



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105

September 30, 2004

Bruce Wolfe
Executive Officer
California Regional Water Quality Control Board,
San Francisco Bay Region
1515 Clay Street, Suite 1400
Oakland, CA 94612

Re: Five-Year Review Report for the TRW Microwave Superfund Site, Sunnyvale, CA

Dear Mr. Wolfe:

The U.S. Environmental Protection Agency, Region 9 (EPA) has reviewed the second Five-Year Review Report for the TRW Microwave Site, prepared by the California Regional Water Quality Control Board, San Francisco Bay Region, dated September 30, 2004. This Five-Year Review was conducted as a matter of EPA policy because cleanup of the site will take five years or more to complete (see OSWER No. 9355.7-03B-P, *Comprehensive Five-Year Review Guidance*, June 2001). The review addresses remedial actions taken pursuant to the September, 1991 Record of Decision for the site.

EPA concurs that the remedy for the TRW site currently protects human health and the environment because institutional controls are in place that prohibit the use of shallow groundwater. EPA concurs with the recommendation that additional indoor air sampling be conducted to verify that the remedy remains protective with respect to the vapor intrusion pathway. In order for the remedy to be protective in the long term, remedial action objectives for groundwater will need to be achieved.

The next Five-Year Review for the TRW Superfund site is required by September 30, 2009. For the next Five-Year Review, EPA recommends that a joint Five-Year Review Report be prepared for the TRW Microwave, AMD 901/902, and AMD 915 facilities. These facilities are located adjacent to one another and share many common characteristics. A single ROD was written for the TRW, AMD 901/902, and Philips facilities (Philips is no longer an NPL site and is being cleaned up under RCRA authority). Groundwater plumes from these three facilities have commingled to form the Companies' Offsite Operable Unit. The groundwater treatment system at AMD 915 is operated by Philips and treats groundwater from both the AMD 915 site and the Offsite OU. The preparation of a single Five-Year Review report for the three facilities would reduce redundancy and would allow readers to more fully understand the cleanup issues in the area.

EPA appreciates the opportunity to work with you on this report. If you have any questions, please feel free to contact Debbie Schechter of my staff at 415-972-3230.

Sincerely,

A handwritten signature in black ink that reads "Elizabeth Adams". The signature is written in a cursive style with a large, prominent "E" at the beginning.

Elizabeth Adams, Chief
Site Cleanup Branch
Superfund Division



California Regional Water Quality Control Board

San Francisco Bay Region



Terry Tamminen
Secretary for
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Arnold Schwarzenegger
Governor

Date: September 30, 2004
File No. 43S0125 (KER)
43S0080 (KER)
43S0973 (KER)

Ms. Elizabeth Adams
Chief, Site Cleanup Branch
Superfund Division
U.S. EPA Region 9
75 Hawthorne Street
San Francisco, CA 94105

SUBJECT: Submittal of Five-Year CERCLA Review for Eastern Sunnyvale TRW and AMD Superfund Sites, Sunnyvale, Santa Clara County, California.

Dear Ms. Adams:

Enclosed for your records and review is a copy of the Five-Year Review for the following Superfund sites:

- Former TRW Microwave site at 825 Stewart Drive
- AMD 901/902 Thompson Place site
- AMD 915 DeGuigne Drive site
- AMD 1165 East Arques Avenue site (formerly Monolithic Memories)

If you have any questions please contact Keith Roberson of my staff at 510 622 2404 or email ker@rb2.swrcb.ca.gov .

Sincerely,

Bruce H. Wolfe
Executive Office

**California Regional Water Quality Control Board
San Francisco Bay Region**

Five-Year Review

**Former TRW Microwave Site
825 Stewart Drive
Sunnyvale, Santa Clara County, California**

Report Approved by: _____

**Stephen A. Hill
Chief, Toxics Cleanup Division
California Regional Water Quality Control Board
San Francisco Bay Region**

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List of Acronyms

AMD	Advanced Micro Devices
ARAR	Applicable or Relevant and Appropriate Requirement
BGS	Below Ground Surface
BPHE	Baseline Public Health Evaluation
DCE	dichloroethene
EAB	Enhanced Anaerobic Biodegradation
ESL	Environmental Screening Levels
FRAP	Final Remedial Action Plan
GWET	Groundwater Extraction and Treatment
MSCA	Multi-State Cooperative Agreement
MCL	Maximum Contaminant Level
ug/L	micrograms per liter
ug/m ³	micrograms per cubic meter
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
PCE	tetrachloroethene
RCRA	Resource Conservation and Recovery Act
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RWQCB	Regional Water Quality Control Board
SCR	Site Cleanup Requirements
SVET	Soil Vapor Extraction and Treatment
TCA	1,1,1-trichloroethane
TCE	trichloroethene
TRW	TRW Corporation
USEPA	United States Environmental Protection Agency
VC	Vinyl chloride
VOC	Volatile Organic Compound

Executive Summary

The remedy for groundwater contamination at the former TRW Microwave (TRW) Superfund site (now owned by Northrop Grumman Space & Mission System Corporation) in Sunnyvale, California has included soil vapor extraction and treatment (SVET), groundwater extraction and treatment (GWET), enhanced anaerobic biodegradation (EAB), groundwater monitoring, and institutional controls. This is the second 5-year review for the former TRW site, and it covers remedial activities conducted between September 1996 and April 2004. The first review covered activities between September 1991 and August 1996.

