STATE OF CALIFORNIA — ENVIRONMENTAL PROTECTION AGENCY

PETE WILSON, Governor

DEPARTMENT OF TOXIC SUBSTANCES CONTROL

REGION 2
700 HEINZ AVE., SUITE 200
BERKELEY, CA 94710-2737

N00296.002055
MOFFETT FIELD
SSIC NO. 5090.3

May 6, 1994

Commander
Western Division
Naval Facilities Engineering Command
Attn: Mr. Stephen Chao, Project Manager
900 Commodore Drive, Bldg. 101
San Bruno, California 94066-2402

Dear Mr. Chao:

DRAFT TECHNICAL MEMORANDUM PETROLEUM SITES PETROLEUM CLEANUP LEVEL ANALYSIS, NAVAL AIR STATION MOFFETT FIELD

The California Environmental Protection Agency (Cal/ EPA) has reviewed the subject document. Comments regarding the document have been prepared by the Department of Toxic Substances Control (DTSC) and San Francisco Regional Water Quality Control Board (RWQCB).

GENERAL COMMENTS

1. The proposed cleanup levels for petroleum products at Moffet Field do not conform to DTSC guidance. It is not advisable to derive generic toxicity criteria for petroleum hydrocarbons. These substances are complex chemical mixture differing among each product (e.g. fuel oil, gasoline, diesel fuel etc), and even batch to batch. Once these mixtures are released to the environment, the individual compounds immediately begin to evaporate, migrate and weather at rates specific to each of the individual chemicals in the mixture. These petroleum products are frequently analyzed for and reported as total petroleum hydrocarbons (TPH). This measurement only reflects the total hydrocarbon content, many of these hydrocarbon constituents are aliphatic and alicyclic compounds such as straight and branched chain alkanes, which with some exceptions (e.g. hexane), are not thought to be of the same order of toxicity as the more toxic constituents of petroleum, namely BTEX compounds (benzene, toluene, ethyl benzene and xylene), poly aromatic hydrocarbons (PAHs), and hexane.

The cleanup numbers should be established for each toxic chemical constituent of the petroleum product. In particular, cleanup numbers should be established and analyses conducted for BTEX constituents (benzene, toluene, ethyl benzene and xylene), poly aromatic hydrocarbons (PAHs), and hexane. A more detailed discussion of these issues is presented in the attached publication (DiZio and Becker, 1990).

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The above notwithstanding, if very high levels of aliphatic (alkanes and alkenes) and alicyclic petroleum hydrocarbons are proposed to be left in soil or ground or surface waters (as proposed in the subject document), toxicity of these constituents may also need to be addressed. This should be done on a site specific bases, taking into account any available toxicity knowledge regarding the aliphatic and alicyclic constituents present and how potential humans or wildlife receptors will be exposed to the contaminated media.

SPECIFIC COMMENTS

1. Page 24, first paragraph

It is contrary to our understanding that a risk of 10^{-4} represents EPA's "de facto cleanup goal". The more accurate statement is that for U.S. EPA and DTSC, 10^{-6} is the "point of departure" or benchmark.

2. Page 24, last paragraph

Although it is not advisable to calculate generic cleanup numbers based on TPH analyses, we will comment on our brief review of the methodology and parameters used in arriving at the cleanup numbers. Our calculations suggest that the PRG calculations for noncarcinogenic effects were based on the less conservative adult exposure scenario. As outlined in the Preliminary Endangerment Assessment guidance (DTSC, 1994), a childhood exposure should be used when calculating cleanup numbers for a residential scenario.

3. Bottom of page 24, top of page 25

It is stated that very high values of TPH are proposed to be left in soil under the risk based proposal, up to 4% in soil and groundwater. At such high levels, factors such as odor and potential toxicity to plants and wildlife could be significant. A specific cleanup number based on factors such as ecotoxicology as discussed above in General Comment could be determined, or as an alternative cleanup numbers recommended by the Regional Board could be used, provided that PRGs are calculated for BTEX compounds, hexane and PAHs.

4. Page A-10

Please note that for a residential scenario DTSC guidance specifies that due to the possibility of excavation, exposure via ingestion, dermal contact and inhaled dust should be considered for chemicals in soils down to depths of 10 feet.

