Kidney	4.3E-1			4.3E-1
			Styrene	NA			0E+0	Blood, Liver	5.9E-2			5.9E-2
			Toluene	NA			0E+0	Liver, Kidney, Respiratory	2.0E-1			2.0E-1
			Xylenes (total)	NA			0E+0	Whole Body	1.4E-1			1.4E-1
			Chemical Total	3E-2			3E-2		2.3E+2			2.3E+2
		Exposure Point Total					3E-2					2.3E+2
	Exposure Medium Total						3E-2					2.3E+2
	Indoor Air	Indoor Air	1,2,4-Trimethylbenzene		NA		0E+0			8E+0		7.8E+0
			1,2-Dichloroethane		2E-4		2E-4			9E+0		8.6E+0
			1,3,5-Trimethylbenzene		NA		0E+0			4E+0		4.1E+0
			Acenaphthene		NA		0E+0			NA		0.0E+0
			Acetone		NA		0E+0			NA		0.0E+0
			Anthracene		NA		0E+0			NA		0.0E+0
			Benzene		3E-2		3E-2			8E+2		8.5E+2
			Benzo[b]fluoranthene		6E-4		6E-4			NA		0.0E+0
			Carbon Disulfide		NA		0E+0	Peripheral Nervous System		6E-3		5.8E-3
			Chrysene		9E-5		9E-5			NA		0.0E+0
			Ethylbenzene		2E-4		2E-4	Developmental		7E-1		6.6E-1
			Fluorene		NA		0E+0			NA		0.0E+0
			Isopropyl benzene		NA		0E+0	Kidney		2E-2		1.6E-2
			Methyl isobutyl ketone		0E+0		0E+0			4E-2		3.6E-2
			Methylene chloride		4E-5		4E-5			5E-2		5.0E-2
			MTBE		1E-6		1E-6	Liver, Kidney		5E-3		5.3E-3
			Naphthalene		NA		0E+0	Respiratory		5E+3		5.3E+3
			n-Butylbenzene		NA		0E+0			NA		0.0E+0
			n-Propylbenzene		NA		0E+0			NA		0.0E+0

TABLE 9.6

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

TIER 1 REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: On-Site Resident
Receptor Age: Child / Age-Adjusted Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
			Pyrene		NA		0E+0			NA		0.0E+0
			Styrene		NA		0E+0	CNS		2E-1		1.5E-1
			Toluene		NA		0E+0	CNS, Respiratory		1E+0		1.4E+0
			Xylenes (total)		NA		0E+0	CNS		4E+0		3.5E+0
			Chemical Total		3E-2		3E-2			6.2E+3		6.2E+3
		Exposure Point Total					3E-2					6.2E+3
	Exposure Medium Total						3E-2					6.2E+3
Medium Total							6E-2					6.4E+3
Current Receptor Total (Inhalation via Soil Vapor)							1E-6					9.1E-3
Current Receptor Total (Inhalation via Groundwater)							1E-4					4.6E-1
Future Receptor Total (Potable Water Use + Inhalation via Soil Vapor)							6E-2					6.4E+3
Future Receptor Total (Potable Water Use + Inhalation via Groundwater)							6E-2					6.4E+3

[1] - Groundwater potable use is a future use scenario.

TABLE 9.7

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

TIER 1 CENTRAL EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: School Student
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil Vapor	Indoor Air	Indoor Air	Benzene		1E-6		1E-6			2E-3		1.6E-3
			Chloroform		6E-9		6E-9			9E-6		8.9E-6
			Ethylbenzene		3E-8		3E-8	Developmental		3E-5		3.4E-5
			m,p-Xylene		NA		0E+0	CNS		5E-4		5.2E-4
			Naphthalene		NA		0E+0	Respiratory		7E-3		6.9E-3
			Tetrachloroethene (PCE)		4E-9		4E-9	Liver, Kidney		5E-5		4.7E-5
			Trichloroethene		3E-9		3E-9	CNS		6E-6		5.7E-6
			Chemical Total		1E-6		1E-6			9.1E-3		9.1E-3
		Exposure Point Total					1E-6					9.1E-3
	Exposure Medium Total						1E-6					9.1E-3
Medium Total							1E-6					9.1E-3
Groundwater	Indoor Air	Indoor Air	1,2,4-Trimethylbenzene		NA		0E+0			8E-4		7.9E-4
			1,2-Dichloroethane		2E-7		2E-7			4E-3		3.5E-3
			1,3,5-Trimethylbenzene		NA		0E+0			1E-2		9.7E-3
			Acetone		NA		0E+0			8E-4		7.9E-4
			Benzene		1E-4		1E-4			2E-1		1.8E-1
			Carbon disulfide		NA		0E+0	Peripheral Nervous System		7E-5		7.1E-5
			Ethylbenzene		7E-7		7E-7	Developmental		7E-4		7.5E-4
			Isopropyl benzene		NA		0E+0	Kidney		4E-5		4.1E-5
			Methyl isobutyl ketone		NA		0E+0			2E-5		1.7E-5
			Methylene chloride		7E-8		7E-8			4E-4		3.9E-4
			MTBE		8E-10		8E-10	Liver, Kidney		9E-7		8.7E-7
			Naphthalene		NA		0E+0	Respiratory		2E-1		2.2E-1
			n-Butylbenzene		NA		0E+0			4E-2		3.8E-2
			n-Propylbenzene		NA		0E+0			NA		0.0E+0
			Styrene		NA		0E+0	CNS		1E-4		1.3E-4

TABLE 9.7

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

TIER 1 CENTRAL EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: School Student
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
			Toluene		NA		0E+0	CNS, Respiratory		4E-3		3.9E-3
			Xylenes (total)		NA		0E+0	CNS		8E-4		8.2E-4
			Chemical Total		1E-4		1E-4			4.6E-1		4.6E-1
		Exposure Point Total					1E-4					4.6E-1
	Exposure Medium Total						1E-4					4.6E-1
Medium Total							1E-4					4.6E-1
Receptor Total (Inhalation via Soil Vapor)							1E-6					9.1E-3
Receptor Total (Inhalation via Groundwater)							1E-4					4.6E-1

TABLE 9.8

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

TIER 1 REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: School Student
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil Vapor	Indoor Air	Indoor Air	Benzene		1E-6		1E-6			2E-3		1.6E-3
			Chloroform		6E-9		6E-9			9E-6		8.9E-6
			Ethylbenzene		3E-8		3E-8	Developmental		3E-5		3.4E-5
			m,p-Xylene		NA		0E+0	CNS		5E-4		5.2E-4
			Naphthalene		NA		0E+0	Respiratory		7E-3		6.9E-3
			Tetrachloroethene (PCE)		4E-9		4E-9	Liver, Kidney		5E-5		4.7E-5
			Trichloroethene		3E-9		3E-9	CNS		6E-6		5.7E-6
			Chemical Total		1E-6		1E-6			9.1E-3		9.1E-3
		Exposure Point Total					1E-6					9.1E-3
	Exposure Medium Total						1E-6					9.1E-3
Medium Total							1E-6					9.1E-3
Groundwater	Indoor Air	Indoor Air	1,2,4-Trimethylbenzene		NA		0E+0			8E-4		7.9E-4
			1,2-Dichloroethane		2E-7		2E-7			4E-3		3.5E-3
			1,3,5-Trimethylbenzene		NA		0E+0			1E-2		9.7E-3
			Acetone		NA		0E+0			8E-4		7.9E-4
			Benzene		1E-4		1E-4			2E-1		1.8E-1
			Carbon disulfide		NA		0E+0	eripheral Nervous System		7E-5		7.1E-5
			Ethylbenzene		7E-7		7E-7	Developmental		7E-4		7.5E-4
			Isopropyl benzene		NA		0E+0	Kidney		4E-5		4.1E-5
			Methyl isobutyl ketone		NA		0E+0			2E-5		1.7E-5
			Methylene chloride		7E-8		7E-8			4E-4		3.9E-4
			MTBE		8E-10		8E-10	Liver, Kidney		9E-7		8.7E-7
			Naphthalene		NA		0E+0	Respiratory		2E-1		2.2E-1
			n-Butylbenzene		NA		0E+0			4E-2		3.8E-2
			n-Propylbenzene		NA		0E+0			NA		0.0E+0
			Styrene		NA		0E+0	CNS		1E-4		1.3E-4

TABLE 9.8

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

TIER 1 REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: School Student
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
			Toluene		NA		0E+0	CNS, Respiratory		4E-3		3.9E-3
			Xylenes (total)		NA		0E+0	CNS		8E-4		8.2E-4
			Chemical Total		1E-4		1E-4			4.6E-1		4.6E-1
		Exposure Point Total					1E-4					4.6E-1
	Exposure Medium Total						1E-4					4.6E-1
Medium Total							1E-4					4.6E-1
Receptor Total (Inhalation via Soil Vapor)							1E-6					9.1E-3
Receptor Total (Inhalation via Groundwater)							1E-4					4.6E-1

TABLE 9.9

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

TIER 1 CENTRAL EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: School Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil Vapor	Indoor Air	Indoor Air	Benzene		1E-6		1E-6			2E-3		1.6E-3
			Chloroform		6E-9		6E-9			9E-6		8.9E-6
			Ethylbenzene		3E-8		3E-8	Developmental		3E-5		3.4E-5
			m,p-Xylene		NA		0E+0	CNS		5E-4		5.2E-4
			Naphthalene		NA		0E+0	Respiratory		7E-3		6.9E-3
			Tetrachloroethene (PCE)		4E-9		4E-9	Liver, Kidney		5E-5		4.7E-5
			Trichloroethene		3E-9		3E-9	CNS		6E-6		5.7E-6
			Chemical Total		1E-6		1E-6			9.1E-3		9.1E-3
		Exposure Point Total					1E-6					9.1E-3
	Exposure Medium Total						1E-6					9.1E-3
Medium Total							1E-6					9.1E-3
Groundwater	Indoor Air	Indoor Air	1,2,4-Trimethylbenzene		NA		0E+0			8E-4		7.9E-4
			1,2-Dichloroethane		2E-7		2E-7			4E-3		3.5E-3
			1,3,5-Trimethylbenzene		NA		0E+0			1E-2		9.7E-3
			Acetone		NA		0E+0			8E-4		7.9E-4
			Benzene		1E-4		1E-4			2E-1		1.8E-1
			Carbon disulfide		NA		0E+0	Peripheral Nervous System		7E-5		7.1E-5
			Ethylbenzene		7E-7		7E-7	Developmental		7E-4		7.5E-4
			Isopropyl benzene		NA		0E+0	Kidney		4E-5		4.1E-5
			Methyl isobutyl ketone		NA		0E+0			2E-5		1.7E-5
			Methylene chloride		7E-8		7E-8			4E-4		3.9E-4
			MTBE		8E-10		8E-10	Liver, Kidney		9E-7		8.7E-7
			Naphthalene		NA		0E+0	Respiratory		2E-1		2.2E-1
			n-Butylbenzene		NA		0E+0			4E-2		3.8E-2
			n-Propylbenzene		NA		0E+0			NA		0.0E+0
			Styrene		NA		0E+0	CNS		1E-4		1.3E-4

TABLE 9.9

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

TIER 1 CENTRAL EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: School Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
			Toluene		NA		0E+0	CNS, Respiratory		4E-3		3.9E-3
			Xylenes (total)		NA		0E+0	CNS		8E-4		8.2E-4
			Chemical Total		1E-4		1E-4			4.6E-1		4.6E-1
		Exposure Point Total					1E-4					4.6E-1
	Exposure Medium Total						1E-4					4.6E-1
Medium Total							1E-4					4.6E-1
Receptor Total (Inhalation via Soil Vapor)							1E-6					9.1E-3
Receptor Total (Inhalation via Groundwater)							1E-4					4.6E-1

TABLE 9.10
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
TIER 1 REASONABLE MAXIMUM EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: School Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil Vapor	Indoor Air	Indoor Air	Benzene		1E-6		1E-6			2E-3		1.6E-3
			Chloroform		6E-9		6E-9			9E-6		8.9E-6
			Ethylbenzene		3E-8		3E-8	Developmental		3E-5		3.4E-5
			m,p-Xylene		NA		0E+0	CNS		5E-4		5.2E-4
			Naphthalene		NA		0E+0	Respiratory		7E-3		6.9E-3
			Tetrachloroethene (PCE)		4E-9		4E-9	Liver, Kidney		5E-5		4.7E-5
			Trichloroethene		3E-9		3E-9	CNS		6E-6		5.7E-6
			Chemical Total		1E-6		1E-6			9.1E-3		9.1E-3
		Exposure Point Total					1E-6					9.1E-3
	Exposure Medium Total						1E-6					9.1E-3
Medium Total							1E-6					9.1E-3
Groundwater	Indoor Air	Indoor Air	1,2,4-Trimethylbenzene		NA		0E+0			8E-4		7.9E-4
			1,2-Dichloroethane		2E-7		2E-7			4E-3		3.5E-3
			1,3,5-Trimethylbenzene		NA		0E+0			1E-2		9.7E-3
			Acetone		NA		0E+0			8E-4		7.9E-4
			Benzene		1E-4		1E-4			2E-1		1.8E-1
			Carbon disulfide		NA		0E+0	eripheral Nervous System		7E-5		7.1E-5
			Ethylbenzene		7E-7		7E-7	Developmental		7E-4		7.5E-4
			Isopropyl benzene		NA		0E+0	Kidney		4E-5		4.1E-5
			Methyl isobutyl ketone		NA		0E+0			2E-5		1.7E-5
			Methylene chloride		7E-8		7E-8			4E-4		3.9E-4
			MTBE		8E-10		8E-10	Liver, Kidney		9E-7		8.7E-7
			Naphthalene		NA		0E+0	Respiratory		2E-1		2.2E-1
			n-Butylbenzene		NA		0E+0			4E-2		3.8E-2
			n-Propylbenzene		NA		0E+0			NA		0.0E+0
			Styrene		NA		0E+0	CNS		1E-4		1.3E-4

TABLE 9.10

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

TIER 1 REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: School Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
			Toluene		NA		0E+0	CNS, Respiratory		4E-3		3.9E-3
			Xylenes (total)		NA		0E+0	CNS		8E-4		8.2E-4
			Chemical Total		1E-4		1E-4			4.6E-1		4.6E-1
		Exposure Point Total					1E-4					4.6E-1
	Exposure Medium Total						1E-4					4.6E-1
Medium Total							1E-4					4.6E-1
Receptor Total (Inhalation via Soil Vapor)							1E-6					9.1E-3
Receptor Total (Inhalation via Groundwater)							1E-4					4.6E-1

TABLE 9.11
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
TIER 2 CENTRAL EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Car Wash Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater Potable Use	Potable Water	Potable Water	Aluminum	NA			0E+0		1.2E-2			1.2E-2
			Antimony	NA			0E+0	Whole Body, Blood	1.1E-2			1.1E-2
			Arsenic	7E-5			7E-5	Skin	6.5E-1			6.5E-1
			Barium	NA			0E+0	Kidney	2.5E-1			2.5E-1
			Beryllium	NA			0E+0	Small Intestine	8.1E-3			8.1E-3
			Cadmium	4E-7			4E-7	Kidney	5.7E-2			5.7E-2
			Chromium	NA			0E+0		6.5E-2			6.5E-2
			Cobalt	NA			0E+0		3.3E-3			3.3E-3
			Copper	NA			0E+0	GI System	2.4E-3			2.4E-3
			Iron	NA			0E+0		1.2E+0			1.2E+0
			Lead	NA			0E+0		NA			0.0E+0
			Manganese	NA			0E+0	CNS	1.6E-1			1.6E-1
			Mercury	NA			0E+0	Immune System	6.5E-3			6.5E-3
			Molybdenum	NA			0E+0	Blood	6.6E-2			6.6E-2
			Nickel	NA			0E+0	Body Weight	7.0E-3			7.0E-3
			Nitrate	NA			0E+0	Blood	3.9E-2			3.9E-2
			Selenium	NA			0E+0	Whole Body	2.3E-2			2.3E-2
			Silver	NA			0E+0	Skin	2.6E-2			2.6E-2
			Thallium	NA			0E+0	Liver, Blood, Hair	1.3E+0			1.3E+0
			Vanadium	NA			0E+0	Hair	2.5E-2			2.5E-2
			Zinc	NA			0E+0	Blood	3.2E-4			3.2E-4
			1,2,4-Trimethylbenzene	NA			0E+0		9.7E-3			9.7E-3
			1,2-Dichloroethane	8E-7			8E-7		1.5E-2			1.5E-2
			1,3,5-Trimethylbenzene	NA			0E+0		5.1E-3			5.1E-3
			Acenaphthene	NA			0E+0	Liver	3.2E-2			3.2E-2
			Acenaphthylene	NA			0E+0		NA			0.0E+0
			Acetone	NA			0E+0	Liver, Kidney	8.8E-1			8.8E-1

TABLE 9.11
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
TIER 2 CENTRAL EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Car Wash Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater Potable Use	Potable Water	Potable Water	Anthracene	NA			0E+0	NOAEL	1.7E-3			1.7E-3
			Benzo[a]anthracene	1E-5			1E-5		NA			0.0E+0
			Benzo[a]pyrene	2E-4			2E-4		NA			0.0E+0
			Benzo[b]fluoranthene	1E-5			1E-5		NA			0.0E+0
			Benzo[g,h,I]perylene	NA			0E+0		NA			0.0E+0
			Benzo[k]fluoranthene	5E-6			5E-6		NA			0.0E+0
			Carbon Disulfide	NA			0E+0	Reproductive/ Teratogenic	4.2E-4			4.2E-4
			Chrysene	2E-6			2E-6		NA			0.0E+0
			Dibenz[a,h]anthracene	4E-6			4E-6		NA			0.0E+0
			Ethylbenzene	1E-6			1E-6	Liver, Kidney	7.0E-2			7.0E-2
			Fluoranthene	NA			0E+0	Kidney, Liver, Blood	6.2E-2			6.2E-2
			Fluorene	NA			0E+0	Blood	1.5E-2			1.5E-2
			Indeno(1,2,3-cd)pyrene	2E-5			2E-5		NA			0.0E+0
			Isopropyl benzene	NA			0E+0	Kidney	6.5E-4			6.5E-4
			Methyl isobutyl ketone	0E+0			0E+0		3.9E-4			3.9E-4
			Methylene chloride	8E-7			8E-7	Liver	2.6E-2			2.6E-2
			MTBE	1E-8			1E-8		NA			0.0E+0
			n-Butylbenzene	NA			0E+0		4.0E-1			4.0E-1
			n-Propylbenzene	NA			0E+0		2.4E-3			2.4E-3
			Phenanthrene	NA			0E+0		NA			0.0E+0
			Pyrene	NA			0E+0	Kidney	5.9E-2			5.9E-2
			Styrene	NA			0E+0	Blood, Liver	8.2E-3			8.2E-3
			Toluene	NA			0E+0	Liver, Kidney, Respiratory	2.7E-2			2.7E-2
			Xylenes (total)	NA			0E+0	Whole Body	1.9E-2			1.9E-2
			Benzene (500 ft)	2E-5			2E-5		1.4E+0			1.4E+0
			Benzene (725 ft)	1E-5			1E-5		9.4E-1			9.4E-1
			Naphthalene (500 ft)	NA			0E+0	Whole Body	1.8E+0			1.8E+0
			Naphthalene (725 ft)	NA			0E+0	Whole Body	1.4E+0			1.4E+0

TABLE 9.11
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
TIER 2 CENTRAL EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Car Wash Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater Potable Use	Potable Water	Potable Water	Chemical Total (krig - 500 ft)	4E-4			4E-4		9E+0			8.8E+0
			Chemical Total (krig - 725 ft)	4E-4			4E-4		8E+0			7.8E+0
		Exposure Point Total	krig - 500 ft				4E-4					8.8E+0
		Exposure Point Total	krig - 725 ft				4E-4					7.8E+0
	Exposure Medium Total	krig - 500 ft					4E-4					8.8E+0
	Exposure Medium Total	krig - 725 ft					4E-4					7.8E+0
Medium Total	krig - 500 ft						4E-4					8.8E+0
Medium Total	krig - 725 ft						4E-4					7.8E+0
Groundwater Industrial Use	Industrial Water	Industrial Water	Aluminum			NA	0E+0				4.9E-5	4.9E-5
			Antimony			NA	0E+0	Whole Body, Blood			4.2E-5	4.2E-5
			Arsenic			3E-7	3E-7	Skin			2.6E-3	2.6E-3
			Barium			NA	0E+0	Kidney			9.8E-4	9.8E-4
			Beryllium			NA	0E+0	Small Intestine			3.2E-5	3.2E-5
			Cadmium			2E-9	2E-9	Kidney			2.3E-4	2.3E-4
			Chromium			NA	0E+0				5.2E-4	5.2E-4
			Cobalt			NA	0E+0				1.3E-5	1.3E-5
			Copper			NA	0E+0	GI System			9.7E-6	9.7E-6
			Iron			NA	0E+0				4.7E-3	4.7E-3
			Lead			NA	0E+0				NA	0.0E+0
			Manganese			NA	0E+0	CNS			6.2E-4	6.2E-4
			Mercury			NA	0E+0	Immune System			2.6E-5	2.6E-5
			Molybdenum			NA	0E+0	Blood			2.6E-4	2.6E-4
			Nickel			NA	0E+0	Body Weight			5.6E-6	5.6E-6
			Nitrate			NA	0E+0	Blood			1.5E-4	1.5E-4
			Selenium			NA	0E+0	Whole Body			9.1E-5	9.1E-5
			Silver			NA	0E+0	Skin			6.3E-5	6.3E-5

TABLE 9.11
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
TIER 2 CENTRAL EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Car Wash Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
			Thallium			NA	0E+0	Liver, Blood, Hair			5.1E-3	5.1E-3
Groundwater	Industrial Water	Industrial Water	Thallium			NA	0E+0	Liver, Blood, Hair			5.1E-3	5.1E-3
Industrial Use			Zinc			NA	0E+0	Blood			7.7E-7	7.7E-7
			1,2,4-Trimethylbenzene			NA	0E+0				0.0E+0	0.0E+0
			1,2-Dichloroethane			1E-7	1E-7				2.5E-3	2.5E-3
			1,3,5-Trimethylbenzene			NA	0E+0				0.0E+0	0.0E+0
			Acenaphthene			NA	0E+0	Liver			0.0E+0	0.0E+0
			Acenaphthylene			NA	0E+0				NA	0.0E+0
			Acetone			NA	0E+0	Liver, Kidney			3.8E-3	3.8E-3
			Anthracene			NA	0E+0	NOAEL			0.0E+0	0.0E+0
			Benzo[a]anthracene			0E+0	0E+0				NA	0.0E+0
			Benzo[a]pyrene			0E+0	0E+0				NA	0.0E+0
			Benzo[b]fluoranthene			0E+0	0E+0				NA	0.0E+0
			Benzo[g,h,I]perylene			NA	0E+0				NA	0.0E+0
			Benzo[k]fluoranthene			0E+0	0E+0				NA	0.0E+0
			Carbon Disulfide			NA	0E+0	Reproductive/ Teratogenic			2.9E-5	2.9E-5
			Chrysene			0E+0	0E+0				NA	0.0E+0
			Dibenz[a,h]anthracene			0E+0	0E+0				NA	0.0E+0
			Ethylbenzene			2E-7	2E-7	Liver, Kidney			1.4E-2	1.4E-2
			Fluoranthene			NA	0E+0	Kidney, Liver, Blood			0.0E+0	0.0E+0
			Fluorene			NA	0E+0	Blood			0.0E+0	0.0E+0
			Indeno(1,2,3-cd)pyrene			0E+0	0E+0				NA	0.0E+0
			Isopropyl benzene			NA	0E+0	Kidney			8.0E-5	8.0E-5
			Methyl isobutyl ketone			0E+0	0E+0				6.1E-6	6.1E-6
			Methylene chloride			1E-8	1E-8	Liver			3.7E-4	3.7E-4
			MTBE			2E-10	2E-10				NA	0.0E+0
			n-Butylbenzene			NA	0E+0				0.0E+0	0.0E+0
			n-Propylbenzene			NA	0E+0				0.0E+0	0.0E+0

TABLE 9.11
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
TIER 2 CENTRAL EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Car Wash Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater Industrial Use	Industrial Water	Industrial Water	Phenanthrene			NA	0E+0				NA	0.0E+0
			Pyrene			NA	0E+0	Kidney			0.0E+0	0.0E+0
			Styrene			NA	0E+0	Blood, Liver			1.2E-3	1.2E-3
			Toluene			NA	0E+0	Liver, Kidney, Respiratory			3.4E-3	3.4E-3
			Xylenes (total)			NA	0E+0	Whole Body			3.9E-3	3.9E-3
			Benzene (500 ft)			1E-6	1E-6				8.7E-2	8.7E-2
			Benzene (725 ft)			6E-7	6E-7				5.7E-2	5.7E-2
			Naphthalene (500 ft)			NA	0E+0	Respiratory			1.1E-1	1.1E-1
			Naphthalene (725 ft)			NA	0E+0	Respiratory			8.5E-2	8.5E-2
			Chemical Total (krig - 500 ft)			2E-6	2E-6				2.5E-1	2.5E-1
			Chemical Total (krig - 725 ft)			1E-6	1E-6				1.9E-1	1.9E-1
		Exposure Point Total	krig - 500 ft				2E-6					2.5E-1
		Exposure Point Total	krig - 725 ft				1E-6					1.9E-1
	Exposure Medium Total	krig - 500 ft					2E-6					2.5E-1
	Exposure Medium Total	krig - 725 ft					1E-6					1.9E-1
	Work Space Air	Work Space Air	1,2,4-Trimethylbenzene		NA		0E+0			9E-4		8.6E-4
			1,2-Dichloroethane		5E-9		5E-9			1E-3		1.2E-3
			1,3,5-Trimethylbenzene		NA		0E+0			5E-4		4.5E-4
			Acenaphthene		NA		0E+0			NA		0.0E+0
			Acetone		NA		0E+0			NA		0.0E+0
			Anthracene		NA		0E+0			NA		0.0E+0
			Benzo[b]fluoranthene		1E-8		1E-8			NA		0.0E+0
			Carbon Disulfide		NA		0E+0	Peripheral Nervous System		8E-7		8.1E-7
			Chrysene		1E-9		1E-9			NA		0.0E+0
			Ethylbenzene		3E-9		3E-9	Developmental		8E-5		7.8E-5

TABLE 9.11

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

TIER 2 CENTRAL EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Car Wash Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater Industrial Use	Work Space Air	Work Space Air	Fluorene		NA		0E+0			NA		0.0E+0
			Isopropyl benzene		NA		0E+0	Kidney		2E-6		1.8E-6
			Methyl isobutyl ketone		0E+0		0E+0			4E-6		3.8E-6
			Methylene chloride		9E-10		9E-10			8E-6		7.7E-6
			MTBE		2E-11		2E-11	Liver, Kidney		7E-7		7.1E-7
			n-Butylbenzene		NA		0E+0			NA		0.0E+0
			n-Propylbenzene		NA		0E+0			NA		0.0E+0
			Pyrene		NA		0E+0			NA		0.0E+0
			Styrene		NA		0E+0	CNS		2E-5		1.8E-5
			Toluene		NA		0E+0	CNS, Respiratory		2E-4		1.7E-4
			Xylenes (total)		NA		0E+0	CNS		5E-4		4.5E-4
			Benzene (500 ft)		6E-8		6E-8			1E-2		9.6E-3
			Benzene (725 ft)		4E-8		4E-8			6E-3		6.2E-3
			Naphthalene (500 ft)		NA		0E+0	Respiratory		1E-1		1.3E-1
			Naphthalene (725 ft)		NA		0E+0	Respiratory		1E-1		9.9E-2
			Chemical Total (krig - 500 ft)		8E-8		8E-8			1.4E-1		1.4E-1
			Chemical Total (krig - 725 ft)		6E-8		6E-8			1.1E-1		1.1E-1
		Exposure Point Total	krig - 500 ft				8E-8					1.4E-1
		Exposure Point Total	krig - 725 ft				6E-8					1.1E-1
	Exposure Medium Total	krig - 500 ft					8E-8					1.4E-1
	Exposure Medium Total	krig - 725 ft					6E-8					1.1E-1
Medium Total	krig - 500 ft						2E-6					3.9E-1
Medium Total	krig - 725 ft						1E-6					3.0E-1
Receptor Total	krig - 500 ft						4E-4					9.2E+0
Receptor Total	krig - 725 ft						4E-4					8.1E+0

TABLE 9.12
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
TIER 2 REASONABLE MAXIMUM EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Car Wash Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater Potable Use	Potable Water	Potable Water	Aluminum	NA			0E+0		1.2E-2			1.2E-2
			Antimony	NA			0E+0	Whole Body, Blood	1.1E-2			1.1E-2
			Arsenic	4E-4			4E-4	Skin	6.5E-1			6.5E-1
			Barium	NA			0E+0	Kidney	2.5E-1			2.5E-1
			Beryllium	NA			0E+0	Small Intestine	8.1E-3			8.1E-3
			Cadmium	2E-6			2E-6	Kidney	5.7E-2			5.7E-2
			Chromium	NA			0E+0		6.5E-2			6.5E-2
			Cobalt	NA			0E+0		3.3E-3			3.3E-3
			Copper	NA			0E+0	GI System	2.4E-3			2.4E-3
			Iron	NA			0E+0		1.2E+0			1.2E+0
			Lead	NA			0E+0		NA			0.0E+0
			Manganese	NA			0E+0	CNS	1.6E-1			1.6E-1
			Mercury	NA			0E+0	Immune System	6.5E-3			6.5E-3
			Molybdenum	NA			0E+0	Blood	6.6E-2			6.6E-2
			Nickel	NA			0E+0	Body Weight	7.0E-3			7.0E-3
			Nitrate	NA			0E+0	Blood	3.9E-2			3.9E-2
			Selenium	NA			0E+0	Whole Body	2.3E-2			2.3E-2
			Silver	NA			0E+0	Skin	2.6E-2			2.6E-2
			Thallium	NA			0E+0	Liver, Blood, Hair	1.3E+0			1.3E+0
			Vanadium	NA			0E+0	Hair	2.5E-2			2.5E-2
			Zinc	NA			0E+0	Blood	3.2E-4			3.2E-4
			1,2,4-Trimethylbenzene	NA			0E+0		9.7E-3			9.7E-3
			1,2-Dichloroethane	4E-6			4E-6		1.5E-2			1.5E-2
			1,3,5-Trimethylbenzene	NA			0E+0		5.1E-3			5.1E-3
			Acenaphthene	NA			0E+0	Liver	3.2E-2			3.2E-2
			Acenaphthylene	NA			0E+0		NA			0.0E+0
			Acetone	NA			0E+0	Liver, Kidney	8.8E-1			8.8E-1

TABLE 9.12

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

TIER 2 REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Car Wash Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
			Anthracene	NA			0E+0	NOAEL	1.7E-3			1.7E-3
Groundwater	Potable Water	Potable Water	Benzo[a]anthracene	5E-5			5E-5		NA			0.0E+0
Potable Use			Benzo[a]pyrene	1E-3			1E-3		NA			0.0E+0
			Benzo[b]fluoranthene	6E-5			6E-5		NA			0.0E+0
			Benzo[g,h,I]perylene	NA			0E+0		NA			0.0E+0
			Benzo[k]fluoranthene	3E-5			3E-5		NA			0.0E+0
			Carbon Disulfide	NA			0E+0	Reproductive/ Teratogenic	4.2E-4			4.2E-4
			Chrysene	9E-6			9E-6		NA			0.0E+0
			Dibenz[a,h]anthracene	2E-5			2E-5		NA			0.0E+0
			Ethylbenzene	5E-6			5E-6	Liver, Kidney	7.0E-2			7.0E-2
			Fluoranthene	NA			0E+0	Kidney, Liver, Blood	6.2E-2			6.2E-2
			Fluorene	NA			0E+0	Blood	1.5E-2			1.5E-2
			Indeno(1,2,3-cd)pyrene	9E-5			9E-5		NA			0.0E+0
			Isopropyl benzene	NA			0E+0	Kidney	6.5E-4			6.5E-4
			Methyl isobutyl ketone	0E+0			0E+0		3.9E-4			3.9E-4
			Methylene chloride	4E-6			4E-6	Liver	2.6E-2			2.6E-2
			MTBE	6E-8			6E-8		NA			0.0E+0
			n-Butylbenzene	NA			0E+0		4.0E-1			4.0E-1
			n-Propylbenzene	NA			0E+0		2.4E-3			2.4E-3
			Phenanthrene	NA			0E+0		NA			0.0E+0
			Pyrene	NA			0E+0	Kidney	5.9E-2			5.9E-2
			Styrene	NA			0E+0	Blood, Liver	8.2E-3			8.2E-3
			Toluene	NA			0E+0	Liver, Kidney, Respiratory	2.7E-2			2.7E-2
			Xylenes (total)	NA			0E+0	Whole Body	1.9E-2			1.9E-2
			Benzene (500 ft)	8E-5			8E-5		1.4E+0			1.4E+0
			Benzene (725 ft)	6E-5			6E-5		9.4E-1			9.4E-1
			Naphthalene (500 ft)	NA			0E+0	Whole Body	1.8E+0			1.8E+0
			Naphthalene (725 ft)	NA			0E+0	Whole Body	1.4E+0			1.4E+0

TABLE 9.12
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
TIER 2 REASONABLE MAXIMUM EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Car Wash Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater Potable Use	Potable Water	Potable Water	Chemical Total (krig - 500 ft)	2E-3			2E-3		9E+0			8.8E+0
			Chemical Total (krig - 725 ft)	2E-3			2E-3		8E+0			7.8E+0
		Exposure Point Total	krig - 500 ft				2E-3					8.8E+0
		Exposure Point Total	krig - 725 ft				2E-3					7.8E+0
	Exposure Medium Total	krig - 500 ft					2E-3					8.8E+0
	Exposure Medium Total	krig - 725 ft					2E-3					7.8E+0
Medium Total	krig - 500 ft						2E-3					8.8E+0
Medium Total	krig - 725 ft						2E-3					7.8E+0
Groundwater Industrial Use	Industrial Water	Industrial Water	Aluminum			NA	0E+0				1.1E-4	1.1E-4
			Antimony			NA	0E+0	Whole Body, Blood			9.7E-5	9.7E-5
			Arsenic			3E-6	3E-6	Skin			5.9E-3	5.9E-3
			Barium			NA	0E+0	Kidney			2.3E-3	2.3E-3
			Beryllium			NA	0E+0	Small Intestine			7.4E-5	7.4E-5
			Cadmium			2E-8	2E-8	Kidney			5.2E-4	5.2E-4
			Chromium			NA	0E+0				1.2E-3	1.2E-3
			Cobalt			NA	0E+0				3.0E-5	3.0E-5
			Copper			NA	0E+0	GI System			2.2E-5	2.2E-5
			Iron			NA	0E+0				1.1E-2	1.1E-2
			Lead			NA	0E+0				NA	0.0E+0
			Manganese			NA	0E+0	CNS			1.4E-3	1.4E-3
			Mercury			NA	0E+0	Immune System			6.0E-5	6.0E-5
			Molybdenum			NA	0E+0	Blood			6.1E-4	6.1E-4
			Nickel			NA	0E+0	Body Weight			1.3E-5	1.3E-5
			Nitrate			NA	0E+0	Blood			3.5E-4	3.5E-4
			Selenium			NA	0E+0	Whole Body			2.1E-4	2.1E-4
			Silver			NA	0E+0	Skin			1.5E-4	1.5E-4

TABLE 9.12
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
TIER 2 REASONABLE MAXIMUM EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Car Wash Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
			Thallium			NA	0E+0	Liver, Blood, Hair			1.2E-2	1.2E-2
Groundwater	Industrial Water	Industrial Water	Thallium			NA	0E+0	Liver, Blood, Hair			1.2E-2	1.2E-2
Industrial Use			Zinc			NA	0E+0	Blood			1.8E-6	1.8E-6
			1,2,4-Trimethylbenzene			NA	0E+0				0.0E+0	0.0E+0
			1,2-Dichloroethane			2E-6	2E-6				5.7E-3	5.7E-3
			1,3,5-Trimethylbenzene			NA	0E+0				0.0E+0	0.0E+0
			Acenaphthene			NA	0E+0	Liver			0.0E+0	0.0E+0
			Acenaphthylene			NA	0E+0				NA	0.0E+0
			Acetone			NA	0E+0	Liver, Kidney			8.7E-3	8.7E-3
			Anthracene			NA	0E+0	NOAEL			0.0E+0	0.0E+0
			Benzo[a]anthracene			0E+0	0E+0				NA	0.0E+0
			Benzo[a]pyrene			0E+0	0E+0				NA	0.0E+0
			Benzo[b]fluoranthene			0E+0	0E+0				NA	0.0E+0
			Benzo[g,h,i]perylene			NA	0E+0				NA	0.0E+0
			Benzo[k]fluoranthene			0E+0	0E+0				NA	0.0E+0
			Carbon Disulfide			NA	0E+0	Reproductive/ Teratogenic			6.6E-5	6.6E-5
			Chrysene			0E+0	0E+0				NA	0.0E+0
			Dibenz[a,h]anthracene			0E+0	0E+0				NA	0.0E+0
			Ethylbenzene			2E-6	2E-6	Liver, Kidney			3.2E-2	3.2E-2
			Fluoranthene			NA	0E+0	Kidney, Liver, Blood			0.0E+0	0.0E+0
			Fluorene			NA	0E+0	Blood			0.0E+0	0.0E+0
			Indeno(1,2,3-cd)pyrene			0E+0	0E+0				NA	0.0E+0
			Isopropyl benzene			NA	0E+0	Kidney			1.8E-4	1.8E-4
			Methyl isobutyl ketone			0E+0	0E+0				1.4E-5	1.4E-5
			Methylene chloride			1E-7	1E-7	Liver			8.5E-4	8.5E-4
			MTBE			2E-9	2E-9				NA	0.0E+0
			n-Butylbenzene			NA	0E+0				0.0E+0	0.0E+0
			n-Propylbenzene			NA	0E+0				0.0E+0	0.0E+0

TABLE 9.12
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
TIER 2 REASONABLE MAXIMUM EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Car Wash Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater Industrial Use	Industrial Water	Industrial Water	Phenanthrene			NA	0E+0				NA	0.0E+0
			Pyrene			NA	0E+0	Kidney			0.0E+0	0.0E+0
			Styrene			NA	0E+0	Blood, Liver			2.8E-3	2.8E-3
			Toluene			NA	0E+0	Liver, Kidney, Respiratory			7.8E-3	7.8E-3
			Xylenes (total)			NA	0E+0	Whole Body			9.1E-3	9.1E-3
			Benzene (500 ft)			1E-5	1E-5				2.0E-1	2.0E-1
			Benzene (725 ft)			8E-6	8E-6				1.3E-1	1.3E-1
			Naphthalene (500 ft)			NA	0E+0	Respiratory			2.5E-1	2.5E-1
			Naphthalene (725 ft)			NA	0E+0	Respiratory			2.0E-1	2.0E-1
			Chemical Total (krig - 500 ft)			2E-5	2E-5				5.7E-1	5.7E-1
			Chemical Total (krig - 725 ft)			1E-5	1E-5				4.4E-1	4.4E-1
		Exposure Point Total	krig - 500 ft				2E-5					5.7E-1
		Exposure Point Total	krig - 725 ft				1E-5					4.4E-1
	Exposure Medium Total	krig - 500 ft					2E-5					5.7E-1
	Exposure Medium Total	krig - 725 ft					1E-5					4.4E-1
	Indoor Air	Indoor Air	1,2,4-Trimethylbenzene		NA		0E+0			3E-3		2.6E-3
			1,2-Dichloroethane		7E-8		7E-8			4E-3		3.8E-3
			1,3,5-Trimethylbenzene		NA		0E+0			1E-3		1.4E-3
			Acenaphthene		NA		0E+0			NA		0.0E+0
			Acetone		NA		0E+0			NA		0.0E+0
			Anthracene		NA		0E+0			NA		0.0E+0
			Benzo[b]fluoranthene		2E-7		2E-7			NA		0.0E+0
			Carbon Disulfide		NA		0E+0	Peripheral Nervous System		2E-6		2.5E-6
			Chrysene		2E-8		2E-8			NA		0.0E+0
			Ethylbenzene		5E-8		5E-8	Developmental		2E-4		2.4E-4