Remedial actions conducted at the site are achieving success. Soil vapor extraction was conducted between 1993 and 1996 and the SVET system was removed in 1998 after soil cleanup guidelines were met. Groundwater extraction was conducted across the entire site through October 2000, at which time groundwater extraction was suspended within the former source area to allow implementation of the EAB remedy. Due to redevelopment construction, groundwater extraction was suspended across the entire site in April 2001 and has not been resumed since that time. Prior to suspension of extraction, groundwater concentrations had declined across the pollution plume but had reached asymptotic levels. Since initiation of EAB, concentrations in the former chemical source area have been reduced dramatically. However, contaminant concentrations remain elevated above cleanup goals in the plume downgradient of the EAB treatment zone. Until cleanup goals are achieved, the remedy is protective of human health and the environment in terms of limiting ingestion of contaminated water through the use of institutional controls prohibiting the use of shallow groundwater.

Recent changes in the methodology of assessing risk from volatile organic compounds (VOCs) required a re-evaluation of the protectiveness of the remedy in terms of its ability to limit exposure to VOC vapors in indoor air. Indoor air was sampled and human health risk associated with vapor intrusion of TCE at the site was re-evaluated in 2003 - 2004. The results of this investigation indicate that additional human health risks associated with vapor intrusion in the former TRW building do not exceed acceptable levels as long as adequate ventilation is maintained in the building.

Five-Year Review Summary Form		
SITE IDENTIFICATION		
Site Name (from WasteLAN): TRW Microwave		
EPA ID (from WasteLAN): CAD009159088		
Region: 9	State: CA	City/County: Sunnyvale/Santa Clara
SITE STATUS		
NPL status: Final		
Remediation Status: Monitoring to assess effectiveness		
Multiple OUs? No	Construction completion date: 1985	
Has site been put into reuse? The site was re-used for several years but has been vacant since January 2001.		
REVIEW STATUS		
Lead agency: State of California		
Author Name: Keith Roberson		
Author title: Engineering Geologist	Author affiliation: CA Regional Water Quality Control Board (Lead Agency)	
Review period: 7/10/96 – 9/13/04		
Date(s) of site inspection: 2/11/04		
Type of Review: (in bold) <input type="checkbox"/> Post-Sara <input type="checkbox"/> Pre-Sara <input type="checkbox"/> NPL-Removal only <input type="checkbox"/> Non-NPL Remedial Action Site <input checked="" type="checkbox"/> NPL State/Tribe-lead <input type="checkbox"/> Regional Discretion		
Review number: (in bold) <input type="checkbox"/> 1 (first) <input checked="" type="checkbox"/> 2 (second) <input type="checkbox"/> 3 (third) Other (specify)		
Triggering action: (in bold) <input type="checkbox"/> Actual RA Onsite Construction at OU#___ <input type="checkbox"/> Actual RA Start at OU#___ <input type="checkbox"/> Construction Completion <input checked="" type="checkbox"/> Previous Five-Year Review Report <input type="checkbox"/> Other (specify)		
Triggering action date (from WasteLAN): 9/30/1999		
Due Date: 9/30/2004		

Five-Year Review Summary Form, continued

Issues:

Four issues identified during the review are:

- 1) enhanced anaerobic biodegradation (EAB) appears to have greater potential towards achieving site cleanup goals than continuing groundwater extraction and treatment;
- 2) Migration of groundwater contaminants onto the subject property from upgradient sources threatens the long-term success of site remediation;
- 3) Resuming groundwater extraction at the site has the potential to induce migration of contaminants onto the property from adjacent sources, and would likely reverse much of the progress that has been achieved through EAB; and
- 4) Vapor intrusion from the groundwater plume into the overlying building has been documented, but appears manageable at levels that do not cause long-term human health risks as long as proper ventilation is maintained.

Recommendations and Follow-up Actions:

The discharger should consider expanding the EAB remedy to portions of the site downgradient from the source area to reduce groundwater contaminant levels. Given the success of EAB in the former source area, an expansion of the EAB treatment seems appropriate, and has the potential to accelerate site cleanup for the remainder of the former TRW plume. A ROD amendment will need to be issued if the remedy will be permanently changed from GWET to EAB. To assess the potential for vapor intrusion, indoor air has been sampled and the potential human health risk associated with vapor intrusion into indoor air has been re-evaluated. Follow-up sampling of indoor air is planned to determine whether vapor intrusion remains a concern at the site.

Protectiveness Statement:

Remedial actions conducted at the site until 2000 under the Final Site Cleanup Requirements Order functioned as designed and achieved positive results by maintaining hydraulic control of plume migration and reducing VOC concentrations in groundwater throughout the plume. Since 2000, the EAB program has accelerated the pace of groundwater remediation. Groundwater cleanup goals (MCLs) have been achieved for TCE and related VOCs in the former TRW source area. Continued monitoring is necessary for several more years to assess whether this success can be maintained without further treatment. It appears possible that cleanup goals can be achieved for the remainder of the TRW plume within five years. The remedy is currently protective of human health and the environment in terms of limiting ingestion of contaminated water through institutional controls prohibiting the use of shallow groundwater.