5. Pages A-11 through A-14, Tables A-1 through A-4

It is noted that the dermal pathway was not used in calculating cleanup numbers. DTSC guidance should be followed including: (a) All complete exposure pathways should be used when calculating cleanup goals, including vapor and dust inhalation and dermal penetration. (b) Residential cleanup numbers generated using non carcinogenic endpoints should be protective of children and these should use exposure parameters for children e.g. 200 mg soil ingestion, 16 kg bodyweight etc. (c) For carcinogenic endpoints, a composite child-adult exposure scenario should be used (6 years child, 24 years adult). (d) Dermal penetration and vapor inhalation during household water use (showering) should be included.

Please respond to all enclosed comments. If you have questions regarding these comments, please contact me at (510) 540-3830 to ensure a coordinated approach for all regulatory comments.

Sincerely,

C. Joseph Chou
Remedial Project Manager
Base Closure Unit
Office of Military Facility

Enclosures

cc: Ms. Elizabeth Adams
Regional Water Quality Control Board
2101 Webster Street, Suite 500
Oakland, California 94612

Mr. Michael D. Gill
U.S. Environmental Protection Agency
Region IX, Mail Stop H-9-2
75 Hawthorne St.
San Francisco, California 94105

Dr. Michael Wade
Dept. of Toxic Substances Control
Office of Scientific Affairs
8950 Cal Center Dr.
Building 3, Suite 101
Sacramento, California 95826

Attachment

REFERENCES

California EPA, Department of Toxic Substances Control, Office of Science Advisor, 1992. Supplemental Guidance for Human Health Multimedia Risk Assessments of Hazardous Waste Sites and Permitted Facilities.

California EPA, Department of Toxic Substances Control, Office of Science Advisor, 1994. Preliminary Endangerment Assessment Guidance Manual.

DiZio, S., and R. Becker (1990) Uses and Misuses of Total Petroleum Hydrocarbon Measurements in Risk Assessments, Proceedings of the Sixth Annual Hazardous Materials Management Conference West (HazMat West), November 6-8, 1990, Long Beach, California.

Uses and Misuses of Total Petroleum Hydrocarbon Measurements in Risk Assessments

by

Stephen M. DiZio, Ph.D. and Richard A. Becker, Ph.D., DABT
Toxicology and Risk Assessment Section, California Department of Health Services Toxic Substances Control Program, 717/744 P Street, P.O. Box 942732, Sacramento, CA, 94234-7320

The most common analytical technique utilized to define soil contamination with petroleum-derived substances is Total Petroleum Hydrocarbon (TPH) analysis. TPH analysis commences with sample preparation; volatile hydrocarbons samples are prepared by a headspace method or a purge and trap method, while semivolatile organic samples are prepared by an extraction procedure. A sample is analyzed by gas chromatography (GC), and components are detected in the GC effluent by a FID detector. Quantitation is achieved by comparing the sum of all of the peak areas of the sample to a standard curve generated by measuring total peak areas from known concentrations of stock standard solutions of either gasoline or diesel fuel. Routine TPH analysis does not provide identification of the individual chemicals within the sample. Instead, the sum total of the concentrations of all chemicals within the sample is quantified, and expressed as TPH concentration, or as "fuel equivalents."

While TPH analysis is useful in defining the extent of contamination, it is generally insufficient for risk assessment purposes because quantitation of contamination in terms of TPH equivalents fails to provide the requisite chemical specificity needed for either a quantitative or qualitative risk assessment. Risk assessment begins with identification of the chemical contaminants, and an evaluation of the inherent toxic potential of these chemicals. In general, TPH analysis does not provide adequate specificity to identify the chemicals of concern and therefore, one cannot determine their inherent hazards. Furthermore, in situations where there are other volatile and semi-volatile organic soil contaminants in addition to petroleum-derived substances, it is likely that the presence of these other substances may not be discerned if they chromatograph similar to petroleum hydrocarbons when subjected to the standard TPH gas chromatographic analysis. Therefore, TPH analysis by itself cannot be used for either quantitative or qualitative risk assessment.