TABLE 9.12
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
TIER 2 REASONABLE MAXIMUM EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Car Wash Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
			Fluorene		NA		0E+0			NA		0.0E+0
Groundwater	Indoor Air	Indoor Air	Isopropyl benzene		NA		0E+0	Kidney		6E-6		5.5E-6
Industrial Use			Methyl isobutyl ketone		0E+0		0E+0			1E-5		1.2E-5
			Methylene chloride		1E-8		1E-8			2E-5		2.4E-5
			MTBE		3E-10		3E-10	Liver, Kidney		2E-6		2.2E-6
			n-Butylbenzene		NA		0E+0			NA		0.0E+0
			n-Propylbenzene		NA		0E+0			NA		0.0E+0
			Pyrene		NA		0E+0			NA		0.0E+0
			Styrene		NA		0E+0	CNS		6E-5		5.6E-5
			Toluene		NA		0E+0	CNS, Respiratory		5E-4		5.2E-4
			Xylenes (total)		NA		0E+0	CNS		1E-3		1.4E-3
			Benzene (500 ft)		1E-6		1E-6			3E-2		2.9E-2
			Benzene (725 ft)		6E-7		6E-7			2E-2		1.9E-2
			Naphthalene (500 ft)		NA		0E+0	Respiratory		4E-1		3.9E-1
			Naphthalene (725 ft)		NA		0E+0	Respiratory		3E-1		3.0E-1
			Chemical Total (krig - 500 ft)		1E-6		1E-6			4.3E-1		4.3E-1
			Chemical Total (krig - 725 ft)		1E-6		1E-6			3.3E-1		3.3E-1
		Exposure Point Total	krig - 500 ft				1E-6					4.3E-1
		Exposure Point Total	krig - 725 ft				1E-6					3.3E-1
	Exposure Medium Total	krig - 500 ft					1E-6					4.3E-1
	Exposure Medium Total	krig - 725 ft					1E-6					3.3E-1
Medium Total	krig - 500 ft						2E-5					1.0E+0
Medium Total	krig - 725 ft						2E-5					7.7E-1
Receptor Total	krig - 500 ft						2E-3					9.8E+0
Receptor Total	krig - 725 ft						2E-3					8.6E+0

TABLE 9.13
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
TIER 2 CENTRAL EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Landscape Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater Potable Use	Potable Water	Potable Water	Aluminum	NA			0E+0		1.2E-2			1.2E-2
			Antimony	NA			0E+0	Whole Body, Blood	1.1E-2			1.1E-2
			Arsenic	9E-5			9E-5	Skin	6.5E-1			6.5E-1
			Barium	NA			0E+0	Kidney	2.5E-1			2.5E-1
			Beryllium	NA			0E+0	Small Intestine	8.1E-3			8.1E-3
			Cadmium	6E-7			6E-7	Kidney	5.7E-2			5.7E-2
			Chromium	NA			0E+0		6.5E-2			6.5E-2
			Cobalt	NA			0E+0		3.3E-3			3.3E-3
			Copper	NA			0E+0	GI System	2.4E-3			2.4E-3
			Iron	NA			0E+0		1.2E+0			1.2E+0
			Lead	NA			0E+0		NA			0.0E+0
			Manganese	NA			0E+0	CNS	1.6E-1			1.6E-1
			Mercury	NA			0E+0	Immune System	6.5E-3			6.5E-3
			Molybdenum	NA			0E+0	Blood	6.6E-2			6.6E-2
			Nickel	NA			0E+0	Body Weight	7.0E-3			7.0E-3
			Nitrate	NA			0E+0	Blood	3.9E-2			3.9E-2
			Selenium	NA			0E+0	Whole Body	2.3E-2			2.3E-2
			Silver	NA			0E+0	Skin	2.6E-2			2.6E-2
			Thallium	NA			0E+0	Liver, Blood, Hair	1.3E+0			1.3E+0
			Vanadium	NA			0E+0	Hair	2.5E-2			2.5E-2
			Zinc	NA			0E+0	Blood	3.2E-4			3.2E-4
			1,2,4-Trimethylbenzene	NA			0E+0		9.7E-3			9.7E-3
			1,2-Dichloroethane	1E-6			1E-6		1.5E-2			1.5E-2
			1,3,5-Trimethylbenzene	NA			0E+0		5.1E-3			5.1E-3
			Acenaphthene	NA			0E+0	Liver	3.2E-2			3.2E-2
			Acenaphthylene	NA			0E+0		NA			0.0E+0
			Acetone	NA			0E+0	Liver, Kidney	8.8E-1			8.8E-1

TABLE 9.13
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
TIER 2 CENTRAL EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Landscape Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater Potable Use	Potable Water	Potable Water	Anthracene	NA			0E+0	NOAEL	1.7E-3			1.7E-3
			Benzo[a]anthracene	1E-5			1E-5		NA			0.0E+0
			Benzo[a]pyrene	3E-4			3E-4		NA			0.0E+0
			Benzo[b]fluoranthene	2E-5			2E-5		NA			0.0E+0
			Benzo[g,h,I]perylene	NA			0E+0		NA			0.0E+0
			Benzo[k]fluoranthene	8E-6			8E-6		NA			0.0E+0
			Carbon Disulfide	NA			0E+0	Reproductive/ Teratogenic	4.2E-4			4.2E-4
			Chrysene	2E-6			2E-6		NA			0.0E+0
			Dibenz[a,h]anthracene	6E-6			6E-6		NA			0.0E+0
			Ethylbenzene	1E-6			1E-6	Liver, Kidney	7.0E-2			7.0E-2
			Fluoranthene	NA			0E+0	Kidney, Liver, Blood	6.2E-2			6.2E-2
			Fluorene	NA			0E+0	Blood	1.5E-2			1.5E-2
			Indeno(1,2,3-cd)pyrene	2E-5			2E-5		NA			0.0E+0
			Isopropyl benzene	NA			0E+0	Kidney	6.5E-4			6.5E-4
			Methyl isobutyl ketone	0E+0			0E+0		3.9E-4			3.9E-4
			Methylene chloride	1E-6			1E-6	Liver	2.6E-2			2.6E-2
			MTBE	2E-8			2E-8		NA			0.0E+0
			n-Butylbenzene	NA			0E+0		4.0E-1			4.0E-1
			n-Propylbenzene	NA			0E+0		2.4E-3			2.4E-3
			Phenanthrene	NA			0E+0		NA			0.0E+0
			Pyrene	NA			0E+0	Kidney	5.9E-2			5.9E-2
			Styrene	NA			0E+0	Blood, Liver	8.2E-3			8.2E-3
			Toluene	NA			0E+0	Liver, Kidney, Respiratory	2.7E-2			2.7E-2
			Xylenes (total)	NA			0E+0	Whole Body	1.9E-2			1.9E-2
			Benzene (500 ft)	2E-5			2E-5		1.4E+0			1.4E+0
			Benzene (725 ft)	1E-5			1E-5		9.4E-1			9.4E-1
			Naphthalene (500 ft)	NA			0E+0	Whole Body	1.8E+0			1.8E+0
			Naphthalene (725 ft)	NA			0E+0	Whole Body	1.4E+0			1.4E+0

TABLE 9.13

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

TIER 2 CENTRAL EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Landscape Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater Potable Use	Potable Water	Potable Water	Chemical Total (krig - 500 ft)	5E-4			5E-4		9E+0			8.8E+0
			Chemical Total (krig - 725 ft)	5E-4			5E-4		8E+0			7.8E+0
		Exposure Point Total	krig - 500 ft				5E-4					8.8E+0
		Exposure Point Total	krig - 725 ft				5E-4					7.8E+0
	Exposure Medium Total	krig - 500 ft					5E-4					8.8E+0
	Exposure Medium Total	krig - 725 ft					5E-4					7.8E+0
Medium Total	krig - 500 ft						5E-4					8.8E+0
Medium Total	krig - 725 ft						5E-4					7.8E+0
Groundwater Industrial Use	Industrial Water	Industrial Water	Aluminum			NA	0E+0				4.9E-5	4.9E-5
			Antimony			NA	0E+0	Whole Body, Blood			4.2E-5	4.2E-5
			Arsenic			4E-7	4E-7	Skin			2.6E-3	2.6E-3
			Barium			NA	0E+0	Kidney			9.8E-4	9.8E-4
			Beryllium			NA	0E+0	Small Intestine			3.2E-5	3.2E-5
			Cadmium			2E-9	2E-9	Kidney			2.3E-4	2.3E-4
			Chromium			NA	0E+0				5.2E-4	5.2E-4
			Cobalt			NA	0E+0				1.3E-5	1.3E-5
			Copper			NA	0E+0	GI System			9.7E-6	9.7E-6
			Iron			NA	0E+0				4.7E-3	4.7E-3
			Lead			NA	0E+0				NA	0.0E+0
			Manganese			NA	0E+0	CNS			6.2E-4	6.2E-4
			Mercury			NA	0E+0	Immune System			2.6E-5	2.6E-5
			Molybdenum			NA	0E+0	Blood			2.6E-4	2.6E-4
			Nickel			NA	0E+0	Body Weight			5.6E-6	5.6E-6
			Nitrate			NA	0E+0	Blood			1.5E-4	1.5E-4
			Selenium			NA	0E+0	Whole Body			9.1E-5	9.1E-5
			Silver			NA	0E+0	Skin			6.3E-5	6.3E-5

TABLE 9.13
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
TIER 2 CENTRAL EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Landscape Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
			Thallium			NA	0E+0	Liver, Blood, Hair			5.1E-3	5.1E-3
Groundwater	Industrial Water	Industrial Water	Vanadium			NA	0E+0	Hair			1.0E-4	1.0E-4
Industrial Use			Zinc			NA	0E+0	Blood			7.7E-7	7.7E-7
			1,2,4-Trimethylbenzene			NA	0E+0				0.0E+0	0.0E+0
			1,2-Dichloroethane			2E-7	2E-7				2.5E-3	2.5E-3
			1,3,5-Trimethylbenzene			NA	0E+0				0.0E+0	0.0E+0
			Acenaphthene			NA	0E+0	Liver			0.0E+0	0.0E+0
			Acenaphthylene			NA	0E+0				NA	0.0E+0
			Acetone			NA	0E+0	Liver, Kidney			3.8E-3	3.8E-3
			Anthracene			NA	0E+0	NOAEL			0.0E+0	0.0E+0
			Benzo[a]anthracene			0E+0	0E+0				NA	0.0E+0
			Benzo[a]pyrene			0E+0	0E+0				NA	0.0E+0
			Benzo[b]fluoranthene			0E+0	0E+0				NA	0.0E+0
			Benzo[g,h,I]perylene			NA	0E+0				NA	0.0E+0
			Benzo[k]fluoranthene			0E+0	0E+0				NA	0.0E+0
			Carbon Disulfide			NA	0E+0	Reproductive/ Teratogenic			2.9E-5	2.9E-5
			Chrysene			0E+0	0E+0				NA	0.0E+0
			Dibenz[a,h]anthracene			0E+0	0E+0				NA	0.0E+0
			Ethylbenzene			3E-7	3E-7	Liver, Kidney			1.4E-2	1.4E-2
			Fluoranthene			NA	0E+0	Kidney, Liver, Blood			0.0E+0	0.0E+0
			Fluorene			NA	0E+0	Blood			0.0E+0	0.0E+0
			Indeno(1,2,3-cd)pyrene			0E+0	0E+0				NA	0.0E+0
			Isopropyl benzene			NA	0E+0	Kidney			8.0E-5	8.0E-5
			Methyl isobutyl ketone			0E+0	0E+0				6.1E-6	6.1E-6
			Methylene chloride			2E-8	2E-8	Liver			3.7E-4	3.7E-4
			MTBE			2E-10	2E-10				NA	0.0E+0
			n-Butylbenzene			NA	0E+0				0.0E+0	0.0E+0
			n-Propylbenzene			NA	0E+0				0.0E+0	0.0E+0

TABLE 9.13
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
TIER 2 CENTRAL EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Landscape Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater Industrial Use	Industrial Water	Industrial Water	Phenanthrene			NA	0E+0				NA	0.0E+0
			Pyrene			NA	0E+0	Kidney			0.0E+0	0.0E+0
			Styrene			NA	0E+0	Blood, Liver			1.2E-3	1.2E-3
			Toluene			NA	0E+0	Liver, Kidney, Respiratory			3.4E-3	3.4E-3
			Xylenes (total)			NA	0E+0	Whole Body			3.9E-3	3.9E-3
			Benzene (500 ft)			1E-6	1E-6				8.7E-2	8.7E-2
			Benzene (725 ft)			9E-7	9E-7				5.7E-2	5.7E-2
			Naphthalene (500 ft)			NA	0E+0	Respiratory			1.1E-1	1.1E-1
			Naphthalene (725 ft)			NA	0E+0	Respiratory			8.5E-2	8.5E-2
			Chemical Total (krig - 500 ft)			2E-6	2E-6				2.4E-1	2.4E-1
			Chemical Total (krig - 725 ft)			2E-6	2E-6				1.9E-1	1.9E-1
		Exposure Point Total	krig - 500 ft				2E-6					2.4E-1
		Exposure Point Total	krig - 725 ft				2E-6					1.9E-1
	Exposure Medium Total	krig - 500 ft					2E-6					2.4E-1
	Exposure Medium Total	krig - 725 ft					2E-6					1.9E-1
Groundwater Industrial Use	Workspace Air	Workspace Air	1,2,4-Trimethylbenzene		NA		0E+0			3E-3		2.6E-3
			1,2-Dichloroethane		2E-8		2E-8			4E-3		3.7E-3
			1,3,5-Trimethylbenzene		NA		0E+0			1E-3		1.4E-3
			Acenaphthene		NA		0E+0			NA		0.0E+0
			Acetone		NA		0E+0			NA		0.0E+0
			Anthracene		NA		0E+0			NA		0.0E+0
			Benzo[b]fluoranthene		4E-8		4E-8			NA		0.0E+0
			Carbon Disulfide		NA		0E+0	Peripheral Nervous System		2E-6		2.4E-6
			Chrysene		6E-9		6E-9			NA		0.0E+0
			Ethylbenzene		1E-8		1E-8	Developmental		2E-4		2.3E-4

TABLE 9.13
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
TIER 2 CENTRAL EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Landscape Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater Industrial Use	Workspace Air	Workspace Air	Fluorene		NA		0E+0			NA		0.0E+0
			Isopropyl benzene		NA		0E+0	Kidney		5E-6		5.3E-6
			Methyl isobutyl ketone		0E+0		0E+0			1E-5		1.1E-5
			Methylene chloride		4E-9		4E-9			2E-5		2.3E-5
			MTBE		9E-11		9E-11	Liver, Kidney		2E-6		2.1E-6
			n-Butylbenzene		NA		0E+0			NA		0.0E+0
			n-Propylbenzene		NA		0E+0			NA		0.0E+0
			Pyrene		NA		0E+0			NA		0.0E+0
			Styrene		NA		0E+0	CNS		5E-5		5.5E-5
			Toluene		NA		0E+0	CNS, Respiratory		5E-4		5.1E-4
			Xylenes (total)		NA		0E+0	CNS		1E-3		1.3E-3
			Benzene (500 ft)		2E-7		2E-7			3E-2		2.8E-2
			Benzene (725 ft)		2E-7		2E-7			2E-2		1.9E-2
			Naphthalene (500 ft)		NA		0E+0	Respiratory		4E-1		3.8E-1
			Naphthalene (725 ft)		NA		0E+0	Respiratory		3E-1		2.9E-1
			Chemical Total (krig - 500 ft)		3E-7		3E-7			4.2E-1		4.2E-1
			Chemical Total (krig - 725 ft)		2E-7		2E-7			3.2E-1		3.2E-1
		Exposure Point Total	krig - 500 ft				3E-7					4.2E-1
		Exposure Point Total	krig - 725 ft				2E-7					3.2E-1
	Exposure Medium Total	krig - 500 ft					3E-7					4.2E-1
	Exposure Medium Total	krig - 725 ft					2E-7					3.2E-1
Medium Total	krig - 500 ft						3E-6					6.6E-1
Medium Total	krig - 725 ft						2E-6					5.1E-1
Receptor Total	krig - 500 ft						5E-4					9.4E+0
Receptor Total	krig - 725 ft						5E-4					8.3E+0

TABLE 9.14

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

TIER 2 REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Landscape Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater Potable Use	Potable Water	Potable Water	Aluminum	NA			0E+0		1.2E-2			1.2E-2
			Antimony	NA			0E+0	Whole Body, Blood	1.1E-2			1.1E-2
			Arsenic	5E-4			5E-4	Skin	6.5E-1			6.5E-1
			Barium	NA			0E+0	Kidney	2.5E-1			2.5E-1
			Beryllium	NA			0E+0	Small Intestine	8.1E-3			8.1E-3
			Cadmium	3E-6			3E-6	Kidney	5.7E-2			5.7E-2
			Chromium	NA			0E+0		6.5E-2			6.5E-2
			Cobalt	NA			0E+0		3.3E-3			3.3E-3
			Copper	NA			0E+0	GI System	2.4E-3			2.4E-3
			Iron	NA			0E+0		1.2E+0			1.2E+0
			Lead	NA			0E+0		NA			0.0E+0
			Manganese	NA			0E+0	CNS	1.6E-1			1.6E-1
			Mercury	NA			0E+0	Immune System	6.5E-3			6.5E-3
			Molybdenum	NA			0E+0	Blood	6.6E-2			6.6E-2
			Nickel	NA			0E+0	Body Weight	7.0E-3			7.0E-3
			Nitrate	NA			0E+0	Blood	3.9E-2			3.9E-2
			Selenium	NA			0E+0	Whole Body	2.3E-2			2.3E-2
			Silver	NA			0E+0	Skin	2.6E-2			2.6E-2
			Thallium	NA			0E+0	Liver, Blood, Hair	1.3E+0			1.3E+0
			Vanadium	NA			0E+0	Hair	2.5E-2			2.5E-2
			Zinc	NA			0E+0	Blood	3.2E-4			3.2E-4
			1,2,4-Trimethylbenzene	NA			0E+0		9.7E-3			9.7E-3
			1,2-Dichloroethane	5E-6			5E-6		1.5E-2			1.5E-2
			1,3,5-Trimethylbenzene	NA			0E+0		5.1E-3			5.1E-3
			Acenaphthene	NA			0E+0	Liver	3.2E-2			3.2E-2
			Acenaphthylene	NA			0E+0		NA			0.0E+0
			Acetone	NA			0E+0	Liver, Kidney	8.8E-1			8.8E-1

TABLE 9.14
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
TIER 2 REASONABLE MAXIMUM EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Landscape Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater Potable Use	Potable Water	Potable Water	Anthracene	NA			0E+0	NOAEL	1.7E-3			1.7E-3
			Benzo[a]anthracene	7E-5			7E-5		NA			0.0E+0
			Benzo[a]pyrene	2E-3			2E-3		NA			0.0E+0
			Benzo[b]fluoranthene	8E-5			8E-5		NA			0.0E+0
			Benzo[g,h,I]perylene	NA			0E+0		NA			0.0E+0
			Benzo[k]fluoranthene	4E-5			4E-5		NA			0.0E+0
			Carbon Disulfide	NA			0E+0	Reproductive/ Teratogenic	4.2E-4			4.2E-4
			Chrysene	1E-5			1E-5		NA			0.0E+0
			Dibenz[a,h]anthracene	3E-5			3E-5		NA			0.0E+0
			Ethylbenzene	7E-6			7E-6	Liver, Kidney	7.0E-2			7.0E-2
			Fluoranthene	NA			0E+0	Kidney, Liver, Blood	6.2E-2			6.2E-2
			Fluorene	NA			0E+0	Blood	1.5E-2			1.5E-2
			Indeno(1,2,3-cd)pyrene	1E-4			1E-4		NA			0.0E+0
			Isopropyl benzene	NA			0E+0	Kidney	6.5E-4			6.5E-4
			Methyl isobutyl ketone	0E+0			0E+0		3.9E-4			3.9E-4
			Methylene chloride	6E-6			6E-6	Liver	2.6E-2			2.6E-2
			MTBE	8E-8			8E-8		NA			0.0E+0
			n-Butylbenzene	NA			0E+0		4.0E-1			4.0E-1
			n-Propylbenzene	NA			0E+0		2.4E-3			2.4E-3
			Phenanthrene	NA			0E+0		NA			0.0E+0
			Pyrene	NA			0E+0	Kidney	5.9E-2			5.9E-2
			Styrene	NA			0E+0	Blood, Liver	8.2E-3			8.2E-3
			Toluene	NA			0E+0	Liver, Kidney, Respiratory	2.7E-2			2.7E-2
			Xylenes (total)	NA			0E+0	Whole Body	1.9E-2			1.9E-2
			Benzene (500 ft)	1E-4			1E-4		1.4E+0			1.4E+0
			Benzene (725 ft)	7E-5			7E-5		9.4E-1			9.4E-1
			Naphthalene (500 ft)	NA			0E+0	Whole Body	1.8E+0			1.8E+0
			Naphthalene (725 ft)	NA			0E+0	Whole Body	1.4E+0			1.4E+0

TABLE 9.14

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

TIER 2 REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Landscape Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater Potable Use	Potable Water	Potable Water	Chemical Total (krig - 500 ft)	3E-3			3E-3		9E+0			8.8E+0
			Chemical Total (krig - 725 ft)	2E-3			2E-3		8E+0			7.8E+0
		Exposure Point Total	krig - 500 ft				3E-3					8.8E+0
		Exposure Point Total	krig - 725 ft				2E-3					7.8E+0
	Exposure Medium Total	krig - 500 ft					3E-3					8.8E+0
	Exposure Medium Total	krig - 725 ft					2E-3					7.8E+0
Medium Total	krig - 500 ft						3E-3					8.8E+0
Medium Total	krig - 725 ft						2E-3					7.8E+0
Groundwater Industrial Use	Industrial Water	Industrial Water	Aluminum			NA	0E+0				1.1E-4	1.1E-4
			Antimony			NA	0E+0	Whole Body, Blood			9.7E-5	9.7E-5
			Arsenic			4E-6	4E-6	Skin			5.9E-3	5.9E-3
			Barium			NA	0E+0	Kidney			2.3E-3	2.3E-3
			Beryllium			NA	0E+0	Small Intestine			7.4E-5	7.4E-5
			Cadmium			3E-8	3E-8	Kidney			5.2E-4	5.2E-4
			Chromium			NA	0E+0				1.2E-3	1.2E-3
			Cobalt			NA	0E+0				3.0E-5	3.0E-5
			Copper			NA	0E+0	GI System			2.2E-5	2.2E-5
			Iron			NA	0E+0				1.1E-2	1.1E-2
			Lead			NA	0E+0				NA	0.0E+0
			Manganese			NA	0E+0	CNS			1.4E-3	1.4E-3
			Mercury			NA	0E+0	Immune System			6.0E-5	6.0E-5
			Molybdenum			NA	0E+0	Blood			6.1E-4	6.1E-4
			Nickel			NA	0E+0	Body Weight			1.3E-5	1.3E-5
			Nitrate			NA	0E+0	Blood			3.5E-4	3.5E-4
			Selenium			NA	0E+0	Whole Body			2.1E-4	2.1E-4
			Silver			NA	0E+0	Skin			1.5E-4	1.5E-4

TABLE 9.14
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
TIER 2 REASONABLE MAXIMUM EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Landscape Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
			Thallium			NA	0E+0	Liver, Blood, Hair			1.2E-2	1.2E-2
Groundwater	Industrial Water	Industrial Water	Vanadium			NA	0E+0	Hair			2.3E-4	2.3E-4
Industrial Use			Zinc			NA	0E+0	Blood			1.8E-6	1.8E-6
			1,2,4-Trimethylbenzene			NA	0E+0				0.0E+0	0.0E+0
			1,2-Dichloroethane			2E-6	2E-6				5.7E-3	5.7E-3
			1,3,5-Trimethylbenzene			NA	0E+0				0.0E+0	0.0E+0
			Acenaphthene			NA	0E+0	Liver			0.0E+0	0.0E+0
			Acenaphthylene			NA	0E+0				NA	0.0E+0
			Acetone			NA	0E+0	Liver, Kidney			8.7E-3	8.7E-3
			Anthracene			NA	0E+0	NOAEL			0.0E+0	0.0E+0
			Benzo[a]anthracene			0E+0	0E+0				NA	0.0E+0
			Benzo[a]pyrene			0E+0	0E+0				NA	0.0E+0
			Benzo[b]fluoranthene			0E+0	0E+0				NA	0.0E+0
			Benzo[g,h,l]perylene			NA	0E+0				NA	0.0E+0
			Benzo[k]fluoranthene			0E+0	0E+0				NA	0.0E+0
			Carbon Disulfide			NA	0E+0	Reproductive/ Teratogenic			6.6E-5	6.6E-5
			Chrysene			0E+0	0E+0				NA	0.0E+0
			Dibenz[a,h]anthracene			0E+0	0E+0				NA	0.0E+0
			Ethylbenzene			3E-6	3E-6	Liver, Kidney			3.2E-2	3.2E-2
			Fluoranthene			NA	0E+0	Kidney, Liver, Blood			0.0E+0	0.0E+0
			Fluorene			NA	0E+0	Blood			0.0E+0	0.0E+0
			Indeno(1,2,3-cd)pyrene			0E+0	0E+0				NA	0.0E+0
			Isopropyl benzene			NA	0E+0	Kidney			1.8E-4	1.8E-4
			Methyl isobutyl ketone			0E+0	0E+0				1.4E-5	1.4E-5
			Methylene chloride			2E-7	2E-7	Liver			8.5E-4	8.5E-4
			MTBE			3E-9	3E-9				NA	0.0E+0
			n-Butylbenzene			NA	0E+0				0.0E+0	0.0E+0
			n-Propylbenzene			NA	0E+0				0.0E+0	0.0E+0

TABLE 9.14

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

TIER 2 REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Landscape Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater Industrial Use	Industrial Water	Industrial Water	Phenanthrene			NA	0E+0				NA	0.0E+0
			Pyrene			NA	0E+0	Kidney			0.0E+0	0.0E+0
			Styrene			NA	0E+0	Blood, Liver			2.8E-3	2.8E-3
			Toluene			NA	0E+0	Liver, Kidney, Respiratory			7.8E-3	7.8E-3
			Xylenes (total)			NA	0E+0	Whole Body			9.1E-3	9.1E-3
			Benzene (500 ft)			2E-5	2E-5				2.0E-1	2.0E-1
			Benzene (725 ft)			1E-5	1E-5				1.3E-1	1.3E-1
			Naphthalene (500 ft)			NA	0E+0	Respiratory			2.5E-1	2.5E-1
			Naphthalene (725 ft)			NA	0E+0	Respiratory			2.0E-1	2.0E-1
			Chemical Total (krig - 500 ft)			2E-5	2E-5				5.6E-1	5.6E-1
			Chemical Total (krig - 725 ft)			2E-5	2E-5				4.3E-1	4.3E-1
		Exposure Point Total	krig - 500 ft				2E-5					5.6E-1
		Exposure Point Total	krig - 725 ft				2E-5					4.3E-1
	Exposure Medium Total	krig - 500 ft					2E-5					5.6E-1
	Exposure Medium Total	krig - 725 ft					2E-5					4.3E-1
Groundwater Industrial Use	Workspace Air	Workspace Air	1,2,4-Trimethylbenzene		NA		0E+0			3E-3		2.6E-3
			1,2-Dichloroethane		9E-8		9E-8			4E-3		3.7E-3
			1,3,5-Trimethylbenzene		NA		0E+0			1E-3		1.4E-3
			Acenaphthene		NA		0E+0			NA		0.0E+0
			Acetone		NA		0E+0			NA		0.0E+0
			Anthracene		NA		0E+0			NA		0.0E+0
			Benzo[b]fluoranthene		2E-7		2E-7			NA		0.0E+0
			Carbon Disulfide		NA		0E+0	Peripheral Nervous System		2E-6		2.4E-6
			Chrysene		3E-8		3E-8			NA		0.0E+0
			Ethylbenzene		7E-8		7E-8	Developmental		2E-4		2.3E-4

TABLE 9.14
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
TIER 2 REASONABLE MAXIMUM EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Landscape Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater Industrial Use	Workspace Air	Workspace Air	Fluorene		NA		0E+0			NA		0.0E+0
			Isopropyl benzene		NA		0E+0	Kidney		5E-6		5.3E-6
			Methyl isobutyl ketone		0E+0		0E+0			1E-5		1.1E-5
			Methylene chloride		2E-8		2E-8			2E-5		2.3E-5
			MTBE		4E-10		4E-10	Liver, Kidney		2E-6		2.1E-6
			n-Butylbenzene		NA		0E+0			NA		0.0E+0
			n-Propylbenzene		NA		0E+0			NA		0.0E+0
			Pyrene		NA		0E+0			NA		0.0E+0
			Styrene		NA		0E+0	CNS		5E-5		5.5E-5
			Toluene		NA		0E+0	CNS, Respiratory		5E-4		5.1E-4
			Xylenes (total)		NA		0E+0	CNS		1E-3		1.3E-3
			Benzene (500 ft)		1E-6		1E-6			3E-2		2.8E-2
			Benzene (725 ft)		8E-7		8E-7			2E-2		1.9E-2
			Naphthalene (500 ft)		NA		0E+0	Respiratory		4E-1		3.8E-1
			Naphthalene (725 ft)		NA		0E+0	Respiratory		3E-1		2.9E-1
			Chemical Total (krig - 500 ft)		2E-6		2E-6			4.2E-1		4.2E-1
			Chemical Total (krig - 725 ft)		1E-6		1E-6			3.2E-1		3.2E-1
		Exposure Point Total	krig - 500 ft				2E-6					4.2E-1
		Exposure Point Total	krig - 725 ft				1E-6					3.2E-1
	Exposure Medium Total	krig - 500 ft					2E-6					4.2E-1
	Exposure Medium Total	krig - 725 ft					1E-6					3.2E-1
Medium Total	krig - 500 ft						3E-5					9.7E-1
Medium Total	krig - 725 ft						2E-5					7.5E-1
Receptor Total	krig - 500 ft						3E-3					9.7E+0
Receptor Total	krig - 725 ft						3E-3					8.6E+0

TABLE 9.15

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

TIER 2 CENTRAL EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: On-Site Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil Vapor	Indoor Air	Indoor Air	Chloroform		6E-9		6E-9			9E-6		8.9E-6
			Ethylbenzene		3E-8		3E-8	Developmental		3E-5		3.4E-5
			m,p-Xylene		NA		0E+0	CNS		5E-4		5.2E-4
			Naphthalene		NA		0E+0	Respiratory		7E-3		6.9E-3
			Tetrachloroethene (PCE)		4E-9		4E-9	Liver, Kidney		5E-5		4.7E-5
			Trichloroethene		3E-9		3E-9	CNS		6E-6		5.7E-6
		Alameda Annex	Benzene (Alameda Annex)		1E-6		1E-6			2E-3		1.6E-3
		Alameda Point - Site 25	Benzene (Alameda Point - Site 25)		4E-9		4E-9			6E-6		6.0E-6
		Alameda Point - Site 30	Benzene (Alameda Point - Site 30)		7E-9		7E-9			9E-6		9.2E-6
		Alameda Point - Site 31	Benzene (Alameda Point - Site 31)		3E-9		3E-9			5E-6		4.6E-6
			Chemical Total (Alameda Annex)		1E-6		1E-6			9.1E-3		9.1E-3
			Chemical Total (Alameda Point - Site 25)		5E-8		5E-8			7.6E-3		7.6E-3
			Chemical Total (Alameda Point - Site 30)		5E-8		5E-8			7.6E-3		7.6E-3
			Chemical Total (Alameda Point - Site 31)		5E-8		5E-8			7.6E-3		7.6E-3
		Exposure Point Total	(Alameda Annex)				1E-6					9.1E-3
		Exposure Point Total	(Alameda Point - Site 25)				5E-8					7.6E-3
		Exposure Point Total	(Alameda Point - Site 30)				5E-8					7.6E-3
		Exposure Point Total	(Alameda Point - Site 31)				5E-8					7.6E-3
	Exposure Medium Total	(Alameda Annex)					1E-6					9.1E-3
	Exposure Medium Total	(Alameda Point - Site 25)					5E-8					7.6E-3
	Exposure Medium Total	(Alameda Point - Site 30)					5E-8					7.6E-3
	Exposure Medium Total	(Alameda Point - Site 31)					5E-8					7.6E-3
Medium Total	(Alameda Annex)						1E-6					9.1E-3
Medium Total	(Alameda Point - Site 25)						5E-8					7.6E-3
Medium Total	(Alameda Point - Site 30)						5E-8					7.6E-3
Medium Total	(Alameda Point - Site 31)						5E-8					7.6E-3

TABLE 9.15

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

TIER 2 CENTRAL EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: On-Site Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Indoor Air	Indoor Air	1,2,4-Trimethylbenzene		NA		0E+0			8E-4		7.9E-4
			1,2-Dichloroethane		2E-7		2E-7			4E-3		3.5E-3
			1,3,5-Trimethylbenzene		NA		0E+0			1E-2		9.7E-3
			Acetone		NA		0E+0			8E-4		7.9E-4
			Carbon disulfide		NA		0E+0	eripheral Nervous System		7E-5		7.1E-5
			Ethylbenzene		7E-7		7E-7	Developmental		7E-4		7.5E-4
			Isopropyl benzene		NA		0E+0	Kidney		4E-5		4.1E-5
			Methyl isobutyl ketone		NA		0E+0			2E-5		1.7E-5
			Methylene chloride		7E-8		7E-8			4E-4		3.9E-4
			MTBE		8E-10		8E-10	Liver, Kidney		9E-7		8.7E-7
			Naphthalene		NA		0E+0	Respiratory		2E-1		2.2E-1
			n-Butylbenzene		NA		0E+0			4E-2		3.8E-2
			n-Propylbenzene		NA		0E+0			NA		0.0E+0
			Styrene		NA		0E+0	CNS		1E-4		1.3E-4
			Toluene		NA		0E+0	CNS, Respiratory		4E-3		3.9E-3
			Xylenes (total)		NA		0E+0	CNS		8E-4		8.2E-4
			Benzene (500 ft)		1E-5		1E-5			1E-2		1.5E-2
			Benzene (725 ft)		7E-6		7E-6			9E-3		9.5E-3
			Chemical Total (krig - 500 ft)		1E-5		1E-5			2.9E-1		2.9E-1
			Chemical Total (krig - 725 ft)		8E-6		8E-6			2.9E-1		2.9E-1
		Exposure Point Total	krig - 500 ft				1E-5					2.9E-1
		Exposure Point Total	krig - 725 ft				8E-6					2.9E-1
	Exposure Medium Total	krig - 500 ft					1E-5					2.9E-1
	Exposure Medium Total	krig - 725 ft					8E-6					2.9E-1
Medium Total	krig - 500 ft						1E-5					2.9E-1
Medium Total	krig - 725 ft						8E-6					2.9E-1

TABLE 9.15
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
TIER 2 CENTRAL EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: On-Site Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater[1] Potable Use	Potable Water	Potable Water	Aluminum	NA			0E+0		4.5E-2			4.5E-2
			Antimony	NA			0E+0	Whole Body, Blood	3.8E-2			3.8E-2
			Arsenic	7E-4			7E-4	Skin	2.3E+0			2.3E+0
			Barium	NA			0E+0	Kidney	8.9E-1			8.9E-1
			Beryllium	NA			0E+0	Small Intestine	2.9E-2			2.9E-2
			Cadmium	4E-6			4E-6	Kidney	2.1E-1			2.1E-1
			Chromium	NA			0E+0		2.3E-1			2.3E-1
			Cobalt	NA			0E+0		1.2E-2			1.2E-2
			Copper	NA			0E+0	GI System	8.8E-3			8.8E-3
			Iron	NA			0E+0		4.2E+0			4.2E+0
			Lead	NA			0E+0		NA			0.0E+0
			Manganese	NA			0E+0	CNS	5.6E-1			5.6E-1
			Mercury	NA			0E+0	Immune System	2.4E-2			2.4E-2
			Molybdenum	NA			0E+0	Blood	2.4E-1			2.4E-1
			Nickel	NA			0E+0	Body Weight	2.6E-2			2.6E-2
			Nitrate	NA			0E+0	Blood	1.4E-1			1.4E-1
			Selenium	NA			0E+0	Whole Body	8.3E-2			8.3E-2
			Silver	NA			0E+0	Skin	9.6E-2			9.6E-2
			Thallium	NA			0E+0	Liver, Blood, Hair	4.7E+0			4.7E+0
			Vanadium	NA			0E+0	Hair	9.1E-2			9.1E-2
			Zinc	NA			0E+0	Blood	1.2E-3			1.2E-3
			1,2,4-Trimethylbenzene	NA			0E+0		3.5E-2			3.5E-2
			1,2-Dichloroethane	8E-6			8E-6		5.3E-2			5.3E-2
			1,3,5-Trimethylbenzene	NA			0E+0		1.9E-2			1.9E-2
			Acenaphthene	NA			0E+0	Liver	1.2E-1			1.2E-1
			Acenaphthylene	NA			0E+0		NA			0.0E+0
			Acetone	NA			0E+0	Liver, Kidney	3.2E+0			3.2E+0

TABLE 9.15
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
TIER 2 CENTRAL EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: On-Site Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater[1] Potable Use	Potable Water	Potable Water	Anthracene	NA			0E+0	NOAEL	6.3E-3			6.3E-3
			Benzo[a]anthracene	1E-4			1E-4		NA			0.0E+0
			Benzo[a]pyrene	2E-3			2E-3		NA			0.0E+0
			Benzo[b]fluoranthene	1E-4			1E-4		NA			0.0E+0
			Benzo[g,h,I]perylene	NA			0E+0		NA			0.0E+0
			Benzo[k]fluoranthene	6E-5			6E-5		NA			0.0E+0
			Carbon Disulfide	NA			0E+0	Reproductive/ Teratogenic	1.5E-3			1.5E-3
			Chrysene	2E-5			2E-5		NA			0.0E+0
			Dibenz[a,h]anthracene	4E-5			4E-5		NA			0.0E+0
			Ethylbenzene	1E-5			1E-5	Liver, Kidney	2.6E-1			2.6E-1
			Fluoranthene	NA			0E+0	Kidney, Liver, Blood	2.2E-1			2.2E-1
			Fluorene	NA			0E+0	Blood	5.6E-2			5.6E-2
			Indeno(1,2,3-cd)pyrene	2E-4			2E-4		NA			0.0E+0
			Isopropyl benzene	NA			0E+0	Kidney	2.4E-3			2.4E-3
			Methyl isobutyl ketone	0E+0			0E+0		1.4E-3			1.4E-3
			Methylene chloride	8E-6			8E-6	Liver	9.6E-2			9.6E-2
			MTBE	1E-7			1E-7		NA			0.0E+0
			n-Butylbenzene	NA			0E+0		1.4E+0			1.4E+0
			n-Propylbenzene	NA			0E+0		8.8E-3			8.8E-3
			Phenanthrene	NA			0E+0		NA			0.0E+0
			Pyrene	NA			0E+0	Kidney	2.1E-1			2.1E-1
			Styrene	NA			0E+0	Blood, Liver	3.0E-2			3.0E-2
			Toluene	NA			0E+0	Liver, Kidney, Respiratory	9.9E-2			9.9E-2
			Xylenes (total)	NA			0E+0	Whole Body	6.8E-2			6.8E-2
			Benzene (500 ft)	2E-4			2E-4		5.3E+0			5.3E+0
			Benzene (725 ft)	1E-4			1E-4		3.4E+0			3.4E+0
			Naphthalene (500 ft)	NA			0E+0	Respiratory	6.7E+0			6.7E+0
			Naphthalene (725 ft)	NA			0E+0	Respiratory	5.2E+0			5.2E+0

TABLE 9.15
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
TIER 2 CENTRAL EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: On-Site Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater[1] Potable Use	Potable Water	Potable Water	Chemical Total (krig - 500 ft)	4E-3			4E-3		3.2E+1			3.2E+1
			Chemical Total (krig - 725 ft)	4E-3			4E-3		2.8E+1			2.8E+1
		Exposure Point Total	krig - 500 ft				4E-3					2.8E+1
		Exposure Point Total	krig - 725 ft				4E-3					2.8E+1
	Exposure Medium Total	krig - 500 ft					4E-3					2.8E+1
	Exposure Medium Total	krig - 725 ft					4E-3					2.8E+1
	Indoor Air	Indoor Air	1,2,4-Trimethylbenzene		NA		0E+0			6E+0		5.8E+0
			1,2-Dichloroethane		7E-5		7E-5			6E+0		6.3E+0
			1,3,5-Trimethylbenzene		NA		0E+0			3E+0		3.0E+0
			Acenaphthene		NA		0E+0			NA		0.0E+0
			Acetone		NA		0E+0			NA		0.0E+0
			Anthracene		NA		0E+0			NA		0.0E+0
			Benzo[b]fluoranthene		2E-4		2E-4			NA		0.0E+0
			Carbon Disulfide		NA		0E+0	eripheral Nervous System		4E-3		4.3E-3
			Chrysene		3E-5		3E-5			NA		0.0E+0
			Ethylbenzene		6E-5		6E-5	Developmental		5E-1		4.9E-1
			Fluorene		NA		0E+0			NA		0.0E+0
			Isopropyl benzene		NA		0E+0	Kidney		1E-2		1.2E-2
			Methyl isobutyl ketone		0E+0		0E+0			3E-2		2.7E-2
			Methylene chloride		1E-5		1E-5			4E-2		3.7E-2
			MTBE		3E-7		3E-7	Liver, Kidney		4E-3		3.9E-3
			n-Butylbenzene		NA		0E+0			NA		0.0E+0
			n-Propylbenzene		NA		0E+0			NA		0.0E+0
			Pyrene		NA		0E+0			NA		0.0E+0
			Styrene		NA		0E+0	CNS		1E-1		1.1E-1
			Toluene		NA		0E+0	CNS, Respiratory		1E+0		1.0E+0

TABLE 9.15

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

TIER 2 CENTRAL EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: On-Site Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater[1] Potable Use	Indoor Air	Indoor Air	Xylenes (total)		NA		0E+0	CNS		3E+0		2.6E+0
			Benzene (500 ft)		9E-4		9E-4			3E+1		2.9E+1
			Benzene (725 ft)		6E-4		6E-4			2E+1		1.9E+1
			Naphthalene (500 ft)		NA		0E+0	Respiratory		4E+0		3.7E+0
			Naphthalene (725 ft)		NA		0E+0	Respiratory		3E+0		2.8E+0
			Chemical Total (krig - 500 ft)		1E-3		1E-3			5.2E+1		5.2E+1
			Chemical Total (krig - 725 ft)		1E-3		1E-3			4.1E+1		4.1E+1
		Exposure Point Total	krig - 500 ft				1E-3					5.2E+1
		Exposure Point Total	krig - 725 ft				1E-3					4.1E+1
	Exposure Medium Total	krig - 500 ft					1E-3					5.2E+1
	Exposure Medium Total	krig - 725 ft					1E-3					4.1E+1
Medium Total	krig - 500 ft						5E-3					8.1E+1
Medium Total	krig - 725 ft						5E-3					7.0E+1
Current Receptor Total (Inhalation via Soil Vapor at Alameda Annex)							1E-6					9.1E-3
Current Receptor Total (Inhalation via Soil Vapor at Alameda Point - Site 25)							5E-8					7.6E-3
Current Receptor Total (Inhalation via Soil Vapor at Alameda Point - Site 30)							5E-8					7.6E-3
Current Receptor Total (Inhalation via Soil Vapor at Alameda Point - Site 31)							5E-8					7.6E-3
Current Receptor Total (Inhalation via Groundwater) krig - 500 ft							1E-5					2.9E-1
Current Receptor Total (Inhalation via Groundwater) krig - 725 ft							8E-6					2.9E-1
Future Receptor Total (Potable Water Use (krig - 500 ft) + Inhalation via Soil Vapor at Alameda Annex)							5E-3					8.1E+1
Future Receptor Total (Potable Water Use (krig - 500 ft) + Inhalation via Soil Vapor at Alameda Point - Site 25)							5E-3					7.0E+1
Future Receptor Total (Potable Water Use (krig - 500 ft) + Inhalation via Soil Vapor at Alameda Point - Site 30)							1E-6					1.7E-2
Future Receptor Total (Potable Water Use (krig - 500 ft) + Inhalation via Soil Vapor at Alameda Point - Site 31)							1E-7					1.5E-2
Future Receptor Total (Potable Water Use (krig - 725 ft) + Inhalation via Soil Vapor at Alameda Annex)							5E-3					7.0E+1
Future Receptor Total (Potable Water Use (krig - 725 ft) + Inhalation via Soil Vapor at Alameda Point - Site 25)							1E-6					1.7E-2
Future Receptor Total (Potable Water Use (krig - 725 ft) + Inhalation via Soil Vapor at Alameda Point - Site 30)							1E-7					1.5E-2

TABLE 9.15

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

TIER 2 CENTRAL EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: On-Site Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Future Receptor Total (Potable Water Use (krig - 725 ft) + Inhalation via Soil Vapor at Alameda Point - Site 31)							1E-7					1.5E-2
Future Receptor Total (Potable Water Use + Inhalation via Groundwater) krig - 500 ft							5E-3					8.1E+1
Future Receptor Total (Potable Water Use + Inhalation via Groundwater) krig - 725 ft							5E-3					7.0E+1

[1] - Groundwater potable use is a future use scenario.