The vapor intrusion threat at the site has been assessed, and has been mitigated to some extent by reduction of groundwater VOC concentrations beneath the

building. The results of indoor air sampling indicate that while vapor intrusion pathways exist, proper ventilation of the building can maintain indoor air concentrations of TCE at levels that do not cause unacceptable, long-term human health risks. The remedy is currently protective of human health and the environment.

**California Regional Water Quality Control Board
San Francisco Bay Region**

Five-Year Review

**Former TRW Microwave Site
825 Stewart Drive
Sunnyvale, California**

I. Introduction

This report is the second five-year review for the former TRW Microwave (TRW) Site at 825 Stewart Drive in Sunnyvale. The California Regional Water Quality Control Board, San Francisco Bay Region (RWQCB), conducted this review pursuant to the Multi-Site Cooperative Agreement (MSCA) between the U.S. EPA Region 9 and the RWQCB. Pursuant to its 1991 Site Cleanup Requirements (Order No. 91-103), TRW evaluated the remedial activities performed at the site to determine if the selected cleanup plans are working. The results were presented to the Water Board in a report titled “*Five-Year Status and Effectiveness Evaluation Report*,” which was submitted on September 14, 2001. The purpose of a five-year review is to ensure that a remedial action remains protective of public health and the environment and is functioning as designed. The five-year review is required because hazardous substances, pollutants, or contaminants remain at the site above levels that allow for unlimited use and unrestricted exposure.

II. Site Chronology

Aertech Industries begins microwave and semiconductor assembly and testing at the site	1968
TRW acquires the site from Aertech Industries; no change in operations	1974
Soil and groundwater contamination discovered at the site	1983
RWQCB issues Cleanup and Abatement Order	June 1984
Removal of underground solvent storage tanks and acid waste sumps and associated piping; Excavation of contaminated soils	1984
Groundwater extraction and treatment begins. NPDES permit issued for discharge of treated effluent.	1985
FEI Microwave acquires site from TRW and continues operations	1987
RWQCB adopts Site Cleanup Requirements order	Jan 1988
Site formally added to the National Priorities List (NPL)	Feb 1990
Baseline Public Health Evaluation completed for site	1990
RWQCB and USEPA approve Final RI/FS Report and Remedial Action Plan (RAP) for TRW and adjacent AMD and Philips sites	June 1991
RWQCB adopts Order No. 91-103, the Final Site Cleanup Requirements Order for the former TRW site.	June 1991
USEPA issues Record of Decision (ROD) for TRW and adjacent AMD and Philips sites	Sept 1991
Industrial operations cease at site	1993

TRW submits first Five-Year Review Report to Regional Board	Sept 1996
TRW submits second Five-Year Review Report to Regional Board	Sept 2001
Groundwater extraction suspended; Enhanced Anaerobic Biodegradation project initiated in B1-zone aquifer in former VOC source area	Oct 2000
Enhanced Anaerobic Biodegradation expanded to A-zone	June 2001
Northrop Grumman Space and Mission Systems Corporation purchased TRW and assumed liability for environmental restoration at the site	Dec 2002
Indoor air sampled for VOCs and vapor intrusion evaluated	Oct 2003
Groundwater cleanup goals achieved by EAB in former source area	Jan 2004

III. Background

Physical Characteristics

The former TRW Microwave site is located south of Highway 101 in Sunnyvale at 825 Stewart Drive (see attached map). The site is located in a light industrial and commercial area dominated by the electronics industry that is known as the Silicon Valley, which is a portion of the larger Santa Clara Valley. Sunnyvale has a population of approximately 100,000, and is part of the San Francisco Bay Metropolitan Region, which has a total population of about six million. Most buildings in the vicinity are low-rise developments containing office space and research and development facilities.

A single, two-story building occupies the site. Groundwater contamination from this site, consisting primarily of trichloroethylene (TCE) and related chlorinated volatile organic compounds (VOCs), commingles with similar discharges from two nearby sites: Advanced Micro Devices (AMD) 901/902 Thompson Place, which is located to the south of TRW, and the Philips Semiconductors site at 811 East Arques Avenue site, which is located to the southwest. An additional VOC release site, the AMD facility at 915 DeGuigne Drive, is located immediately north of TRW. Along with the TRW Microwave site, the two AMD sites are Superfund sites, whereas the Philips site is regulated under the RCRA program. A commingled VOC plume has migrated northward from the TRW, Philips, and AMD 901/902 Thompson Place sites. This commingled plume is referred to as "The Companies" Offsite Operable Unit.

Site Operational History

Industrial operations began at the site in 1968, when Aertech Industries began assembling and testing microwave and semiconductor components. In 1974, TRW acquired the site from Aertech and continued similar operations. In 1987, Tech Facility 1, Inc. purchased the site from TRW and leased the facility to FEI Microwave. FEI Microwave operated the facility until 1993. Operations were continuous with no significant process changes between 1968 and 1993. During this time, TCE and other industrial solvents and hazardous compounds were used and hazardous wastes were generated as a by-product of operations. Waste solvent composed primarily of TCE was stored in an underground storage tank (UST) from 1970 until 1982. An in-ground acid neutralization system was also used between 1968 and 1984.

In 1995, the property was purchased by Stewart Associates, who leased the property to Diablo Research Corporation, a contract research and development company. The building has been vacant since January 2001, and underwent significant renovation in 2002 – 2003.

Northrop Grumman Space & Mission System Corporation (Northrop Grumman) purchased TRW's assets in 2003 and assumed responsibility for cleanup of the former TRW Microwave site at that time.