Why is it necessary to evaluate soil contaminated with petroleum-derived substances to an extent that provides the specificity necessary to distinguish, with reasonable certainty, the identity of the chemical contaminants? Because the toxic potential of petroleum-derived substances differs considerably. For example, the International Agency for Research on Cancer has determined that occupational exposures in petroleum refining are probably carcinogenic to humans, while exposures to gasoline, marine diesel fuel, and heavy fuel oil are possibly carcinogenic to humans, and that exposures to crude oil, jet fuel, light diesel fuel oil and light fuel oil are not classifiable as to their carcinogenicity to humans.

The assessment of health risks associated with environmental contamination of petroleum-derived substances is complicated. Unlike other chemicals which are commonly associated with hazardous wastes, petroleum-derived substances themselves are complex mixtures of aliphatic, alicyclic and aromatic hydrocarbons, and in addition, may contain components that have nitrogen, sulfur or some other element.

To assess the health risks posed by exposure to environmental media contaminated with the complex mixtures of petroleum--derived substances two techniques are commonly utilized. The first technique is a wholistic approach, which is based upon the the assumption that the toxic potential of the contaminated media is equal to an equivalent concentration of the pure petroleum-derived substance. This approach would lead to the assumption that gasoline contaminated soil would possess the same toxic potential as an equivalent concentration of gasoline straight from the pump. The major advantage of this approach is that the potential toxicity of exposure to the media contaminated with the petroleum-derived substance can be assessed based upon the published data concerning the toxic effects of the particular petroleum-derived substance of concern. For example, in assessing the potential risks associated with ingestion of soil contaminated with gasoline, one would estimate the health risks by estimating the exposure to an equivalent concentration of pure gasoline. The major disadvantage of this technique is that it entirely ignores the fact that once the petroleum derived substance is released into the environment, environmental processes such as evaporation, migration through soil etc. exert effects such that the chemical composition of the substance with time is different from that of the pure product.

The second technique is a reductionist technique, which is based upon the assumption that once a petroleum-derived substance is released into the environment, fate and transport processes act such that the toxic potential of material can no longer be approximated by comparison to the toxic potential of the pure substance. In this case, each and every chemical

component of the contaminated media should be quantified, and the health risks associated with each component quantified. For example, in assessing the potential risks associated with ingestion of soil contaminated with gasoline, one would first quantify the degree of contamination by measuring the concentration of each and every chemical in the soil, and then estimate the health risks for exposure to each and every individual chemical, and then all chemicals in combination (e.g calculate a hazard index). The major disadvantage of this technique is that it is cumbersome, expensive, and in some cases, health criteria may not be available for all of the components.

Which approach should be used to assess risks posed by exposure to petroleum-derived substances which contaminate environmental media?

For air and water contaminated by petroleum-derived substances one should measure the concentration of each and every individual contaminant and conduct a quantitative risk assessment.

The process recommended for assessing the risks posed by exposure to soil contaminated by petroleum-derived substances is more complicated and is a combination of both the wholistic and reductionist techniques. It is recommended that a combination of a qualitative and a quantitative assessment be conducted. For hazard identification, begin by determining what was the likely petroleum product that was released into the soil. Then select appropriate analytical techniques that can validate this this hypothesis. In many cases it may be possible to use a "fingerprint" chemical analysis to validate the hypothesis. In addition, it is necessary to analyze for such specific critical chemicals as benzene, and individual polycyclic aromatic hydrocarbons (such as benzo[a]pyrene, chyrsene, naphthalene etc.. Such specific analyses are necessary because these substances pose a definite carcinogenic risk to humans. The risks posed by the critical chemicals identified (PAHs, benzene etc.) should be calculated using quantitative risk assessment techniques, and the risks posed by the petroleum product (from the fingerprint analysis) that was released into the soil should be discussed in qualitative terms.

When conducting such specific analysis for PAHs in soil using common analytical techniques, matrix interference may lead to unacceptable levels of sensitivity (e.g. a high limit of detection). Because specific PAHs pose a carcinogenic risk to humans, it is necessary to carefully evaluate the analytical data, and determine whether or not the degree of sensitivity afforded by the analysis is sufficient to adequately characterize the potential risks. Cases may arise where it is

necessary to use special analytical techniques to remove the matrix interferences (e.g. a clean up column) prior to quantitation of specific PAHs. Because many PAHs pose a carcinogenic risk, adequate specificity and sensitivity is required. In cases where carcinogenic PAHs are found (or suspected) and some samples are found to be below the detection limit (or quantitation limit), it is common to assume that PAHs are present at 1/2 the limit of detection. In cases where the analysis does not afford adequate sensitivity, this assumption may lead to an unrealistic over estimate of the potential cancer risks. Therefore, it is recommended that special analytical techniques be used to afford the requisite level of sensitivity in cases where matrix interference results in a high limit of detection for PAHs.