TABLE 9.16

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

TIER 2 REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: On-Site Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil Vapor	Indoor Air	Indoor Air	Chloroform		6E-9		6E-9			9E-6		8.9E-6
			Ethylbenzene		3E-8		3E-8	Developmental		3E-5		3.4E-5
			m,p-Xylene		NA		0E+0	CNS		5E-4		5.2E-4
			Naphthalene		NA		0E+0	Respiratory		7E-3		6.9E-3
			Tetrachloroethene (PCE)		4E-9		4E-9	Liver, Kidney		5E-5		4.7E-5
			Trichloroethene		3E-9		3E-9	CNS		6E-6		5.7E-6
		Alameda Annex	Benzene (Alameda Annex)		1E-6		1E-6			2E-3		1.6E-3
		Alameda Point - Site 25	Benzene (Alameda Point - Site 25)		4E-9		4E-9			6E-6		6.0E-6
		Alameda Point - Site 30	Benzene (Alameda Point - Site 30)		7E-9		7E-9			9E-6		9.2E-6
		Alameda Point - Site 31	Benzene (Alameda Point - Site 31)		3E-9		3E-9			5E-6		4.6E-6
			Chemical Total (Alameda Annex)		1E-6		1E-6			9.1E-3		9.1E-3
			Chemical Total (Alameda Point - Site 25)		5E-8		5E-8			7.6E-3		7.6E-3
			Chemical Total (Alameda Point - Site 30)		5E-8		5E-8			7.6E-3		7.6E-3
			Chemical Total (Alameda Point - Site 31)		5E-8		5E-8			7.6E-3		7.6E-3
		Exposure Point Total	(Alameda Annex)				1E-6					9.1E-3
		Exposure Point Total	(Alameda Point - Site 25)				5E-8					7.6E-3
		Exposure Point Total	(Alameda Point - Site 30)				5E-8					7.6E-3
		Exposure Point Total	(Alameda Point - Site 31)				5E-8					7.6E-3
	Exposure Medium Total	(Alameda Annex)					1E-6					9.1E-3
	Exposure Medium Total	(Alameda Point - Site 25)					5E-8					7.6E-3
	Exposure Medium Total	(Alameda Point - Site 30)					5E-8					7.6E-3
	Exposure Medium Total	(Alameda Point - Site 31)					5E-8					7.6E-3
Medium Total	(Alameda Annex)						1E-6					9.1E-3
Medium Total	(Alameda Point - Site 25)						5E-8					7.6E-3
Medium Total	(Alameda Point - Site 30)						5E-8					7.6E-3
Medium Total	(Alameda Point - Site 31)						5E-8					7.6E-3

TABLE 9.16
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
TIER 2 REASONABLE MAXIMUM EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: On-Site Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Indoor Air	Indoor Air	1,2,4-Trimethylbenzene		NA		0E+0			8E-4		7.9E-4
			1,2-Dichloroethane		2E-7		2E-7			4E-3		3.5E-3
			1,3,5-Trimethylbenzene		NA		0E+0			1E-2		9.7E-3
			Acetone		NA		0E+0			8E-4		7.9E-4
			Carbon disulfide		NA		0E+0	Peripheral Nervous System		7E-5		7.1E-5
			Ethylbenzene		7E-7		7E-7	Developmental		7E-4		7.5E-4
			Isopropyl benzene		NA		0E+0	Kidney		4E-5		4.1E-5
			Methyl isobutyl ketone		NA		0E+0			2E-5		1.7E-5
			Methylene chloride		7E-8		7E-8			4E-4		3.9E-4
			MTBE		8E-10		8E-10	Liver, Kidney		9E-7		8.7E-7
			Naphthalene		NA		0E+0	Respiratory		2E-1		2.2E-1
			n-Butylbenzene		NA		0E+0			4E-2		3.8E-2
			n-Propylbenzene		NA		0E+0			NA		0.0E+0
			Styrene		NA		0E+0	CNS		1E-4		1.3E-4
			Toluene		NA		0E+0	CNS, Respiratory		4E-3		3.9E-3
			Xylenes (total)		NA		0E+0	CNS		8E-4		8.2E-4
			Benzene (500 ft)		1E-5		1E-5			1E-2		1.5E-2
			Benzene (725 ft)		7E-6		7E-6			9E-3		9.5E-3
			Chemical Total (krig - 500 ft)		1E-5		1E-5			2.9E-1		2.9E-1
			Chemical Total (krig - 725 ft)		8E-6		8E-6			2.9E-1		2.9E-1
		Exposure Point Total	krig - 500 ft				1E-5					2.9E-1
		Exposure Point Total	krig - 725 ft				8E-6					2.9E-1
	Exposure Medium Total	krig - 500 ft					1E-5					2.9E-1
	Exposure Medium Total	krig - 725 ft					8E-6					2.9E-1
Medium Total	krig - 500 ft						1E-5					2.9E-1
Medium Total	krig - 725 ft						8E-6					2.9E-1

TABLE 9.16
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
TIER 2 REASONABLE MAXIMUM EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: On-Site Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater[1] Potable Use	Potable Water	Potable Water	Aluminum	NA			0E+0		8.9E-2			8.9E-2
			Antimony	NA			0E+0	Whole Body, Blood	7.7E-2			7.7E-2
			Arsenic	3E-3			3E-3	Skin	4.7E+0			4.7E+0
			Barium	NA			0E+0	Kidney	1.8E+0			1.8E+0
			Beryllium	NA			0E+0	Small Intestine	5.8E-2			5.8E-2
			Cadmium	2E-5			2E-5	Kidney	4.1E-1			4.1E-1
			Chromium	NA			0E+0		4.7E-1			4.7E-1
			Cobalt	NA			0E+0		2.4E-2			2.4E-2
			Copper	NA			0E+0	GI System	1.8E-2			1.8E-2
			Iron	NA			0E+0		8.5E+0			8.5E+0
			Lead	NA			0E+0		NA			0.0E+0
			Manganese	NA			0E+0	CNS	1.1E+0			1.1E+0
			Mercury	NA			0E+0	Immune System	4.7E-2			4.7E-2
			Molybdenum	NA			0E+0	Blood	4.8E-1			4.8E-1
			Nickel	NA			0E+0	Body Weight	5.1E-2			5.1E-2
			Nitrate	NA			0E+0	Blood	2.8E-1			2.8E-1
			Selenium	NA			0E+0	Whole Body	1.7E-1			1.7E-1
			Silver	NA			0E+0	Skin	1.9E-1			1.9E-1
			Thallium	NA			0E+0	Liver, Blood, Hair	9.3E+0			9.3E+0
			Vanadium	NA			0E+0	Hair	1.8E-1			1.8E-1
			Zinc	NA			0E+0	Blood	2.3E-3			2.3E-3
			1,2,4-Trimethylbenzene	NA			0E+0		7.0E-2			7.0E-2
			1,2-Dichloroethane	3E-5			3E-5		1.1E-1			1.1E-1
			1,3,5-Trimethylbenzene	NA			0E+0		3.7E-2			3.7E-2
			Acenaphthene	NA			0E+0	Liver	2.3E-1			2.3E-1
			Acenaphthylene	NA			0E+0		NA			0.0E+0
			Acetone	NA			0E+0	Liver, Kidney	6.4E+0			6.4E+0

TABLE 9.16
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
TIER 2 REASONABLE MAXIMUM EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: On-Site Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
			Anthracene	NA			0E+0	NOAEL	1.3E-2			1.3E-2
Groundwater[1] Potable Use	Potable Water	Potable Water	Benzo[a]anthracene	5E-4			5E-4		NA			0.0E+0
			Benzo[a]pyrene	1E-2			1E-2		NA			0.0E+0
			Benzo[b]fluoranthene	5E-4			5E-4		NA			0.0E+0
			Benzo[g,h,i]perylene	NA			0E+0		NA			0.0E+0
			Benzo[k]fluoranthene	2E-4			2E-4		NA			0.0E+0
			Carbon Disulfide	NA			0E+0	Reproductive/ Teratogenic	3.1E-3			3.1E-3
			Chrysene	8E-5			8E-5		NA			0.0E+0
			Dibenz[a,h]anthracene	2E-4			2E-4		NA			0.0E+0
			Ethylbenzene	5E-5			5E-5	Liver, Kidney	5.1E-1			5.1E-1
			Fluoranthene	NA			0E+0	Kidney, Liver, Blood	4.5E-1			4.5E-1
			Fluorene	NA			0E+0	Blood	1.1E-1			1.1E-1
			Indeno(1,2,3-cd)pyrene	8E-4			8E-4		NA			0.0E+0
			Isopropyl benzene	NA			0E+0	Kidney	4.7E-3			4.7E-3
			Methyl isobutyl ketone	0E+0			0E+0		2.8E-3			2.8E-3
			Methylene chloride	4E-5			4E-5	Liver	1.9E-1			1.9E-1
			MTBE	5E-7			5E-7		NA			0.0E+0
			n-Butylbenzene	NA			0E+0		2.9E+0			2.9E+0
			n-Propylbenzene	NA			0E+0		1.8E-2			1.8E-2
			Phenanthrene	NA			0E+0		NA			0.0E+0
			Pyrene	NA			0E+0	Kidney	4.3E-1			4.3E-1
			Styrene	NA			0E+0	Blood, Liver	5.9E-2			5.9E-2
			Toluene	NA			0E+0	Liver, Kidney, Respiratory	2.0E-1			2.0E-1
			Xylenes (total)	NA			0E+0	Whole Body	1.4E-1			1.4E-1
			Benzene (500 ft)	7E-4			7E-4		1.1E+1			1.1E+1
			Benzene (725 ft)	5E-4			5E-4		6.9E+0			6.9E+0
			Naphthalene (500 ft)	NA			0E+0	Respiratory	1.3E+1			1.3E+1
			Naphthalene (725 ft)	NA			0E+0	Respiratory	1.0E+1			1.0E+1

TABLE 9.16
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
TIER 2 REASONABLE MAXIMUM EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: On-Site Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater[1] Potable Use	Potable Water	Potable Water	Chemical Total (krig - 500 ft)	2E-2			2E-2		6.4E+1			6.4E+1
			Chemical Total (krig - 725 ft)	2E-2			2E-2		5.7E+1			5.7E+1
		Exposure Point Total	krig - 500 ft				2E-2					5.7E+1
		Exposure Point Total	krig - 725 ft				2E-2					5.7E+1
	Exposure Medium Total	krig - 500 ft					2E-2					5.7E+1
	Exposure Medium Total	krig - 725 ft					2E-2					5.7E+1
	Indoor Air	Indoor Air	1,2,4-Trimethylbenzene		NA		0E+0			8E+0		7.8E+0
			1,2-Dichloroethane		7E-5		7E-5			6E+0		6.3E+0
			1,3,5-Trimethylbenzene		NA		0E+0			3E+0		3.0E+0
			Acenaphthene		NA		0E+0			NA		0.0E+0
			Acetone		NA		0E+0			NA		0.0E+0
			Anthracene		NA		0E+0			NA		0.0E+0
			Benzo[b]fluoranthene		2E-4		2E-4			NA		0.0E+0
			Carbon Disulfide		NA		0E+0	Peripheral Nervous System		4E-3		4.3E-3
			Chrysene		3E-5		3E-5			NA		0.0E+0
			Ethylbenzene		6E-5		6E-5	Developmental		5E-1		4.9E-1
			Fluorene		NA		0E+0			NA		0.0E+0
			Isopropyl benzene		NA		0E+0	Kidney		1E-2		1.2E-2
			Methyl isobutyl ketone		0E+0		0E+0			3E-2		2.7E-2
			Methylene chloride		1E-5		1E-5			4E-2		3.7E-2
			MTBE		3E-7		3E-7	Liver, Kidney		4E-3		3.9E-3
			n-Butylbenzene		NA		0E+0			NA		0.0E+0
			n-Propylbenzene		NA		0E+0			NA		0.0E+0
			Pyrene		NA		0E+0			NA		0.0E+0
			Styrene		NA		0E+0	CNS		1E-1		1.1E-1
			Toluene		NA		0E+0	CNS, Respiratory		1E+0		1.0E+0

TABLE 9.16

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

TIER 2 REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: On-Site Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater[1] Potable Use	Indoor Air	Indoor Air	Xylenes (total)		NA		0E+0	CNS		3E+0		2.6E+0
			Benzene (500 ft)		9E-4		9E-4			3E+1		2.9E+1
			Benzene (725 ft)		6E-4		6E-4			2E+1		1.9E+1
			Naphthalene (500 ft)		NA		0E+0	Respiratory		4E+0		3.7E+0
			Naphthalene (725 ft)		NA		0E+0	Respiratory		3E+0		2.8E+0
			Chemical Total (krig - 500 ft)		1E-3		1E-3			5.4E+1		5.4E+1
			Chemical Total (krig - 725 ft)		1E-3		1E-3			4.3E+1		4.3E+1
		Exposure Point Total	krig - 500 ft				1E-3					5.4E+1
		Exposure Point Total	krig - 725 ft				1E-3					4.3E+1
	Exposure Medium Total	krig - 500 ft					1E-3					5.4E+1
	Exposure Medium Total	krig - 725 ft					1E-3					4.3E+1
Medium Total	krig - 500 ft						2E-2					1.1E+2
Medium Total	krig - 725 ft						2E-2					1.0E+2
Current Receptor Total (Inhalation via Soil Vapor at Alameda Annex)							1E-6					9.1E-3
Current Receptor Total (Inhalation via Soil Vapor at Alameda Point - Site 25)							5E-8					7.6E-3
Current Receptor Total (Inhalation via Soil Vapor at Alameda Point - Site 30)							5E-8					7.6E-3
Current Receptor Total (Inhalation via Soil Vapor at Alameda Point - Site 31)							5E-8					7.6E-3
Current Receptor Total (Inhalation via Groundwater) krig - 500 ft							1E-5					2.9E-1
Current Receptor Total (Inhalation via Groundwater) krig - 725 ft							8E-6					2.9E-1
Future Receptor Total (Potable Water Use (krig - 500 ft) + Inhalation via Soil Vapor at Alameda Annex)							2E-2					1.1E+2
Future Receptor Total (Potable Water Use (krig - 500 ft) + Inhalation via Soil Vapor at Alameda Point - Site 25)							2E-2					1.0E+2
Future Receptor Total (Potable Water Use (krig - 500 ft) + Inhalation via Soil Vapor at Alameda Point - Site 30)							1E-6					1.7E-2
Future Receptor Total (Potable Water Use (krig - 500 ft) + Inhalation via Soil Vapor at Alameda Point - Site 31)							1E-7					1.5E-2
Future Receptor Total (Potable Water Use (krig - 725 ft) + Inhalation via Soil Vapor at Alameda Annex)							2E-2					1.0E+2
Future Receptor Total (Potable Water Use (krig - 725 ft) + Inhalation via Soil Vapor at Alameda Point - Site 25)							1E-6					1.7E-2
Future Receptor Total (Potable Water Use (krig - 725 ft) + Inhalation via Soil Vapor at Alameda Point - Site 30)							1E-7					1.5E-2

TABLE 9.16

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

TIER 2 REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: On-Site Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Future Receptor Total (Potable Water Use (krig - 725 ft) + Inhalation via Soil Vapor at Alameda Point - Site 31)							1E-7					1.5E-2
Future Receptor Total (Potable Water Use + Inhalation via Groundwater) krig - 500 ft							2E-2					1.1E+2
Future Receptor Total (Potable Water Use + Inhalation via Groundwater) krig - 725 ft							2E-2					1.0E+2

[1] - Groundwater potable use is a future use scenario.

TABLE 9.17

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

TIER 2 CENTRAL EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: School Student
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil Vapor	Indoor Air	Indoor Air	Chloroform		6E-9		6E-9			9E-6		8.9E-6
			Ethylbenzene		3E-8		3E-8	Developmental		3E-5		3.4E-5
			m,p-Xylene		NA		0E+0	CNS		5E-4		5.2E-4
			Naphthalene		NA		0E+0	Respiratory		7E-3		6.9E-3
			Tetrachloroethene (PCE)		4E-9		4E-9	Liver, Kidney		5E-5		4.7E-5
			Trichloroethene		3E-9		3E-9	CNS		6E-6		5.7E-6
		Alameda Annex	Benzene (Alameda Annex)		1E-7		1E-7			8E-4		8.1E-4
		Alameda Point - Site 25	Benzene (Alameda Point - Site 25)		4E-10		4E-10			3E-6		3.0E-6
		Alameda Point - Site 30	Benzene (Alameda Point - Site 30)		7E-10		7E-10			5E-6		4.7E-6
		Alameda Point - Site 31	Benzene (Alameda Point - Site 31)		3E-10		3E-10			2E-6		2.3E-6
			Chemical Total (Alameda Annex)		2E-7		2E-7			8.4E-3		8.4E-3
			Chemical Total (Alameda Point - Site 25)		5E-8		5E-8			7.6E-3		7.6E-3
			Chemical Total (Alameda Point - Site 30)		5E-8		5E-8			7.6E-3		7.6E-3
			Chemical Total (Alameda Point - Site 31)		5E-8		5E-8			7.6E-3		7.6E-3
		Exposure Point Total	(Alameda Annex)				2E-7					8.4E-3
		Exposure Point Total	(Alameda Point - Site 25)				5E-8					7.6E-3
		Exposure Point Total	(Alameda Point - Site 30)				5E-8					7.6E-3
		Exposure Point Total	(Alameda Point - Site 31)				5E-8					7.6E-3
	Exposure Medium Total	(Alameda Annex)					2E-7					8.4E-3
	Exposure Medium Total	(Alameda Point - Site 25)					5E-8					7.6E-3
	Exposure Medium Total	(Alameda Point - Site 30)					5E-8					7.6E-3
	Exposure Medium Total	(Alameda Point - Site 31)					5E-8					7.6E-3
Medium Total	(Alameda Annex)						2E-7					8.4E-3
Medium Total	(Alameda Point - Site 25)						5E-8					7.6E-3
Medium Total	(Alameda Point - Site 30)						5E-8					7.6E-3
Medium Total	(Alameda Point - Site 31)						5E-8					7.6E-3

TABLE 9.17

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

TIER 2 CENTRAL EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: School Student
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Indoor Air	Indoor Air	1,2,4-Trimethylbenzene		NA		0E+0			8E-4		7.9E-4
			1,2-Dichloroethane		2E-7		2E-7			4E-3		3.5E-3
			1,3,5-Trimethylbenzene		NA		0E+0			1E-2		9.7E-3
			Acetone		NA		0E+0			8E-4		7.9E-4
			Carbon disulfide		NA		0E+0	eripheral Nervous System		7E-5		7.1E-5
			Ethylbenzene		7E-7		7E-7	Developmental		7E-4		7.5E-4
			Isopropyl benzene		NA		0E+0	Kidney		4E-5		4.1E-5
			Methyl isobutyl ketone		NA		0E+0			2E-5		1.7E-5
			Methylene chloride		7E-8		7E-8			4E-4		3.9E-4
			MTBE		8E-10		8E-10	Liver, Kidney		9E-7		8.7E-7
			Naphthalene		NA		0E+0	Respiratory		2E-1		2.2E-1
			n-Butylbenzene		NA		0E+0			4E-2		3.8E-2
			n-Propylbenzene		NA		0E+0			NA		0.0E+0
			Styrene		NA		0E+0	CNS		1E-4		1.3E-4
			Toluene		NA		0E+0	CNS, Respiratory		4E-3		3.9E-3
			Xylenes (total)		NA		0E+0	CNS		8E-4		8.2E-4
			Benzene (500 ft)		1E-6		1E-6			7E-3		7.5E-3
			Benzene (725 ft)		7E-7		7E-7			5E-3		4.9E-3
			Chemical Total (krig - 500 ft)		2E-6		2E-6			2.9E-1		2.9E-1
			Chemical Total (krig - 725 ft)		2E-6		2E-6			2.9E-1		2.9E-1
		Exposure Point Total	krig - 500 ft				2E-6					2.9E-1
		Exposure Point Total	krig - 725 ft				2E-6					2.9E-1
	Exposure Medium Total	krig - 500 ft					2E-6					2.9E-1
	Exposure Medium Total	krig - 725 ft					2E-6					2.9E-1

TABLE 9.17

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

TIER 2 CENTRAL EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: School Student
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Medium Total	krig - 500 ft						2E-6					2.9E-1
Medium Total	krig - 725 ft						2E-6					2.9E-1
Receptor Total (Inhalation via Soil Vapor at Alameda Annex)							2E-7					8.4E-3
Receptor Total (Inhalation via Soil Vapor at Alameda Point - Site 25)							5E-8					7.6E-3
Receptor Total (Inhalation via Soil Vapor at Alameda Point - Site 30)							5E-8					7.6E-3
Receptor Total (Inhalation via Soil Vapor at Alameda Point - Site 31)							5E-8					7.6E-3
Receptor Total (Inhalation via Groundwater) krig - 500 ft							2E-6					2.9E-1
Receptor Total (Inhalation via Groundwater) krig - 725 ft							2E-6					2.9E-1

TABLE 9.18

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

TIER 2 REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: School Student
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil Vapor	Indoor Air	Indoor Air	Chloroform		6E-9		6E-9			9E-6		8.9E-6
			Ethylbenzene		3E-8		3E-8	Developmental		3E-5		3.4E-5
			m,p-Xylene		NA		0E+0	CNS		5E-4		5.2E-4
			Naphthalene		NA		0E+0	Respiratory		7E-3		6.9E-3
			Tetrachloroethene (PCE)		4E-9		4E-9	Liver, Kidney		5E-5		4.7E-5
			Trichloroethene		3E-9		3E-9	CNS		6E-6		5.7E-6
		Alameda Annex	Benzene (Alameda Annex)		1E-7		1E-7			8E-4		8.1E-4
		Alameda Point - Site 25	Benzene (Alameda Point - Site 25)		4E-10		4E-10			3E-6		3.0E-6
		Alameda Point - Site 30	Benzene (Alameda Point - Site 30)		7E-10		7E-10			5E-6		4.7E-6
		Alameda Point - Site 31	Benzene (Alameda Point - Site 31)		3E-10		3E-10			2E-6		2.3E-6
			Chemical Total (Alameda Annex)		2E-7		2E-7			8.4E-3		8.4E-3
			Chemical Total (Alameda Point - Site 25)		5E-8		5E-8			7.6E-3		7.6E-3
			Chemical Total (Alameda Point - Site 30)		5E-8		5E-8			7.6E-3		7.6E-3
			Chemical Total (Alameda Point - Site 31)		5E-8		5E-8			7.6E-3		7.6E-3
		Exposure Point Total	(Alameda Annex)				2E-7					8.4E-3
		Exposure Point Total	(Alameda Point - Site 25)				5E-8					7.6E-3
		Exposure Point Total	(Alameda Point - Site 30)				5E-8					7.6E-3
		Exposure Point Total	(Alameda Point - Site 31)				5E-8					7.6E-3
	Exposure Medium Total	(Alameda Annex)					2E-7					8.4E-3
	Exposure Medium Total	(Alameda Point - Site 25)					5E-8					7.6E-3
	Exposure Medium Total	(Alameda Point - Site 30)					5E-8					7.6E-3
	Exposure Medium Total	(Alameda Point - Site 31)					5E-8					7.6E-3
Medium Total	(Alameda Annex)						2E-7					8.4E-3
Medium Total	(Alameda Point - Site 25)						5E-8					7.6E-3
Medium Total	(Alameda Point - Site 30)						5E-8					7.6E-3
Medium Total	(Alameda Point - Site 31)						5E-8					7.6E-3

TABLE 9.18

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

TIER 2 REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: School Student
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Indoor Air	Indoor Air	1,2,4-Trimethylbenzene		NA		0E+0			8E-4		7.9E-4
			1,2-Dichloroethane		2E-7		2E-7			4E-3		3.5E-3
			1,3,5-Trimethylbenzene		NA		0E+0			1E-2		9.7E-3
			Acetone		NA		0E+0			8E-4		7.9E-4
			Carbon disulfide		NA		0E+0	Peripheral Nervous System		7E-5		7.1E-5
			Ethylbenzene		7E-7		7E-7	Developmental		7E-4		7.5E-4
			Isopropyl benzene		NA		0E+0	Kidney		4E-5		4.1E-5
			Methyl isobutyl ketone		NA		0E+0			2E-5		1.7E-5
			Methylene chloride		7E-8		7E-8			4E-4		3.9E-4
			MTBE		8E-10		8E-10	Liver, Kidney		9E-7		8.7E-7
			Naphthalene		NA		0E+0	Respiratory		2E-1		2.2E-1
			n-Butylbenzene		NA		0E+0			4E-2		3.8E-2
			n-Propylbenzene		NA		0E+0			NA		0.0E+0
			Styrene		NA		0E+0	CNS		1E-4		1.3E-4
			Toluene		NA		0E+0	CNS, Respiratory		4E-3		3.9E-3
			Xylenes (total)		NA		0E+0	CNS		8E-4		8.2E-4
			Benzene (500 ft)		1E-6		1E-6			7E-3		7.5E-3
			Benzene (725 ft)		7E-7		7E-7			5E-3		4.9E-3
			Chemical Total (krig - 500 ft)		2E-6		2E-6			2.9E-1		2.9E-1
			Chemical Total (krig - 725 ft)		2E-6		2E-6			2.9E-1		2.9E-1
		Exposure Point Total	krig - 500 ft				2E-6					2.9E-1
		Exposure Point Total	krig - 725 ft				2E-6					2.9E-1
	Exposure Medium Total	krig - 500 ft					2E-6					2.9E-1
	Exposure Medium Total	krig - 725 ft					2E-6					2.9E-1

TABLE 9.18

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

TIER 2 REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: School Student
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Medium Total	krig - 500 ft						2E-6					2.9E-1
Medium Total	krig - 725 ft						2E-6					2.9E-1
Receptor Total (Inhalation via Soil Vapor at Alameda Annex)							2E-7					8.4E-3
Receptor Total (Inhalation via Soil Vapor at Alameda Point - Site 25)							5E-8					7.6E-3
Receptor Total (Inhalation via Soil Vapor at Alameda Point - Site 30)							5E-8					7.6E-3
Receptor Total (Inhalation via Soil Vapor at Alameda Point - Site 31)							5E-8					7.6E-3
Receptor Total (Inhalation via Groundwater) krig - 500 ft							2E-6					2.9E-1
Receptor Total (Inhalation via Groundwater) krig - 725 ft							2E-6					2.9E-1

TABLE 9.19

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

TIER 2 CENTRAL EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: School Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil Vapor	Indoor Air	Indoor Air	Chloroform		6E-9		6E-9			9E-6		8.9E-6
			Ethylbenzene		3E-8		3E-8	Developmental		3E-5		3.4E-5
			m,p-Xylene		NA		0E+0	CNS		5E-4		5.2E-4
			Naphthalene		NA		0E+0	Respiratory		7E-3		6.9E-3
			Tetrachloroethene (PCE)		4E-9		4E-9	Liver, Kidney		5E-5		4.7E-5
			Trichloroethene		3E-9		3E-9	CNS		6E-6		5.7E-6
		Alameda Annex	Benzene (Alameda Annex)		7E-7		7E-7			1E-3		1.1E-3
		Alameda Point - Site 25	Benzene (Alameda Point - Site 25)		3E-9		3E-9			4E-6		4.2E-6
		Alameda Point - Site 30	Benzene (Alameda Point - Site 30)		4E-9		4E-9			7E-6		6.5E-6
		Alameda Point - Site 31	Benzene (Alameda Point - Site 31)		2E-9		2E-9			3E-6		3.3E-6
			Chemical Total (Alameda Annex)		8E-7		8E-7			8.7E-3		8.7E-3
			Chemical Total (Alameda Point - Site 25)		5E-8		5E-8			7.6E-3		7.6E-3
			Chemical Total (Alameda Point - Site 30)		5E-8		5E-8			7.6E-3		7.6E-3
			Chemical Total (Alameda Point - Site 31)		5E-8		5E-8			7.6E-3		7.6E-3
		Exposure Point Total	(Alameda Annex)				8E-7					8.7E-3
		Exposure Point Total	(Alameda Point - Site 25)				5E-8					7.6E-3
		Exposure Point Total	(Alameda Point - Site 30)				5E-8					7.6E-3
		Exposure Point Total	(Alameda Point - Site 31)				5E-8					7.6E-3
	Exposure Medium Total	(Alameda Annex)					8E-7					8.7E-3
	Exposure Medium Total	(Alameda Point - Site 25)					5E-8					7.6E-3
	Exposure Medium Total	(Alameda Point - Site 30)					5E-8					7.6E-3
	Exposure Medium Total	(Alameda Point - Site 31)					5E-8					7.6E-3
Medium Total	(Alameda Annex)						8E-7					8.7E-3
Medium Total	(Alameda Point - Site 25)						5E-8					7.6E-3
Medium Total	(Alameda Point - Site 30)						5E-8					7.6E-3
Medium Total	(Alameda Point - Site 31)						5E-8					7.6E-3

TABLE 9.19
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
TIER 2 CENTRAL EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: School Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Indoor Air	Indoor Air	1,2,4-Trimethylbenzene		NA		0E+0			8E-4		7.9E-4
			1,2-Dichloroethane		2E-7		2E-7			4E-3		3.5E-3
			1,3,5-Trimethylbenzene		NA		0E+0			1E-2		9.7E-3
			Acetone		NA		0E+0			8E-4		7.9E-4
			Carbon disulfide		NA		0E+0	Peripheral Nervous System		7E-5		7.1E-5
			Ethylbenzene		7E-7		7E-7	Developmental		7E-4		7.5E-4
			Isopropyl benzene		NA		0E+0	Kidney		4E-5		4.1E-5
			Methyl isobutyl ketone		NA		0E+0			2E-5		1.7E-5
			Methylene chloride		7E-8		7E-8			4E-4		3.9E-4
			MTBE		8E-10		8E-10	Liver, Kidney		9E-7		8.7E-7
			Naphthalene		NA		0E+0	Respiratory		2E-1		2.2E-1
			n-Butylbenzene		NA		0E+0			4E-2		3.8E-2
			n-Propylbenzene		NA		0E+0			NA		0.0E+0
			Styrene		NA		0E+0	CNS		1E-4		1.3E-4
			Toluene		NA		0E+0	CNS, Respiratory		4E-3		3.9E-3
			Xylenes (total)		NA		0E+0	CNS		8E-4		8.2E-4
			Benzene (500 ft)		6E-6		6E-6			1E-2		1.0E-2
			Benzene (725 ft)		4E-6		4E-6			7E-3		6.8E-3
			Chemical Total (krig - 500 ft)		7E-6		7E-6			2.9E-1		2.9E-1
			Chemical Total (krig - 725 ft)		5E-6		5E-6			2.9E-1		2.9E-1
		Exposure Point Total	krig - 500 ft				7E-6					2.9E-1
		Exposure Point Total	krig - 725 ft				5E-6					2.9E-1
	Exposure Medium Total	krig - 500 ft					7E-6					2.9E-1
	Exposure Medium Total	krig - 725 ft					5E-6					2.9E-1

TABLE 9.19

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

TIER 2 CENTRAL EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: School Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Medium Total	krig - 500 ft						7E-6					2.9E-1
Medium Total	krig - 725 ft						5E-6					2.9E-1
Receptor Total (Inhalation via Soil Vapor at Alameda Annex)							8E-7					8.7E-3
Receptor Total (Inhalation via Soil Vapor at Alameda Point - Site 25)							5E-8					7.6E-3
Receptor Total (Inhalation via Soil Vapor at Alameda Point - Site 30)							5E-8					7.6E-3
Receptor Total (Inhalation via Soil Vapor at Alameda Point - Site 31)							5E-8					7.6E-3
Receptor Total (Inhalation via Groundwater) krig - 500 ft							7E-6					2.9E-1
Receptor Total (Inhalation via Groundwater) krig - 725 ft							5E-6					2.9E-1

TABLE 9.20
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
TIER 2 REASONABLE MAXIMUM EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: School Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil Vapor	Indoor Air	Indoor Air	Chloroform		6E-9		6E-9			9E-6		8.9E-6
			Ethylbenzene		3E-8		3E-8	Developmental		3E-5		3.4E-5
			m,p-Xylene		NA		0E+0	CNS		5E-4		5.2E-4
			Naphthalene		NA		0E+0	Respiratory		7E-3		6.9E-3
			Tetrachloroethene (PCE)		4E-9		4E-9	Liver, Kidney		5E-5		4.7E-5
			Trichloroethene		3E-9		3E-9	CNS		6E-6		5.7E-6
		Alameda Annex	Benzene (Alameda Annex)		7E-7		7E-7			1E-3		1.1E-3
		Alameda Point - Site 25	Benzene (Alameda Point - Site 25)		3E-9		3E-9			4E-6		4.2E-6
		Alameda Point - Site 30	Benzene (Alameda Point - Site 30)		4E-9		4E-9			7E-6		6.5E-6
		Alameda Point - Site 31	Benzene (Alameda Point - Site 31)		2E-9		2E-9			3E-6		3.3E-6
			Chemical Total (Alameda Annex)		8E-7		8E-7			8.7E-3		8.7E-3
			Chemical Total (Alameda Point - Site 25)		5E-8		5E-8			7.6E-3		7.6E-3
			Chemical Total (Alameda Point - Site 30)		5E-8		5E-8			7.6E-3		7.6E-3
			Chemical Total (Alameda Point - Site 31)		5E-8		5E-8			7.6E-3		7.6E-3
		Exposure Point Total	(Alameda Annex)				8E-7					8.7E-3
		Exposure Point Total	(Alameda Point - Site 25)				5E-8					7.6E-3
		Exposure Point Total	(Alameda Point - Site 30)				5E-8					7.6E-3
		Exposure Point Total	(Alameda Point - Site 31)				5E-8					7.6E-3
	Exposure Medium Total	(Alameda Annex)					8E-7					8.7E-3
	Exposure Medium Total	(Alameda Point - Site 25)					5E-8					7.6E-3
	Exposure Medium Total	(Alameda Point - Site 30)					5E-8					7.6E-3
	Exposure Medium Total	(Alameda Point - Site 31)					5E-8					7.6E-3
Medium Total	(Alameda Annex)						8E-7					8.7E-3
Medium Total	(Alameda Point - Site 25)						5E-8					7.6E-3
Medium Total	(Alameda Point - Site 30)						5E-8					7.6E-3
Medium Total	(Alameda Point - Site 31)						5E-8					7.6E-3

TABLE 9.20
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
TIER 2 REASONABLE MAXIMUM EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: School Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Indoor Air	Indoor Air	1,2,4-Trimethylbenzene		NA		0E+0			8E-4		7.9E-4
			1,2-Dichloroethane		2E-7		2E-7			4E-3		3.5E-3
			1,3,5-Trimethylbenzene		NA		0E+0			1E-2		9.7E-3
			Acetone		NA		0E+0			8E-4		7.9E-4
			Carbon disulfide		NA		0E+0	Peripheral Nervous System		7E-5		7.1E-5
			Ethylbenzene		7E-7		7E-7	Developmental		7E-4		7.5E-4
			Isopropyl benzene		NA		0E+0	Kidney		4E-5		4.1E-5
			Methyl isobutyl ketone		NA		0E+0			2E-5		1.7E-5
			Methylene chloride		7E-8		7E-8			4E-4		3.9E-4
			MTBE		8E-10		8E-10	Liver, Kidney		9E-7		8.7E-7
			Naphthalene		NA		0E+0	Respiratory		2E-1		2.2E-1
			n-Butylbenzene		NA		0E+0			4E-2		3.8E-2
			n-Propylbenzene		NA		0E+0			NA		0.0E+0
			Styrene		NA		0E+0	CNS		1E-4		1.3E-4
			Toluene		NA		0E+0	CNS, Respiratory		4E-3		3.9E-3
			Xylenes (total)		NA		0E+0	CNS		8E-4		8.2E-4
			Benzene (500 ft)		6E-6		6E-6			1E-2		1.0E-2
			Benzene (725 ft)		4E-6		4E-6			7E-3		6.8E-3
			Chemical Total (krig - 500 ft)		7E-6		7E-6			2.9E-1		2.9E-1
			Chemical Total (krig - 725 ft)		5E-6		5E-6			2.9E-1		2.9E-1
		Exposure Point Total	krig - 500 ft				7E-6					2.9E-1
		Exposure Point Total	krig - 725 ft				5E-6					2.9E-1
	Exposure Medium Total	krig - 500 ft					7E-6					2.9E-1
	Exposure Medium Total	krig - 725 ft					5E-6					2.9E-1