This five-year review covers only remedial activities conducted at the former TRW site. Separate Five-Year Reviews will be prepared and issued for the adjacent Superfund sites at 901/902 Thompson Place and 915 DeGuigne Drive.

Hydrogeology

The site is located in the Santa Clara Valley, a structural basin filled with marine and alluvial sediments. The coarser deposits are probably the result of deposition in or near stream channels that drain the highlands that surround the basin. Finer-grained deposits result from a variety of conditions with the eventual result of a heterogeneous sequence of interbedded sands, silts, and clays. The natural groundwater flow direction beneath the site is to the north towards San Francisco Bay. Municipal water supply wells tap an extensive, deep, regional, confined aquifer that lies generally greater than 200 to 300 feet below ground surface (bgs). A thick, relatively impermeable aquitard separates this deep aquifer from a complex series of laterally discontinuous aquifers and aquitards that can extend up to within a few feet of the ground surface.

Four distinct water-bearing zones in the upper 100 feet bgs have been characterized at this site. These coarse-grained, transmissive units are generally composed of sand or sandy gravel. The first encountered water-bearing zone, called the A-zone, is found from about 5 to 25 feet bgs. The next encountered water-bearing zone is called the B1-zone and is found from about 30 to 45 feet bgs. The B2-zone is typically found between 45 and 60 feet bgs. Deeper aquifers have not been impacted by chemicals at this site. The upper aquifer zones are separated by variable thicknesses of clay to silty sand. There is some degree of hydraulic connection between the zones due to the discontinuous nature of the sediment types. The highest concentrations of contaminants exist in the A-zone and B1-zone. VOCs are also present in elevated concentrations in the B2-zone beneath the site, but the composition of chemicals in this zone suggests migration from an off-site source. The commingled groundwater VOC plumes from the Philips, AMD, and TRW sites in the A- and B1-zones are approximately 4,000 feet long and extend beyond Highway 101.

History of Contamination

Site remedial investigations began in 1983 with the discovery of VOCs in soil and groundwater at the site. The main contaminant of concern at the site is TCE. The source of the contamination was determined to be a leaking underground storage tank (UST) located along the north edge of the building. Additional remedial investigations

conducted between 1983 and 1986 confirmed that the UST location was the source of contamination and determined the extent of contamination. Contaminants from the site are believed to have migrated downgradient across the property boundary and commingled with similar contaminants from the adjacent Philips and AMD 901/902 Thompson Place sites. VOCs in groundwater are limited to water-bearing units in the upper 60 feet that are not used for public water supply.

Initial Response

Remedial action at the site began in 1984 with the removal of the UST and associated contaminated soils. Groundwater extraction and treatment (GWET) began in 1985.

Summary of Basis for Taking Action

The site overlies the Santa Clara Valley groundwater basin. Groundwater from this basin provides up to 50% of the municipal drinking water for over 1.4 million residents of the Santa Clara Valley. The TRW site was made a Superfund site primarily because of the past chemical releases' potential threat to this valuable resource.

IV. Remedial Actions

Remedy Selection

A Baseline Public Health Evaluation (BPHE) was submitted in 1990. The Remedial Investigation/Feasibility Study (RI/FS) was approved by USEPA and RWQCB in June 1991. These documents form the basis of the remedial action plan. The RWQCB adopted Final Site Cleanup Requirements (SCR) Order No. 91-103 in June 1991. The Final SCR contain the approved remedy for cleanup at the site. A Record of Decision (ROD) was issued by USEPA in September 1991. The remedy selected in the SCR and the ROD consisted of the following elements:

- 1) soil vapor extraction and treatment
- 2) groundwater extraction
- 3) treatment of extracted groundwater by air stripping or ozone oxidation
- 4) discharge of treated water under NPDES permit
- 5) deed restriction prohibiting the use of shallow groundwater for drinking water.

The SCR set groundwater cleanup standards at California proposed or adopted Maximum Contaminant Levels (MCLs), USEPA MCLs, California Action Levels, or levels based on a risk assessment. The groundwater cleanup levels are:

Chemical	Cleanup Standard (ug/L)
1,1-dichloroethane (1,1-DCA)	5
cis-1,2-dichloroethene (cis-1,2-DCE)	6
trans-1,2-dichloroethene (trans-1,2-DCE)	10
1,1-dichloroethene (1,1-DCE)	6
Freon 113	1,200
vinyl chloride	0.5
tetrachloroethene	5
1,2-dichlorobenzene (1,2-DCB)	600
1,1,1-trichloroethane (1,1,1-TCA)	200
trichloroethene (TCE)	5

Remedy Implementation

The GWET system and groundwater monitoring program were fully implemented at the time the final SCR were adopted in 1991. A deed restriction was prepared for the property and recorded with the Santa Clara County Records Office on August 20, 1992. The deed restriction prohibits the use of groundwater from the shallow aquifer (i.e., A- and B-zone aquifers as described above) as a source of drinking water. Soil vapor extraction and treatment (SVET) was initiated in 1993 and concluded in 1996 upon receiving confirmation from the Regional Board that site-specific soil cleanup objectives were met.