The views expressed in this manuscript are those of the authors and do not represent formal policies of the California Department of Health Services Toxic Substances Control Program.

Proceedings of

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HAZARDOUS MATERIALS MANAGEMENT CONFERENCE & EXHIBITION/WEST
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Alan John Borner, General Program Chairman

HazMat 90 west

STATE OF CALIFORNIA

PETE WILSON, Governor

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN FRANCISCO BAY REGION
2101 WEBSTER STREET, SUITE 500
OAKLAND, CA 94612
(510) 286-1255

DEPARTMENT OF TOXIC SUBSTANCES CONTROL
REGION 2
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STATE OF CALIFORNIA
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Mr. Joseph Chou
Department of Toxic Substances Control
700 Heinz, Suite 200
Berkeley, CA 94710-2737

April 29, 1994
File No. 2189.8009

Subject: Comments on the Technical Memorandum Petroleum Sites Petroleum Cleanup Level Determination, March 1994

Dear Mr. Chou:

The San Francisco Bay Regional Water Quality Control Board staff have reviewed the subject document and have the following comments which need to be addressed by the Navy. Thank you for forwarding these comments to the Navy.

General Comments:

1. The text often refers to "sensitive environments" and the wetlands on the northern portion of the base, without defining the exact areas that are being modeled or described. The ecological habitats that need to be evaluated are the Marriage and Patrol Road ditches where groundwater exfiltrates, Navy Channel and Northern Channel, as well as the diked wetland areas. The pathways to these areas include groundwater movement through natural gradients, as well as groundwater movement that is influenced by the pumping of building 191. Migration of the groundwater contamination through the horizontal conduit created by the storm sewers, as well as potential vertical conduits to deeper aquifers, need to be addressed in the evaluation of the fate and transport of the petroleum contamination. Throughout the years at Moffett Field several historic agricultural wells, drilled to the lower aquifers, have been discovered on site, and there is a potential for more vertical conduits to exist.

2. It seems appropriate to use benzene to model the petroleum hydrocarbon contamination at Site 9 since the majority of the contamination is gasoline. However, utilizing n-hexane or naphthalene for the modeling efforts at Site 5 does not take into consideration the presence of solvents in the surrounding groundwater that will help to mobilize the less mobile constituents of jet fuel. It would be helpful to gather the most recent data for the petroleum sites and create plume maps of the solvent contamination along with the petroleum contamination plumes. Any model for Site 5 needs to take into account the strong influence the pumping at building 191 has over the gradients in the northern area of the site. It has already been seen that solvent contamination in Operable Unit (OU) 5 is being drawn towards the pumping station.

3. This evaluation of cleanup levels does not address important State Board Resolutions No. 68-16, the Antidegradation policy or No. 88-63, Sources of Drinking Water Policy. These are State policies that guide the determination of cleanup strategies of aquifers and should be addressed in this document. The evaluation of the three different cleanup scenarios avoids the issue of which one complies with promulgated State ARARs. This is unacceptable. State Board Resolutions should be included in the evaluation. Allowing the petroleum plumes to continue to migrate is in violation of the Anti-degradation policy.

4. The section on future land use in this document is inconsistent with the same presentation of the data in the OU 5 Feasibility Study (FS). This presentation of the data did not include all of the data presented previously and was biased towards the data that may indicate that the future land use will always be industrial with no possibility of future residential use. The presentation in the OU5 FS concluded that there may be a potential for residential use of the land if the government closed NASA. RWQCB comments on the OU5 FS land use section are applicable to this discussion also. In addition, the Regional Board has required clean up of groundwater at private company sites that are in areas specifically zoned industrial, unlike Moffett Field, and where the companies have far more control over the future land use than NASA does, in order to protect the resource.