TABLE 9.20

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

TIER 2 REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: School Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Medium Total	krig - 500 ft						7E-6					2.9E-1
Medium Total	krig - 725 ft						5E-6					2.9E-1
Receptor Total (Inhalation via Soil Vapor at Alameda Annex)							8E-7					8.7E-3
Receptor Total (Inhalation via Soil Vapor at Alameda Point - Site 25)							5E-8					7.6E-3
Receptor Total (Inhalation via Soil Vapor at Alameda Point - Site 30)							5E-8					7.6E-3
Receptor Total (Inhalation via Soil Vapor at Alameda Point - Site 31)							5E-8					7.6E-3
Receptor Total (Inhalation via Groundwater) krig - 500 ft							7E-6					2.9E-1
Receptor Total (Inhalation via Groundwater) krig - 725 ft							5E-6					2.9E-1

TABLE 10.1
RISK SUMMARY
TIER 1 CENTRAL EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Car Wash Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater Potable Use	Potable Water	Potable Water	Arsenic	2E-4			2E-4	Skin	6.5E-1			6.5E-1
			Cadmium	1E-6			1E-6	Kidney	5.7E-2			5.7E-2
			Iron	NA			0E+0		1.2E+0			1.2E+0
			Thallium	NA			0E+0	Liver, Blood, Hair	1.3E+0			1.3E+0
			1,2-Dichloroethane	2E-6			2E-6		1.5E-2			1.5E-2
			Benzene	5E-4			5E-4		1.8E+1			1.8E+1
			Benzo[a]anthracene	3E-5			3E-5		NA			0.0E+0
			Benzo[a]pyrene	6E-4			6E-4		NA			0.0E+0
			Benzo[b]fluoranthene	3E-5			3E-5		NA			0.0E+0
			Benzo[k]fluoranthene	1E-5			1E-5		NA			0.0E+0
			Chrysene	4E-6			4E-6		NA			0.0E+0
			Dibenz[a,h]anthracene	1E-5			1E-5		NA			0.0E+0
			Ethylbenzene	3E-6			3E-6	Developmental	7.0E-2			7.0E-2
			Indeno(1,2,3-cd)pyrene	4E-5			4E-5		NA			0.0E+0
			Methylene chloride	2E-6			2E-6		2.6E-2			2.6E-2
			Naphthalene	NA			0E+0	Respiratory	8.4E+0			8.4E+0
			Chemical Total	1E-3			1E-3		2.9E+1			2.9E+1
		Exposure Point Total					1E-3					2.9E+1
	Exposure Medium Total						1E-3					2.9E+1
Medium Total							1E-3					2.9E+1
Groundwater Industrial Use	Industrial Water	Industrial Water	Benzene			3E-5	3E-5				1.1E+0	1.1E+0
			Naphthalene			NA	0E+0	Whole Body			1.6E+0	1.6E+0
			Chemical Total			3E-5	3E-5				2.6E+0	2.6E+0
		Exposure Point Total					3E-5					2.6E+0
	Exposure Medium Total						3E-5					2.6E+0

TABLE 10.1
RISK SUMMARY
TIER 1 CENTRAL EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Car Wash Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
	Work Space Air	Work Space Air	Benzene		2E-6		2E-6			1E-1		1.2E-1
			Chemical Total		2E-6		2E-6			1.2E-1		1.2E-1
		Exposure Point Total					2E-6					1.2E-1
	Exposure Medium Total						2E-6					1.2E-1
Medium Total							3E-5					2.7E+0
Receptor Total							1E-3					3.2E+1

TABLE 10.2
RISK SUMMARY
TIER 1 REASONABLE MAXIMUM EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Car Wash Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater Potable Use	Potable Water	Potable Water	Arsenic	7E-4			7E-4	Skin	6.5E-1			6.5E-1
			Cadmium	4E-6			4E-6	Kidney	5.7E-2			5.7E-2
			Iron	NA			0E+0		1.2E+0			1.2E+0
			Thallium	NA			0E+0	Liver, Blood, Hair	1.3E+0			1.3E+0
			1,2-Dichloroethane	7E-6			7E-6		1.5E-2			1.5E-2
			Benzene	2E-3			2E-3		1.8E+1			1.8E+1
			Benzo[a]anthracene	1E-4			1E-4		NA			0.0E+0
			Benzo[a]pyrene	2E-3			2E-3		NA			0.0E+0
			Benzo[b]fluoranthene	1E-4			1E-4		NA			0.0E+0
			Benzo[k]fluoranthene	5E-5			5E-5		NA			0.0E+0
			Chrysene	2E-5			2E-5		NA			0.0E+0
			Dibenz[a,h]anthracene	4E-5			4E-5		NA			0.0E+0
			Ethylbenzene	1E-5			1E-5	Developmental	7.0E-2			7.0E-2
			Indeno(1,2,3-cd)pyrene	2E-4			2E-4		NA			0.0E+0
			Methylene chloride	8E-6			8E-6		2.6E-2			2.6E-2
			Naphthalene	NA			0E+0	Respiratory	8.4E+0			8.4E+0
			Chemical Total	5E-3			5E-3		2.9E+1			2.9E+1
		Exposure Point Total					5E-3					2.9E+1
Medium Total							5E-3					2.9E+1
Groundwater	Potable Water	Potable Water	Arsenic			6E-6	6E-6	Skin			5.9E-3	5.9E-3
Groundwater	Potable Water	Potable Water	1,2-Dichloroethane			3E-6	3E-6				5.7E-3	5.7E-3
Potable Use			Benzene			3E-4	3E-4				2.4E+0	2.4E+0
			Ethylbenzene			4E-6	4E-6	Liver, Kidney			3.2E-2	3.2E-2
			Naphthalene			NA	0E+0	Whole Body			3.6E+0	3.6E+0

TABLE 10.2
RISK SUMMARY
TIER 1 REASONABLE MAXIMUM EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Car Wash Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
			Chemical Total			3E-4	3E-4				6.1E+0	6.1E+0
	Exposure Medium Total						3E-4					6.1E+0
	Work Space Air	Work Space Air	Benzene		2E-5		2E-5			4E-1		3.6E-1
			Chemical Total		2E-5		2E-5			3.6E-1		3.6E-1
		Exposure Point Total					2E-5					3.6E-1
	Exposure Medium Total						2E-5					3.6E-1
Medium Total							3E-4					6.4E+0
Receptor Total							6E-3					3.6E+1

TABLE 10.3
RISK SUMMARY
TIER 1 CENTRAL EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Landscape Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater Potable Use	Potable Water	Potable Water	Arsenic	2E-4			2E-4	Skin	6.5E-1			6.5E-1
			Cadmium	1E-6			1E-6	Kidney	5.7E-2			5.7E-2
			Iron	NA			0E+0		1.2E+0			1.2E+0
			Thallium	NA			0E+0	Liver, Blood, Hair	1.3E+0			1.3E+0
			1,2-Dichloroethane	2E-6			2E-6		1.5E-2			1.5E-2
			Benzene	5E-4			5E-4		1.8E+1			1.8E+1
			Benzo[a]anthracene	3E-5			3E-5		NA			0.0E+0
			Benzo[a]pyrene	6E-4			6E-4		NA			0.0E+0
			Benzo[b]fluoranthene	3E-5			3E-5		NA			0.0E+0
			Benzo[k]fluoranthene	1E-5			1E-5		NA			0.0E+0
			Chrysene	4E-6			4E-6		NA			0.0E+0
			Dibenz[a,h]anthracene	1E-5			1E-5		NA			0.0E+0
			Ethylbenzene	3E-6			3E-6	Developmental	7.0E-2			7.0E-2
			Indeno(1,2,3-cd)pyrene	4E-5			4E-5		NA			0.0E+0
			Methylene chloride	2E-6			2E-6		2.6E-2			2.6E-2
			Naphthalene	NA			0E+0	Respiratory	8.4E+0			8.4E+0
			Chemical Total	1E-3			1E-3		2.9E+1			2.9E+1
		Exposure Point Total					1E-3					2.9E+1
	Exposure Medium Total						1E-3					2.9E+1
Medium Total							1E-3					2.9E+1
Groundwater Potable Use	Potable Water	Potable Water	Benzene			2E-5	2E-5				1.5E+0	1.5E+0
			Naphthalene			NA	0E+0	Whole Body			2.2E+0	2.2E+0
			Chemical Total			2E-5	2E-5				3.6E+0	3.6E+0
		Exposure Point Total					2E-5					3.6E+0
	Exposure Medium Total						2E-5					3.6E+0

TABLE 10.3
RISK SUMMARY
TIER 1 CENTRAL EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Landscape Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
	Work Space Air	Work Space Air	Benzene		6E-6		6E-6	Respiratory		3E-1		3.5E-1
			Naphthalene		NA		0E+0			2E+0		1.7E+0
			Chemical Total		6E-6		6E-6			2.1E+0		2.1E+0
		Exposure Point Total					6E-6					2.1E+0
	Exposure Medium Total						6E-6					2.1E+0
Medium Total							2E-5					5.7E+0
Receptor Total							1E-3					3.5E+1

TABLE 10.4
RISK SUMMARY
TIER 1 REASONABLE MAXIMUM EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Landscape Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater Potable Use	Potable Water	Potable Water	Arsenic	7E-4			7E-4	Skin	6.5E-1			6.5E-1
			Cadmium	4E-6			4E-6	Kidney	5.7E-2			5.7E-2
			Iron	NA			0E+0		1.2E+0			1.2E+0
			Thallium	NA			0E+0	Liver, Blood, Hair	1.3E+0			1.3E+0
			1,2-Dichloroethane	7E-6			7E-6		1.5E-2			1.5E-2
			Benzene	2E-3			2E-3		1.8E+1			1.8E+1
			Benzo[a]anthracene	1E-4			1E-4		NA			0.0E+0
			Benzo[a]pyrene	2E-3			2E-3		NA			0.0E+0
			Benzo[b]fluoranthene	1E-4			1E-4		NA			0.0E+0
			Benzo[k]fluoranthene	5E-5			5E-5		NA			0.0E+0
			Chrysene	2E-5			2E-5		NA			0.0E+0
			Dibenz[a,h]anthracene	4E-5			4E-5		NA			0.0E+0
			Ethylbenzene	1E-5			1E-5	Developmental	7.0E-2			7.0E-2
			Indeno(1,2,3-cd)pyrene	2E-4			2E-4		NA			0.0E+0
			Methylene chloride	8E-6			8E-6		2.6E-2			2.6E-2
			Naphthalene	NA			0E+0	Respiratory	8.4E+0			8.4E+0
			Chemical Total	5E-3			5E-3		2.9E+1			2.9E+1
		Exposure Point Total					5E-3					2.9E+1
Medium Total							5E-3					2.9E+1
Groundwater	Potable Water	Potable Water	Arsenic			4E-6	4E-6	Skin			7.7E-3	7.7E-3
Groundwater	Potable Water	Potable Water	1,2-Dichloroethane			2E-6	2E-6				7.3E-3	7.3E-3
Potable Use			Benzene			2E-4	2E-4				3.1E+0	3.1E+0
			Ethylbenzene			3E-6	3E-6	Liver, Kidney			4.1E-2	4.1E-2
			Naphthalene			NA	0E+0	Whole Body			4.7E+0	4.7E+0
			n-Butylbenzene			NA	0E+0				0.0E+0	0.0E+0

TABLE 10.4
RISK SUMMARY
TIER 1 REASONABLE MAXIMUM EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Landscape Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
			Chemical Total			2E-4	2E-4				7.9E+0	7.9E+0
		Exposure Point Total					2E-4					7.9E+0
	Exposure Medium Total						2E-4					7.9E+0
	Work Space Air	Work Space Air	Benzene		2E-5		2E-5	Respiratory		3E-1		3.5E-1
			Naphthalene		NA		0E+0			2E+0		1.7E+0
			Chemical Total		2E-5		2E-5			2.1E+0		2.1E+0
		Exposure Point Total					2E-5					2.1E+0
	Exposure Medium Total						2E-5					2.1E+0
Medium Total							2E-4					1.0E+1
Receptor Total							6E-3					3.9E+1

TABLE 10.5
RISK SUMMARY
TIER 1 CENTRAL EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: On-Site Resident
Receptor Age: Child / Age-Adjusted Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil Vapor	Indoor Air	Indoor Air	Benzene		1E-6		1E-6			2E-3		1.6E-3
			Chemical Total		1E-6		1E-6			1.6E-3		1.6E-3
		Exposure Point Total					1E-6					1.6E-3
	Exposure Medium Total						1E-6					1.6E-3
Medium Total							1E-6					1.6E-3
Groundwater	Indoor Air	Indoor Air	Benzene		1E-4		1E-4			2E-1		1.8E-1
			Chemical Total		1E-4		1E-4			1.8E-1		1.8E-1
		Exposure Point Total					1E-4					1.8E-1
	Exposure Medium Total						1E-4					1.8E-1
Medium Total							1E-4					1.8E-1
Groundwater[1] Potable Use	Potable Water	Potable Water	Arsenic	7E-4			7E-4	Skin	2.3E+0			2.3E+0
			Cadmium	4E-6			4E-6	Kidney	2.1E-1			2.1E-1
			Iron	NA			0E+0		4.2E+0			4.2E+0
			Thallium	NA			0E+0	Liver, Blood, Hair	4.7E+0			4.7E+0
			1,2-Dichloroethane	8E-6			8E-6		5.3E-2			5.3E-2
			Benzene	2E-3			2E-3		6.4E+1			6.4E+1
			Benzo[a]anthracene	1E-4			1E-4		NA			0.0E+0
			Benzo[a]pyrene	2E-3			2E-3		NA			0.0E+0
			Benzo[b]fluoranthene	1E-4			1E-4		NA			0.0E+0
			Benzo[k]fluoranthene	6E-5			6E-5		NA			0.0E+0
			Chrysene	2E-5			2E-5		NA			0.0E+0
			Dibenz[a,h]anthracene	4E-5			4E-5		NA			0.0E+0
			Ethylbenzene	1E-5			1E-5	Liver, Kidney	2.6E-1			2.6E-1

TABLE 10.5
RISK SUMMARY
TIER 1 CENTRAL EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: On-Site Resident
Receptor Age: Child / Age-Adjusted Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
			Indeno(1,2,3-cd)pyrene	2E-4			2E-4		NA			0.0E+0
			Methylene chloride	8E-6			8E-6	Liver	9.6E-2			9.6E-2
			Naphthalene	NA			0E+0	Whole Body	3.0E+1			3.0E+1
			Chemical Total	6E-3			6E-3		1.1E+2			1.1E+2
		Exposure Point Total					6E-3					1.1E+2
	Exposure Medium Total						6E-3					1.1E+2
	Indoor Air	Indoor Air	1,2,4-Trimethylbenzene		NA		0E+0			6E+0		5.8E+0
			1,2-Dichloroethane		7E-5		7E-5			6E+0		6.3E+0
			1,3,5-Trimethylbenzene		NA		0E+0			3E+0		3.0E+0
			Benzene		1E-2		1E-2			6E+2		6.3E+2
			Benzo[b]fluoranthene		2E-4		2E-4			NA		0.0E+0
			Chrysene		3E-5		3E-5			NA		0.0E+0
			Ethylbenzene		6E-5		6E-5	Developmental		5E-1		4.9E-1
			Methylene chloride		1E-5		1E-5			4E-2		3.7E-2
			Naphthalene		NA		0E+0	Respiratory		4E+3		3.9E+3
			Toluene		NA		0E+0	CNS, Respiratory		1E+0		1.0E+0
			Xylenes (total)		NA		0E+0	CNS		3E+0		2.6E+0
			Chemical Total		1E-2		1E-2			4.6E+3		4.6E+3
		Exposure Point Total					1E-2					4.6E+3
	Exposure Medium Total						1E-2					4.6E+3
Medium Total							2E-2					4.7E+3
Current Receptor Total (Inhalation via Soil Vapor)							1E-6					1.6E-3
Current Receptor Total (Inhalation via Groundwater)							1E-4					1.8E-1
Future Receptor Total (Potable Water Use + Inhalation via Soil Vapor)							2E-2					4.7E+3
Future Receptor Total (Potable Water Use + Inhalation via Groundwater)							2E-2					4.7E+3

[1] - Groundwater potable use is a future use scenario.

TABLE 10.6
RISK SUMMARY
TIER 1 REASONABLE MAXIMUM EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: On-Site Resident
Receptor Age: Child / Age-Adjusted Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil Vapor	Indoor Air	Indoor Air	Benzene		1E-6		1E-6			2E-3		1.6E-3
			Chemical Total		1E-6		1E-6			1.6E-3		1.6E-3
		Exposure Point Total					1E-6					1.6E-3
	Exposure Medium Total						1E-6					1.6E-3
Medium Total							1E-6					1.6E-3
Groundwater	Indoor Air	Indoor Air	Benzene		1E-4		1E-4			2E-1		1.8E-1
			Chemical Total		1E-4		1E-4			1.8E-1		1.8E-1
		Exposure Point Total					1E-4					1.8E-1
	Exposure Medium Total						1E-4					1.8E-1
Medium Total							1E-4					1.8E-1
Groundwater[1] Potable Use	Potable Water	Potable Water	Arsenic	3E-3			3E-3	Skin	4.7E+0			4.7E+0
			Barium	NA			0E+0	Kidney	1.8E+0			1.8E+0
			Cadmium	2E-5			2E-5	Kidney	4.1E-1			4.1E-1
			Iron	NA			0E+0		8.5E+0			8.5E+0
			Manganese	NA			0E+0	CNS	1.1E+0			1.1E+0
			Thallium	NA			0E+0	Liver, Blood, Hair	9.3E+0			9.3E+0
			1,2-Dichloroethane	3E-5			3E-5		1.1E-1			1.1E-1
			Acetone	NA			0E+0	Liver, Kidney	6.4E+0			6.4E+0
			Benzene	9E-3			9E-3		1.3E+2			1.3E+2
			Benzo[a]anthracene	5E-4			5E-4		NA			0.0E+0
			Benzo[a]pyrene	1E-2			1E-2		NA			0.0E+0
			Benzo[b]fluoranthene	5E-4			5E-4		NA			0.0E+0
			Benzo[k]fluoranthene	2E-4			2E-4		NA			0.0E+0

TABLE 10.6
RISK SUMMARY
TIER 1 REASONABLE MAXIMUM EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: On-Site Resident
Receptor Age: Child / Age-Adjusted Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
			Chrysene	8E-5			8E-5		NA			0.0E+0
			Dibenz[a,h]anthracene	2E-4			2E-4		NA			0.0E+0
			Ethylbenzene	5E-5			5E-5	Liver, Kidney	5.1E-1			5.1E-1
			Indeno(1,2,3-cd)pyrene	8E-4			8E-4		NA			0.0E+0
			Methylene chloride	4E-5			4E-5	Liver	1.9E-1			1.9E-1
			Naphthalene	NA			0E+0	Whole Body	6.1E+1			6.1E+1
			n-Butylbenzene	NA			0E+0		2.9E+0			2.9E+0
			Chemical Total	2E-2			2E-2		2.0E+2			2.0E+2
		Exposure Point Total					2E-2					2.0E+2
	Exposure Medium Total						2E-2					2.0E+2
	Indoor Air	Indoor Air	1,2-Dichloroethane		2E-4		2E-4			9E+0		8.6E+0
			1,2,4-Trimethylbenzene		NA		0E+0			8E+0		7.8E+0
			1,3,5-Trimethylbenzene		NA		0E+0			4E+0		4.1E+0
			Benzene		3E-2		3E-2			8E+2		8.5E+2
			Benzo[b]fluoranthene		6E-4		6E-4			NA		0.0E+0
			Chrysene		9E-5		9E-5			NA		0.0E+0
			Ethylbenzene		2E-4		2E-4	Developmental		7E-1		6.6E-1
			Methylene chloride		4E-5		4E-5			5E-2		5.0E-2
			MTBE		1E-6		1E-6	Liver, Kidney		5E-3		5.3E-3
			Naphthalene		NA		0E+0	Respiratory		5E+3		5.3E+3
			Toluene		NA		0E+0	CNS, Respiratory		1E+0		1.4E+0
			Xylenes (total)		NA		0E+0	CNS		4E+0		3.5E+0
			Chemical Total		3E-2		3E-2			6.2E+3		6.2E+3
		Exposure Point Total					3E-2					6.2E+3
	Exposure Medium Total						3E-2					6.2E+3

TABLE 10.6

RISK SUMMARY

TIER 1 REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: On-Site Resident
Receptor Age: Child / Age-Adjusted Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Medium Total							6E-2					6.4E+3
Current Receptor Total (Inhalation via Soil Vapor)							1E-6					1.6E-3
Current Receptor Total (Inhalation via Groundwater)							1E-4					1.8E-1
Future Receptor Total (Potable Water Use + Inhalation via Soil Vapor)							6E-2					6.4E+3
Future Receptor Total (Potable Water Use + Inhalation via Groundwater)							6E-2					6.4E+3

[1] - Groundwater potable use is a future use scenario.

TABLE 10.7
RISK SUMMARY
TIER 1 CENTRAL EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: School Student
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil Vapor	Indoor Air	Indoor Air	Benzene		1E-6		1E-6			2E-3		1.6E-3
			Chemical Total		1E-6		1E-6			1.6E-3		1.6E-3
		Exposure Point Total					1E-6					1.6E-3
	Exposure Medium Total						1E-6					1.6E-3
Medium Total							1E-6					1.6E-3
Groundwater	Indoor Air	Indoor Air	Benzene		1E-4		1E-4			2E-1		1.8E-1
			Chemical Total		1E-4		1E-4			1.8E-1		1.8E-1
		Exposure Point Total					1E-4					1.8E-1
	Exposure Medium Total						1E-4					1.8E-1
Medium Total							1E-4					1.8E-1
Receptor Total (Inhalation via Soil Vapor)							1E-6					1.6E-3
Receptor Total (Inhalation via Groundwater)							1E-4					1.8E-1

TABLE 10.8

RISK SUMMARY

TIER 1 REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: School Student
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil Vapor	Indoor Air	Indoor Air	Benzene		1E-6		1E-6			2E-3		1.6E-3
			Chemical Total		1E-6		1E-6			1.6E-3		1.6E-3
		Exposure Point Total					1E-6					1.6E-3
	Exposure Medium Total						1E-6					1.6E-3
Medium Total							1E-6					1.6E-3
Groundwater	Indoor Air	Indoor Air	Benzene		1E-4		1E-4			2E-1		1.8E-1
			Chemical Total		1E-4		1E-4			1.8E-1		1.8E-1
		Exposure Point Total					1E-4					1.8E-1
	Exposure Medium Total						1E-4					1.8E-1
Medium Total							1E-4					1.8E-1
Receptor Total (Inhalation via Soil Vapor)							1E-6					1.6E-3
Receptor Total (Inhalation via Groundwater)							1E-4					1.8E-1

TABLE 10.9
RISK SUMMARY
TIER 1 CENTRAL EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: School Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil Vapor	Indoor Air	Indoor Air	Benzene		1E-6		1E-6			2E-3		1.6E-3
			Chemical Total		1E-6		1E-6			1.6E-3		1.6E-3
		Exposure Point Total					1E-6					1.6E-3
	Exposure Medium Total						1E-6					1.6E-3
Medium Total							1E-6					1.6E-3
Groundwater	Indoor Air	Indoor Air	Benzene		1E-4		1E-4			2E-1		1.8E-1
			Chemical Total		1E-4		1E-4			1.8E-1		1.8E-1
		Exposure Point Total					1E-4					1.8E-1
	Exposure Medium Total						1E-4					1.8E-1
Medium Total							1E-4					1.8E-1
Receptor Total (Inhalation via Soil Vapor)							1E-6					1.6E-3
Receptor Total (Inhalation via Groundwater)							1E-4					1.8E-1

TABLE 10.10

RISK SUMMARY

TIER 1 REASONABLE MAXIMUM EXPOSURE

FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: School Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil Vapor	Indoor Air	Indoor Air	Benzene		1E-6		1E-6			2E-3		1.6E-3
			Chemical Total		1E-6		1E-6			1.6E-3		1.6E-3
		Exposure Point Total					1E-6					1.6E-3
	Exposure Medium Total						1E-6					1.6E-3
Medium Total							1E-6					1.6E-3
Groundwater	Indoor Air	Indoor Air	Benzene		1E-4		1E-4			2E-1		1.8E-1
			Chemical Total		1E-4		1E-4			1.8E-1		1.8E-1
		Exposure Point Total					1E-4					1.8E-1
	Exposure Medium Total						1E-4					1.8E-1
Medium Total							1E-4					1.8E-1
Receptor Total (Inhalation via Soil Vapor)							1E-6					1.6E-3
Receptor Total (Inhalation via Groundwater)							1E-4					1.8E-1

TABLE 10.11
RISK SUMMARY
TIER 2 CENTRAL EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Car Wash Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater Potable Use	Potable Water	Potable Water	Arsenic	7E-5			7E-5	Skin	6.5E-1			6.5E-1
			Cadmium	4E-7			4E-7	Kidney	5.7E-2			5.7E-2
			Iron	NA			0E+0		1.2E+0			1.2E+0
			Thallium	NA			0E+0	Liver, Blood, Hair	1.3E+0			1.3E+0
			1,2-Dichloroethane	8E-7			8E-7		1.5E-2			1.5E-2
			Benzo[a]anthracene	1E-5			1E-5		NA			0.0E+0
			Benzo[a]pyrene	2E-4			2E-4		NA			0.0E+0
			Benzo[b]fluoranthene	1E-5			1E-5		NA			0.0E+0
			Benzo[k]fluoranthene	5E-6			5E-6		NA			0.0E+0
			Chrysene	2E-6			2E-6		NA			0.0E+0
			Dibenz[a,h]anthracene	4E-6			4E-6		NA			0.0E+0
			Ethylbenzene	1E-6			1E-6	Liver, Kidney	7.0E-2			7.0E-2
			Indeno(1,2,3-cd)pyrene	2E-5			2E-5		NA			0.0E+0
			Methylene chloride	8E-7			8E-7	Liver	2.6E-2			2.6E-2
			Benzene (500 ft)	2E-5			2E-5		1.4E+0			1.4E+0
			Benzene (725 ft)	1E-5			1E-5		9.4E-1			9.4E-1
			Naphthalene (500 ft)	NA			0E+0	Whole Body	1.8E+0			1.8E+0
			Naphthalene (725 ft)	NA			0E+0	Whole Body	1.4E+0			1.4E+0
			Chemical Total (krig - 500 ft)	4E-4			4E-4		7E+0			6.5E+0
			Chemical Total (krig - 725 ft)	3E-4			3E-4		5E+0			5.0E+0
		Exposure Point Total	krig - 500 ft				4E-4					6.5E+0
		Exposure Point Total	krig - 725 ft				3E-4					5.0E+0
	Exposure Medium Total	krig - 500 ft					4E-4					6.5E+0
	Exposure Medium Total	krig - 725 ft					3E-4					5.0E+0
Medium Total	krig - 500 ft						4E-4					6.5E+0
Medium Total	krig - 725 ft						3E-4					5.0E+0

TABLE 10.11
RISK SUMMARY
TIER 2 CENTRAL EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Car Wash Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater Industrial Use	Industrial Water	Industrial Water	Benzene (500 ft)			1E-6	1E-6				8.7E-2	8.7E-2
			Benzene (725 ft)			6E-7	6E-7				5.7E-2	5.7E-2
			Chemical Total (krig - 500 ft)			1E-6	1E-6				9E-2	8.7E-2
			Chemical Total (krig - 725 ft)			6E-7	6E-7				6E-2	5.7E-2
		Exposure Point Total	krig - 500 ft				1E-6					8.7E-2
		Exposure Point Total	krig - 725 ft				6E-7					5.7E-2
	Exposure Medium Total	krig - 500 ft					1E-6					8.7E-2
	Exposure Medium Total	krig - 725 ft					6E-7					5.7E-2
	Work Space Air	Work Space Air			NA		NA			NA		NA
			Chemical Total (krig - 500 ft)									
			Chemical Total (krig - 725 ft)									
		Exposure Point Total	krig - 500 ft				0E+0					0.0E+0
		Exposure Point Total	krig - 725 ft				0E+0					0.0E+0
	Exposure Medium Total	krig - 500 ft					0E+0					0.0E+0
	Exposure Medium Total	krig - 725 ft					0E+0					0.0E+0
Medium Total	krig - 500 ft						1E-6					8.7E-2
Medium Total	krig - 725 ft						6E-7					5.7E-2
Receptor Total	krig - 500 ft						4E-4					6.6E+0
Receptor Total	krig - 725 ft						3E-4					5.0E+0

TABLE 10.12
RISK SUMMARY
TIER 2 REASONABLE MAXIMUM EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Car Wash Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater Potable Use	Potable Water	Potable Water	Arsenic	4E-4			4E-4	Skin	6.5E-1			6.5E-1
			Cadmium	2E-6			2E-6	Kidney	5.7E-2			5.7E-2
			Iron	NA			0E+0		1.2E+0			1.2E+0
			Thallium	NA			0E+0	Liver, Blood, Hair	1.3E+0			1.3E+0
			1,2-Dichloroethane	4E-6			4E-6		1.5E-2			1.5E-2
			Benzo[a]anthracene	5E-5			5E-5		NA			0.0E+0
			Benzo[a]pyrene	1E-3			1E-3		NA			0.0E+0
			Benzo[b]fluoranthene	6E-5			6E-5		NA			0.0E+0
			Benzo[k]fluoranthene	3E-5			3E-5		NA			0.0E+0
			Chrysene	9E-6			9E-6		NA			0.0E+0
			Dibenz[a,h]anthracene	2E-5			2E-5		NA			0.0E+0
			Ethylbenzene	5E-6			5E-6	Liver, Kidney	7.0E-2			7.0E-2
			Indeno(1,2,3-cd)pyrene	9E-5			9E-5		NA			0.0E+0
			Methylene chloride	4E-6			4E-6	Liver	2.6E-2			2.6E-2
			Benzene (500 ft)	8E-5			8E-5		1.4E+0			1.4E+0
			Benzene (725 ft)	6E-5			6E-5		9.4E-1			9.4E-1
			Naphthalene (500 ft)	NA			0E+0	Whole Body	1.8E+0			1.8E+0
			Naphthalene (725 ft)	NA			0E+0	Whole Body	1.4E+0			1.4E+0
			Chemical Total (krig - 500 ft)	2E-3			2E-3		7E+0			6.5E+0
			Chemical Total (krig - 725 ft)	2E-3			2E-3		5E+0			5.0E+0
		Exposure Point Total	krig - 500 ft				2E-3					6.5E+0
		Exposure Point Total	krig - 725 ft				2E-3					5.0E+0
	Exposure Medium Total	krig - 500 ft					2E-3					6.5E+0
	Exposure Medium Total	krig - 725 ft					2E-3					5.0E+0
Medium Total	krig - 500 ft						2E-3					6.5E+0
Medium Total	krig - 725 ft						2E-3					5.0E+0

TABLE 10.12
RISK SUMMARY
TIER 2 REASONABLE MAXIMUM EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Car Wash Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater Industrial Use	Industrial Water	Industrial Water	Arsenic			3E-6	3E-6	Skin			5.9E-3	5.9E-3
			1,2-Dichloroethane			2E-6	2E-6				5.7E-3	5.7E-3
			Ethylbenzene			2E-6	2E-6	Liver, Kidney			3.2E-2	3.2E-2
			Benzene (500 ft)			1E-5	1E-5				2.0E-1	2.0E-1
			Benzene (725 ft)			8E-6	8E-6				1.3E-1	1.3E-1
			Chemical Total (krig - 500 ft)			2E-5	2E-5				2E-1	2.4E-1
			Chemical Total (krig - 725 ft)			1E-5	1E-5				2E-1	1.7E-1
		Exposure Point Total	krig - 500 ft				2E-5					2.4E-1
		Exposure Point Total	krig - 725 ft				1E-5					1.7E-1
	Exposure Medium Total	krig - 500 ft					2E-5					2.4E-1
	Exposure Medium Total	krig - 725 ft					1E-5					1.7E-1
	Work Space Air	Work Space Air	Benzene (500 ft)		1E-6		1E-6			3E-2		2.9E-2
			Benzene (725 ft)		6E-7		6E-7			2E-2		1.9E-2
			Chemical Total (krig - 500 ft)		1E-6		1E-6			2.9E-2		2.9E-2
			Chemical Total (krig - 725 ft)		6E-7		6E-7			1.9E-2		1.9E-2
		Exposure Point Total	krig - 500 ft				1E-6					2.9E-2
		Exposure Point Total	krig - 725 ft				6E-7					1.9E-2
	Exposure Medium Total	krig - 500 ft					1E-6					2.9E-2
	Exposure Medium Total	krig - 725 ft					6E-7					1.9E-2
Medium Total	krig - 500 ft						2E-5					2.7E-1
Medium Total	krig - 725 ft						2E-5					1.9E-1
Receptor Total	krig - 500 ft						2E-3					6.8E+0
Receptor Total	krig - 725 ft						2E-3					5.2E+0

TABLE 10.13
RISK SUMMARY
TIER 2 CENTRAL EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Landscape Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater Potable Use	Potable Water	Potable Water	Arsenic	9E-5			9E-5	Skin	6.5E-1			6.5E-1
			Cadmium	6E-7			6E-7	Kidney	5.7E-2			5.7E-2
			Iron	NA			0E+0		1.2E+0			1.2E+0
			Thallium	NA			0E+0	Liver, Blood, Hair	1.3E+0			1.3E+0
			1,2-Dichloroethane	1E-6			1E-6		1.5E-2			1.5E-2
			Benzo[a]anthracene	1E-5			1E-5		NA			0.0E+0
			Benzo[a]pyrene	3E-4			3E-4		NA			0.0E+0
			Benzo[b]fluoranthene	2E-5			2E-5		NA			0.0E+0
			Benzo[k]fluoranthene	8E-6			8E-6		NA			0.0E+0
			Chrysene	2E-6			2E-6		NA			0.0E+0
			Dibenz[a,h]anthracene	6E-6			6E-6		NA			0.0E+0
			Ethylbenzene	1E-6			1E-6	Liver, Kidney	7.0E-2			7.0E-2
			Indeno(1,2,3-cd)pyrene	2E-5			2E-5		NA			0.0E+0
			Methylene chloride	1E-6			1E-6	Liver	2.6E-2			2.6E-2
			Benzene (500 ft)	2E-5			2E-5		1.4E+0			1.4E+0
			Benzene (725 ft)	1E-5			1E-5		9.4E-1			9.4E-1
			Naphthalene (500 ft)	NA			0E+0	Whole Body	1.8E+0			1.8E+0
			Naphthalene (725 ft)	NA			0E+0	Whole Body	1.4E+0			1.4E+0
			Chemical Total (krig - 500 ft)	5E-4			5E-4		7E+0			6.5E+0
			Chemical Total (krig - 725 ft)	4E-4			4E-4		5E+0			5.0E+0
		Exposure Point Total	krig - 500 ft				5E-4					6.5E+0
		Exposure Point Total	krig - 725 ft				4E-4					5.0E+0
	Exposure Medium Total	krig - 500 ft					5E-4					6.5E+0
	Exposure Medium Total	krig - 725 ft					4E-4					5.0E+0
Medium Total	krig - 500 ft						5E-4					6.5E+0
Medium Total	krig - 725 ft						4E-4					5.0E+0

TABLE 10.13
RISK SUMMARY
TIER 2 CENTRAL EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Landscape Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater Industrial Use	Industrial Water	Industrial Water	Arsenic			4E-7	4E-7	Skin			2.6E-3	2.6E-3
			1,2-Dichloroethane			2E-7	2E-7				2.5E-3	2.5E-3
			Ethylbenzene			3E-7	3E-7	Liver, Kidney			1.4E-2	1.4E-2
			Benzene (500 ft)			1E-6	1E-6				8.7E-2	8.7E-2
			Benzene (725 ft)			9E-7	9E-7				5.7E-2	5.7E-2
			Chemical Total (krig - 500 ft)			2E-6	2E-6				1.1E-1	1.1E-1
			Chemical Total (krig - 725 ft)			2E-6	2E-6				7.5E-2	7.5E-2
		Exposure Point Total	krig - 500 ft				2E-6					1.1E-1
		Exposure Point Total	krig - 725 ft				2E-6					7.5E-2
	Exposure Medium Total	krig - 500 ft					2E-6					1.1E-1
	Exposure Medium Total	krig - 725 ft					2E-6					7.5E-2
	Workspace Air	Workspace Air			NA		NA			NA		NA
			Chemical Total (krig - 500 ft)		0E+0		0E+0			0.0E+0		0.0E+0
			Chemical Total (krig - 725 ft)		0E+0		0E+0			0.0E+0		0.0E+0
		Exposure Point Total	krig - 500 ft				0E+0					0.0E+0
		Exposure Point Total	krig - 725 ft				0E+0					0.0E+0
	Exposure Medium Total	krig - 500 ft					0E+0					0.0E+0
	Exposure Medium Total	krig - 725 ft					0E+0					0.0E+0
Medium Total	krig - 500 ft						2E-6					1.1E-1
Medium Total	krig - 725 ft						2E-6					7.5E-2
Receptor Total	krig - 500 ft						5E-4					6.7E+0
Receptor Total	krig - 725 ft						4E-4					5.1E+0

TABLE 10.14
RISK SUMMARY
TIER 2 REASONABLE MAXIMUM EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Landscape Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater Potable Use	Potable Water	Potable Water	Arsenic	5E-4			5E-4	Skin	6.5E-1			6.5E-1
			Cadmium	3E-6			3E-6	Kidney	5.7E-2			5.7E-2
			Iron	NA			0E+0		1.2E+0			1.2E+0
			Thallium	NA			0E+0	Liver, Blood, Hair	1.3E+0			1.3E+0
			1,2-Dichloroethane	5E-6			5E-6		1.5E-2			1.5E-2
			Benzo[a]anthracene	7E-5			7E-5		NA			0.0E+0
			Benzo[a]pyrene	2E-3			2E-3		NA			0.0E+0
			Benzo[b]fluoranthene	8E-5			8E-5		NA			0.0E+0
			Benzo[k]fluoranthene	4E-5			4E-5		NA			0.0E+0
			Chrysene	1E-5			1E-5		NA			0.0E+0
			Dibenz[a,h]anthracene	3E-5			3E-5		NA			0.0E+0
			Ethylbenzene	7E-6			7E-6	Liver, Kidney	7.0E-2			7.0E-2
			Indeno(1,2,3-cd)pyrene	1E-4			1E-4		NA			0.0E+0
			Methylene chloride	6E-6			6E-6	Liver	2.6E-2			2.6E-2
			Benzene (500 ft)	1E-4			1E-4		1.4E+0			1.4E+0
			Benzene (725 ft)	7E-5			7E-5		9.4E-1			9.4E-1
			Naphthalene (500 ft)	NA			0E+0	Whole Body	1.8E+0			1.8E+0
			Naphthalene (725 ft)	NA			0E+0	Whole Body	1.4E+0			1.4E+0
			Chemical Total (krig - 500 ft)	3E-3			3E-3		7E+0			6.5E+0
			Chemical Total (krig - 725 ft)	2E-3			2E-3		5E+0			5.0E+0
		Exposure Point Total	krig - 500 ft				3E-3					6.5E+0
		Exposure Point Total	krig - 725 ft				2E-3					5.0E+0
	Exposure Medium Total	krig - 500 ft					3E-3					6.5E+0
	Exposure Medium Total	krig - 725 ft					2E-3					5.0E+0
Medium Total	krig - 500 ft						3E-3					6.5E+0
Medium Total	krig - 725 ft						2E-3					5.0E+0

TABLE 10.14
RISK SUMMARY
TIER 2 REASONABLE MAXIMUM EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Future
Receptor Population: Landscape Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater Industrial Use	Industrial Water	Industrial Water	Arsenic			4E-6	4E-6	Skin			5.9E-3	5.9E-3
			1,2-Dichloroethane			2E-6	2E-6				5.7E-3	5.7E-3
			Ethylbenzene			3E-6	3E-6	Liver, Kidney			3.2E-2	3.2E-2
			Benzene (500 ft)			2E-5	2E-5				2.0E-1	2.0E-1
			Benzene (725 ft)			1E-5	1E-5				1.3E-1	1.3E-1
			Chemical Total (krig - 500 ft)			2E-5	2E-5				2.4E-1	2.4E-1
			Chemical Total (krig - 725 ft)			2E-5	2E-5				1.7E-1	1.7E-1
		Exposure Point Total	krig - 500 ft				2E-5					2.4E-1
		Exposure Point Total	krig - 725 ft				2E-5					1.7E-1
	Exposure Medium Total	krig - 500 ft					2E-5					2.4E-1
	Exposure Medium Total	krig - 725 ft					2E-5					1.7E-1
	Workspace Air	Workspace Air	Benzene (500 ft)		1E-6		1E-6			3E-2		2.8E-2
			Benzene (725 ft)		8E-7		8E-7			2E-2		1.9E-2
			Chemical Total (krig - 500 ft)		1E-6		1E-6			2.8E-2		2.8E-2
			Chemical Total (krig - 725 ft)		8E-7		8E-7			1.9E-2		1.9E-2
		Exposure Point Total	krig - 500 ft				1E-6					2.8E-2
		Exposure Point Total	krig - 725 ft				8E-7					1.9E-2
	Exposure Medium Total	krig - 500 ft					1E-6					2.8E-2
	Exposure Medium Total	krig - 725 ft					8E-7					1.9E-2
Medium Total	krig - 500 ft						3E-5					2.7E-1
Medium Total	krig - 725 ft						2E-5					1.9E-1
Receptor Total	krig - 500 ft						3E-3					6.8E+0
Receptor Total	krig - 725 ft						2E-3					5.2E+0