Groundwater Extraction and Treatment

Full-scale groundwater remediation began at the site in 1985 with implementation of the GWET system. The GWET system, which consists of eight onsite groundwater extraction wells that are screened in the A-, B1-, and B2- aquifer zones and an air stripper, provided hydraulic capture of the VOC plume and reduced groundwater VOC concentrations. The GWET system operated 95% of the time between 1996 and 2000. Treated groundwater was discharged to an on-site storm sewer under RWQCB Order No. 94-087 and NPDES Permit No. CAG912003, both issued in December 1994. The storm sewer discharges into Calabazas Creek at Highway 101.

Groundwater extraction from the B1-zone and B2-zone aquifers in the vicinity of the former source area was suspended in October 2000 with permission from the Water Board. In April 2001, the remaining operational extraction wells were turned off to allow relocation of the GWET system, which was necessitated by site redevelopment activities. No groundwater has been extracted for remediation purposes at the site since that time.

A total of 3,100 pounds of TCE was removed from groundwater at the site during operation of the GWET system.

Soil Vapor Extraction and Treatment

A SVET system was constructed at the site in July 1993. The SVET system operated full-time through November 1996. Approximately 140 pounds of TCE was removed by SVET. Rebound testing was conducted in September 1997 and July 1998, during which time VOC concentrations decreased to 5 parts per million or lower except for one extraction point in the former UST location. In August 1998, TRW demonstrated that the RWQCB's six criteria for SVE closure had been fulfilled and the site-specific soil cleanup criteria had been met, and received permission from the RWQCB to terminate soil remediation. The SVET system was removed in November 1998.

Systems Operation/O&M

GWET has been suspended since 2001, but groundwater monitoring has continued on an annual basis across the site and on a quarterly basis within the EAB treatment area since that time. Northrop Grumman submits groundwater monitoring reports to the Water Board annually.

Costs associated with operation and maintenance of the GWET system, and associated reporting, between September 1996 and April 2001 totaled about \$300,000.

V. Progress Since Last Review

Groundwater Extraction and Treatment

Between 1996 and 2001, 35 million gallons of groundwater were extracted, from which 483 pounds of VOCs were removed. In comparison, 975 pounds of VOCs were removed from a similar volume of water during the previous five-year period. The amount of VOCs removed during the last five years declined by 50% from the previous five-year period. Mass removal efficiency declined from about 39 pounds of VOCs per million gallons of water extracted (lbs/MG) in 1990 to 13.9 lbs/MG in 2000. A total of 3,100 pounds of TCE was removed through GWET at the site.

VOC concentrations across the plume continue to decline, indicating that the contribution of VOCs to the commingled plume from the former TRW site is being reduced. VOC concentrations in the former source area have been reduced dramatically due to the success of the EAB. For most compounds, concentrations appear to have stabilized at levels below or near the groundwater cleanup goals in the EAB treatment area; however, some rebound may occur due to migration of chemicals from upgradient sources (the AMD 901/902 Thompson Place site or the Philips 811 E. Arques Avenue site).

Remedial efforts have reduced VOC concentrations in source areas and across the plume. Maximum VOC concentrations in on-site groundwater have been reduced by several orders of magnitude, from over 6,000,000 ug/L in August 1983 to less than 1,000 ug/L (total VOCs) in October 2003. The current maximum VOC concentrations on the former TRW property now occur at the downgradient property boundary where VOCs from

releases at adjacent properties commingle with VOCs associated with the TRW release. VOC concentrations in groundwater outside the EAB treatment area remain above cleanup objectives due to the complexity of site hydrogeology and the limitations of the remedial methods that have been implemented in these areas (i.e., GWET).

Enhanced Anaerobic Bioremediation

In October 2000, an *in situ* Enhanced Anaerobic Bioremediation (EAB) program was initiated at the TRW site to test the possibility of accelerating groundwater remediation through the use of methods other than GWET. Polylactate ester was injected as an electron donor into the B1-zone in the former source area to stimulate the activity of indigenous microbial organisms known to be capable of biodegrading chlorinated VOCs. Extraction wells in the vicinity of the injection area were turned off, with approval from RWQCB, to facilitate the EAB program. On the basis of the initial positive results from the EAB program in the B1-zone and evidence that VOC concentrations had been reduced in the A-zone, the EAB program was expanded by injection of polylactate ester into the A-zone in the former source area in June 2001.

Since EAB was initiated, concentrations of VOCs in the source area have been reduced by over 99%. All three wells (T-2A, T-2B, and the Eductor well) in the EAB treatment area (i.e., the former source area) have shown a remarkable response to EAB, with significant degradation of PCE and TCE to cis-1,2-DCE, followed by degradation of cis-1,2-DCE to vinyl chloride (VC), and finally, breakdown of VC and production of significant amounts of the predicted end-products, ethane and ethane.

As the EAB program progressed, aqueous VOC concentrations fluctuated dramatically in the Eductor well for about two years as the hydrogeochemical system attempted to reach equilibrium between VOC concentrations in the soil matrix and groundwater. The oscillations in aqueous VOC concentrations appear to have been caused by desorption of VOCs from the soil matrix into groundwater accompanied by breakdown of parent VOCs (PCE and TCE) into degradation by-products (cis-1,2-DCE and VC). The decreasing chemical concentration trends indicated that the EAB process was still active more than two years after the last lactate injection. By April 2004, concentrations of PCE, TCE, cis-1,2-DCE, and VC had stabilized in the eductor well at non-detectable concentrations (less than 1.0 ug/L).