5. Generically, the risk assessment is flawed due to the fact that the hazard index for each constituent, gasoline, JP5 and JP4 was calculated individually, instead of as a mixture. At both Sites 5 and 9 soil analyses have shown jet fuel and gasoline-related contaminants. The <u>sum</u> of the values for all three constituents should equal a hazard quotient of one in order to reflect the mixtures found on site. This would lower the acceptable concentrations of petroleum related contamination for the human risk assessment.

6. The text should indicate that the cost benefit analysis is a present value analysis. In general, more cost data is required in order to evaluate the final costs presented in this analysis. The text needs to include the discount rate utilized in the cost benefit analysis.

7. Our copy of the document had no figures included in the text.

<u>Specific Comments:</u>

1. pg. 5, par 2 Please retain the same units, micrograms per liter, when describing the TPH contamination in groundwater. It seems as though the text is minimizing the contamination of 570 parts per billion, downgradient of W05-25, when the units change to parts per million.

2. pg. 6, par 3 The text states that the groundwater source control extraction wells at Site 9 were placed for removal of

gasoline-related constituents. It has been the Agency's understanding that these extraction wells have been located to primarily address the A1 aquifer solvent contamination. Please provide a figure depicting the concentrations of petroleum contamination in groundwater and the location of the extraction wells in the area to document that these extraction wells are placed in TPH source areas.

3. pg. 7, par 1 Please provide the technical basis, pumping tests or other data, for the statements that there are upward gradients in the vicinity of Site 9. Please include the number of times the A2 wells have been sampled since November 1991 with no detections of TPH. Have there been detections of TPH further downgradient from the A2 wells that showed TPH contamination in July and November 1991?

4. pg. 18, par 2 The text states that a portion of a gasoline spill will volatilize to the atmosphere. This needs to be clarified since it does not pertain to releases from underground storage tanks that may be directly released to the saturated zones ten or more feet below land surface.

5. pg. 19, par 1 It is inappropriate to cite the one groundwater data point at Tank 53 to support the model because it excludes the nature of the soil contamination and the lack of groundwater data in the area. The Tank 53 area has only one A1 monitoring well to the north of the tank, however the majority of soil contamination has been found to the south and southeast of the tank following the local topography which slopes towards a drain that transports surface water to Marriage Road ditch. There are no monitoring wells to the southeast of the tank to determine if the higher levels of soil contamination have impacted the groundwater, and localized groundwater gradients are probably influenced by the drain, instead of following the regional flow patterns. It is inappropriate to state that groundwater monitoring data from the Tank 53 area support the leaching model if there is no groundwater data available from the contaminated areas. RWQCB staff has commented on several documents requesting that groundwater data from the area southeast of Tank 53 be obtained to determine the extent of groundwater contamination in the area.

The text states that the model indicates that concentrations of fuel would not <u>significantly</u> impact groundwater at Tank 53. Please avoid using qualifiers such as these to describe situations. From the cleanup levels chosen in this document, it is obvious that there are different notions of what are significant impacts to groundwater.

6. pg. 20, par 4 Alkanes are less mobile than benzene, toluene and other volatile organics, but are not immobile as the text states.

7. pg. 24, par 1 The risk-based concentrations for fuels presented in section 4.2 are <u>not</u> protective of the environment as the text indicates, but are protective of human health. It should be noted

that 1 x 10^{-6}, and not the range EPA accepts, is the departure point for the State of California.

8. pg. 25, section 4.3 The text is wrong in stating that the site-wide ecological assessment has dismissed the potential impacts of petroleum related contamination to ecological receptors. The assessment has not been completed.

9. pg. 26 & 27, section 4.3.1 & 4.3.2 More detail is needed in the text to describe the locations of the sensitive habitats and the groundwater pathways utilized in the development of the "environmental risk-based" levels. See general comment #1.

10. pg. 28,sec 4.3.2 The use of n-hexane to model the petroleum contamination at Site 5 does not take into account the mixtures of jet fuel and aviation gas, as well as the nearby solvent contamination that can increase the mobility of the contamination.

11. pg. 31, sec 5.1.2 The Air Force has found that bioventing has worked better in finer grained substrate mixtures, such as silty clays, than in sandy soils.

13. pg. 34, sec 5.3.1 The soil vapor extraction (SVE) technology chosen to develop the cost-benefit analysis may not be the most efficient system since the longer chained hydrocarbons such as jet fuel will not respond as well to this technology as to bioventing. The total cost and length of operation may be decreased by a system combining the two technologies.