TABLE 10.15
RISK SUMMARY
TIER 2 CENTRAL EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: On-Site Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil Vapor	Indoor Air	Indoor Air Alameda Annex	Benzene (Alameda Annex)		1E-6		1E-6			2E-3		1.6E-3
			Chemical Total (Alameda Annex)		1E-6		1E-6			1.6E-3		1.6E-3
			Chemical Total (Alameda Point - Site 25)		0E+0		0E+0			0.0E+0		0.0E+0
			Chemical Total (Alameda Point - Site 30)		0E+0		0E+0			0.0E+0		0.0E+0
			Chemical Total (Alameda Point - Site 31)		0E+0		0E+0			0.0E+0		0.0E+0
		Exposure Point Total	(Alameda Annex)				1E-6					1.6E-3
		Exposure Point Total	(Alameda Point - Site 25)				0E+0					0.0E+0
		Exposure Point Total	(Alameda Point - Site 30)				0E+0					0.0E+0
		Exposure Point Total	(Alameda Point - Site 31)				0E+0					0.0E+0
	Exposure Medium Total	(Alameda Annex)					1E-6					1.6E-3
	Exposure Medium Total	(Alameda Point - Site 25)					0E+0					0.0E+0
	Exposure Medium Total	(Alameda Point - Site 30)					0E+0					0.0E+0
	Exposure Medium Total	(Alameda Point - Site 31)					0E+0					0.0E+0
Medium Total	(Alameda Annex)						1E-6					1.6E-3
Medium Total	(Alameda Point - Site 25)						0E+0					0.0E+0
Medium Total	(Alameda Point - Site 30)						0E+0					0.0E+0
Medium Total	(Alameda Point - Site 31)						0E+0					0.0E+0

TABLE 10.15
RISK SUMMARY
TIER 2 CENTRAL EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: On-Site Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Indoor Air	Indoor Air	Benzene (500 ft)		1E-5		1E-5			1E-2		1.5E-2
			Benzene (725 ft)		7E-6		7E-6			9E-3		9.5E-3
			Chemical Total (krig - 500 ft)		1E-5		1E-5			1.5E-2		1.5E-2
			Chemical Total (krig - 725 ft)		7E-6		7E-6			9.5E-3		9.5E-3
		Exposure Point Total	krig - 500 ft				1E-5					1.5E-2
		Exposure Point Total	krig - 725 ft				7E-6					9.5E-3
	Exposure Medium Total	krig - 500 ft					1E-5					1.5E-2
	Exposure Medium Total	krig - 725 ft					7E-6					9.5E-3
Medium Total	krig - 500 ft						1E-5					1.5E-2
Medium Total	krig - 725 ft						7E-6					9.5E-3
Groundwater[1] Potable Use	Potable Water	Potable Water	Arsenic	7E-4			7E-4	Skin	2.3E+0			2.3E+0
			Barium	NA			0E+0	Kidney	8.9E-1			8.9E-1
			Cadmium	4E-6			4E-6	Kidney	2.1E-1			2.1E-1
			Iron	NA			0E+0		4.2E+0			4.2E+0
			Manganese	NA			0E+0	CNS	5.6E-1			5.6E-1
			Thallium	NA			0E+0	Liver, Blood, Hair	4.7E+0			4.7E+0
			1,2-Dichloroethane	8E-6			8E-6		5.3E-2			5.3E-2
			Acetone	NA			0E+0	Liver, Kidney	3.2E+0			3.2E+0
			Benzo[a]anthracene	1E-4			1E-4		NA			0.0E+0
			Benzo[a]pyrene	2E-3			2E-3		NA			0.0E+0
			Benzo[b]fluoranthene	1E-4			1E-4		NA			0.0E+0
			Benzo[k]fluoranthene	6E-5			6E-5		NA			0.0E+0
			Chrysene	2E-5			2E-5		NA			0.0E+0
			Dibenz[a,h]anthracene	4E-5			4E-5		NA			0.0E+0

TABLE 10.15
RISK SUMMARY
TIER 2 CENTRAL EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: On-Site Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater[1] Potable Use	Potable Water	Potable Water	Ethylbenzene	1E-5			1E-5	Liver, Kidney	2.6E-1			2.6E-1
			Indeno(1,2,3-cd)pyrene	2E-4			2E-4		NA			0.0E+0
			Methylene chloride	8E-6			8E-6	Liver	9.6E-2			9.6E-2
			n-Butylbenzene	NA			0E+0		1.4E+0			1.4E+0
			Benzene (500 ft)	2E-4			2E-4		5.3E+0			5.3E+0
			Benzene (725 ft)	1E-4			1E-4		3.4E+0			3.4E+0
			Naphthalene (500 ft)	NA			0E+0	Respiratory	6.7E+0			6.7E+0
			Naphthalene (725 ft)	NA			0E+0	Respiratory	5.2E+0			5.2E+0
			Chemical Total (krig - 500 ft)	4E-3			4E-3		3.0E+1			3.0E+1
			Chemical Total (krig - 725 ft)	4E-3			4E-3		2.7E+1			2.7E+1
		Exposure Point Total	krig - 500 ft				4E-3					2.7E+1
		Exposure Point Total	krig - 725 ft				4E-3					2.7E+1
	Exposure Medium Total	krig - 500 ft					4E-3					2.7E+1
	Exposure Medium Total	krig - 725 ft					4E-3					2.7E+1
	Indoor Air	Indoor Air	1,2,4-Trimethylbenzene		NA		0E+0			6E+0		5.8E+0
			1,2-Dichloroethane		7E-5		7E-5			6E+0		6.3E+0
			1,3,5-Trimethylbenzene		NA		0E+0			3E+0		3.0E+0
			Benzo[b]fluoranthene		2E-4		2E-4			NA		0.0E+0
			Chrysene		3E-5		3E-5			NA		0.0E+0
			Ethylbenzene		6E-5		6E-5	Developmental		5E-1		4.9E-1
			Methylene chloride		1E-5		1E-5			4E-2		3.7E-2
			Toluene		NA		0E+0	CNS, Respiratory		1E+0		1.0E+0
			Xylenes (total)		NA		0E+0	CNS		3E+0		2.6E+0
			Benzene (500 ft)		9E-4		9E-4			3E+1		2.9E+1

TABLE 10.15
RISK SUMMARY
TIER 2 CENTRAL EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: On-Site Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater[1] Potable Use	Indoor Air	Indoor Air	Benzene (725 ft)		6E-4		6E-4			2E+1		1.9E+1
			Naphthalene (500 ft)		NA		0E+0	Respiratory		4E+0		3.7E+0
			Naphthalene (725 ft)		NA		0E+0	Respiratory		3E+0		2.8E+0
			Chemical Total (krig - 500 ft)		1E-3		1E-3			5.2E+1		5.2E+1
			Chemical Total (krig - 725 ft)		1E-3		1E-3			4.1E+1		4.1E+1
		Exposure Point Total	krig - 500 ft				1E-3					5.2E+1
		Exposure Point Total	krig - 725 ft				1E-3					4.1E+1
	Exposure Medium Total	krig - 500 ft					1E-3					5.2E+1
	Exposure Medium Total	krig - 725 ft					1E-3					4.1E+1
Medium Total	krig - 500 ft						5E-3					7.9E+1
Medium Total	krig - 725 ft						5E-3					6.8E+1
Current Receptor Total (Inhalation via Soil Vapor at Alameda Annex)							1E-6					1.6E-3
Current Receptor Total (Inhalation via Soil Vapor at Alameda Point - Site 25)							0E+0					0.0E+0
Current Receptor Total (Inhalation via Soil Vapor at Alameda Point - Site 30)							0E+0					0.0E+0
Current Receptor Total (Inhalation via Soil Vapor at Alameda Point - Site 31)							0E+0					0.0E+0
Current Receptor Total (Inhalation via Groundwater) krig - 500 ft							1E-5					1.5E-2
Current Receptor Total (Inhalation via Groundwater) krig - 725 ft							7E-6					9.5E-3
Future Receptor Total (Potable Water Use (krig - 500 ft) + Inhalation via Soil Vapor at Alameda Annex)							5E-3					7.9E+1
Future Receptor Total (Potable Water Use (krig - 500 ft) + Inhalation via Soil Vapor at Alameda Point - Site 25)							5E-3					6.8E+1
Future Receptor Total (Potable Water Use (krig - 500 ft) + Inhalation via Soil Vapor at Alameda Point - Site 30)							1E-6					1.6E-3
Future Receptor Total (Potable Water Use (krig - 500 ft) + Inhalation via Soil Vapor at Alameda Point - Site 31)							0E+0					0.0E+0
Future Receptor Total (Potable Water Use (krig - 725 ft) + Inhalation via Soil Vapor at Alameda Annex)							5E-3					6.8E+1
Future Receptor Total (Potable Water Use (krig - 725 ft) + Inhalation via Soil Vapor at Alameda Point - Site 25)							1E-6					1.6E-3
Future Receptor Total (Potable Water Use (krig - 725 ft) + Inhalation via Soil Vapor at Alameda Point - Site 30)							0E+0					0.0E+0
Future Receptor Total (Potable Water Use (krig - 725 ft) + Inhalation via Soil Vapor at Alameda Point - Site 31)							0E+0					0.0E+0
Future Receptor Total (Potable Water Use + Inhalation via Groundwater) krig - 500 ft							5E-3					7.9E+1
Future Receptor Total (Potable Water Use + Inhalation via Groundwater) krig - 725 ft							5E-3					6.8E+1

[1] - Groundwater potable use is a future use scenario.

TABLE 10.16
RISK SUMMARY
TIER 2 REASONABLE MAXIMUM EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: On-Site Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil Vapor	Indoor Air	Indoor Air Alameda Annex	Benzene (Alameda Annex)		1E-6		1E-6			2E-3		1.6E-3
			Chemical Total (Alameda Annex)		1E-6		1E-6			1.6E-3		1.6E-3
			Chemical Total (Alameda Point - Site 25)		0E+0		0E+0			0.0E+0		0.0E+0
			Chemical Total (Alameda Point - Site 30)		0E+0		0E+0			0.0E+0		0.0E+0
			Chemical Total (Alameda Point - Site 31)		0E+0		0E+0			0.0E+0		0.0E+0
		Exposure Point Total	(Alameda Annex)				1E-6					1.6E-3
		Exposure Point Total	(Alameda Point - Site 25)				0E+0					0.0E+0
		Exposure Point Total	(Alameda Point - Site 30)				0E+0					0.0E+0
		Exposure Point Total	(Alameda Point - Site 31)				0E+0					0.0E+0
	Exposure Medium Total	(Alameda Annex)					1E-6					1.6E-3
	Exposure Medium Total	(Alameda Point - Site 25)					0E+0					0.0E+0
	Exposure Medium Total	(Alameda Point - Site 30)					0E+0					0.0E+0
	Exposure Medium Total	(Alameda Point - Site 31)					0E+0					0.0E+0
Medium Total	(Alameda Annex)						1E-6					1.6E-3
Medium Total	(Alameda Point - Site 25)						0E+0					0.0E+0
Medium Total	(Alameda Point - Site 30)						0E+0					0.0E+0
Medium Total	(Alameda Point - Site 31)						0E+0					0.0E+0

TABLE 10.16
RISK SUMMARY
TIER 2 REASONABLE MAXIMUM EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: On-Site Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Indoor Air	Indoor Air	Benzene (500 ft)		1E-5		1E-5			1E-2		1.5E-2
			Benzene (725 ft)		7E-6		7E-6			9E-3		9.5E-3
			Chemical Total (krig - 500 ft)		1E-5		1E-5			1.5E-2		1.5E-2
			Chemical Total (krig - 725 ft)		7E-6		7E-6			9.5E-3		9.5E-3
		Exposure Point Total	krig - 500 ft				1E-5					1.5E-2
		Exposure Point Total	krig - 725 ft				7E-6					9.5E-3
	Exposure Medium Total	krig - 500 ft					1E-5					1.5E-2
	Exposure Medium Total	krig - 725 ft					7E-6					9.5E-3
Medium Total	krig - 500 ft						1E-5					1.5E-2
Medium Total	krig - 725 ft						7E-6					9.5E-3
Groundwater[1] Potable Use	Potable Water	Potable Water	Arsenic	3E-3			3E-3	Skin	4.7E+0			4.7E+0
			Barium	NA			0E+0	Kidney	1.8E+0			1.8E+0
			Cadmium	2E-5			2E-5	Kidney	4.1E-1			4.1E-1
			Iron	NA			0E+0		8.5E+0			8.5E+0
			Manganese	NA			0E+0	CNS	1.1E+0			1.1E+0
			Thallium	NA			0E+0	Liver, Blood, Hair	9.3E+0			9.3E+0
			1,2-Dichloroethane	3E-5			3E-5		1.1E-1			1.1E-1
			Acetone	NA			0E+0	Liver, Kidney	6.4E+0			6.4E+0
			Benzo[a]anthracene	5E-4			5E-4		NA			0.0E+0
			Benzo[a]pyrene	1E-2			1E-2		NA			0.0E+0
			Benzo[b]fluoranthene	5E-4			5E-4		NA			0.0E+0
			Benzo[k]fluoranthene	2E-4			2E-4		NA			0.0E+0
			Chrysene	8E-5			8E-5		NA			0.0E+0
			Dibenz[a,h]anthracene	2E-4			2E-4		NA			0.0E+0
			Ethylbenzene	5E-5			5E-5	Liver, Kidney	5.1E-1			5.1E-1

TABLE 10.16
RISK SUMMARY
TIER 2 REASONABLE MAXIMUM EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: On-Site Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater[1] Potable Use	Potable Water	Potable Water	Indeno(1,2,3-cd)pyrene	8E-4			8E-4		NA			0.0E+0
			Methylene chloride	4E-5			4E-5	Liver	1.9E-1			1.9E-1
			n-Butylbenzene	NA			0E+0		2.9E+0			2.9E+0
			Benzene (500 ft)	7E-4			7E-4		1.1E+1			1.1E+1
			Benzene (725 ft)	5E-4			5E-4		6.9E+0			6.9E+0
			Naphthalene (500 ft)	NA			0E+0	Respiratory	1.3E+1			1.3E+1
			Naphthalene (725 ft)	NA			0E+0	Respiratory	1.0E+1			1.0E+1
			Chemical Total (krig - 500 ft)	2E-2			2E-2		6.0E+1			6.0E+1
			Chemical Total (krig - 725 ft)	2E-2			2E-2		5.3E+1			5.3E+1
		Exposure Point Total	krig - 500 ft				2E-2					5.3E+1
		Exposure Point Total	krig - 725 ft				2E-2					5.3E+1
	Exposure Medium Total	krig - 500 ft					2E-2					5.3E+1
	Exposure Medium Total	krig - 725 ft					2E-2					5.3E+1
	Indoor Air	Indoor Air	1,2,4-Trimethylbenzene		NA		0E+0			8E+0		7.8E+0
			1,2-Dichloroethane		7E-5		7E-5			6E+0		6.3E+0
			1,3,5-Trimethylbenzene		NA		0E+0			3E+0		3.0E+0
			Benzo[b]fluoranthene		2E-4		2E-4			NA		0.0E+0
			Chrysene		3E-5		3E-5			NA		0.0E+0
			Ethylbenzene		6E-5		6E-5	Developmental		5E-1		4.9E-1
			Methylene chloride		1E-5		1E-5			4E-2		3.7E-2
			Toluene		NA		0E+0	CNS, Respiratory		1E+0		1.0E+0
			Xylenes (total)		NA		0E+0	CNS		3E+0		2.6E+0
			Benzene (500 ft)		9E-4		9E-4			3E+1		2.9E+1
			Benzene (725 ft)		6E-4		6E-4			2E+1		1.9E+1

TABLE 10.16
RISK SUMMARY
TIER 2 REASONABLE MAXIMUM EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: On-Site Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater[1] Potable Use	Indoor Air	Indoor Air	Naphthalene (500 ft)		NA		0E+0	Respiratory		4E+0		3.7E+0
			Naphthalene (725 ft)		NA		0E+0	Respiratory		3E+0		2.8E+0
			Chemical Total (krig - 500 ft)		1E-3		1E-3			5.4E+1		5.4E+1
			Chemical Total (krig - 725 ft)		1E-3		1E-3			4.3E+1		4.3E+1
		Exposure Point Total	krig - 500 ft				1E-3					5.4E+1
		Exposure Point Total	krig - 725 ft				1E-3					4.3E+1
	Exposure Medium Total	krig - 500 ft					1E-3					5.4E+1
	Exposure Medium Total	krig - 725 ft					1E-3					4.3E+1
Medium Total	krig - 500 ft						2E-2					1.1E+2
Medium Total	krig - 725 ft						2E-2					9.6E+1
Current Receptor Total (Inhalation via Soil Vapor at Alameda Annex)							1E-6					1.6E-3
Current Receptor Total (Inhalation via Soil Vapor at Alameda Point - Site 25)							0E+0					0.0E+0
Current Receptor Total (Inhalation via Soil Vapor at Alameda Point - Site 30)							0E+0					0.0E+0
Current Receptor Total (Inhalation via Soil Vapor at Alameda Point - Site 31)							0E+0					0.0E+0
Current Receptor Total (Inhalation via Groundwater) krig - 500 ft							1E-5					1.5E-2
Current Receptor Total (Inhalation via Groundwater) krig - 725 ft							7E-6					9.5E-3
Future Receptor Total (Potable Water Use (krig - 500 ft) + Inhalation via Soil Vapor at Alameda Annex)							2E-2					1.1E+2
Future Receptor Total (Potable Water Use (krig - 500 ft) + Inhalation via Soil Vapor at Alameda Point - Site 25)							2E-2					9.6E+1
Future Receptor Total (Potable Water Use (krig - 500 ft) + Inhalation via Soil Vapor at Alameda Point - Site 30)							1E-6					1.6E-3
Future Receptor Total (Potable Water Use (krig - 500 ft) + Inhalation via Soil Vapor at Alameda Point - Site 31)							0E+0					0.0E+0
Future Receptor Total (Potable Water Use (krig - 725 ft) + Inhalation via Soil Vapor at Alameda Annex)							2E-2					9.6E+1
Future Receptor Total (Potable Water Use (krig - 725 ft) + Inhalation via Soil Vapor at Alameda Point - Site 25)							1E-6					1.6E-3
Future Receptor Total (Potable Water Use (krig - 725 ft) + Inhalation via Soil Vapor at Alameda Point - Site 30)							0E+0					0.0E+0
Future Receptor Total (Potable Water Use (krig - 725 ft) + Inhalation via Soil Vapor at Alameda Point - Site 31)							0E+0					0.0E+0
Future Receptor Total (Potable Water Use + Inhalation via Groundwater) krig - 500 ft							2E-2					1.1E+2
Future Receptor Total (Potable Water Use + Inhalation via Groundwater) krig - 725 ft							2E-2					9.6E+1

[1] - Groundwater potable use is a future use scenario.

TABLE 10.17
RISK SUMMARY
TIER 2 CENTRAL EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: School Student
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil Vapor	Indoor Air	Indoor Air			NA		NA			NA		NA
			Chemical Total		0E+0		0E+0			0.0E+0		0.0E+0
		Exposure Point Total					0E+0					0.0E+0
	Exposure Medium Total						0E+0					0.0E+0
Medium Total							0E+0					0.0E+0
Groundwater	Indoor Air	Indoor Air	Benzene (500 ft) Benzene (725 ft)		1E-6 7E-7		1E-6 7E-7			7E-3 5E-3		7.5E-3 4.9E-3
			Chemical Total (krig - 500 ft)		1E-6		1E-6			7.5E-3		7.5E-3
			Chemical Total (krig - 725 ft)		7E-7		7E-7			4.9E-3		4.9E-3
		Exposure Point Total krig - 500 ft					1E-6					7.5E-3
		Exposure Point Total krig - 725 ft					7E-7					4.9E-3
	Exposure Medium Total krig - 500 ft						1E-6					7.5E-3
	Exposure Medium Total krig - 725 ft						7E-7					4.9E-3
Medium Total krig - 500 ft							1E-6					7.5E-3
Medium Total krig - 725 ft							7E-7					4.9E-3
Receptor Total (Inhalation via Soil Vapor)							0E+0					0.0E+0
Receptor Total (Inhalation via Groundwater) krig - 500 ft							1E-6					7.5E-3
Receptor Total (Inhalation via Groundwater) krig - 725 ft							7E-7					4.9E-3

TABLE 10.18
RISK SUMMARY
TIER 2 REASONABLE MAXIMUM EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: School Student
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil Vapor	Indoor Air	Indoor Air			NA		NA			NA		NA
			Chemical Total		0E+0		0E+0			0.0E+0		0.0E+0
		Exposure Point Total					0E+0					0.0E+0
	Exposure Medium Total						0E+0					0.0E+0
Medium Total							0E+0					0.0E+0
Groundwater	Indoor Air	Indoor Air	Benzene (500 ft) Benzene (725 ft)		1E-6 7E-7		1E-6 7E-7			7E-3 5E-3		7.5E-3 4.9E-3
			Chemical Total (krig - 500 ft)		1E-6		1E-6			7E-3		7.5E-3
			Chemical Total (krig - 725 ft)		7E-7		7E-7			5E-3		4.9E-3
		Exposure Point Total krig - 500 ft					1E-6					7.5E-3
		Exposure Point Total krig - 725 ft					7E-7					4.9E-3
	Exposure Medium Total krig - 500 ft						1E-6					7.5E-3
	Exposure Medium Total krig - 725 ft						7E-7					4.9E-3
Medium Total krig - 500 ft							1E-6					7.5E-3
Medium Total krig - 725 ft							7E-7					4.9E-3
Receptor Total (Inhalation via Soil Vapor)							0E+0					0.0E+0
Receptor Total (Inhalation via Groundwater) krig - 500 ft							1E-6					7.5E-3
Receptor Total (Inhalation via Groundwater) krig - 725 ft							7E-7					4.9E-3

TABLE 10.19
RISK SUMMARY
TIER 2 CENTRAL EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: School Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil Vapor	Indoor Air	Indoor Air			NA		0E+0			NA		0.0E+0
			Chemical Total		NA		0E+0			NA		0.0E+0
		Exposure Point Total					0E+0					0.0E+0
	Exposure Medium Total						0E+0					0.0E+0
Medium Total							0E+0					0.0E+0
Groundwater	Indoor Air	Indoor Air	Benzene (500 ft)		6E-6		6E-6			1E-2		1.0E-2
			Benzene (725 ft)		4E-6		4E-6			7E-3		6.8E-3
			Chemical Total (krig - 500 ft)		6E-6		6E-6			1.0E-2		1.0E-2
			Chemical Total (krig - 725 ft)		4E-6		4E-6			6.8E-3		6.8E-3
		Exposure Point Total	krig - 500 ft				6E-6					1.0E-2
		Exposure Point Total	krig - 725 ft				4E-6					6.8E-3
	Exposure Medium Total	krig - 500 ft					6E-6					1.0E-2
	Exposure Medium Total	krig - 725 ft					4E-6					6.8E-3
Medium Total	krig - 500 ft						6E-6					1.0E-2
Medium Total	krig - 725 ft						4E-6					6.8E-3

TABLE 10.19
RISK SUMMARY
TIER 2 CENTRAL EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: School Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Receptor Total (Inhalation via Soil Vapor)							0E+0					0.0E+0
Receptor Total (Inhalation via Groundwater) krig - 500 ft							6E-6					1.0E-2
Receptor Total (Inhalation via Groundwater) krig - 725 ft							4E-6					6.8E-3

TABLE 10.20
RISK SUMMARY
TIER 2 REASONABLE MAXIMUM EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: School Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil Vapor	Indoor Air	Indoor Air			NA		0E+0			NA		0.0E+0
			Chemical Total		NA		0E+0			NA		0.0E+0
		Exposure Point Total					0E+0					0.0E+0
	Exposure Medium Total						0E+0					0.0E+0
Medium Total							0E+0					0.0E+0
Groundwater	Indoor Air	Indoor Air	Benzene (500 ft)		6E-6		6E-6			1E-2		1.0E-2
			Benzene (725 ft)		4E-6		4E-6			7E-3		6.8E-3
			Chemical Total (krig - 500 ft)		6E-6		6E-6			1.0E-2		1.0E-2
			Chemical Total (krig - 725 ft)		4E-6		4E-6			6.8E-3		6.8E-3
		Exposure Point Total	krig - 500 ft				6E-6					1.0E-2
		Exposure Point Total	krig - 725 ft				4E-6					6.8E-3
	Exposure Medium Total	krig - 500 ft					6E-6					1.0E-2
	Exposure Medium Total	krig - 725 ft					4E-6					6.8E-3
Medium Total	krig - 500 ft						6E-6					1.0E-2
Medium Total	krig - 725 ft						4E-6					6.8E-3

TABLE 10.20
RISK SUMMARY
TIER 2 REASONABLE MAXIMUM EXPOSURE
FISCO ALAMEDA FACILITY/ANNEX SITE

Scenario Timeframe: Current/Future
Receptor Population: School Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Receptor Total (Inhalation via Soil Vapor)							0E+0					0.0E+0
Receptor Total (Inhalation via Groundwater) krig - 500 ft							6E-6					1.0E-2
Receptor Total (Inhalation via Groundwater) krig - 725 ft							4E-6					6.8E-3

APPENDIX A

FATE AND TRANSPORT MODELING TABLES

TABLE A-1
CASH WASH WATER USE PARAMETERS
FISCO ALAMEDA FACILITY/ANNEX SITE

Parameter	Abbrev.	Units	Average	RME
Water Flow[a]		gal./min	2.3	3.5
Water Flow - Unit Change[b]	W	L/sec	0.14	0.22
Fraction of Day Spraying Water[c]	FD	--	0.38	0.63
Adjusted Water Flow[d]		L/sec	0.05	0.14

[a]Based communications with Custom Craft and Pro Equipment Co. (1999).

[b]3.8 L/gallon x min/60sec

[c]Based on car wash water exposure time (See Table 8).

[d]W × FD

TABLE A-2
CHEMICAL PROPERTIES
FISCO ALAMEDA FACILITY/ANNEX SITE

Substance	Molecular Weight (g/mol)	H (Pa-L/mol)	Dair (m^2/s)	Dwater (m^2/s)	Mass transfer Efficiency (water to air)
1,2-Dichloroethane	99	5.7E+05	7.4E-06	1.1E-09	0.74
cis-1,2-Dichloroethene	99	9.9E+04	1.0E-05	9.9E-10	0.70
Acetone	58	3.9E+03	1.2E-05	1.1E-09	0.52
Benzene	78	5.6E+05	8.8E-06	9.8E-10	0.71
Chloroform	119	3.7E+05	1.0E-05	1.0E-09	0.72
Ethylbenzene	106	8.0E+05	7.5E-06	7.8E-10	0.61
Styrene	104	2.8E+05	7.1E-06	8.0E-10	0.62
Toluene	92	6.7E+05	8.7E-06	8.6E-10	0.65
Vinyl Chloride	63	2.7E+06	1.1E-05	1.2E-10	0.50
Xylenes (total)	106	6.8E+05	7.80E-06	8.75E-10	0.66
1,1,1,2-Tetrachloroethane	168	3.5E+04	7.10E-06	7.90E-10	0.58
1,2,4-Trimethylbenzene	120	5.8E+05	7.50E-06	7.10E-10	0.57
1,2-Dichlorobenzene	147	1.9E+05	6.90E-06	7.90E-10	0.61
1,3,5-Trimethylbenzene	120	7.8E+05	7.50E-06	7.10E-10	0.57
2-Butanone	72	2.8E+03	8.95E-06	9.80E-10	0.39
Acenaphthene	154	1.6E+04	4.21E-06	7.69E-10	0.50
Anthracene	178	6.6E+03	3.24E-06	7.74E-10	0.50
Benzo[b]fluoranthene	252	1.1E+04	2.26E-06	5.56E-10	0.50
Bromodichloromethane	164	1.6E+05	2.98E-06	1.06E-09	0.73
Carbon disulfide	76	3.1E+06	1.04E-05	1.00E-09	0.72
Chloromethane	51	2.4E+06	1.09E-05	6.50E-10	0.54
Chrysene	228	9.6E+03	2.48E-06	6.21E-10	0.50
Dibromochloromethane	208	8.6E+04	9.60E-06	1.00E-09	0.70
Dichlorodifluoromethane	121	1.0E+07	8.00E-06	1.05E-09	0.74
trans-1,2-Dichloroethene	99	9.9E+04	1.0E-05	9.9E-10	0.70
Fluorene	166	7.8E+03	6.08E-06	7.88E-10	0.50
Isopropyl benzene	120	1.2E+06	7.50E-06	7.10E-10	0.57
Methyl isobutyl ketone	100	1.4E+04	7.50E-06	7.80E-10	0.53
Methylene chloride	85	2.2E+05	1.01E-05	1.17E-09	0.79
MTBE	85	6.0E+04	8.00E-06	1.00E-09	0.69
Naphthalene	128	4.9E+04	5.90E-06	7.50E-10	0.57
n-Butylbenzene	134	1.3E+06	7.50E-06	7.80E-10	0.61
n-Propylbenzene	121	1.3E+06	7.50E-06	7.80E-10	0.61
Pyrene	200	1.1E+03	2.72E-06	7.24E-10	0.50
sec-Butylbenzene	134.22	1.9E+06	7.50E-06	7.80E-10	0.61

TABLE A-3

OUTDOOR AIR MODELING-CAR WASH SCENARIO[a]

FISCO ALAMEDA FACILITY/ANNEX SITE

Parameter	Abbrev.	Units	Value
Emission rate[b]	E	mg/sec	1.0 E+0
Length dimension perpendicular to the wind[c]	LS	m	30.48
Effective mixing height[d]	MH	m	2.0
Wind speed[e]	V	m/s	2.25
Ambient outdoor air concentration per unit flux[f]	C_n	mg/m^3 per mg/sec	3.6 E-2

[a]Based on DTSC (1994).

[b]Unit emission rate from water use.

[c] Based unit area of 100 ft × 100 ft.

[d]A mixing height of 2 meters (*i.e.* , the breathing zone) is used.

[e]Based on default wind speed (DTSC, 1994)

[f](E) / (LS × V × MH).

TABLE A-4

IRRIGATION WATER USE CALCULATIONS

FISCO ALAMEDA FACILITY/ANNEX SITE

Parameter	Abbrev.	Units	Average	RME
Irrigation Application[a]	IR	m/day	0.0033	0.0076
Water application volume per area[b]		m^3/m^2-d	0.0033	0.0076
Water application area adjusted[c]	AV	L/m^2-d	3.3	7.6
Daily exposure[d]	ET	hr/d	8.00	8.00
Daily exposure[e]	ET	sec/d	28,800	28,800
Water Application Rate[f]	AR_I	L/m^2-sec	0.00012	0.00026

[a]Based on estimated turf water demands (Waterrights, 1999).

[b]IR x m^2/m^2.

[c]1000 L/m^3.

[d]From daily exposure time for landscape worker (See Table 4), used to estimate average outdoor air exposure concentration during workday.

[e]8hr/d x 60min/hr x 60sec/min.

[f]AV / ET.

TABLE A-5

LANDSCAPE WORKER OUTDOOR AIR MODELING[a]

FISCO ALAMEDA FACILITY/ANNEX SITE

Parameter	Abbrev.	Units	Value
Unit emission rate[b]	E'	mg/m^2-sec	1.0 E+0
Area of contamination[c]	A	m^2	929
Emission rate[d]	E	mg/sec	9.3 E+2
Length dimension perpendicular to the wind [c]	LS	m	30.48
Effective mixing height[e]	MH	m	2.0
Wind speed[f]	V	m/s	2.25
Ambient outdoor air concentration per unit flux[g]	C_a	mg/m^3 per mg/m^2-sec	6.8 E+0

[a]Based on DTSC (1994).

[b]Unit flux (E') from soil. Actual flux is chemical specific and is entered in the exposure tables.

[c] Based unit area of 100 ft × 100 ft.

[d]E' × A

[e]A mixing height of 2 meters (*i.e.* , the breathing zone) is used.

[f]Based on default wind speed (DTSC, 1994)

[g](E) / (LS × V × MH).

TABLE A-6
TIER 1 JOHNSON AND ETTINGER INPUT PARAMETERS
FISCO ALAMEDA FACILITY/ANNEX SITE

Parameter	Abbrev.	RME Value	Units	Reference
Depth below grade to bottom of enclosed space floor	Lf	15	cm	EPA, 1997 default
Depth below grade to water table	Lwt	219	cm	site-specific
Depth below grade to shallow soil gas	Lsgs	61	cm	site-specific
Depth below grade to deep soil gas	Lsgd	183	cm	site-specific
SCS soil type directly above aquifer	IR	SL	--	site-specific
Average soil groundwater temperature	Ts	10	°C	EPA, 1997 default
Vadose SCS soil type	IR	SL	--	site-specific
Vadose zone soil dry bulk density	ρ_b^V	1.5	(g/cm^3)	EPA, 1997 based on soil type
Vadose zone soil total porosity	n^V	0.41	(cm^3/cm^3)	EPA, 1997 based on soil type
Vadose zone soil water-filled porosity	θ_w^V	0.3	(cm^3/cm^3)	EPA, 1997 based on soil type

TABLE A-7

CHEMICAL PROPERTIES FOR CALCULATING

DERMAL ABSORPTION FROM WATER[a]

FISCO ALAMEDA FACILITY/ANNEX SITE

Chemical	Dermal Permeability Coefficient K_p (cm/hr)
Aluminum	1.0 E-3
Antimony	1.0 E-3
Arsenic	1.0 E-3
Barium	1.0 E-3
Beryllium	1.0 E-3
Cadmium	1.0 E-3
Calcium	1.0 E-3
Chloride	1.0 E-3
Chromium	2.0 E-3
Cobalt	1.0 E-3
Copper	1.0 E-3
Iron	1.0 E-3
Lead	1.0 E-3
Magnesium	1.0 E-3
Manganese	1.0 E-3
Mercury	1.0 E-3
Molybdenum	1.0 E-3
Nickel	2.0 E-4
Nitrate	1.0 E-3
Potassium	1.0 E-3
Selenium	1.0 E-3
Silver	6.0 E-4
Sodium	1.0 E-3
Thallium	1.0 E-3
Vanadium	1.0 E-3
Zinc	6.0 E-4
Benzene	1.5 E-2
cis-1,2-Dichloroethene	7.7 E-3
trans-1,2-Dichloroethene	7.7 E-3
Toluene	3.1 E-2
1,1,1,2-Tetrachloroethane	6.9 E-3
1,2-Dichlorobenzene	4.0 E-2
1,2-Dichloroethane	4.2 E-2
1,2-Dichloropropane	7.8 E-3
1,4-Dichlorobenzene	4.2 E-2
Acetone	1.1 E-3
Chloroform	6.8 E-3
Methylene Chloride	3.5 E-3
1,2,4-Trimethylbenzene	0.0 E+0
1,3,5-Trimethylbenzene	0.0 E+0
2-Butanone	9.6 E-4
4-Isopropyltoluene	0.0 E+0
Acenaphthene	0.0 E+0

TABLE A-7

CHEMICAL PROPERTIES FOR CALCULATING

DERMAL ABSORPTION FROM WATER[a]

FISCO ALAMEDA FACILITY/ANNEX SITE

Chemical	Dermal Permeability Coefficient K_p (cm/hr)
Acenaphthylene	
Anthracene	0.0 E+0
Benzo[a]anthracene	0.0 E+0
Benzo[a]pyrene	0.0 E+0
Benzo[b]fluoranthene	0.0 E+0
Benzo[g,h,I]perylene	0.0 E+0
Benzo[k]fluoranthene	0.0 E+0
Bromodichloromethane	4.6 E-3
Carbon disulfide	1.7 E-2
chloromethane	3.3 E-3
Chrysene	0.0 E+0
Dibenz[a,h]anthracene	0.0 E+0
Dibromochloromethane	4.6 E-3
Dichlorodifluoromethane	9.0 E-3
Ethylbenzene	4.9 E-2
Fluoranthene	0.0 E+0
Fluorene	0.0 E+0
Indeno(1,2,3-cd)pyrene	0.0 E+0
Isopropyl benzene	3.1 E-2
Methyl isobutyl ketone	4.0 E-3
MTBE	3.9 E-3
Naphthalene	4.7 E-2
n-Butylbenzene	0.0 E+0
n-Propylbenzene	0.0 E+0
Phenanthrene	0.0 E+0
Pyrene	0.0 E+0
sec-Butylbenzene	0.0 E+0
Styrene	3.7 E-2
Vinyl chloride	5.6 E-3
Xylenes (total)	5.3 E-2

[a]Calculation from EPA (2001b). See text for explanation.

TABLE A-8
TIER 2 JOHNSON AND ETTINGER INPUT PARAMETERS
FISCO ALAMEDA FACILITY/ANNEX SITE

Parameter	Abbrev.	RME Value	Units	Reference
Depth below grade to bottom of enclosed space floor	Lf	15	cm	EPA, 1997 default
Depth below grade to water table	Lwt	219	cm	site-specific
Depth below grade to shallow soil gas	Lsgs	61	cm	site-specific
Depth below grade to deep soil gas	Lsgd	183	cm	site-specific
SCS soil type directly above aquifer	IR	SL	--	site-specific
Average soil groundwater temperature	Ts	10	°C	EPA, 1997 default
Vadose SCS soil type	IR	SL	--	site-specific
Vadose zone soil dry bulk density	ρ_b^V	1.5	(g/cm^3)	EPA, 1997 based on soil type
Vadose zone soil total porosity	n^V	0.41	(cm^3/cm^3)	EPA, 1997 based on soil type
Vadose zone soil water-filled porosity	θ_w^V	0.3	(cm^3/cm^3)	EPA, 1997 based on soil type
Exposure frequency, Current/future student child	EF	180	days/year	Calif. Education Code #46200
Exposure frequency, Current/future site worker	EF	250	days/year	DTSC, 1992, 1994
Exposure duration, Current/future student child	ED	6	years	DTSC, 1992, 1994
Exposure duration, Current/future site worker	ED	25	years	DTSC, 1992, 1994

Appendix F
Monitored Natural Attenuation Description

APPENDIX F – MNA DESCRIPTION

MNA Description

As previously detailed within the main sections of this report, monitored natural attenuation (MNA) uses a set of natural processes to degrade contaminants in situ. Monitoring and documenting these natural processes over time, usually through a carefully designed monitoring well network, is referred to as MNA.

The primary natural processes utilized in MNA are dispersion, dilution, sorption, volatilization, solubility and biodegradation. Of these processes, biodegradation is the largest factor in significantly reducing the mass of a contaminant in groundwater. The available body of information suggests that the major agents causing biological transformations are the indigenous microorganisms, such as yeast, fungi and bacteria, present in the subsurface. These microorganisms act to convert, or break down a contaminant into other substances. In many cases the final end products are innocuous, such as CO_2 and water, but in some cases, interim byproducts may be even more toxic than the original contaminant. The primary contaminant in the present study area is benzene, which breaks down into innocuous CO_2 and water.

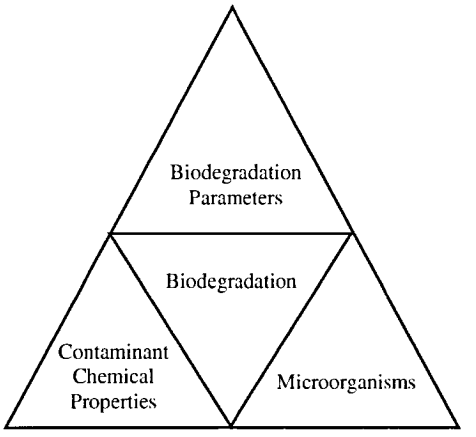
Microorganisms have the ability to degrade, or metabolize, substances in the presence of oxygen or without oxygen, with the help of other nutrients, such as nitrogen (N), phosphorous (P), sulfur (S), and other trace substances. Most natural systems have the necessary amounts of N, P, and S, but may have other limiting conditions for natural degradation. Degradation occurring in the presence of oxygen is referred to as aerobic, and degradation occurring without oxygen is referred to as anaerobic. A useful measurement to determine if conditions are aerobic or anaerobic is a dissolved oxygen (DO) reading. Aerobic environments typically have DO readings ranging from 3-5 parts per million (ppm), and anaerobic environments have DO readings less than 2 ppm.