In well T-2A, which is located ten feet downgradient from the Eductor well, TCE concentrations have been reduced to less than the drinking water standard (5 ug/L). TCE concentrations averaged about 4 ug/L over the past year, down from a pre-EAB concentration of 160 ug/L. Cis-1,2-DCE concentrations averaged about 26 ug/L over the past year, down from pre-EAB concentrations of over 500 ug/L. PCE concentrations have remained below the MCL or below the detection limit for over two years. A significant amount of VC has been produced through breakdown of cis-1,2-DCE in the vicinity of this well, and VC concentrations remain moderately elevated (30 ug/L in April 2004). VC concentrations are expected to drop, given the very low concentrations of parent VOCs (TCE and cis-1,2-DCE) and evidence of ongoing degradation to ethane and ethene.

In the B1-zone, the reductions are more significant. The cis-1,2-DCE concentration in well T-2B has fallen from a pre-injection level of 1,700 ug/L to 3.3 ug/L in April 2004. Since July 2003, drinking water standards have been met and maintained for all chemicals except VC. While VC concentrations still exceed the cleanup goal of 0.5 ug/L, VC is not expected to persist given the current low concentrations of the parent VOC compounds, and evidence of ongoing degradation of VC to ethane and ethene.

Outside the treatment area, response to the EAB program has been more pronounced in the B1-zone, consistent with better hydraulic connection and greater transmissivity in the deeper aquifers. In the B1-zone, downgradient monitoring well T-8B has shown TCE and cis-1,2-DCE concentrations drop by more than 40% from pre-injection levels, but these declines have been accompanied by significantly higher VC concentrations. In well T-4B, TCE has declined while cis-1,2-DCE has risen to all-time highs. In both wells, these trends appear to be directly associated with EAB activity in the treatment area.

In downgradient monitoring wells in the A-zone, the observed trends since the initiation of the EAB program in 2000 are less dramatic and may not be clearly attributable to EAB activity in the treatment area. In well T-8A, TCE and cis-1,2-DCE concentrations have declined by 10 to 25%. Further downgradient, in well T-9A, TCE and cis-1,2-DCE concentrations have declined by 40 to 45%. The observed trends in the A-zone aquifer downgradient from the treatment area, especially those at T-9A, probably have more to do with the suspension of pumping rather than EAB.

Overall, conditions in the downgradient areas have improved since the EAB program. VOC concentrations have declined faster in the past three years than in the years prior to the EAB program, consistent with reduction of VOC mass in the former source area. Rising levels of degradation products in the B1-zone (cis-1,2-DCE in well T-8B and VC in well T-4B) should be closely monitored, but these trends should soon reverse given the near-complete degradation of TCE in the former source area (well T-2B). The limited response in the downgradient of the treatment area in the A-zone (well T-8A) indicates low groundwater flow rates and suggests that EAB program is probably not capable of quickly achieving cleanup goals across the entire site unless the EAB program is expanded to other portions of the site.

Projections of the long-term effects of the EAB application are complicated by the fact that moderate levels of TCE and DCE continue to migrate onto the former TRW site from upgradient sources, as indicated by VOC concentrations in wells along the upgradient property boundary. In any event, the results achieved to date indicate that EAB is clearly capable of achieving groundwater cleanup goals at the site. Whether these reductions can be sustained over time is less clear given the presence of upgradient VOC sources.

One potentially toxic or mobile transformation product has been identified during recent monitoring that was not already present at the time of the Record of Decision, and

therefore did not have a cleanup standard specified in the Site Cleanup Requirements. Chlorobenzene has been detected at the site only in the EAB treatment zone, and only since the EAB program was initiated. Chlorobenzene was detected at 510 ug/L in the Educator well, 70 ug/L in well T-2B, and 24 ug/L in well T-2A in April 2004. The MCL for chlorobenzene is 70 ug/L. The recent appearance of chlorobenzene is believed to be the result of microbially-induced degradation of 1,2-dichlorobenzene in the EAB treatment zone. Chlorobenzene concentrations will be monitored closely to assess attenuation over time.

VI. Five-Year Review Process

Document Review

This five-year review consisted of a review of relevant documents including TRW's Five-Year status report (submitted to the Water Board on September 14, 2001), annual groundwater monitoring reports, and EAB progress reports. There have been no changes in the cleanup standards contained in the Final Site Cleanup Requirements.

Data Review

Groundwater monitoring data collected from 1991 to 2004 were reviewed to evaluate progress in remediating the groundwater pollutant plume. GWET conducted through 2001 was successful in controlling migration of the plume, in removing VOC mass from saturated soil, and reducing concentrations of VOCs in groundwater. There is no evidence that groundwater contamination has migrated vertically since GWET began. Further reductions in groundwater concentrations in the former source area have been achieved through EAB since 2000.

Site Inspection

The most recent site inspection was conducted by RWQCB staff on February 11, 2004. Redevelopment and reoccupation of the property has the potential to interfere with cleanup of the site; however this has not happened to date. The institutional controls that are in place include prohibitions on the use of groundwater until cleanup levels are achieved. No activities were observed that would have violated the institutional controls. VOC contamination is largely confined to groundwater; however, vapor intrusion from the groundwater plume into the overlying building has been documented. The vapor intrusion threat has been assessed for this site.

VII. Technical Assessment

Question A: Is the remedy functioning as intended by the decision documents?