13. pg. 35, sec 5.3.2 NATURAL ATTENUATION IS NOT A TECHNOLOGY.

14. pg. 41 and 42, sec 6.3.1 The future land use section is not consistent with the same section in the OU5 FS. This section does not state that there are residential as well as industrial zoning surrounding Moffett Field, and the OU5 FS stated that there may be the need for more residential areas in the future whereas this document dismisses any future residential use of the area. Land use is pertinent to the development of industrial and residential risks due to soil contamination, but is not applicable to groundwater resources. The groundwater at Moffett Field meets the sources of drinking water policy requirements and therefore is regarded as a future resource to the State of California.

There is not much strength in the argument that the government will not close down NASA activities at Moffett Field due to the loss of jobs. The Bay Area has been subject to over ten closures of Department of Defense facilities without any regard for the substantial loss of jobs from these closures.

15. pg. 43 & 44, sec 6.3.2 The OU5 FS report stated that the surplus water supply in Mountain View and Sunnyvale was calculated during non-drought years, and therefore may not reflect the conditions during a drought.

This section does not address State Board Resolution 88-63 that states that all groundwater with pumping rates over 200 gallons per day and total dissolved solids (TDS) under 3,000 parts per million is a potential drinking water source. The majority of the groundwater at Moffett Field meets these requirements. The Basin Plan numbers for TDS and metals quoted in this document are objectives for operating municipal drinking water sources. These levels are not intended to define potential drinking water sources. The definition of drinking water from State Board Resolution #88-63 has been adopted by the San Francisco Bay Regional Board members and is included in our Basin Plan.

16. pg. 51, sec 6.4.6 The rates of pumping that would be required to remediate the A1 and A2 aquifer of contamination are not high enough to impact either the recharge of surface waters or cause saltwater intrusion. The radius of influence of extraction wells pumping at a maximum of 3-5 gpm is not great enough to induce salt water intrusion.

17. pg. 53, Table 1 The Regional Board would assume that the probability of future residential use of the area to be 100 percent. This Table does not include the benefit of protecting the groundwater as a resource for any future use.

18. pg. 55, sec 7.0 The Regional Board does not agree with the conclusion that the high-range cleanup levels chosen are protective of potential beneficial uses of the groundwater. The proposed groundwater cleanup levels are higher than any currently known groundwater contamination on site! How can this be a cleanup level? The cost benefit analysis seems to indicate that scenario B is both cost effective and beneficial to the people of the State of California. This scenario reduces toxicity in the groundwater to MCLs and prevents further degradation of groundwater. Scenario B allows the Navy to be in compliance with both State Board Resolution 88-63 and State Board Resolution 68-16. The cost of this cleanup scenario, and the time it takes to implement do not create an excess burden on the Navy.

19. pg. A-3 The State of California does not accept the premise that no action is warranted for any risks less than 1×10^{-4}. It is also our Agency's understanding that the US EPA, in practice, views risks that are calculated between 1×10^{-4} to 1×10^{-6} as a range in which risk management decisions are to be made, not necessarily that no action is warranted.

20. pg. A-4 The Regional Board does not agree with the premise that it is unlikely that Moffett Field may be developed for future residential use.

21. pg. A-9, par 3 The 50-foot seal required for wells by the Santa Clara Valley Water District (SCVWD) is not intended to prevent the utilization of shallow groundwater as a domestic source. The intent of this requirement is to protect the shallow aquifers from surface contamination (SCVWD, 1993). In addition, as

stated in a letter from the Santa Clara Valley Water District, dated November 18, 1993 to Richard McMurtry, Regional Water Quality Control Board, the agency expressed their concern regarding the clean up of the shallow aquifers at Moffett Field.

> "We are concerned that the shallow groundwater has a potential to migrate laterally or vertically to present drinking water zones. We believe there are improperly abandoned water wells and cathodic protection wells within the contaminated area that could have the potential to serve as vertical conduits for contamination."

Potential vertical and horizontal conduits need to be addressed in the presentation and evaluation of cleanup alternatives for all groundwater contamination on site.

If you have any questions, please call me at the San Francisco Bay Regional Water Quality Control Board at (510) 286-3980.

Sincerely,

Elizabeth J. Adams

Elizabeth J. Adams
Project Manager