During the process of degradation, contaminants are broken down via biological oxidation, where electron donors and electron acceptors are combined to produce energy for microbial growth and metabolic byproducts. The contaminant serves as the electron donor and in aerobic environments, dissolved oxygen acts as the electron acceptor in the process.

Degradation in anaerobic environments uses nitrate, manganese, iron, sulfate, and carbon dioxide to help complete the process. Anaerobic reactions can be further divided into anaerobic respiration, fermentation, and methane fermentation. The availability of electron acceptors is usually the limiting factor in biodegradation.

An additional useful tool in understanding biodegradation is the "Biodegradation Triangle", shown below. As shown, complete understanding of a biodegradation process can be achieved by studying:

1). The microbial community present in the subsurface
2). Site-specific environmental conditions (degradation parameters)
3). The contaminant chemical properties (biodegradation potential)



"The Biodegradation Triangle"

When all of these factors are present, contaminants can be degraded or transformed into either interim by-products, or directly into more innocuous end-products. Microbial transformations of organic compounds are frequently described by the terms, degradation, mineralization, detoxification, and activation. Degradation means that the initial contaminant no longer exists. Mineralization refers to the complete conversion of organic structure to inorganic forms such as CO_2, H2O, and Cl-. Detoxification is the transformation of the compound to some intermediate form that is nontoxic, or less toxic. The process of forming toxic end products or intermediate products is known as activation.

Biodegradation of Aromatic Hydrocarbons

Because benzene is one of the primary COCs, its natural degradation potential, as well as the potentials of the other BTEX (benzene, toluene, ethylbenzne, and xylene) compounds, is of particular interest. BTEX compounds are classified as aromatic hydrocarbons, which contain the benzene ring as their parent structure. BTEX compounds have been shown to "biodegrade" in both aerobic and anaerobic environments. Almost all dissolved petroleum hydrocarbons have been found to be biodegradable under aerobic conditions, where microorganisms use O_2 as the electron acceptor and contaminants as the food source for their growth and energy. Petroleum hydrocarbons do however have differing degradation properties, and benzene has a slower degradation rate than the other BTEX compounds.

Microorganisms capable of metabolizing single-ring aromatic hydrocarbons are usually ubiquitous in the subsurface. Given the site specifics of Alameda Point/Annex (high organic content from previous bay sediments, shallow groundwater, and unconfined aquifer), it can be assumed that microorganisms are also ubiquitous at Alameda Point.

Biodegradation of BTEX compounds under aerobic conditions can occur by one of two modes: 1) a dioxygenase route, which involves the insertion of two oxygen groups; the benzene molecule is transformed to a smaller size, gradually "breaking off" CO2 units; and 2) oxidation of any alkyl substitutes in the ring. After aerobic degradation has depleted the dissolved oxygen source, the process becomes anaerobic.

Under anaerobic conditions, microorganisms will begin to use nitrate as the electron acceptor. Once the available oxygen and nitrate are depleted, microorganisms may use oxidized ferric ion (Fe(III)) as an electron acceptor. When the redox conditions are further reduced, sulfate may act as the electron acceptor. Under significantly lower redox conditions (within the heart of the plume), methanogenic conditions will exist and the microorganisms can degrade the contaminants using water as the electron acceptor. These processes can be referred to as denitrifying, manganese reducing, iron reducing, sulfate reducing, and methanogenic conditions.

If biodegradation is occurring, field tests and analyses will typically indicate a relative decrease in electron acceptors (dissolved oxygen, nitrate, sulfate) and oxidation-reduction potential, plus an increase in ferrous ions, alkalinity, methane, and sulfide (also see Section 4.3 of the Draft Final Alameda Point OU-5 RI [IT 2002] for an MNA explanation).

At any given location, aerobic or anaerobic, BTEX biodegradation will depend on the availability of electron acceptors and the redox potential of the environment.

Biodegradation of PAHs

In addition to benzene, PAHs have been found as COCs in groundwater. PAHs have multiple rings in their molecular structure, and include the frequently found compounds such as naphthalene and anthracene, and the more complex compounds such as pyrene and benzo(a)pyrene. In general, PAHs which contain two or three rings, such as naphthalene, anthracene, and phenanthrene, are degraded at reasonable rates when O_2 is present. Compounds with four rings, such as chrysene, pyrene, and pentacyclic compounds are highly persistent and are considered recalcitrant.

Estimating Biodegradation Rates

While biodegradation processes can be generally determined in well defined, optimal laboratory conditions, correlation with actual site biodegradation rates can be difficult since degradation depends strongly on site-specific environmental conditions. Site-specific conditions may include contaminant

types and concentrations, temperature, moisture, and the availability of nutrients and other compounds that influence the metabolism of microorganisms.

Calculation of a contaminant "half life" is sometimes performed to estimate degradation, since it is based on easily obtained contaminant concentrations. Other methods of estimating microbial degradation have also been employed, however, they are sometimes based on empirical data, reflecting a lack of knowledge of microbial populations and their site-specific activities. Modeling can also be performed, however, it is not a simple undertaking because of the complex nature of microbial kinetics, lack of accurate field data, and the lack of robust numerical methods available to simulate the physical, chemical, and biological processes accurately.

Because of these factors, biodegradation rates, when calculated, are considered estimates at best, and many times the confirmation of degradation is taken from observed plume reduction and or a decrease in contaminant concentrations.

Bio-Buffering

Intrinsic bioremediation can use a wide range of electron acceptors under varying redox conditions. The biochemical reactions facilitated by these electron acceptors fall into two categories:

- Faster transformations that involve O_2 and nitrates
- Slower transformations that involve the reduction of Fe(III), sulfates and methanogenesis using H_2O

Once the faster reactions have occurred, and the O_2 and nitrates have been depleted, the environment will turn anaerobic and the slower reactions will begin. However, even in anaerobic environments both reactions will occur due to the inflow of groundwater from upgradient sources or infiltration.

The concept of biobuffering is basically that the degradative capacity of the aquifer is much more than the measurable DO in the system. Among all the typical electron receptors, O_2 and CO_2 are the most readily available and renewable, due to natural recharge processes and aquifer geochemistry.

Bio-buffering therefore allow for more biodegradation to occur than would be estimated using DO readings without taking into account groundwater recharge.

Biodegradation Zones

Due to the dynamics of aquifers and microorganisms, zones of biodegradation will typically occur. In the horizontal direction, the outermost edges of a contaminant plume will typically undergo faster aerobic degradation. As the distance to the center of the plume decreases, so can aerobic degradation, until anaerobic areas are reached where the dissolved oxygen has already been consumed.

Degradation zones can also be created vertically, depending on the aquifer dynamics and characteristics of the original source(s). Case studies have shown that point-source discharges can leave higher contaminant concentrations deeper, since the upper parts of the water column are more prone to groundwater recharge, continuing aerobic degradation, and other dynamics. The presence of organic materials at depth may also tend to entrap contaminants and cause a relatively longer degradation time.

Factors to Consider for an MNA Program

Prior to implementing an MNA program, a thorough site characterization is required. The characterization should yield valuable information such as:

- Nature and extent of contamination defined
- Geochemical data such as pH, temperature, dissolved oxygen, nitrate, sulfate, methane, total organic carbon, and iron
- Hydrogeological data, including groundwater flow gradients, preferential flow paths, and data on the interaction between groundwater and surface water.
- Location of potential receptors: groundwater wells, surface water discharge points, underground utilities and possible preferential pathways
- Site reuse plans
- Risk assessments
- Potential groundwater beneficial reuse

Once an area has been thoroughly characterized to determine if the right ingredients are present for natural attenuation, an MNA program can be designed and implemented.

There are generally three lines of evidence that are used to support natural attenuation as a remedy:

- Historical documentation of a decreasing, or stable, plume contaminant concentrations (in conjunction with hydrogeological information)
- Chemical analysis to determine if degradation is occurring, if there is a sufficient supply of nutrients and other compounds to continue the process, and to what degree degradation is responsible for decreased contaminant concentrations.
- Microcosm studies to demonstrate that bacteria at the site do indeed destroy the contaminants by extracting bacteria from the site and a determination of degradation rates.

The best evidence that natural attenuation is occurring is usually statistical stabilization or loss of contamination of mass over time. Documenting biogeochemical changes prove a favorable environment for biodegradation exists, and microcosm studies simulate field conditions to evaluate effectiveness.

As part of documenting a decreasing or stable plume, a "zero line", or down-gradient leading edge of the plume is usually established. While Hydropunch™ sampling can be used to gain valuable plume information, monitoring wells are usually used to monitor plume movement. Monitoring wells are placed

to encircle the affected area, and a specially designed groundwater sampling and analysis program is usually implemented.

Proper implementation of an MNA program should involve collection of not only chemical data from monitoring wells, but also collection of biogeochemical data and trend analysis. Biogeochemical trends can be monitored by analyzing for parameters such as dissolved oxygen, redox potential, pH, temperature, conductivity, alkalinity, nitrate, sulfate, ferrous iron, carbon dioxide, methane, chloride, and others.

Other factors to consider during consideration of an MNA program are:

- The relative timeframe restoration
- Any long-term detrimental impacts on natural resources,
- The reliability of monitoring and institutional controls over long time periods
- Funding for monitoring and performance evaluation over the time period required for remediation.

Conclusion

In most cases, significant decreases in contaminant mass and concentrations, coupled with appropriate biogeochemical trends, will be sufficient to verify that natural biodegradation is occurring. Laboratory confirmation of microbial activity can also be performed to assist the evaluation. Laboratory confirmation can vary from enumerating the microbial population to performing detailed microcosm studies.

An MNA program must be monitored over a long-term period to demonstrate that contaminant concentrations continue to decrease to insure no health threat is created. USEPA also recommends monitoring potentially toxic byproducts of biodegradation, lateral and vertical plume expansion, inhibiting effects on downstream receptors, and all hydrogeological, geochemical, or microbiological parameters that share the effectiveness of natural attenuation. Frequent sampling over long periods of time, even after cleanup goals are met, leads to a more reliable conclusion that the plume is stable.

Appendix G
Biosparging Description

APPENDIX G – BIOSPARGING DESCRIPTION

Biosparging Technology Description

Biosparging is an in situ remediation technology that utilizes indigenous microorganisms to biodegrade organic constituents in the saturated zone. Biosparging involves the controlled injection of a flow of air (or oxygen) and nutrients (if needed) into the saturated zone to enhance the biological activity of the indigenous microorganisms. Biosparging can be used to reduce concentrations of petroleum constituents that are dissolved in groundwater, adsorbed to soil below the water table, and within the capillary fringe.

As described in the main portion of this report, the primary difference between biosparging and air sparging is the flow rate of air injected into the subsurface. Biosparging flow rates are usually site-specific, and can range from one to 25 standard cubic feet per minute, per injection well. Airflow is controlled such that volatile constituents are not released into the atmosphere but are biodegraded in the groundwater or vadose zone. However, when volatile constituents are present in and around sensitive receptors, biosparging is often combined with soil vapor extraction to create a negative pressure in the vadose zone controlling the vapor plume migration. In simple biosparging systems, vapor collection and treatment may not be required. However, if control of vapors is an issue, then vapor collection or extraction wells should be included as part of the design.

Some of the primary factors to consider for implementation of a biosparging system are:

- Soil permeability, which affects the rate at which oxygen can be supplied to the microorganisms in the subsurface
- Nature and extent of contamination
- Biodegradability of contaminants
- Geology and hydrogeology of the site (i.e. depth to groundwater; excess or lack of organic carbon [too much or too little retards biodegradation])
- Physical site characteristics:
  - Presence of nearby confined spaces or underground utilities which may accumulate volatilized contaminants
  - Presence of sensitive receptors
  - Surface obstacles
- Geochemical data: DO readings indicate all areas suitable for biosparging
- Performance Criteria (cleanup goals, degradation rates, cleanup time-frame)

In general, biosparging is best applied to sites where:

- There is no free product
- Anaerobic conditions exist (less than 2 mg/L DO)
- Permeability is acceptable (at least greater than $1x10^{-9}$ cm^2/sec)
- The aquifer is unconfined, so that volatilized gases do not migrate to different areas
- Contaminants include, but are not limited to, mid- to heavy-weight petroleum hydrocarbons
- Contaminants are not considered recalcitrant to biodegradation and are aerobically biodegradable
- Shorter, economical cleanup timeframes are desired

All of these requirements are met for the Site.

An additional resource which can be used when considering a biosparging system, is a series of evaluative flowcharts that USEPA developed (USEPA, 1995). The flow charts have been included at the end of this Appendix and can guide the user through a series of parameters to consider. The first flow chart directs the user to implement vapor controls if required (for nearby confined subgrade spaces or sensitive receptors), and stipulates that biosparging cannot be used in the presence of free product.

The second flowchart determines if the parameters listed in the table below are acceptable.

USEPA Biosparge Evaluative Parameters

Biosparge Evaluative Parameter	Applicability to Investigation Area
Permeability is < 10^{-9} cm^2?	Yes
Groundwater temperature is between 10° C and 45° C?	Yes
Subsurface pH levels are between 6 and 8?	Yes
Heterotrophic bacterial population density is > 1,000 CFU/gram?	Not analyzed to date; assumed acceptable
Dissolved iron concentrations < 10 mg/L?	Some data points are below 10 mg/L

The second USEPA flow chart also evaluates vapor pressures, boiling points, and Henry's Law Constants of the contaminants to determine if they have the potential to volatilize, and if vapor controls are necessary.

The final flowchart provides an overview of the evaluation process for the system design and step-by-step cross-references for development of the operation and monitoring plans that will be used throughout the duration of operation.

Applying the USEPA flow chart parameters listed above, it is apparent that biosparging is a viable alternative for the Site, and that vapor controls will be necessary to address possible benzene volatilization. Volatilization of benzene within Biosparging Zone 1 (Alameda Point Site 25) is of special concern due to the residential housing currently in place.

A biosparging system is considered viable for the Site because:

- Soils at the site have medium to good permeability
- Benzene and naphthalene are both biodegradable
- Depth to groundwater is not too shallow (shallow defined as less than 5 feet bgs), but tends to vary seasonally
- There are anaerobic conditions at depth and within plume centers
- Natural degradation is already occurring and will be expedited by biosparging
- Temperature, pH, and other groundwater geochemical parameters appear to be within acceptable limits

There are some surface obstacles at the Site, but a biosparging system can be specially designed to account for them. The presence of the asphalt cap in Alameda Annex IR-02 will also assist in collection of any vapors from the treatment area.

After evaluating the initial parameters to see if biosparging will be effective at a site, a pilot study is typically required to fine-tune the system design. A pilot study is recommended primarily due to the usual lack of correlation between theoretical designs and actual field performance. Pilot studies usually has the following components:

Biosparge Pilot Study Components

Biosparge Pilot Study Component	Comment
Laboratory Microbial Screening	This has not been performed to date, however, degradation rates indicate that sufficient microbial populations are present at the site.
Laboratory Biodegradation Study	This also has not been performed to date, but is recommended to more accurately estimate time required for cleanup.
Field tests to derive a more accurate understanding of site lithology	CPT testing can be performed to identify areas with higher permeabilities, and therefore higher biosparging effectiveness.
Field tests to determine sparging air flow rates and air pressures	Flow rates to grouped sparge wells, or individual sparge wells can be adjusted throughout the project to maximize contaminant degradation.

Biosparge Pilot Study Components (continued)

Biosparge Pilot Study Component	Comment
Field tests to determine the sparge well radius of influence (also referred to as the bubble radius)	Field tests for this parameter are especially applicable to the investigation area which has known areas of heterogeneity.
Field tests to establish baseline conditions (oxygen, contaminant concentrations, CO_2, etc)	Baseline conditions are very location-specific at the site and should carefully be established and evaluated.
Evaluation of site-specific construction limitations	On-site houses and utility lines will require special design consideration.

After a pilot study has been performed to fine-tune system design, the individual components of a biosparging system can be specified. The components of a typical system will include:

Biosparging Components:

- Air compressor (typically oil-less) capable of constant operation
- Air injection wells (similar in construction to monitoring wells)
- System controls, such as shutoff valves, pressure regulators and gauges, pressure relief valves, and airflow meters
- Sampling ports, compressor intake particulate filter, remote access hardware/software (optional)
- Soil-gas monitoring probes
- Piping and hoses to interconnect wells, compressor, and system components
- Enclosed area to house system components

For purposes of this investigation, a pilot study has been included within the costs for implementation of a biosparging system. Pilot tests are usually implemented in areas such as plume centers, which is the primary area of treatment for this investigation. It is therefore possible that a pilot study for the Site could be modified in the field and converted to the final treatment system.

There are also certain design variations which can be used for a biosparge system. One is the orientation or design of the injection well. Horizontal wells can be constructed for situations where groundwater is very shallow (less than five feet bgs), or where plume areas are rather large. However, there are also added constructability issues which accompany horizontal well construction. Trenching to install horizontal wells exposes workers to the contamination they are attempting to remove. Horizontal drilling costs are considerably more than typical vertical drilling and installation costs. Horizontal wells can be effective though in situations such as a cut-off wall, which stops plume migration.

There are other variations possible for both injection and extraction wells (USEPA, 1995). Grouping or nesting of wells can be done, with a closer grouping implemented in areas with higher contamination. For purposes of this investigation, some amount of grouping has been assumed; however, the impact on cost is not significant enough to define a specific grouping design. Instead, conservative costs have been included to allow for various design adjustments.

Prior to bringing a biosparging system to fully operational, a baseline monitoring phase and "system shakedown" are usually required. The baseline monitoring phase should record groundwater levels in nearby wells, baseline contaminant concentrations, initial soil-gas concentrations, and other parameters which can later be used to evaluate system performance.

After baseline monitoring has been performed, the system can be initiated with a "shakedown" phase, to identify and correct installation and construction weaknesses. Once the shakedown (which can last up to two weeks) has been performed, a preliminary operation phase can be performed during which the various fluid transport mechanisms are allowed to reach equilibrium. During both the shakedown and preliminary operation phases it is recommended that the vapor extraction components be tested first, followed by gradual startup of air injection. The gradual air injection startup is recommended based on case studies have shown that high initial injection pressures develop preferential pathways within the aquifer, which remain in place. For both the shakedown and startup phases, appropriate plans are recommended to document procedures, and subsequently performance.

After gradual startup, and system fine-tuning, operations may continue on a continuous basis, or injection may be pulsed, or cycled, which has been shown to increase contaminant removal efficiencies (Fields, et al, 2002). Pulsing (performed on air sparging systems more than biosparging systems) is the cessation of air injection anywhere from a half an hour to 24 hours, and has been shown to increase petroleum hydrocarbon removal rates by as much as 30 percent. Pulsing increases mixing and the sparging zone of influence, and also reduces energy usage. Cycling, which may last more than a few days, also increases system performance, and helps to minimize any groundwater mounding that may occur due to air saturation of the aquifer. Cycling also helps to avoid rebound of contaminant concentrations, which can cause unforeseen project costs and elongated cleanup times.

Once a biosparging system has been designed and fine tuned, the total time required for contaminant remediation typically lasts from six months to two years, depending on the contaminants present at the site. For the present investigation, a cleanup timeframe of two years has been assumed, to provide maximum destruction efficiency of naphthalene. The cleanup goals selected for the project are the Federal MCL for benzene, and a USEPA Health Advisory for naphthalene. These goals were used because the risk assessment has shown that current risks from the site are within USEPAs acceptable risk management range (10^{-4} to 10^{-6}), provided shallow groundwater is not used as a potable water supply. Remediating groundwater to below the cleanup goals would permanently eliminate any possibility for completion of the drinking water pathway resulting and avoid unacceptable risks to human health.

Biosparging Case Studies:

Biosparging of Contaminated Groundwater at the T-Dock Site, South Prudence Bay Island Park, Portsmouth, Rhode Island

Operation Time: February 1998-February 2000

Contaminants of Concern: Organic Compounds (BTEX)

Maximum detected concentrations:

- Benzene at 2,050 µg/L
- Toluene at 7,830 µg/L
- Ethylbenzene at 3,470 µg/L
- Xylene at 11,000 µg/L

Description: South Prudence Bay Island park is located in Portsmouth, Rhode Island and is used mainly for public recreation. The T-dock site is located on a two-acre parcel of the park, and is directly adjacent to the Narragansett Bay. In between 1940 and 1985, the T-dock site was used mainly for fuel storage and distribution operations. In 1985 and 1992, removal of one 10,000-gallon gasoline underground storage tank (UST) and the associated fuel distribution pipeline system occurred on site. Subsequent investigations determined that groundwater contamination existed within the former locations of the UST and fuel pipeline system, with BTEX compounds being the main constituents of concern.

In 1996 and 1997, pilot tests were conducted in a small section of the T-dock site, including the installation of one sparge well, one SVE well, and six groundwater monitoring wells. The first test was performed to evaluate the expected performance of the combination of SVE and sparging. Results of the first test indicated that the SVE well had a limited area of influence. A second test was performed to determine if a low-flow sparging system without SVE could be operated at the site to treat BTEX in groundwater, while not exceeding Rhode Island state air emission standards. Following the second test, it was discovered that a system operated with pulsed air injection, at a rate of 1 cubic foot per minute (cfm) for twenty minutes out of every hour, would meet the requirements set for the project.

The biosparging system was constructed in 1997 and 1998, including a total of twenty-two sparge wells and thirteen groundwater-monitoring wells. Ten of the thirteen monitoring wells consisted of five nests of two wells each, one screened at a shallow depth and one screened at a deeper depth. Atmospheric air was delivered to the wells via a compressor, blower, and distribution manifold. After it was determined that air emission standards would not be violated by increasing air flow to the sparging system, air flow rates were modified as necessary to address differing areas of contamination. Air flow rates to the system varied from 0.2 to 9.5 cfm during the project.

Quarterly sampling results throughout the duration of operation indicated that BTEX compounds were being treated to achieve remediation goals. Overall, the system worked effectively to treat contaminated groundwater to acceptable results and state air emission requirements were met throughout the operation of the treatment system. Treatment was completed in 1999 and the system was shutdown in 2000.

Cost: $280,946

Biosparging at the Myrtle Beach Air Force Base (MOGAS) Site, Myrtle Beach, South Carolina

Operation Time: June 1998 to 1999

Contaminants of Concern: Organic Compounds (BTEX)

- BTEX (Soil Gas) at 2,000-4,000 mg/kg (total)
- TPH (Soil Gas) at 100,000-180,000 mg/kg (total)
- BTEX (Groundwater) up to 47,300 µg/L
- Naphthalene (Groundwater) up to 760 µg/L

Description: The MOGAS site was the location of the former motor pool, which provided fueling and repair services for motor vehicles on the base in Myrtle Beach, South Carolina. Four 5,000-gallon USTs were used to store gasoline and diesel fuel. Following individual occurrences of fuel sheens within site drainage areas in the 1980s, sub-surface investigations were conducted and found that site soils were saturated with fuel and free product existed at the surface of site groundwater. Removal of the leaking USTs and associated fuel delivery lines ensued in April 1993. During excavation activities, large quantities of contaminated soils were encountered; the majority of these soils remained in place. Subsequent soil sampling, performed in 1995, indicated the presence of a residual product smear zone extending from the former UST locations to the edge of the nearby drainage ditch, which constitutes a groundwater discharge point. Free product was not encountered during the 1995 investigations.

An SVE pilot test was initiated in October 1995 and run over a 3-month period to evaluate the feasibility of removing VOCs and reducing contaminant mass in the source area utilizing this technology. Results indicated that a significant amount of oxygen utilization was observed in the site soils, indicating a very active microbial population capable of degrading fuel residuals.

Based upon the pilot test findings and the presence of significant soil contamination below the water table, installation of a biosparging system was recommended to remediate the residual contamination. Following a 41-day biosparging pilot test in early 1998, a full-scale operation was installed and became operational in June 1998. The system included 40 small-diameter sparging points screened approximately 5-7 feet below the water table.

Results: Analytical results for the soil samples collected from 1988 to 1995 indicated the presence of significant contamination. Soil sampling has not occurred since the inception of the biosparging system; however, the degree to which soil contamination has been remediated can be gauged using the following soil gas and groundwater quality data that has been collected post system start-up:

MOGAS Analytical Data Summary (as of 1999)

Soil Gas Data

Location ID	Date Sampled: (pre-biosparge) (post-biosparge)	Benzene (ppm)	Toluene (ppm)	Ethylbenzene (ppm)	Xylene (ppm)	TPH (ppm)
Vent 01	(Sept/Oct-95)	1,300	910	62	120	180,000
	(Oct-99)	1.1	4.4	1.2	8.6	75
Vent 02	(Sept/Oct-95)	1,300	2,000	200	410	100,000
	(Oct-99)	64	72	1.8	5.5	1,500

Groundwater Data

Location ID	Date Sampled: (pre-biosparge) (post-biosparge)	Benzene (µg/L)	Toluene (µg/L)	Ethylbenzene (µg/L)	Xylene (µg/L)	Naphthalene (µg/L)
MW-112	(Jan-95)	5,430	23,400	2,430	10,843	510 (Oct-97)
	(Aug-99)	8.3	25	23	104	150
MW-113	(Aug-95)	3,000	2,100	200	860	150 (Oct-97)
	(Aug-99)	1.4	1	0.54	2	0.56
MW-04	(Aug-95)	63	14	22	27	760 (Oct.-98)
	(Aug-99)	3	1	1	2	1
MOC-7	(Aug-95)	40	8.3	2.5	8.2	1(Oct.-98)
	(Aug-99)	12	1	2.5	2	1
MOC-5	(Jan-95)	4,850	6,800	912	3,540	NA
	(Oct-98)	25	0.27	2	1.75	

In summary, the combination of sandy homogeneous soils, shallow depth to groundwater, and closely spaced sparging points, throughout the main source area, has contributed to the success of this specific biosparging system. Groundwater quality results for this site strongly indicate that where a significant smear zone exists below the water table, closely spaced biosparging points may be more effective than bioventing or SVE at remediating BTEX and naphthalene concentrations in submerged soils and groundwater.

Cost: Not available

Biosparging at a Former Gas Manufacturing Site, Northern England (UK)

Operation Time: July 1999- November 2000

Contaminants of Concern: Organic Compounds (BTEX, Naphthalene)

- Benzene up to approximately 2,200 µg/L
- Naphthalene up to approximately 9 mg/L

Description: In 1999, a program of voluntary remediation was initiated at a former gas-manufacturing site located in Northern England. The primary objective was to reduce the site owner's risk of incurring liabilities as a result of historic groundwater contamination. Storage tanks, gas-holder bases, and other sources of contamination had already been removed from the site during decommissioning activities in the 1960s. The remediation program was designed for and focused on treating residual BTEX, phenols, and PAHs, within a shallow sand aquifer beneath the site, to avoid plume migration beyond site boundaries.

With no immediate plans to sell or redevelop the land, the owner had more than enough time to screen and choose the appropriate remediation technology. Two biosparging pilot tests confirmed that the technology would generate a significant reduction in hydrocarbon contamination and that aquifer materials contained sufficient amounts of aerobic bacteria to support biodegrading of contaminants.

Once selected, the full-scale treatment system incorporated 22 air injection points forming an "aeration curtain" within the site boundaries, with groundwater monitoring wells strategically placed in and around the treatment area. The sparging system was operated in conjunction with SVE to collect any volatile hydrocarbons given off during the treatment.

Results: Upon commencement of the system, dissolved oxygen concentrations within the treatment zone increased rapidly. Following the conclusion of injection activities, the dissolved oxygen levels gradually decreased in response to the increase in biodegradation processes. Over a period of approximately one year and six months, the biosparging/SVE combination system achieved the remedial targets. Overall, reductions in TPH concentrations lagged behind reductions in BTEX. The lagging noted in the study was thought to have been due to the two separate removal processes within biosparging. The initial removal process was likely to have been volatilization, followed by biodegradation, which becomes effective after a short delay.

The following key benefits were discovered upon completion of this study:

- The use of biosparging resulted in significant cost savings compared with physical treatment options,
- The application was economical on labor and energy,
- The system required little maintenance,

- The system caused minimal impact on workers and the environment,
- The system performance was monitored via a telemetry system, enabling the site to be left unattended.

Conducting pilot-scale field trials prior to any type of system implementation is necessary to increase confidence in the design and operation of the full-scale treatment system and to aid in achieving the above-listed benefits, while attaining set project remedial goals.

Cost: Not available

Biosparging Technology Conclusion:

In cases where a significant amount of residual fuel contamination is present below the average water table, the potential effectiveness of biosparging should be assessed, as shown in the above case studies. Biosparging is most effective in sandy (permeable), homogeneous soils that do not promote channeling of injected air (see Figure G-1).

The results obtained within the previous site examples indicate that biosparging can cause rapid decreases in dissolved contaminant (BTEX, naphthalene) concentrations if the proper subsurface conditions and design specifications are present. Air injection wells should be as closely spaced as possible throughout the source area(s) to achieve the maximum effects. In addition, biosparging is most effective at sites where dissolved contaminant concentrations decrease rapidly with depth, making air injection within the top 10 feet of the saturated zone feasible. The potential effectiveness of biosparging can be greatly diminished if chosen for sites with stratigraphic variability, such as non-uniform permeability distribution that creates preferential pathways for channeled air flow. While air sparging removes constituents primarily through volatilization, using higher air flow injection rates, biosparging promotes remediation by biodegradation with a lower degree of volatilization. In essence, the effectiveness of biosparging depends primarily upon two factors: the permeability of the soil and the biodegradability of the petroleum constituents in question.

With biosparging, the goal is to reduce the volatilization rate to a level where an SVE system is not necessary, with the hope that the resulting air injection rate is capable of maintaining a well-oxygenated treatment zone and a sufficient aerobic biodegradation rate.

Biosparging can also be combined with SVE for additional vapor control. When biosparging is combined with SVE, the vapor extraction system creates a negative pressure in the vadose zone through a series of extraction wells that control the vapor plume from migrating off-site. When including SVE into the biosparging system design, the following components and information will be necessary to facilitate the proper design specifications: vapor pretreatment design, vapor treatment system selection, and blower specification. Figure G-2 shows the typical components of a biosparging system with vapor controls.

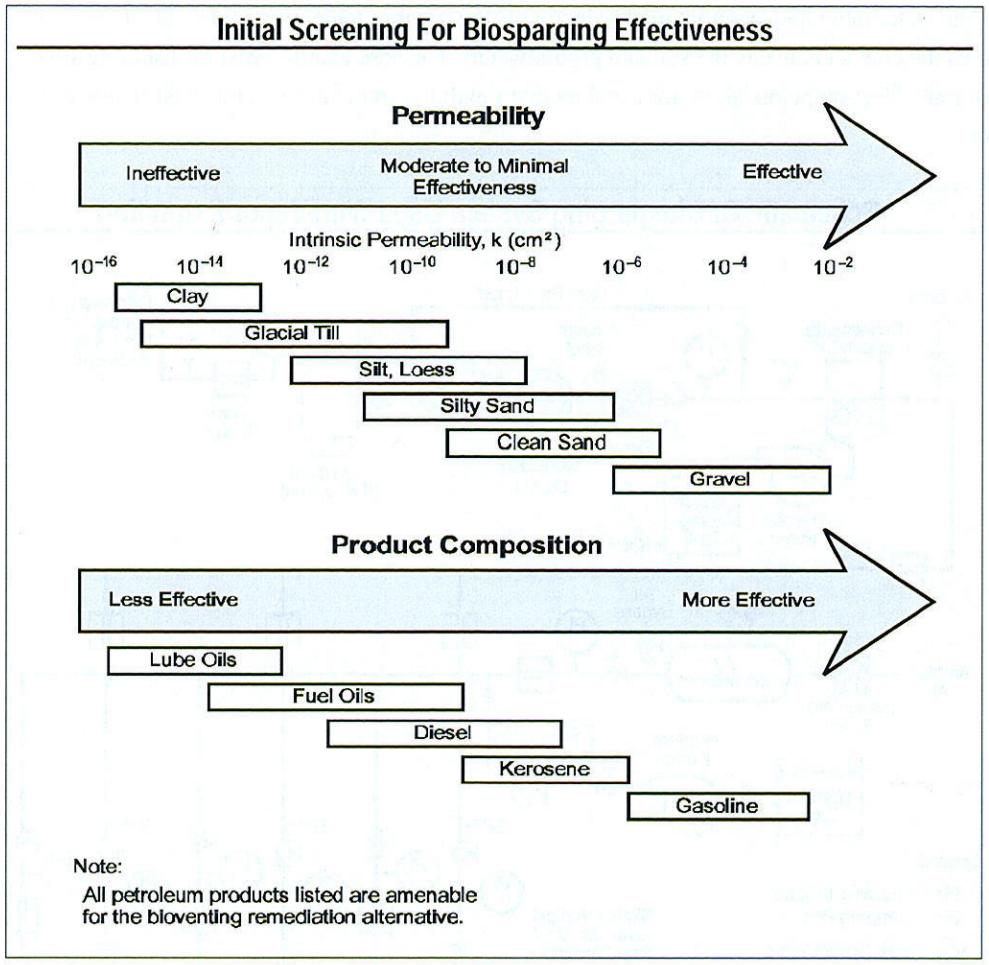


Figure G-1: Initial Screening for Biosparging Effectiveness

Overall, the potential to encounter limiting factors, which may severely reduce the effectiveness of biosparging, highlight the need for careful and thorough site characterization prior to the selection and implementation of the remedial approach. Biosparging should not be considered if the following site conditions exist:

- Free product is present,
- Nearby basements, sewers, or other subsurface confined spaces that are present at the site (potentially dangerous constituent vapor migration in sensitive areas can be controlled by adding an SVE component to the selected biosparging system.),
- Contaminated groundwater is located in a confined aquifer system.

When used appropriately, biosparging can be an efficient and simple remedial tool for reducing mid- and light-weight petroleum residuals at a given site. Simply by injecting pressurized air at a reduced rate

below the water table, biosparging quickly increases the mixing in the saturated zone and thereby increases the contact between the soil and groundwater. The ease and low cost of installing small-diameter air injection points allow for considerable flexibility in the design and construction of the system.

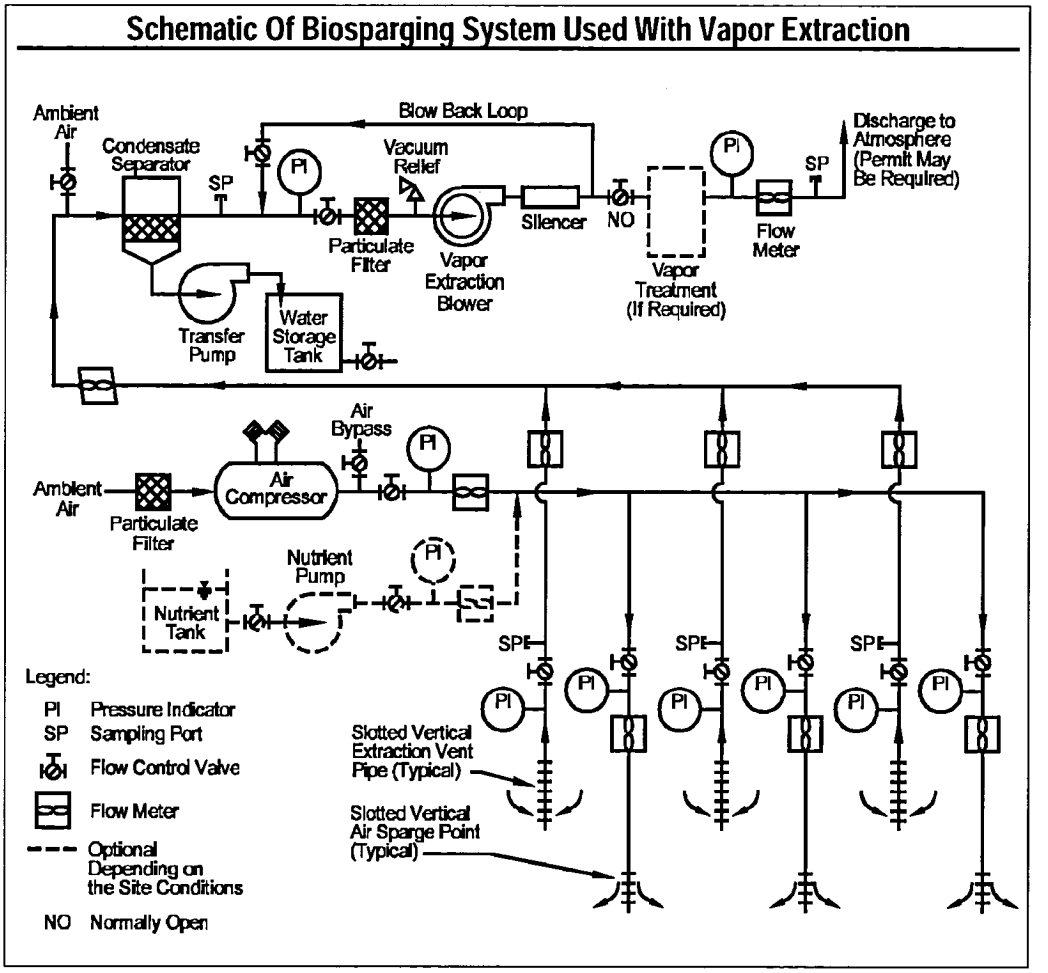


Figure G-2: Biosparge System Schematic (with SVE)