The current groundwater monitoring program is sufficient to track the plume and detect any migration beyond the current plume boundaries, as well as track the effectiveness of remedial actions. The remedy selected in the Final Remedial Action Plan (GWET, SVET, and institutional controls) was implemented as planned and achieved some

success by removing VOCs from vadose zone soil and soil vapor, maintaining plume control, and reducing VOC concentrations in groundwater. In 2000, because of declining effectiveness of the selected remedy, TRW requested and received RWQCB approval to test an in situ remedy (EAB). In the past three years, some of the contaminant mass in the former source area has been degraded to innocuous by-products by the successful EAB program, and groundwater cleanup goals have been achieved in the EAB treatment area. Outside the EAB treatment area, VOC concentrations are declining but remain above cleanup levels. Concentrations in this area are expected to continue to decline given the reduction of mass in the source area. The contribution of VOCs from the TRW site to the commingled plume downgradient of the property is decreasing. Contamination remains confined to the shallow groundwater bearing zones.

The institutional controls in place include prohibitions on the use of groundwater until cleanup levels are achieved. No activities were observed that would have violated the institutional controls.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

In an effort to determine whether the remedy at the former TRW site remains protective of human health and the environment, this section discusses changes in site conditions, changes in exposure pathways, changes in toxicity values, changes in remedial action objectives, and changes in ARARs since selection of the Site remedy.

Changes in Site Conditions

The building and site formerly occupied by TRW has been vacant since January 2001. The use of the downgradient area under which the groundwater plume has migrated remains commercial, light industrial, office space, and residential. Three schools are located above the commingled, off-site groundwater plume.

Since groundwater extraction was suspended in 2000-2001 to allow implementation of the EAB program and relocation of the treatment system, hydrochemical conditions at the site have changed in ways that could affect the protectiveness of the remedy. Specifically, concentrations of TCE and its breakdown products have fluctuated widely since electron donor material was injected into the shallow aquifers in 2000 – 2001. As EAB progressed, concentrations of PCE and TCE increased temporarily due to desorption from saturated soil matrix into groundwater. Likewise, concentrations of cis-1,2-DCE and VC showed temporary increases due to microbially induced degradation of PCE and TCE. Since January 2004, however, concentrations of PCE, TCE, DCE, and VC have stabilized at concentrations below the detection limit (1 ug/L) in the former source area. The net result of the EAB program has been a significant reduction of VOC concentrations and mass in groundwater, as shown by the production of ethane and ethane. Thus, overall chemical conditions at the site have improved significantly since the last Five-Year Review. In terms of groundwater quality, the protectiveness of the remedy has improved since the last five-year review period.

Changes in Exposure Pathways

A baseline human health risk assessment for the TRW Site was conducted in 1990. This risk assessment was incorporated into the RI/FS Report and Final Remedial Action Plan, and was used in evaluating and selecting remedial options for the site. The risk assessment focused on the potential for future exposure to contamination if the groundwater and its contaminant sources were left untreated, and if that water was used for domestic purposes (e.g., drinking, showering, washing). Exposure to contamination through these pathways contributes the greatest risk to human health where those pathways are complete. At the former TRW site, however, the groundwater currently is not used for domestic purposes; thus, those exposure scenarios were considered unlikely. Additionally, because the contamination at the site is primarily in the groundwater, the 1990 risk assessment concluded that potential exposure to site contaminants through the inhalation pathway presented negligible risks.

Since 1990, however, the understanding of the fate and transport of chemicals in the subsurface has evolved. We now understand that, under certain conditions, VOCs in the soil and/or groundwater emit vapors that can migrate upward through subsurface soils and enter overlying buildings through cracks in floors or through piping conduits. In September 2002, USEPA's Office of Solid Waste and Emergency Response (OSWER) released an external review draft "Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils" (2002) that focuses specifically on this pathway. Given the relatively shallow water table at the former TRW site (approximately 10 feet bgs), coupled with the high TCE concentrations that have been measured in groundwater beneath the building in recent years (up to 17,000 µg/L), USEPA identified the former TRW site as one requiring evaluation of the potential for groundwater contamination to impact indoor air.

Samples collected from the building on the former TRW site in October 2003 and April 2004 indicated indoor air concentrations of PCE, TCE, VC, and chloroform that were elevated above background levels, and above USEPA's draft long-term health-protective risk range and/or the California EPA health-based screening levels. At the time these samples were collected, the building was unoccupied and had been unventilated for over 2-½ years. Re-sampling in April 2004 under active ventilation yielded either non-detectable concentrations or concentrations below USEPA and California EPA screening criteria. Thus, it appears that proper ventilation is capable of maintaining indoor air vapor concentrations at levels that pose no additional long-term risk to building occupants.

Changes in Toxicity Values

Since the 1990 risk assessment, there have been a number of changes to the toxicity values for certain contaminants of concern at the TRW Site. Revisions to the toxicity value for 1,1-DCE and VC indicate a lower risk from exposure to these chemicals than previously considered. On the other hand, recent studies of the toxicity values for PCE and TCE may indicate higher risks from exposure than previously considered.