EXHIBIT VIII-3

Biosparging Evaluation Process Flow Chart

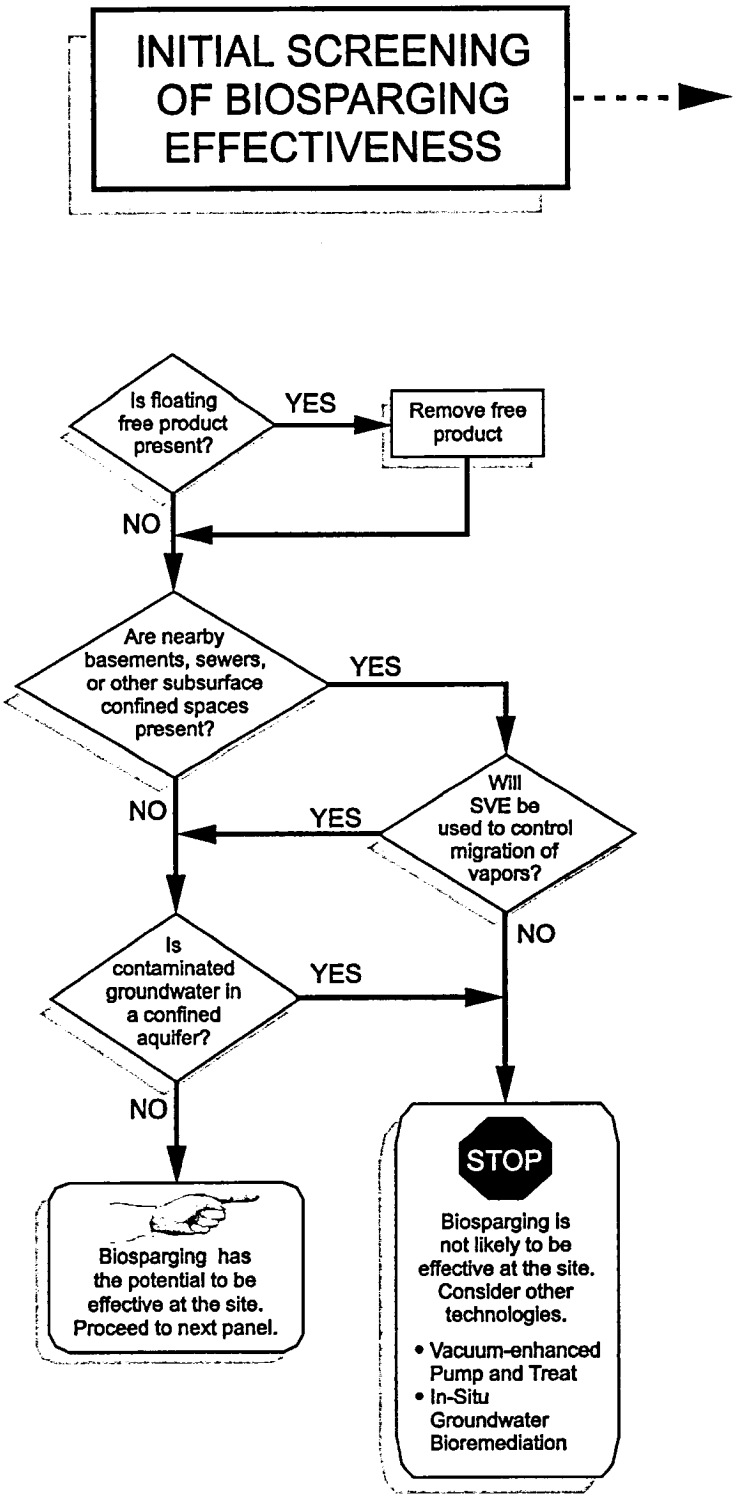


Exhibit VIII-3
Biosparging Evaluation Process Flow Chart

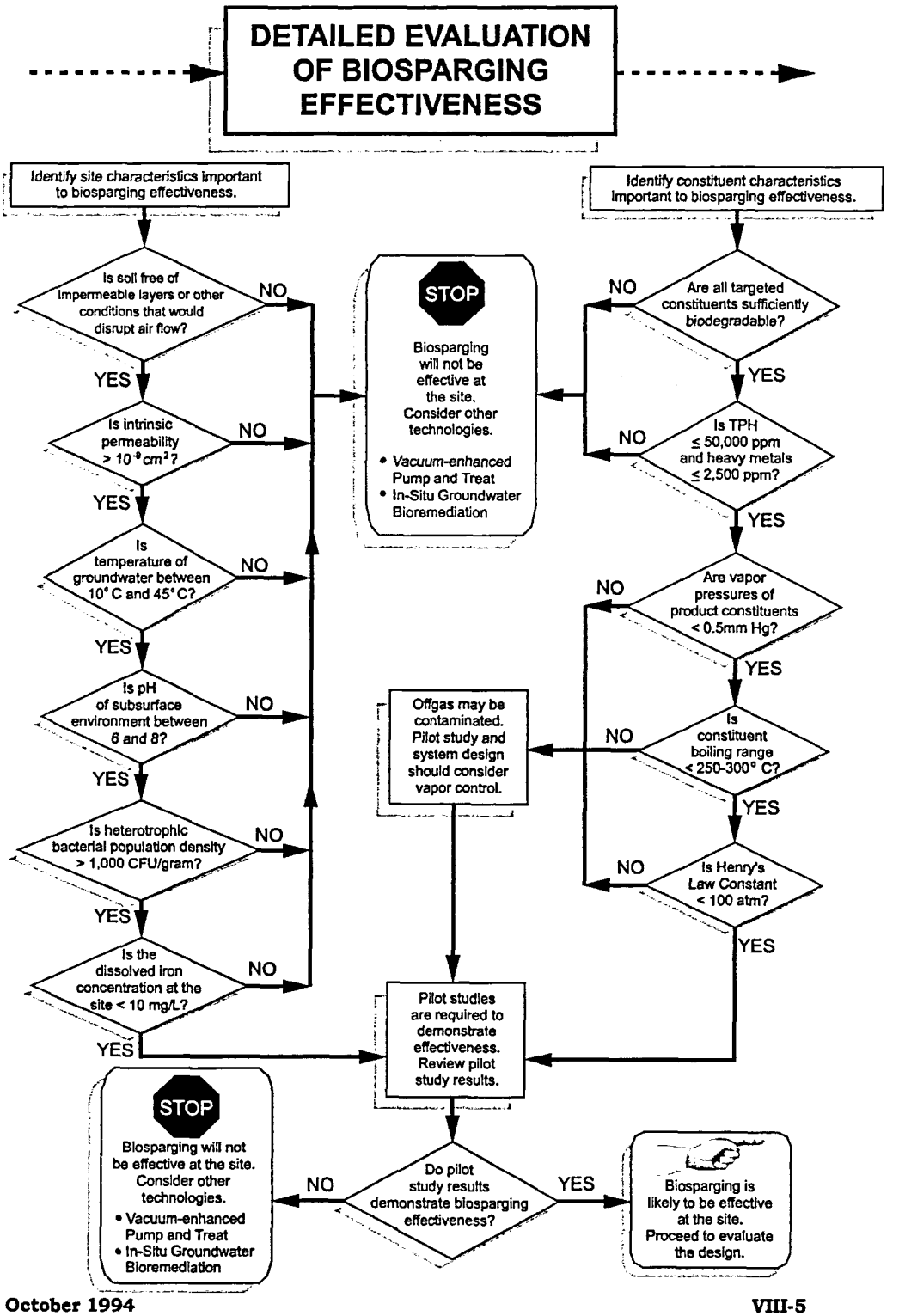
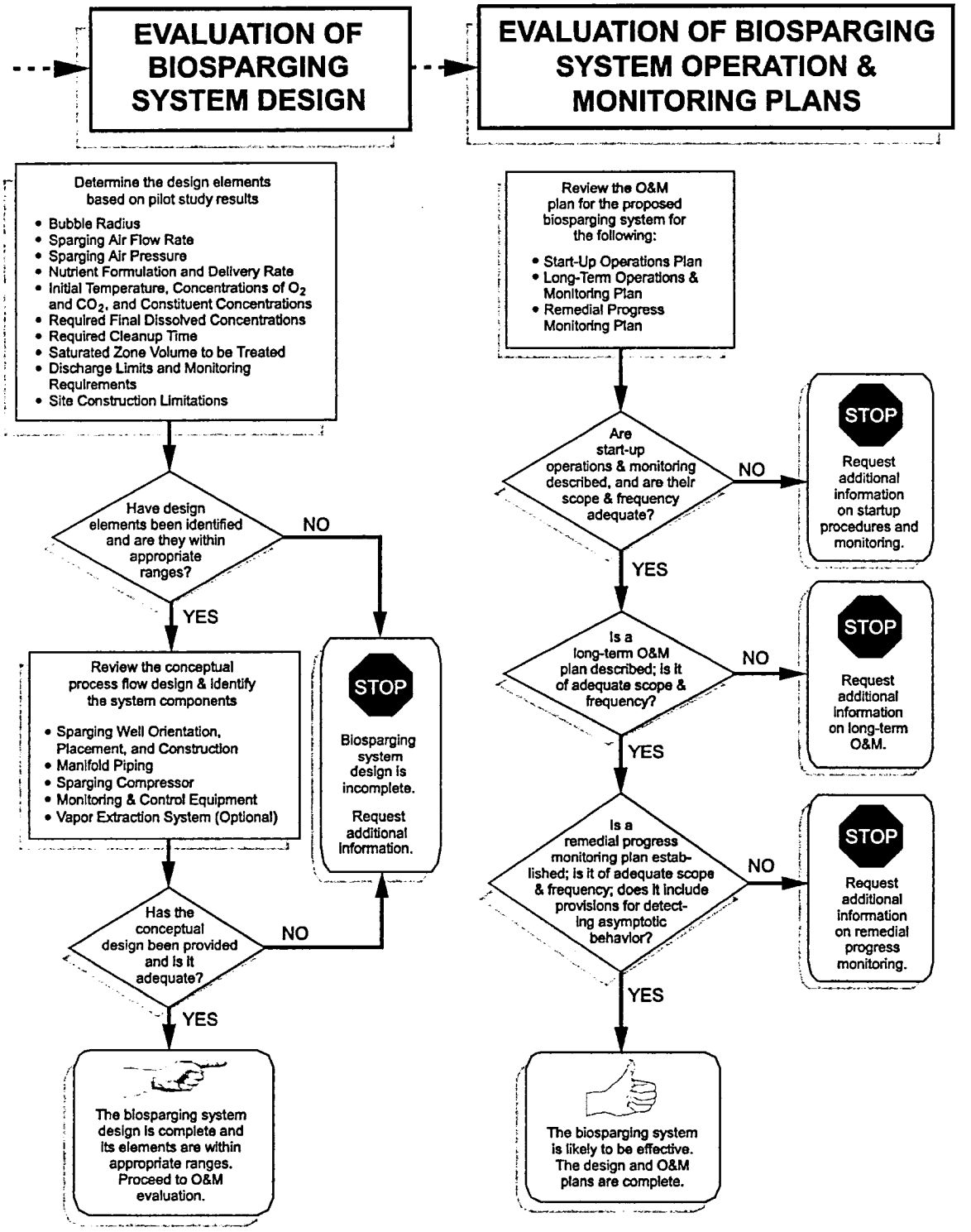


Exhibit VIII-3
Biosparging Evaluation Process Flow Chart



Appendix H
Remedial Alternative Cost Estimates

APPENDIX H – REMEDIAL ALTERNATIVE COST ESTIMATES

The following cost estimates have been prepared in accordance with EPA guidance for developing and documenting Feasibility Study Cost Estimates (EPA, 2000). The estimates for Alternatives 2 through 6 consist of three components: the cost summary, cash flow summary, and cost estimate assumptions. The cost and cash flow summaries are provided in tables at the end of this appendix. Cost estimate assumptions are summarized below.

ALTERNATIVE 2 - MONITORED NATURAL ATTENUATION WITH INSTITUTIONAL CONTROLS

The remedy requires developing a program to evaluate the success of contaminant reduction in groundwater via natural attenuation. This program requires a direct capital investment to establish the monitoring network and collect baseline contamination attenuation information. Once the monitoring components are in place, it is anticipated that post closure monitoring will continue for 50 years. A complete description of the alternative is provided in Section 9 and a summary of the remedial technology is included in Appendix F.

In all cases, cost estimates were prepared using year 2004 dollars as the basis. Annual operation and maintenance costs have been provided for this 50-year period. Based on the National Contingency Plan (NCP) and EPA guidance, constant dollar costs projected into the future should be discounted to present value costs. For Federal facilities being cleaned up under Superfund authority, the real discount rates to be used are found in current Office of Management and Budget (OMB) directives (EPA, 2000). OMB Circular A-94 guidance specified real discount rate to be used for a 50-year federal project at 3.5 percent (OMB, 2004).

COST ESTIMATE ASSUMPTIONS – DIRECT COSTS

Line Item 1 – Develop Work Plans

- It will be necessary to collect additional data to define natural attenuation processes occurring in groundwater at the site.
- Nine (9) additional monitoring wells will be required along with 11 existing wells.
- Health and Safety Plan, Sampling and Analysis Plan, Waste Management Plan, Data Validation/Data Reporting Plan, and Quality Assurance Project Plan will be needed for data collection efforts.
- Since natural attenuation groundwater monitoring is now ongoing, development of above referenced plans is assumed to require minimal additional effort and the bulk of submittals will be obtained from existing project documents.

Line Item 2 – Install Additional Wells

- Nine (9) additional monitoring wells will be required to complete the 20 well monitoring network assumed to be adequate for establishing criteria and ongoing monitoring.
- Assumed well specifications: Total depth approximately 20-feet, 2-inch diameter PVC casing, 5-foot well screen at depth 15-20 feet below ground surface (bgs), static water level 6-10 feet bgs.

Line Item 3 – MNA Sampling Evaluation

- Perform groundwater sampling and analysis to develop adequate understanding of site conditions and ongoing natural attenuation (Cost Estimate Assumed 1 Year of Data Collection with 20 well monitoring network).
- Work involves evaluating monitoring data to more accurately identify/define natural attenuation processes occurring at the site, and establishing sensitivity parameters to adequately represent attenuation.
- Develop hypotheses for natural attenuation processes.

Line Item 4 – Develop Natural Attenuation Model

- Test hypotheses developed in #3
- Develop groundwater model to accurately reflect attenuation previously monitored on site (model calibration).
- Work backward from present using historical data to further identify/delineate potential contaminant sources or source areas.

Line Item 5 – Develop Post-Closure Monitoring Program

- Assume 20-well monitoring program is adequate for future monitoring.
- Cost analysis assumed that monitoring will begin with 5-year program at same frequency and using same analytes as program used to establish natural attenuation criteria. Any required modifications to locations, frequencies, or parameters will be determined during this Task.

Line Item 6 – Develop Land Use Controls Implementation Plan

- Establish a groundwater exclusion area. Costs include administrative and legal procedures to implement this control.
- Costs also include establishing property deed restrictions.

INDIRECT COSTS

Line Item 1 – Project Management/Administration

- Costs for project management and administration are assumed to be 15% of Direct Costs

Line Item 2 – Legal, License, and Permits

- Costs for legal work, licenses and well installation/construction permits are assumed to be 1% of Direct Costs

Operations and Maintenance (O&M) COSTS

Line Item 1 – Maintain Institutional Controls

- It will be necessary to provide funding to local government to maintain the groundwater exclusion zone until naturally attenuated contaminant levels reach remediation goals. It is assumed that the boundary will shrink or retract over time as natural attenuation progresses; however costs for institutional controls (ICs) remain the same regardless of the size of the exclusion zone.

Line Item 2 – Monitored Natural Attenuation

- It is assumed that for years 0-5, the monitoring network will consist of 20 wells sampled at the same frequency and for same analytes as during establishment of criteria.

- During years 5-10 the monitoring network will include 20 wells sampled at ½ the frequency for chemical analyses and attenuation parameters outlined in years 0-5 (i.e. quarterly monitoring will become semi-annual).
- During years 11-50, the monitoring network will include 10 wells sampled at ½ the frequency for chemical analyses and attenuation parameters outlined in years 0-5 (i.e. quarterly monitoring will become semi-annual).

Line Item 3 – Replacement Monitoring Wells

- It is anticipated that it will be necessary to replace wells that get damaged, become non-functional, or need to be relocated.
- One (1) well will be replaced every three years.
- Two (2) wells will be replaced in year 15
- Four (4) wells will be replaced in year 39

Line Item 4 – Well Abandonment

- As the contaminant plume diminishes in size fewer wells will be required for monitoring, and wells will be abandoned.
- Well abandonment shall consist of the following: auger out PVC casing and materials filling the annular space outside the casing.
- Borings will be filled with cement grout
- Well abandonment will be performed concurrently with well replacements so additional mobilization/demobilization costs are avoided.
- Eleven (11) wells are planned for abandonment in year 20 (includes 10 wells dropped from the monitoring network and 1 that is being replaced)
- Two (2) additional wells will be abandoned in year 30.

Line Item 5 – 5 Year Review

- NCP requires 5-year reviews during the post closure care period to determine that the remedy continues to be effective or if modifications are required.
- Review will be conducted for both IC's and Monitored Natural Attenuation

Contingency

- A contingency fee of 10% is assumed. This contingency is applied to the subtotaled value that is obtained by combining the total Capital Costs and total O&M Costs.

ALTERNATIVE 3 – BIOSPARGING WITH MNA AND INSTITUTIONAL CONTROLS

The remedy requires the injection of air into the saturated zone to increase the biological activity of in-situ microorganisms, and therefore the contaminant degradation rate, as well as continued monitoring and institutional controls while the treatment is in progress. The cost for a soil vapor extraction system (SVE) is included in this cost estimate in the event that injected air creates an unacceptable exposure risk. This program requires a direct capital investment to establish the treatment system and monitoring network and to collect baseline contamination attenuation information. A complete description of the alternative is provided in Section 9.

In all cases, cost estimates were prepared using year 2004 dollars as the basis. Annual operation and maintenance costs have been provided for a 9-year period, following 2 years of biosparging. Based on the National NCP and EPA guidance, constant dollar costs projected into the future should be discounted to present value costs. For Federal facilities being cleaned up under Superfund authority, the real discount rates to be used are found in current OMB directives (EPA, 2000). OMB Circular A-94 guidance specified real discount rate to be used for a 9-year federal project at 2.7 percent (OMB, 2004).

COST ESTIMATE ASSUMPTIONS – DIRECT COSTS

Line Item 1 – Pre-Design Investigation

- A Health and Safety Plan, Sampling and Analysis Plan, Waste Management Plan, Data Validation/Data Reporting Plan, and Quality Assurance Project Plan will be needed for pre-design activities.
- Further delineate extent of groundwater and soil contamination prior to biosparging system design.
- Perform groundwater sampling and analysis to develop adequate understanding of site conditions and ongoing natural attenuation (Cost Estimate Assumed 1 Year of Data Collection with 20 well monitoring network).
- Collect samples of bacterial activity in the soil, more thoroughly research soil porosity, and other site characteristics to determine the location and quantity of biosparge wells, monitoring wells, soil-gas monitoring probes, and soil vapor extraction wells.
- Work involves evaluating monitoring data to more accurately identify/define natural attenuation processes occurring at the site, and establishing sensitivity parameters to adequately represent attenuation.
- Refine hypotheses for natural attenuation processes.

Line Item 2 – Develop RD/RA, and Land Use Controls Plan

- A Health and Safety Plan, Sampling and Analysis Plan, Waste Management Plan, Data Validation/Data Reporting Plan, and Quality Assurance Project Plan will be needed for remedial design activities.
- Develop Remedial Design for biosparging system based on pre-design investigation and document field implementation procedures.
- Develop Post Closure MNA Program.
    - Assume 20-well monitoring program is adequate for future monitoring.
    - Cost analysis assumes that monitoring will begin with 5-year program at the same frequency and using same analytes as program used to establish natural attenuation criteria. Any required modifications to locations, frequencies, or parameters will be determined during this Task.

- Develop Land Use Controls Implementation Plans.
    - Establish a groundwater exclusion area. Costs include administrative and legal procedures to implement this control.
    - Costs also include establishing property deed restrictions.

Line Item 3 – Field Work

- Install Additional Monitoring Wells
    - Nine (9) additional monitoring wells will be required to complete the 20 well monitoring network assumed to be adequate for establishing criteria and ongoing monitoring.
    - Assumed well specifications: Total depth approximately 20-feet, 2-inch diameter PVC casing, 5-foot well screen at depth 15-20 feet below ground surface (bgs), static water level 6-10 feet bgs.

- Initial Cone Penetration Testing (CPT)
    - Cost of initial field event whereby subsurface soil characteristics are determined when a cone penetrometer, attached to a data acquisition system, is pushed into the subsurface using a hydraulic ram.

- Laboratory Treatability Studies (Microcosm & Slurry)
    - Treatability studies will be used to determine if site conditions demonstrate sufficient microbial activity in the soil or aquifer material and its ability to degrade the contaminants of concern.

- Install Soil Gas Monitoring Probes
    - Ten (10) additional shallow soil gas monitoring probes will be installed to (along with five existing deep soil gas probes) monitor hydrocarbons and determine the need for SVE and measure effectiveness in the treatment zone, respectively.
    - Assumed well specifications: ¼" tubing, 6" screen, screened area 5 feet bgs (shallow) or 12-20 feet bgs (deep).

- Install Biosparge Wells
    - Fifty (50) biosparge wells will be installed to increase airflow to areas with high benzene concentrations.
    - Rig Mobilization and mileage costs are assumed to be an initial cost occurring one time only and will not be applied to each biosparge well installation.
    - Biosparge well installation will be focused on three designated Treatment Areas. Treatment Area 1 centered around monitoring well P181-MW47 near Kollmann Circle measures approximately 2 acres and will require twenty-three (23) biosparge wells to assist in the reduction of benzene levels within the designated area. Treatment Area 2 centered around monitoring well EW-2, west of Tinker Avenue, measuring approximately 1.0 acre will require fifteen (15) biosparge wells to assist in the reduction of benzene levels within the designated area. Treatment Area 3 centered near monitoring wells P181-MW45 and M25-01, measuring approximately 1.0 acre will require twelve (12) biosparge wells to assist in the reduction of benzene levels within the designated area.
    - Assumed well specifications: Total depth approximately 20-feet, 2-inch diameter schedule 40 PVC casing, 0.02 inch screen slot aperture, screened area 16-20 feet bgs, spaced on approximately 40-foot centers.

- Install Biosparge Buildings, Equipment and Controls
    - An operations and support building for each location will be required to house the equipment for the biosparging system, including the air compressors and associated equipment.
    - System equipment and controls will consist of: electrical connection and control panels, control valves, sample ports, airflow meters, tubing and connections, trenching and backfill, and oil-less air compressors.

- Install Soil Vapor Extraction Wells
    - A total of fifteen (15) soil vapor extraction wells and associated piping will be installed throughout the biosparging areas as contingency for vadose zone vapor recovery.
    - Assumed well specifications: Total depth approximately 15-feet, 4-inch diameter schedule 40 PVC casing, 0.01 inch screen slot aperture, screened area 5-10 feet bgs.

- Install Soil Vapor Extraction Equipment and Controls
    - The operations and support buildings will also house the soil vapor extraction blowers, electrical equipment, control panels, water knockout vessels, and Granular Activated Carbon (GAC) vapor-phase treatment vessels.
    - Two (2) GAC units will be used for each treatment area. The cost for GAC includes three (3) scheduled replacements of the filtration units for each treatment area.

- Prepare Construction Completion Report
    - Preparation of a construction completion report for the regulatory agencies will be required after installation of remedial systems.

INDIRECT COSTS

Line Item 1 – Project Management/Administration

- Costs for project management and administration are assumed to be 15% of Direct Costs

Line Item 2 – Legal, License, and Permits

- Costs for legal work, licenses and well installation/construction permits are assumed to be 1% of Direct Costs

O&M COSTS

Line Item 1 – Maintain Institutional Controls

- It will be necessary to provide funding to local government to maintain the groundwater exclusion zone until naturally attenuated contaminant levels reach remediation goals. It is assumed that the boundary will shrink or retract over time as natural attenuation progresses; however costs for ICs remain the same regardless of the size of the exclusion zone.

Line Item 2 – Monitoring & Reporting

- It is assumed that for years 0-2, during active biosparging, the monitoring network will consist of 20 wells sampled at the same quarterly frequency and for same analytes as during establishment of criteria.
- During years 3-7 the monitoring network will include 20 wells sampled at a semi-annual frequency.

- During years 8-9 the monitoring network will include ten (10) wells sampled at a semi-annual frequency.
- From year 10 onward, assuming several non-detect readings, the monitoring network will no longer require sampling.

Line Item 3 – Hydropunch Sampling

- Hydropunch sampling activities will take place on a quarterly basis to more accurately monitor the effectiveness of the biosparge system.

Line Item 4 – Electricity Charge Rate – Biosparging Air Compressors

- It is necessary for constant operation of the air compressors throughout the duration of active biosparging. The cost is based upon a projected amount of electricity consumed per month and the monetary rate charged for consumed energy (per kWh).

Line Item 5 – Biosparging System Maintenance

- For estimating purposes, it is assumed that bi-weekly maintenance visits will be required throughout the duration of active biosparging. The cost is based upon a single field technician making a combined total of two days per month for the entire biosparging network.

Line Item 6 – Electricity Charge Rate – SVE Vacuum Blowers

- For estimating purposes, it is assumed that constant operation of the vacuum blowers will be required throughout the duration of active biosparging. The cost is based upon a projected amount of electricity consumed per month and the monetary rate charged for consumed energy (per kWh).

Line Item 7 – SVE System Maintenance

- For estimating purposes, it is assumed that bi-weekly maintenance visits will be required throughout the duration of active biosparging for the SVE system. The cost is based upon a single field technician making a combined total of two days per month for the entire soil vapor extraction network.

Line Item 8 – Replacement Monitoring Wells

- It is anticipated that it will be necessary to replace wells that get damaged, become non-functional, or need to be relocated.
- One (1) well will be replaced in each of the years 3, 6 and 9.

Line Item 9 – Well Abandonment

- As the contaminant plume diminishes in size fewer wells will be required for monitoring, and wells will be abandoned.
- Well abandonment shall consist of the following: auger out PVC casing and materials filling the annular space outside the casing.
- Borings will be filled with cement grout.
- Well abandonment will be performed concurrently with well replacements so additional mobilization/demobilization costs are avoided.
- Active biosparging activities are scheduled to take place through the first two years of the system. Following active biosparging and SVE activities, all fifty (50) biosparge wells, and fifteen (15) SVE wells shall be abandoned.
- Ten (10) wells are planned for abandonment in year (as they are dropped from the monitoring network).

Line Item 10 – 6 Month Review

- The effectiveness of the system will be reviewed after six months to evaluate the progress. Findings will indicate that the remedy continues to be effective or whether modifications are required (*e.g.*, installation of additional biosparge wells, increasing the air injection rate, or cycling air injection on and off to increase the zone of influence achieved by the system).

Line Item 11 – 5 Year Review

- NCP requires 5-year reviews during the post closure care period to determine that the remedy continues to be effective or if modifications are required.
- Review will be conducted for the ICs, Monitored Natural Attenuation, and Biosparging effectiveness.

Contingency

- A contingency fee of 10% is assumed. This contingency is applied to the subtotaled value that is obtained by combining the total Capital Costs and total O&M Costs.

ALTERNATIVE 4 - BIOSPARGING WITH NUTRIENT ENHANCEMENT, MNA, AND INSTITUTIONAL CONTROLS

The remedy requires the addition of injected air into the saturated zone to increase the biological activity of in-situ microorganisms, and therefore the contaminant degradation rate, as well as continued monitoring and institutional controls while the treatment is in progress. This alternative includes the cost for nutrient enhancement during active biosparging operation. In addition, the cost for a SVE is included in this cost estimate in the event that injected air creates an unacceptable exposure risk. This program requires a direct capital investment to establish the treatment system and monitoring network and to collect baseline contamination attenuation information. A complete description of the alternative is provided in Section 9.

In all cases, cost estimates were prepared using year 2004 dollars as the basis. Annual operation and maintenance costs have been provided for this 8-year period, following 2 years of biosparging. Based on the NCP and EPA guidance, constant dollar costs projected into the future should be discounted to present value costs. For Federal facilities being cleaned up under Superfund authority, the real discount rates to be used are found in current OMB directives (EPA, 2000). OMB Circular A-94 guidance specified real discount rate to be used for an 8-year federal project at 2.6 percent (OMB, 2004).

COST ESTIMATE ASSUMPTIONS – DIRECT COSTS

Line Item 1 – Pre-Design Investigation

- A Health and Safety Plan, Sampling and Analysis Plan, Waste Management Plan, Data Validation/Data Reporting Plan, and Quality Assurance Project Plan will be needed for pre-design activities.
- Further delineate extent of groundwater and soil contamination prior to biosparging system design.
- Perform groundwater sampling and analysis to develop adequate understanding of site conditions and ongoing natural attenuation (Cost Estimate Assumed 1 Year of Data Collection with 20 well monitoring network).
- Collect samples of bacterial activity in the soil, more thoroughly research soil porosity, and other site characteristics to determine the location and quantity of biosparge wells, monitoring wells, soil-gas monitoring probes, and soil vapor extraction wells.
- Work involves evaluating monitoring data to more accurately identify/define natural attenuation processes occurring at the site, and establishing sensitivity parameters to adequately represent attenuation.
- Refine hypotheses for natural attenuation processes.

Line Item 2 – Develop RD/RA, and Land Use Controls Plan

- A Health and Safety Plan, Sampling and Analysis Plan, Waste Management Plan, Data Validation/Data Reporting Plan, and Quality Assurance Project Plan will be needed for remedial design activities.
- Develop Remedial Design for biosparging with nutrient enhancement based on pre-design investigation.
- Develop Post Closure MNA Program.
    - Assume 20-well monitoring program is adequate for future monitoring.
    - Cost analysis assumes that monitoring will begin with 5-year program at the same frequency and using same analytes as program used to establish natural attenuation

criteria. Any required modifications to locations, frequencies, or parameters will be determined during this Task.

- Develop Land Use Controls Implementation Plans.
  - Establish a groundwater exclusion area. Costs include administrative and legal procedures to implement this control.
  - Costs also include establishing property deed restrictions.

Line Item 3 – Field Work

- Install Additional Monitoring Wells
  - Nine (9) additional monitoring wells will be required to complete the 20 well monitoring network assumed to be adequate for establishing criteria and ongoing monitoring.
  - Assumed well specifications: Total depth approximately 20-feet, 2-inch diameter PVC casing, 5-foot well screen at depth 15-20 feet below ground surface (bgs), static water level 6-10 feet bgs.

- Initial Cone Penetration Testing (CPT)
  - Cost of initial field event whereby subsurface soil characteristics are determined when a cone penetrometer, attached to a data acquisition system, is pushed into the subsurface using a hydraulic ram.

- Laboratory Treatability Studies (Microcosm & Slurry)
  - Treatability studies will be used to determine if site conditions demonstrate sufficient microbial activity in the soil or aquifer material and its ability to degrade the contaminants of concern.

- Install Soil Gas Monitoring Probes
  - Ten (10) additional shallow soil gas monitoring probes will be installed to (along with five existing deep soil gas probes) monitor hydrocarbons and determine the need for SVE and measure effectiveness in the treatment zone, respectively.
  - Assumed well specifications: ¼" tubing, 6" screen, screened area 5 feet bgs (shallow) or 12-20 feet bgs (deep).

- Install Biosparge Wells
  - Fifty (50) biosparge wells will be installed to increase airflow to areas with high benzene concentrations.
  - Rig Mobilization and mileage costs are assumed to be an initial cost occurring one time only and will not be applied to each biosparge well installation.
  - Biosparge well installation will be focused on three designated Treatment Areas. Treatment Area 1 centered around monitoring well P181-MW47 near Kollmann Circle measures approximately 2 acres and will require twenty-three (23) biosparge wells to assist in the reduction of benzene levels within the designated area. Treatment Area 2 centered around monitoring well EW-2, west of Tinker Avenue, measuring approximately 1.0 acre will require fifteen (15) biosparge wells to assist in the reduction of benzene levels within the designated area. Treatment Area 3 centered near monitoring wells P181-MW45 and M25-01, measuring approximately 1.0 acre will require twelve (12) biosparge wells to assist in the reduction of benzene levels within the designated area.

- Assumed well specifications: Total depth approximately 20-feet, 2-inch diameter schedule 40 PVC casing, 0.02 inch screen slot aperture, screened area 16-20 feet bgs, spaced on approximately 40-foot centers.

- Install Biosparge Buildings, Equipment and Controls
  - An operations and support building for each location will be required to house the equipment for the biosparging system, including the air compressors and associated equipment.
  - System equipment and controls will consist of: electrical connection and control panels, control valves, sample ports, airflow meters, tubing and connections, trenching and backfill, and oil-less air compressors.

- Install Soil Vapor Extraction Wells
  - A total of fifteen (15) soil vapor extraction wells and associated piping will be installed throughout the biosparging areas as contingency for vadose zone vapor recovery.
  - Assumed well specifications: Total depth approximately 15-feet, 4-inch diameter schedule 40 PVC casing, 0.01 inch screen slot aperture, screened area 5-10 feet bgs.

- Install Soil Vapor Extraction Equipment and Controls
  - The operations and support buildings will also house the soil vapor extraction blowers, electrical equipment, control panels, water knockout vessels, and GAC vapor-phase treatment vessels.
  - Two (2) GAC units will be used for each treatment area. The cost for GAC includes three (3) scheduled replacements of the filtration units for each treatment area.

- Prepare Construction Completion Report
  - Preparation of a construction completion report for the regulatory agencies will be required after installation of remedial systems.

INDIRECT COSTS

Line Item 1 – Project Management/Administration

- Costs for project management and administration are assumed to be 15% of Direct Costs.

Line Item 2 – Legal, License, and Permits

- Costs for legal work, licenses and well installation/construction permits are assumed to be 1% of Direct Costs.

O&M COSTS

Line Item 1 – Maintain Institutional Controls

- It will be necessary to provide funding to local government to maintain the groundwater exclusion zone until naturally attenuated contaminant levels reach remediation goals. It is assumed that the boundary will shrink or retract over time as natural attenuation progresses; however IC's costs remain the same regardless of the size of the exclusion zone.

Line Item 2 – Monitoring & Reporting

- It is assumed that for years 0-2, during active biosparging, the monitoring network will consist of 20 wells sampled at the same quarterly frequency and for same analytes as during establishment of criteria.
- During years 3-7 the monitoring network will include 20 wells sampled at a semi-annual frequency.
- During year 8 the monitoring network will include 10 wells sampled at a semi-annual frequency.
- From year 9 onward, assuming several non-detect readings, the monitoring network will no longer require sampling.

Line Item 3 – Hydropunch Sampling

- Hydropunch sampling activities will take place on a quarterly basis to more accurately monitor the effectiveness of the biosparge system.

Line Item 4 – Electricity Charge Rate – Biosparging Air Compressors

- It is necessary for constant operation of the air compressors throughout the duration of active biosparging. The cost is based upon a projected amount of electricity consumed per month and the monetary rate charged for consumed energy (per kWh).

Line Item 5 – Biosparging System Maintenance

- For estimating purposes, it is assumed that bi-weekly maintenance visits will be required throughout the duration of active biosparging. The cost is based upon a single field technician making a combined total of two days per month for the entire biosparging network.

Line Item 6 – Electricity Charge Rate – SVE Vacuum Blowers

- For estimating purposes, it is assumed that constant operation of the vacuum blowers will be required throughout the duration of active biosparging. The cost is based upon a projected amount of electricity consumed per month and the monetary rate charged for consumed energy (per kWh).

Line Item 7 – SVE System Maintenance

- For estimating purposes, it is assumed that bi-weekly maintenance visits will be required throughout the duration of active biosparging for the SVE system. The cost is based upon a single field technician making a combined total of two days per month for the entire soil vapor extraction network.

Line Item 8 – Nutrient Enhancement – Material Costs

- For estimating purposes, it is assumed that nutrient enhancement will be administered during the active biosparging. The cost for nutrient enhancement material is based upon number biosparging injection points.

Line Item 9 – Nutrient Enhancement - Material Application

- For estimating purposes, it is assumed that bi-weekly maintenance visits will be required throughout the duration of active biosparging for nutrient enhancement. The cost is based upon a single field technician making a combined total of two days per month for the entire biosparging network.

Line Item 10 – Replacement Monitoring Wells

- It is anticipated that it will be necessary to replace wells that get damaged, become non-functional, or need to be relocated.
- One (1) well will be replaced in each of the years 3, 6 and 8.

Line Item 11 – Well Abandonment

- As the contaminant plume diminishes in size fewer wells will be required for monitoring, and wells will be abandoned.
- Well abandonment shall consist of the following: auger out PVC casing and materials filling the annular space outside the casing.
- Borings will be filled with cement grout.
- Well abandonment will be performed concurrently with well replacements so additional mobilization/demobilization costs are avoided.
- Active biosparging activities are scheduled to take place through the first two years of the system. Following active biosparging and SVE activities, all fifty (50) biosparge wells, and fifteen (15) SVE wells shall be abandoned.
- Ten (10) wells are planned for abandonment in year (as they are dropped from the monitoring network).

Line Item 12 – 6 Month Review

- The effectiveness of the system will be reviewed after six months to evaluate the progress. Findings will indicate that the remedy continues to be effective or whether modifications are required (*e.g.*, installation of additional biosparge wells, increasing the air injection rate, or cycling air injection on and off to increase the zone of influence achieved by the system).

Line Item 13 – 5 Year Review

- NCP requires 5-year reviews during the post closure care period to determine that the remedy continues to be effective or if modifications are required.
- Review will be conducted for the ICs, Monitored Natural Attenuation, Biosparging, and Nutrient Enhancement effectiveness.

Contingency

- A contingency fee of 10% is assumed. This contingency is applied to the subtotaled value that is obtained by combining the total Capital Costs and total O&M Costs.

ALTERNATIVE 5 - AIR SPARGING WITH MNA AND INSTITUTIONAL CONTROLS

The remedy requires the injection of air into the saturated zone to volatilize contaminants and also increase the biological activity of in-situ microorganisms, and therefore the contaminant degradation rate, as well as continued monitoring and institutional controls while the treatment is in progress. This remedy requires a concurrent SVE to recover volatilized contaminants which is included in this cost estimate. This program requires a direct capital investment to establish the treatment and recovery system and monitoring network and to collect baseline contamination attenuation information. A complete description of the alternative is provided in Section 9.

In all cases, cost estimates were prepared using year 2004 dollars as the basis. Annual operation and maintenance costs have been provided for this 8-year period, following 1 year of air sparging. Based on the NCP and EPA guidance, constant dollar costs projected into the future should be discounted to present value costs. For Federal facilities being cleaned up under Superfund authority, the real discount rates to be used are found in current OMB directives (EPA, 2000). OMB Circular A-94 guidance specified real discount rate to be used for an 8-year federal project at 2.6 percent (OMB, 2004).

COST ESTIMATE ASSUMPTIONS – DIRECT COSTS

Line Item 1 – Pre-Design Investigation

- A Health and Safety Plan, Sampling and Analysis Plan, Waste Management Plan, Data Validation/Data Reporting Plan, and Quality Assurance Project Plan will be needed for pre-design activities.
- Further delineate extent of groundwater and soil contamination prior to air sparging system design.
- Perform groundwater sampling and analysis to develop adequate understanding of site conditions and ongoing natural attenuation (Cost Estimate Assumed 1 Year of Data Collection with 20 well monitoring network).
- Collect samples of the soil to more thoroughly research soil porosity, and other site characteristics to determine the location and quantity of air sparge wells, monitoring wells, soil-gas monitoring probes, and soil vapor extraction wells.
- Work involves evaluating monitoring data to more accurately identify/define natural attenuation processes occurring at the site, and establishing sensitivity parameters to adequately represent attenuation.
- Refine hypotheses for natural attenuation processes.

Line Item 2 – Develop RD/RA, and Land Use Controls Plan

- A Health and Safety Plan, Sampling and Analysis Plan, Waste Management Plan, Data Validation/Data Reporting Plan, and Quality Assurance Project Plan will be needed for remedial design activities.
- Develop Remedial Design for air sparging system based on pre-design investigation and document field implementation procedures.
- Develop Post Closure MNA Program.
    - Assume 20-well monitoring program is adequate for future monitoring.
    - Cost analysis assumes that monitoring will begin with 5-year program at the same frequency and using same analytes as program used to establish natural attenuation criteria. Any required modifications to locations, frequencies, or parameters will be determined during this Task.

- Develop Land Use Controls Implementation Plans
    - Establish a groundwater exclusion area. Costs include administrative and legal procedures to implement this control.
    - Costs also include establishing property deed restrictions.

Line Item 3 – Field Work

- Install Additional Monitoring Wells
    - Nine (9) additional monitoring wells will be required to complete the 20 well monitoring network assumed to be adequate for establishing criteria and ongoing monitoring.
    - Assumed well specifications: Total depth approximately 20-feet, 2-inch diameter PVC casing, 5-foot well screen at depth 15-20 feet below ground surface (bgs), static water level 6-10 feet bgs.

- Initial Cone Penetration Testing (CPT)
    - Cost of initial field event whereby subsurface soil characteristics are determined when a cone penetrometer, attached to a data acquisition system, is pushed into the subsurface using a hydraulic ram.

- Laboratory Treatability Studies (Microcosm & Slurry)
    - Treatability studies will be used to determine if site conditions demonstrate sufficient microbial activity in the soil or aquifer material and its ability to assist in the degradation the contaminants of concern.

- Install Soil Gas Monitoring Probes
    - Ten (10) additional shallow soil gas monitoring probes will be installed to (along with five existing deep soil gas probes) monitor hydrocarbons and determine the need for SVE and measure effectiveness in the treatment zone, respectively.
    - Assumed well specifications: ¼" tubing, 6" screen, screened area 5 feet bgs (shallow) or 12-20 feet bgs (deep).

- Install Air Sparging Wells
    - Fifty (50) air sparging wells will be installed to increase airflow to areas with high benzene concentrations.
    - Rig Mobilization and mileage costs are assumed to be an initial cost occurring one time only and will not be applied to each biosparge well installation.
    - Air sparging well installation will be focused on three designated Treatment Areas. Treatment Area 1 centered around monitoring well P181-MW47 near Kollmann Circle measures approximately 2.0 acres and will require twenty-three (23) air sparging wells to assist in the reduction of benzene levels within the designated area. Treatment Area 2 centered around monitoring well EW-2, west of Tinker Avenue, measuring approximately 1.0 acre will require fifteen (15) air sparging wells to assist in the reduction of benzene levels within the designated area. Treatment Area 3 centered near monitoring wells P181-MW45 and M25-01, measuring approximately 1.0 acre will require twelve (12) air sparging wells to assist in the reduction of benzene levels within the designated area.
    - Assumed well specifications: Total depth approximately 20-feet, 2-inch diameter schedule 40 PVC casing, 0.02 inch screen slot aperture, screened area 16-20 feet bgs, spaced on approximately 40-foot centers.

- Install Air Sparging Buildings, Equipment and Controls
    - An operations and support building for each location will be required to house the equipment for the air sparging system, including the air compressors and associated equipment.
    - System equipment and controls will consist of: electrical connection and control panels, control valves, sample ports, airflow meters, tubing and connections, trenching and backfill, and oil-less air compressors.

- Install Soil Vapor Extraction Wells
    - A total of fifteen (15) soil vapor extraction wells and associated piping will be installed throughout the air sparging areas as contingency for vadose zone vapor recovery.
    - Assumed well specifications: Total depth approximately 15-feet, 4-inch diameter schedule 40 PVC casing, 0.01 inch screen slot aperture, screened area 5-10 feet bgs.

- Install Soil Vapor Extraction Equipment and Controls
    - The operations and support buildings will also house the soil vapor extraction blowers, electrical equipment, control panels, water knockout vessels, and GAC vapor-phase treatment vessels.
    - Two (2) GAC units will be used for each treatment area. The cost for GAC includes three (3) scheduled replacements of the filtration units for each treatment area.

- Prepare Construction Completion Report
    - Preparation of a construction completion report for the regulatory agencies will required after installation of remedial systems.

INDIRECT COSTS

Line Item 1 – Project Management/Administration

- Costs for project management and administration are assumed to be 15% of Direct Costs.

Line Item 2 – Legal, License, and Permits

- Costs for legal work, licenses and well installation/construction permits are assumed to be 1% of Direct Costs.

O&M COSTS

Line Item 1 – Maintain Institutional Controls

- It will be necessary to provide funding to local government to maintain the groundwater exclusion zone until naturally attenuated contaminant levels reach remediation goals. It is assumed that the boundary will shrink or retract over time as natural attenuation progresses; however ICs costs remain the same regardless of the size of the exclusion zone.

Line Item 2 – Monitoring & Reporting

- It is assumed that for years 0-1, during active air sparging, the monitoring network will consist of 20 wells sampled at the same quarterly frequency and for same analytes as during establishment of criteria.
- During years 2-7 the monitoring network will include 20 wells sampled at a semi-annual frequency.

- During year 8 the monitoring network will include 10 wells sampled at a semi-annual frequency.
- From year 9 onward, assuming several non-detect readings, the monitoring network will no longer require sampling.

Line Item 3 – Hydropunch Sampling

- Hydropunch sampling activities will take place on a quarterly basis to more accurately monitor the effectiveness of the air sparge system.

Line Item 4 – Electricity Charge Rate – Air Sparging Air Compressors

- It is necessary for constant operation of the air compressors throughout the duration of active air sparging. The cost is based upon a projected amount of electricity consumed per month and the monetary rate charged for consumed energy (per kWh).

Line Item 5 – Air Sparging System Maintenance

- For estimating purposes, it is assumed that bi-weekly maintenance visits will be required throughout the duration of active air sparging. The cost is based upon a single field technician making a combined total of two days per month for the entire air sparging network.

Line Item 6 – Electricity Charge Rate – SVE Vacuum Blowers

- Constant operation of the vacuum blowers will be required throughout the duration of active air sparging. The cost is based upon a projected amount of electricity consumed per month and the monetary rate charged for consumed energy (per kWh).

Line Item 7 – SVE System Maintenance

- For estimating purposes, it is assumed that bi-weekly maintenance visits will be required throughout the duration of active air sparging for the SVE system. The cost is based upon a single field technician making a combined total of two days per month for the entire soil vapor extraction network.

Line Item 8 – Replacement Monitoring Wells

- It is anticipated that it will be necessary to replace wells that get damaged, become non-functional, or need to be relocated.
- One (1) well will be replaced in each of the years 3, 6 and 8.

Line Item 9 – Well Abandonment

- As the contaminant plume diminishes in size fewer wells will be required for monitoring, and wells will be abandoned.
- Well abandonment shall consist of the following: auger out PVC casing and materials filling the annular space outside the casing.
- Borings will be filled with cement grout
- Well abandonment will be performed concurrently with well replacements so additional mobilization/demobilization costs are avoided.
- Active air sparging activities are scheduled to take place through the first two years of the system. Following active air sparging and SVE activities, all fifty (50) air sparge wells, and fifteen (15) SVE wells shall be abandoned.
- Ten (10) wells are planned for abandonment in year (as they are dropped from the monitoring network)

Line Item 10 – 6 Month Review

- The effectiveness of the system will be reviewed after six months to evaluate the progress. Findings will indicate that the remedy continues to be effective or whether modifications are required (*e.g.*, installation of additional air sparging wells, increasing the air injection rate, or cycling air injection on and off to increase the zone of influence achieved by the system).

Line Item 11 – 5 Year Review

- NCP requires 5-year reviews during the post closure care period to determine that the remedy continues to be effective or if modifications are required.
- Review will be conducted for the ICs, Monitored Natural Attenuation, and Air Sparging effectiveness.

Contingency

- A contingency fee of 10% is assumed. This contingency is applied to the subtotaled value that is obtained by combining the total Capital Costs and total O&M Costs.

ALTERNATIVE 6 – GROUNDWATER PUMP & TREAT WITH MNA AND INSTITUTIONAL CONTROLS

The remedy requires the extraction and treatment of groundwater to reduce contaminant concentrations, as well as continued monitoring and institutional controls while the treatment is in progress. For estimating purposes, it is assumed that onsite treatment of the extracted groundwater will be required throughout the duration of active pumping. The cost for offsite disposal of the treated groundwater into the sanitary sewer system is also included in this cost estimate. This program requires a direct capital investment to establish the extraction and treatment system and monitoring network and to collect baseline contamination attenuation information. A complete description of the alternative is provided in Section 9.

In all cases, cost estimates were prepared using year 2004 dollars as the basis. Annual operation and maintenance costs have been provided for this 15-year period, following 8 years of groundwater extraction. Based on the NCP and EPA guidance, constant dollar costs projected into the future should be discounted to present value costs. For Federal facilities being cleaned up under Superfund authority, the real discount rates to be used are found in current OMB directives (EPA, 2000). OMB Circular A-94 guidance specified real discount rate to be used for a 15-year federal project at 3.0 percent (OMB, 2004).

COST ESTIMATE ASSUMPTIONS – DIRECT COSTS

Line Item 1 – Pre-Design Investigation

- A Health and Safety Plan, Sampling and Analysis Plan, Waste Management Plan, Data Validation/Data Reporting Plan, and Quality Assurance Project Plan will be needed for pre-design activities.
- Further delineate extent of groundwater and soil contamination prior to extraction system design.
- Perform groundwater sampling and analysis to develop adequate understanding of site conditions and ongoing natural attenuation (Cost Estimate Assumed 1 Year of Data Collection with 20 well monitoring network).
- Collect samples of the soil to more thoroughly research soil porosity and other site characteristics, and perform pump tests on existing wells to determine the location and quantity of pumping and monitoring wells.
- Work involves evaluating monitoring data to more accurately identify/define natural attenuation processes occurring at the site, and establishing sensitivity parameters to adequately represent attenuation.
- Refine hypotheses for natural attenuation processes.

Line Item 2 – Develop RD/RA, and Land Use Controls Plan

- A Health and Safety Plan, Sampling and Analysis Plan, Waste Management Plan, Data Validation/Data Reporting Plan, and Quality Assurance Project Plan will be needed for remedial design activities.
- Develop Remedial Design for groundwater extraction and treatment system based on pre-design investigation and document field implementation procedures.
- Develop Post Closure MNA Program.
    - Assume 20-well monitoring program is adequate for future monitoring.
    - Cost analysis assumes that monitoring will begin with 5-year program at the same frequency and using same analytes as program used to establish natural attenuation

criteria. Any required modifications to locations, frequencies, or parameters will be determined during this Task.

- Develop Land Use Controls Implementation Plans.
  - Establish a groundwater exclusion area. Costs include administrative and legal procedures to implement this control.
  - Costs also include establishing property deed restrictions.

Line Item 3 – Field Work

- Install Additional Monitoring Wells
  - Nine (9) additional monitoring wells will be required to complete the 20 well monitoring network assumed to be adequate for establishing criteria and ongoing monitoring.
  - Assumed well specifications: Total depth approximately 20-feet, 2-inch diameter PVC casing, 5-foot well screen at depth 15-20 feet below ground surface (bgs), static water level 6-10 feet bgs.

- Initial Cone Penetration Testing (CPT)
  - Cost of initial field event whereby subsurface soil characteristics are determined when a cone penetrometer, attached to a data acquisition system, is pushed into the subsurface using a hydraulic ram.

- Laboratory Treatability Studies (Microcosm & Slurry)
  - Treatability studies will be used to determine if site conditions demonstrate sufficient microbial activity in the soil or aquifer material and its ability to assist in the degradation the contaminants of concern.

- Install Groundwater Extraction Wells
  - Sixteen (16) extraction wells will be installed to reduce contaminant concentrations.
  - Rig Mobilization and Mileage costs are assumed to be an initial cost occurring one time only and will not be applied to each biosparge well installation.
  - Groundwater extraction well installation will be focused on three designated Treatment Areas. Treatment Area 1 centered around monitoring well P181-MW47 near Kollmann Circle measures approximately 2.0 acres and will require eight (8) extraction wells to assist in the reduction of benzene levels within the designated area. Treatment Area 2 centered around monitoring well EW-2, west of Tinker Avenue, measuring approximately 1.0 acre will require four (4) extraction wells to assist in the reduction of benzene levels within the designated area. Treatment Area 3 centered near monitoring wells P181-MW45 and M25-01, measuring approximately 1.0 acre will require four (4) extraction wells to assist in the reduction of benzene levels within the designated area.
  - Assumed well specifications: Total depth approximately 30-feet, 6-inch diameter schedule 40 PVC casing, 0.02 inch screen slot aperture, screened area 10-25 feet bgs, spaced on approximately 100-foot centers.

- Install Extraction and Treatment System Buildings, Equipment and Controls
  - An operations and support building for each of the three locations will be required to house the equipment for the pumping and treatment system equipment, including carbon vessels, air compressors and associated equipment.

- System equipment and controls will consist of: electrical connection and control panels, activated carbon canisters, controller-less pneumatic pumps, well boxes, tubing and connections, trenching and backfill, and oil-less air compressors.
- Each treatment location will also require connection to the existing sanitary sewer system for disposal of treated groundwater.

- Prepare Construction Completion Report
  - Preparation of a construction completion report for the regulatory agencies will required after installation of remedial systems.

INDIRECT COSTS

Line Item 1 – Project Management/Administration

- Costs for project management and administration are assumed to be 15% of Direct Costs.

Line Item 2 – Legal, License, and Permits

- Costs for legal work, licenses and well installation/construction permits are assumed to be 1% of Direct Costs.

O&M COSTS

Line Item 1 – Maintain Institutional Controls

- It will be necessary to provide funding to local government to maintain the groundwater exclusion zone until naturally attenuated contaminant levels reach remediation goals. It is assumed that the boundary will shrink or retract over time as natural attenuation progresses; however ICs costs remain the same regardless of the size of the exclusion zone.

Line Item 2 – Monitoring & Reporting

- It is assumed that for years 0-8, during active groundwater pumping, the monitoring network will consist of 20 wells sampled at the same quarterly frequency and for same analytes as during establishment of criteria.
- During years 9-12 the monitoring network will include 20 wells sampled at a semi-annual frequency.
- During years 13-15 the monitoring network will include 10 wells sampled at a semi-annual frequency.
- From year 15 onward, assuming several non-detect readings, the monitoring network will no longer require sampling.

Line Item 3 – Electricity Charge Rate – Air Compressors for Pneumatic Pumps

- It is necessary for constant operation of the air compressors during operation of the pneumatic groundwater pumps. The cost is based upon a projected amount of electricity consumed per month and the monetary rate charged for consumed energy (per kWh).

Line Item 4 – Treatment and Disposal Costs

- For estimating purposes, it is assumed that activated carbon vessels will require change out at a rate of once per year for each of the three locations throughout the duration of active pumping, in addition to sewer disposal fees based on the discharge volumes.

Line Item 5 – Pumping and Treatment System Maintenance

- For estimating purposes, it is assumed that bi-weekly maintenance visits will be required throughout the duration of active pumping. The cost is based upon a single field technician making a combined total of four days per month for the entire pumping network.

Line Item 6 – Replacement Monitoring Wells

- It is anticipated that it will be necessary to replace wells that get damaged, become non-functional, or need to be relocated.
- One (1) well will be replaced in each of the years 3, 6, 9, 12 and 15.

Line Item 7 – Well Abandonment

- As the contaminant plume diminishes in size fewer wells will be required for monitoring, and wells will be abandoned.
- Well abandonment shall consist of the following: auger out PVC casing and materials filling the annular space outside the casing.
- Borings will be filled with cement grout.
- Well abandonment will be performed concurrently with well replacements so additional mobilization/demobilization costs are avoided.
- Active air sparging activities are scheduled to take place through the first two years of the system. Following active air sparging and SVE activities, all fifty (50) air sparge wells, and fifteen (15) SVE wells shall be abandoned.
- Ten (10) wells are planned for abandonment in year (as they are dropped from the monitoring network).

Line Item 8 – 6 Month Review

- The effectiveness of the system will be reviewed after six months to evaluate the progress. Findings will indicate that the remedy continues to be effective or whether modifications are required (*e.g.*, installation of additional air sparging wells, increasing the air injection rate, or cycling air injection on and off to increase the zone of influence achieved by the system).

Line Item 9 – 5 Year Review

- NCP requires 5-year reviews during the post closure care period to determine that the remedy continues to be effective or if modifications are required.
- Review will be conducted for the ICs, Monitored Natural Attenuation, and Air Sparging effectiveness.

Contingency

- A contingency fee of 10% is assumed. This contingency is applied to the subtotaled value that is obtained by combining the total Capital Costs and total O&M Costs.

REFERENCES

United States Environmental Protection Agency, A Guide to Developing and Documenting Cost Estimates During the Feasibility Study, OSWER 9355.0-75, July 2000.

Office of Management and Budget, Circular No. A-94, Appendix C, "Discount Rates for Cost Effectiveness Analyses", Revised February 2004.

Table H-1
Cost Estimate Alternative 2 - Monitored Natural Attenuation
Alameda Point/Alameda Annex Groundwater RI/FS

Item No.	Description	Quantity	Unit	Unit Cost	Total Cost
DIRECT COSTS					
1	**Develop Work Plans**	1	LS	15,000	15,000.00
2	**Install Additional Wells**	9	EA	2,100	18,900.00
3	**MNA Sampling Evaluation**	1	LS	30,000.00	30,000.00
4	**Develop Natural Attenuation Model**	1	LS	60,000.00	60,000.00
5	**Develop Post Closure MNA Program**	1	LS	20,000.00	20,000.00
7	**Establish Institutional Controls (LUCIP)**	1	LS	50,000	50,000.00
				Subtotal:	*193,900.00*
INDIRECT COSTS					
1	**Project Management & Administration**	15%			29,085.00
2	**Legal and Licenses**	1%			1,939.00
				Capital Costs TOTAL:	***224,924.00***
O & M COSTS (Annual)					
1	**Maintain Institutional Controls**	1	YR	10,000.00	10,000.00
2	**Monitored Natural Attenuation**				
	Year 0-5	1	Annual	124,386.00	124,386.00
	Year 6-10	1	Annual	71,377.00	71,377.00
	Year 11-50	1	Annual	35,688.50	35,688.50
3	**Replacement of Monitoring Wells**				
	Year 0-50 (YR3-48)	1	EA	2,100.00	2,100.00
	Year 11-30 (YR15)	2	EA	2,100.00	4,200.00
	Year 31-50(YR39)	4	EA	2,100.00	8,400.00
4	**Well Abandonment**				
	Year 6-10 (YR8)	11	EA	1,900.00	20,900.00
	Year 11-15 (YR13)	2	EA	1,900.00	3,800.00
5	**5 Year Review**				
	ICs (YR 5,10,15,20,25,30,35,40,45,50)	1	LS	30,000.00	30,000.00
	MNA (YR 5,10,15,20,25,30,35,40,45,50)	1	LS	20,000.00	20,000.00
	TOTAL O&M Net Present Value (30 Years)				***$1,798,997.83***
	Discount Rate 3.5%				
				Subtotal:	*$2,023,921.83*
				10% Contingency	*202,392.18*
	TOTAL PRESENT VALUE COST OF ALTERNATIVE				**$2,226,314.01**

Table H-2
50-Year Cash Flow Analysis Alternative 2 - Monitored Natural Attenuation
Alameda Point/Alameda Annex Groundwater RI/FS

Year	IC's	G/W	5-Yr Review	Well Replace	Well Abandon	TOTAL
1	$ 10,000.00	$ 124,386.00				$ 134,386.00
2	$ 10,000.00	$ 106,864.00				$ 116,864.00
3	$ 10,000.00	$ 106,864.00		$ 2,100.00		$ 118,964.00
4	$ 10,000.00	$ 106,864.00				$ 116,864.00
5	$ 10,000.00	$ 106,864.00	$ 50,000.00			$ 166,864.00
6	$ 10,000.00	$ 71,377.00		$ 2,100.00		$ 83,477.00
7	$ 10,000.00	$ 71,377.00				$ 81,377.00
8	$ 10,000.00	$ 71,377.00				$ 81,377.00
9	$ 10,000.00	$ 71,377.00		$ 2,100.00		$ 83,477.00
10	$ 10,000.00	$ 71,377.00	$ 50,000.00		$ 20,900.00	$ 152,277.00
11	$ 10,000.00	$ 35,688.50				$ 45,688.50
12	$ 10,000.00	$ 35,688.50		$ 2,100.00		$ 47,788.50
13	$ 10,000.00	$ 35,688.50				$ 45,688.50
14	$ 10,000.00	$ 35,688.50				$ 45,688.50
15	$ 10,000.00	$ 35,688.50	$ 50,000.00	$ 4,200.00		$ 99,888.50
16	$ 10,000.00	$ 35,688.50				$ 45,688.50
17	$ 10,000.00	$ 35,688.50				$ 45,688.50
18	$ 10,000.00	$ 35,688.50		$ 2,100.00		$ 47,788.50
19	$ 10,000.00	$ 35,688.50				$ 45,688.50
20	$ 10,000.00	$ 35,688.50	$ 50,000.00			$ 95,688.50
21	$ 10,000.00	$ 35,688.50		$ 2,100.00		$ 47,788.50
22	$ 10,000.00	$ 35,688.50				$ 45,688.50
23	$ 10,000.00	$ 35,688.50				$ 45,688.50
24	$ 10,000.00	$ 35,688.50		$ 2,100.00		$ 47,788.50
25	$ 10,000.00	$ 35,688.50	$ 50,000.00			$ 95,688.50
26	$ 10,000.00	$ 35,688.50				$ 45,688.50
27	$ 10,000.00	$ 35,688.50		$ 2,100.00		$ 47,788.50
28	$ 10,000.00	$ 35,688.50				$ 45,688.50
29	$ 10,000.00	$ 35,688.50				$ 45,688.50
30	$ 10,000.00	$ 35,688.50	$ 50,000.00	$ 2,100.00	$ 3,800.00	$ 101,588.50
31	$ 10,000.00	$ 35,688.50				$ 45,688.50
32	$ 10,000.00	$ 35,688.50				$ 45,688.50
33	$ 10,000.00	$ 35,688.50		$ 2,100.00		$ 47,788.50
34	$ 10,000.00	$ 35,688.50				$ 45,688.50
35	$ 10,000.00	$ 35,688.50	$ 50,000.00			$ 95,688.50
36	$ 10,000.00	$ 35,688.50		$ 2,100.00		$ 47,788.50
37	$ 10,000.00	$ 35,688.50				$ 45,688.50
38	$ 10,000.00	$ 35,688.50				$ 45,688.50
39	$ 10,000.00	$ 35,688.50		$ 8,400.00		$ 54,088.50
40	$ 10,000.00	$ 35,688.50	$ 50,000.00			$ 95,688.50
41	$ 10,000.00	$ 35,688.50				$ 45,688.50
42	$ 10,000.00	$ 35,688.50		$ 2,100.00		$ 47,788.50
43	$ 10,000.00	$ 35,688.50				$ 45,688.50
44	$ 10,000.00	$ 35,688.50				$ 45,688.50
45	$ 10,000.00	$ 35,688.50	$ 50,000.00	$ 2,100.00		$ 97,788.50
46	$ 10,000.00	$ 35,688.50				$ 45,688.50
47	$ 10,000.00	$ 35,688.50				$ 45,688.50
48	$ 10,000.00	$ 35,688.50		$ 2,100.00		$ 47,788.50
49	$ 10,000.00	$ 35,688.50				$ 45,688.50
50	$ 10,000.00	$ 35,688.50	$ 50,000.00			$ 95,688.50
Subtotals:	***$ 500,000.00***	***$ 2,336,267.00***	***$ 500,000.00***	***$ 42,000.00***	***$ 24,700.00***	
					Total Cash Flow:	**$ 3,402,967.00**

Table H-3
Cost Estimate Alternative 3 - Biosparging
with Monitored Natural Attenuation and Institutional Controls
Alameda Point/Alameda Annex Groundwater RI/FS

Item No.	Description	Quantity	Unit	Unit Cost ($)	Total Cost ($)
DIRECT COSTS					
1	**Pre-Design Investigation**				
	Develop Work Plans	1	LS	15,000.00	15,000.00
	Additional GW/Soil Contamination Delinieation	1	LS	60,000.00	60,000.00
	MNA Sampling Evaluation	1	LS	30,000.00	30,000.00
	Reporting	1	LS	15,000.00	15,000.00
2	**Remedial Design**				
	Develop Work Plans	1	LS	15,000.00	15,000.00
	Develop RD/RA Plans	1	LS	60,000.00	60,000.00
	Develop Post Closure MNA Program	1	LS	20,000.00	20,000.00
	Establish Institutional Controls (LUCIP)	1	LS	50,000.00	50,000.00
3	**Remedial Action Field Work**				
	Install Additional Monitoring Wells	9	EA	2,100.00	18,900.00
	Initial Cone Penetration Testing (CPT)	1	LS	8,000.00	8,000.00
	Lab - Microcosm & Slurry Study	3	EA	3,000.00	9,000.00
	Install Soil Gas Monitoring Probes	10	EA	1,500.00	15,000.00
	Install Biosparge Wells	50	EA	2,100.00	105,000.00
	Biosparge Equipment & Installation	1	LS	165,250.00	165,250.00
	Install SVE Wells	15	EA	2,100.00	31,500.00
	SVE Equipment & Installation	1	LS	167,375.00	167,375.00
	Construction Completion Report	1	LS	15,000.00	15,000.00
				Subtotal:	*800,025.00*
INDIRECT COSTS					
1	**Project Management & Administration**	15%			120,003.75
2	**Legal, License, Permits**	1%			8,000.25
				Capital Costs TOTAL:	***928,029.00***
O & M COSTS (Annual)					
1	**Maintain Institutional Controls** Year 0-9	1	Annual	10,000.00	10,000.00
2	**Monitoring & Reporting**				
	Year 0-2	1	Annual	124,386.00	124,386.00
	Year 3-7	1	Annual	62,193.00	62,193.00
	Year 8-9	1	Annual	35,688.50	35,688.50
3	**Hydropunch Sampling**				
	Year 0-2	1	Annual	46,880.00	46,880.00
4	**Electricity Charge Rate - Biosparging**				
	Year 0-2 (active biosparging)	1	Annual	19,896.00	19,896.00
5	**Maintenance - Biosparging**				
	Year 0-2 (active biosparging)	1	Annual	48,000.00	48,000.00
6	**Electricity Charge Rate - SVE**				
	Year 0-2 (active biosparging)	3	Annual	29,844.00	89,532.00
7	**Maintenance - SVE**				
	Year 0-2 (active biosparging)	1	Annual	48,000.00	48,000.00
8	**Replacement Monitoring Wells**				
	Years 3, 6 & 9	1	EA	2,100.00	2,100.00
9	**Well Abandonment**				
	Year 3 (YR2-all biosparge)	50	EA	1,900.00	95,000.00
	Year 3 (YR2-all SVE)	15	EA	1,900.00	28,500.00
	Year 8-9	10	EA	1,900.00	19,000.00
10	**6 Month System Review**	1	LS	10,000.00	10,000.00
11	**5 Year Review**				
	Institutional Controls (YR 5)	2	LS	30,000.00	60,000.00
	Monitored Natural Attenuation (YR 5)	2	LS	20,000.00	40,000.00
	TOTAL O&M Net Present Value (9 Years)				***$1,105,028.71***
	Discount Rate 2.7%				
				Subtotal:	*$2,033,057.71*
				10% Contingency:	*$203,305.77*
	TOTAL PRESENT VALUE COST OF ALTERNATIVE				**$2,236,363.48**

Table H-4
9-Year Cash Flow Analysis Alternative 3 - Biosparging with MNA and ICs
Alameda Point/Alameda Annex Groundwater RI/FS

Year	IC's	Monitoring	Review	Hydropunch	O&M	Well Replace	Well Abandon	TOTAL
1	$ 10,000.00	$ 124,386.00	$ 10,000.00	$ 46,880.00	$ 72,870.00			$ 264,136.00
2	$ 10,000.00	$ 124,386.00		$ 46,880.00	$ 72,870.00			$ 254,136.00
3	$ 10,000.00	$ 62,193.00				$ 2,100.00	$ 123,500.00	$ 197,793.00
4	$ 10,000.00	$ 62,193.00						$ 72,193.00
5	$ 10,000.00	$ 62,193.00	$ 50,000.00					$ 122,193.00
6	$ 10,000.00	$ 62,193.00				$ 2,100.00		$ 74,293.00
7	$ 10,000.00	$ 62,193.00						$ 72,193.00
8	$ 10,000.00	$ 35,688.50					$ 19,000.00	$ 64,688.50
9	$ 10,000.00	$ 35,688.50	$ 50,000.00			$ 2,100.00		$ 97,788.50
Subtotals:	***$ 90,000.00***	***$ 631,114.00***	***$ 110,000.00***	***$ 93,760.00***	***$ 145,740.00***	***$ 6,300.00***	***$ 142,500.00***	
					Total Cash Flow:			**$ 1,219,414.00**

Table H-5
Cost Estimate Alternative 4 - Biosparging
with Nutrient Enhancement, Monitored Natural Attenuation, and Institutional Controls
Alameda Point/Alameda Annex Groundwater RI/FS

Item No.	Description	Quantity	Unit	Unit Cost ($)	Total Cost ($)
DIRECT COSTS					
1	**Pre-Design Investigation**				
	Develop Work Plans	1	LS	15,000.00	15,000.00
	Additional GW/Soil Contamination Delinieation	1	LS	60,000.00	60,000.00
	MNA Sampling Evaluation	1	LS	30,000.00	30,000.00
	Reporting	1	LS	15,000.00	15,000.00
2	**Remedial Design**				
	Develop Work Plans	1	LS	15,000.00	15,000.00
	Develop RD/RA Plans	1	LS	60,000.00	60,000.00
	Develop Post Closure MNA Program	1	LS	20,000.00	20,000.00
	Establish Institutional Controls (LUCIP)	1	LS	50,000.00	50,000.00
3	**Remedial Action Field Work**				
	Install Additional Monitoring Wells	9	EA	2,100.00	18,900.00
	Initial Cone Penetration Testing (CPT)	1	LS	8,000.00	8,000.00
	Lab - Microcosm & Slurry Study	3	EA	3,000.00	9,000.00
	Install Soil Gas Monitoring Probes	10	EA	1,500.00	15,000.00
	Install Biosparge Wells	50	EA	2,100.00	105,000.00
	Biosparge Equipment & Installation	1	LS	165,250.00	165,250.00
	Install SVE Wells	15	EA	2,100.00	31,500.00
	SVE Equipment & Installation	1	LS	167,375.00	167,375.00
	Construction Completion Report	1	LS	15,000.00	15,000.00
				Subtotal:	*800,025.00*
INDIRECT COSTS					
1	**Project Management & Administration**	15%			120,003.75
2	**Legal, License, Permits**	1%			8,000.25
				Capital Costs TOTAL:	***928,029.00***
O & M COSTS (Annual)					
1	**Maintain Institutional Controls**	1	YR	10,000.00	10,000.00
2	**Monitoring**				
	Year 0-2	1	Annual	139,786.00	139,786.00
	Year 3-7	1	Annual	62,193.00	62,193.00
	Year 8	1	Annual	35,688.50	35,688.50
3	**Hydropunch Sampling**				
	Year 0-2	1	Annual	53,880.00	53,880.00
4	**Electricity Charge Rate - Biosparging**				
	Year 0-2 (active biosparging)	1	Annual	19,896.00	19,896.00
5	**Maintenance - Biosparging**				
	Year 0-2 (active biosparging)	1	Annual	48,000.00	48,000.00
6	**Electricity Charge Rate - SVE**				
	Year 0-2 (active biosparging)	1	Annual	29,844.00	29,844.00
7	**Maintenance - SVE**				
	Year 0-2 (active biosparging)	1	Annual	48,000.00	48,000.00
8	**Material Cost - Nutirent Enhancement**				
	Year 0-2 (active biosparging)	1	Annual	12,000.00	12,000.00
9	**Maintenance - Nutrient Enhancement**				
	Year 0-2 (active biosparging)	1	Annual	48,000.00	48,000.00
10	**Replacement Monitoring Wells**				
	Years 3, 6 & 8	1	EA	2,100.00	2,100.00
11	**Well Abandonment**				
	Year 3 (YR2-all biosparge)	50	EA	1,900.00	95,000.00
	Year 3 (YR2-all SVE)	15	EA	1,900.00	28,500.00
	Year 8	10	EA	1,900.00	19,000.00
12	**6 Month System Review**	1	LS	10,000.00	10,000.00
13	**5 Year Review**				
	Institutional Control's (YR 5)	1	LS	30,000.00	30,000.00
	Monitored Natural Attenuation (YR 5)	1	LS	20,000.00	20,000.00
	TOTAL O&M Net Present Value (9 Years)				***$1,178,305.40***
	Discount Rate 2.5%				
				Subtotal:	*$2,106,334.40*
				10% Contingency:	*$210,633.44*
	TOTAL PRESENT VALUE COST OF ALTERNATIVE				**$2,316,967.84**

Table H-6
8-Year Cash Flow Analysis Alternative 4 - Biosparging with Nutrient Enhancement, MNA and ICs
Alameda Point/Alameda Annex Groundwater RI/FS

Year	IC's	Monitoring	Review	Hydropunch	O&M	Well Replace	Well Abandon	TOTAL
1	$ 10,000.00	$ 139,786.00	$ 10,000.00	$ 53,880.00	$ 102,870.00			$ 316,536.00
2	$ 10,000.00	$ 139,786.00		$ 53,880.00	$ 102,870.00			$ 306,536.00
3	$ 10,000.00	$ 62,193.00				$ 2,100.00	$ 123,500.00	$ 197,793.00
4	$ 10,000.00	$ 62,193.00						$ 72,193.00
5	$ 10,000.00	$ 62,193.00	$ 50,000.00					$ 122,193.00
6	$ 10,000.00	$ 62,193.00				$ 2,100.00		$ 74,293.00
7	$ 10,000.00	$ 62,193.00						$ 72,193.00
8	$ 10,000.00	$ 35,688.50	$ 50,000.00			$ 2,100.00	$ 19,000.00	$ 116,788.50
Subtotals:	***$ 80,000.00***	***$ 626,225.50***	***$ 110,000.00***	***$ 107,760.00***	***$ 205,740.00***	***$ 6,300.00***	***$ 142,500.00***	
						Total Cash Flow:		**$ 1,278,525.50**

Table H-7
Cost Estimate Alternative 5 - Air Sparging
with Monitored Natural Attenuation and Institutional Controls
Alameda Point/Alameda Annex Groundwater RI/FS

Item No.	Description	Quantity	Unit	Unit Cost ($)	Total Cost ($)
DIRECT COSTS					
1	**Pre-Design Investigation**				
	Develop Work Plans	1	LS	15,000.00	15,000.00
	Additional GW/Soil Contamination Delinieation	1	LS	60,000.00	60,000.00
	MNA Sampling Evaluation	1	LS	30,000.00	30,000.00
	Reporting	1	LS	15,000.00	15,000.00
2	**Remedial Design**				
	Develop Work Plans	1	LS	15,000.00	15,000.00
	Develop RD/RA Plans	1	LS	60,000.00	60,000.00
	Develop Post Closure MNA Program	1	LS	20,000.00	20,000.00
	Establish Institutional Controls (LUCIP)	1	LS	50,000.00	50,000.00
3	**Remedial Action Field Work**				
	Install Additional Monitoring Wells	9	EA	2,100.00	18,900.00
	Initial Cone Penetration Testing (CPT)	1	LS	8,000.00	8,000.00
	Lab - Microcosm & Slurry Study	3	EA	3,000.00	9,000.00
	Install Soil Gas Monitoring Probes	10	EA	1,500.00	15,000.00
	Install Air Sparge Wells	50	EA	2,100.00	105,000.00
	Air Sparge Equipment & Installation	1	LS	187,750.00	187,750.00
	Install SVE Wells	15	EA	2,100.00	31,500.00
	SVE Equipment & Installation	1	LS	197,375.00	197,375.00
	Construction Completion Report	1	LS	15,000.00	15,000.00
				Subtotal:	*852,525.00*
INDIRECT COSTS					
1	**Project Management & Administration**	15%			127,878.75
2	**Legal, License, Permits**	1%			8,525.25
				Capital Costs TOTAL:	***988,929.00***
O & M COSTS (Annual)					
1	**Maintain Institutional Controls**	1	YR	10,000.00	10,000.00
2	**Monitoring**				
	Year 0-1	1	Annual	124,386.00	124,386.00
	Year 2-7	1	Annual	62,193.00	62,193.00
	Year 8	1	Annual	35,688.50	35,688.50
3	**Hydropunch Sampling**				
	Year 0-1	1	Annual	46,880.00	46,880.00
4	**Electricity Charge Rate - Air Sparging**				
	Year 0-1 (active air sparging)	1	Annual	19,896.00	19,896.00
5	**Maintenance - Air Sparging**				
	Year 0-1 (active air sparging)	1	Annual	24,000.00	24,000.00
6	**Electricity Charge Rate - SVE**				
	Year 0-1 (active air sparging)	1	Annual	29,844.00	29,844.00
7	**Maintenance - SVE**				
	Year 0-1 (active air sparging)	1	Annual	24,000.00	24,000.00
8	**Replacement Monitoring Wells**				
	Years 3, 6 & 8	1	EA	2,100.00	2,100.00
9	**Well Abandonment**				
	Year 2 (YR2-all air sparge)	50	EA	1,900.00	95,000.00
	Year 3 (YR2-all SVE)	15	EA	1,900.00	28,500.00
	Year 8	10	EA	1,900.00	19,000.00
10	**6 Month System Review**	1	LS	10,000.00	10,000.00
11	**5 Year Review**				
	Institutional Controls (YR 5)	1	LS	30,000.00	30,000.00
	Monitored Natural Attenuation (YR 5)	1	LS	20,000.00	20,000.00
	TOTAL O&M Net Present Value (8 Years)				***$1,028,753.94***
	Discount Rate 2.6%				
				Subtotal:	*$2,017,682.94*
				10% Contingency:	*$201,768.29*
	TOTAL PRESENT VALUE COST OF ALTERNATIVE				**$2,219,451.24**

Table H-8
8-Year Cash Flow Analysis Alternative 5 - Air Sparging with MNA and ICs
Alameda Point/Alameda Annex Groundwater RI/FS

Year	IC's	Monitoring	Review	Hydropunch	O&M	Well Replace	Well Abandon	TOTAL
1	$ 10,000.00	$ 124,386.00	$ 10,000.00	$ 46,880.00	$ 97,740.00			$ 289,006.00
2	$ 10,000.00	$ 124,386.00		$ 46,880.00				$ 181,266.00
3	$ 10,000.00	$ 62,193.00				$ 2,100.00	$ 123,500.00	$ 197,793.00
4	$ 10,000.00	$ 62,193.00						$ 72,193.00
5	$ 10,000.00	$ 62,193.00	$ 50,000.00					$ 122,193.00
6	$ 10,000.00	$ 62,193.00				$ 2,100.00		$ 74,293.00
7	$ 10,000.00	$ 62,193.00						$ 72,193.00
8	$ 10,000.00	$ 35,688.50	$ 50,000.00			$ 2,100.00	$ 19,000.00	$ 116,788.50
Subtotals:	***$ 80,000.00***	***$ 595,425.50***	***$ 110,000.00***	***$ 93,760.00***	***$ 97,740.00***	***$ 6,300.00***	***$ 142,500.00***	
							Total Cash Flow:	**$ 1,125,725.50**

Table H-9
Cost Estimate Alternative 6 - Pump and Treat
with Monitored Natural Attenuation and Institutional Controls
Alameda Point/Alameda Annex Groundwater RI/FS

Item No.	Description	Quantity	Unit	Unit Cost ($)	Total Cost ($)
DIRECT COSTS					
1	**Pre-Design Investigation**				
	Develop Work Plans	1	LS	15,000.00	15,000.00
	Additional GW/Soil Contamination Delinieation	1	LS	60,000.00	60,000.00
	MNA Sampling Evaluation	1	LS	30,000.00	30,000.00
	Reporting	1	LS	15,000.00	15,000.00
2	**Remedial Design**				
	Develop Work Plans	1	LS	15,000.00	15,000.00
	Develop RD/RA Plans	1	LS	60,000.00	60,000.00
	Develop Post Closure MNA Program	1	LS	20,000.00	20,000.00
	Establish Institutional Controls (LUCIP)	1	LS	50,000.00	50,000.00
3	**Remedial Action Field Work**				
	Install Additional Monitoring Wells	9	EA	2,100.00	18,900.00
	Initial Cone Penetration Testing (CPT)	1	LS	8,000.00	8,000.00
	Lab - Microcosm & Slurry Study	3	EA	3,000.00	9,000.00
	Install Groundwater Extraction Wells	16	EA	4,000.00	64,000.00
	Pump&Treat Equipment & Installation	1	LS	233,000.00	233,000.00
	Disposal Connections	1	LS	21,792.54	21,792.54
	Construction Completion Report	1	LS	15,000.00	15,000.00
				Subtotal:	*634,692.54*
INDIRECT COSTS					
1	**Project Management & Administration**	15%			95,203.88
2	**Legal, License, Permits**	1%			6,346.93
				Capital Costs TOTAL:	***736,243.35***
O & M COSTS (Annual)					
1	**Maintain Institutional Controls** Year 0-15	1	Annual	10,000.00	10,000.00
2	**Monitoring & Reporting**				
	Year 0-8	1	Annual	124,386.00	124,386.00
	Year 9-12	1	Annual	62,193.00	62,193.00
	Year 13-15	1	Annual	35,688.50	35,688.50
3	**Electricity Charge Rate - Pump & Treat**				
	Year 0-8 (active pumping)	3	Annual	44,793.00	134,379.00
4	**Treatment & Disposal Costs**				
	Year 0-8 (active pumping)	1	Annual	6,384.00	6,384.00
5	**Maintenance Costs**				
	Year 0-8 (active pumping)	1	Annual	48,000.00	48,000.00
6	**Replacement Monitoring Wells**				
	Years 3, 6 & 9	1	EA	2,100.00	2,100.00
7	**Well Abandonment**				
	Year 9 (YR2-all extraction)	16	EA	1,900.00	30,400.00
	Year 9-12	10	EA	1,900.00	19,000.00
	Year 13-15	5	EA	1,900.00	9,500.00
8	**6 Month System Review**	1	LS	10,000.00	10,000.00
9	**5 Year Review**				
	Institutional Controls (YR 5/10/15)	1	LS	30,000.00	30,000.00
	Monitored Natural Attenuation (YR 5/10/15)	1	LS	20,000.00	20,000.00
	TOTAL O&M Net Present Value (15 Years)				***$2,150,246.20***
	Discount Rate 3.0%				
				Subtotal:	*$2,886,489.55*
				10% Contingency:	*$288,648.95*
	TOTAL PRESENT VALUE COST OF ALTERNATIVE				**$3,175,138.50**

Table H-10
15-Year Cash Flow Analysis Alternative 6 - Pump and Treat with MNA and ICs
Alameda Point/Alameda Annex Groundwater RI/FS

Year	IC's	Monitoring	Review	O&M	Well Replace	Well Abandon	TOTAL
1	$ 10,000.00	$ 124,386.00	$ 10,000.00	$ 105,177.00			$ 249,563.00
2	$ 10,000.00	$ 124,386.00		$ 105,177.00			$ 239,563.00
3	$ 10,000.00	$ 124,386.00		$ 105,177.00	$ 2,100.00		$ 241,663.00
4	$ 10,000.00	$ 124,386.00		$ 105,177.00			$ 239,563.00
5	$ 10,000.00	$ 124,386.00	$ 50,000.00	$ 105,177.00			$ 289,563.00
6	$ 10,000.00	$ 124,386.00		$ 105,177.00	$ 2,100.00		$ 241,663.00
7	$ 10,000.00	$ 124,386.00		$ 105,177.00			$ 239,563.00
8	$ 10,000.00	$ 124,386.00		$ 105,177.00			$ 239,563.00
9	$ 10,000.00	$ 62,193.00			$ 2,100.00	$ 30,400.00	$ 104,693.00
10	$ 10,000.00	$ 62,193.00	$ 50,000.00				$ 122,193.00
11	$ 10,000.00	$ 62,193.00					$ 72,193.00
12	$ 10,000.00	$ 62,193.00			$ 2,100.00		$ 74,293.00
13	$ 10,000.00	$ 35,688.50					$ 45,688.50
14	$ 10,000.00	$ 35,688.50				$ 19,000.00	$ 64,688.50
15	$ 10,000.00	$ 35,688.50	$ 50,000.00		$ 2,100.00		$ 97,788.50
Subtotals:	***$ 150,000.00***	***$ 1,350,925.50***	***$ 160,000.00***	***$ 841,416.00***	***$ 10,500.00***	***$ 49,400.00***	
					Total Cash Flow:		**$ 2,562,241.50**