The greatest uncertainty with toxicological changes for the former TRW site contaminants is associated with TCE. In August 2001, USEPA's Office of Research and Development (ORD) released "Trichloroethylene Health Risk Assessment: Synthesis and Characterization" (TCE Health Risk Assessment) for external peer review. The draft TCE Health Risk Assessment takes into account recent scientific studies of the health risks posed by TCE. According to the draft TCE Health Risk Assessment, for those who have increased susceptibility and/or higher background exposures, TCE could pose a higher risk through inhalation than previously considered. The Draft TCE Health Risk Assessment is available online at:
<http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=23249>.

The Science Advisory Board, a team of outside experts convened by USEPA, reviewed the draft TCE Health Risk Assessment in 2002. The Science Advisory Board's review of the draft TCE Health Risk Assessment is available at:
<http://www.epa.gov/sab/pdf/ehc03002.pdf>.

USEPA's ORD and OSWER have requested additional external peer review of the draft TCE Health Risk Assessment by the National Academy of Sciences. Consequently, review of the toxicity value for TCE may continue for a number of years. In the interim, because of the uncertainties associated with the draft TCE Health Risk Assessment, USEPA Region 9 is considering both the draft TCE Health Risk Assessment toxicity values, as well as the California TCE toxicity value (similar to USEPA's previously listed TCE toxicity value from 1987), in evaluating potential health risks from exposure, and in making protectiveness determinations. The toxicity criteria that have been used to evaluate the remedy's protectiveness are based on long-term exposures (24 hours, 350 days, 30 years) for residential settings and (10 hours, 250 days, 25 years) for commercial/industrial settings. To date, none of the immediate or short-term health criteria for air have been exceeded in any buildings.

USEPA evaluates potential health risks by considering a number of important factors: the toxicity of the chemical, the amount of the chemical, the exposure pathway, and the duration to which an individual may be exposed to the chemical. USEPA uses a toxicity assessment to identify what types of health effects each chemical can cause, and how much exposure is harmful (such as the TCE Health Risk Assessment). The results of the risk characterization are probabilities, not certainties, and are typically based on maximum exposures to the most sensitive members of a community. Risk characterizations are never predictions of health outcomes for any individual in a community.

Changes in Remedial Action Objectives

The Final Remedial Action Plan (FRAP) for the former TRW site approved by the RWQCB and USEPA in 1991 focused on reducing levels of contaminants in groundwater (and contaminant sources to groundwater) so that the groundwater could ultimately be used for domestic purposes. At that time, plans to mitigate the subsurface vapor intrusion pathway were not considered.

In 2003 and 2004, the vapor intrusion into indoor air pathway was investigated at the former TRW facility. The results of this investigation, summarized above, indicate that any additional risk from vapor intrusion of TCE is likely to be negligible as long as proper ventilation is maintained. Additional investigation scheduled for October 2004 should help determine if vapor intrusion will remain a concern at the site.

Changes in ARARs

Applicable or Relevant and Appropriate Requirements (ARARs) and cleanup levels for soil contamination at the former TRW site have been met in accordance with the Final Site Cleanup Order. There have been no changes in ARARs that would affect operations or the protectiveness of the remedy.

The RWQCB has developed risk-based Environmental Screening Levels (ESL) for a variety of exposure routes including vapor intrusion into buildings from underlying groundwater contamination. The current levels of TCE and cis-1,2-DCE in groundwater beneath the building are below the RWQCB's residential screening levels for potential indoor air risk. TCE concentrations may still exceed levels of concern if the new draft USEPA guidance on TCE toxicity is used in the risk assessment.

One of the action-specific ARARs from the ROD cites the NPDES discharge standards in accordance with the RWQCB Water Quality Control Plan, San Francisco Bay Region (Region 2) (RWQCB, 1995). The Basin Plan references standards that were adopted from USEPA's Ambient Water Quality Criteria, as adopted by the RWQCB in 1986. In 2000, USEPA promulgated the California Toxics Rule, which updates and adds standards for discharges to surface waters. The California Toxics Rule standards for VOCs are not lower than those in the NPDES permits for the groundwater treatment systems; therefore, these new standards do not affect the NPDES discharge standards for the treated effluent, and they do not affect the protectiveness of the remedy. Also, GWET has not been performed at the site since 2001; therefore, there have been no NPDES discharges since that time. Given the success of EAB as a remedy for groundwater contamination at the site, it is not likely that GWET will be resumed at the site.

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

New draft USEPA guidance on the toxicity of TCE and new concerns regarding intrusion of volatile organic vapors, as discussed above, required a re-evaluation of the protectiveness of the remedy at the former TRW site. In 2003 – 2004, Northrop Grumman measured VOC concentrations in indoor air at the 825 Stewart Drive building and re-evaluated human health risk associated with vapor intrusion at the site.

Samples of indoor air from the building on the former TRW site were collected on October 30, 2003, and analyzed for volatile organic compounds (VOCs) known to be present in the underlying groundwater plume. The concentrations of TCE (2.6 to 5.2 ug/m³) detected in all six indoor air samples exceeded the RWQCB's ESLs for both

residential and commercial long-term exposure scenarios. Likewise, the measured concentrations of VC (0.1 to 0.16 ug/m³) also exceeded residential and commercial long-term exposure ESLs. The measured PCE concentrations (0.4 to 0.67 ug/m³) slightly exceeded the Board's residential exposure ESL, but fell slightly below the commercial exposure scenario. These concentrations suggested that additional measures to reduce human exposure would be necessary if the building were occupied.

At the time these samples were collected, the building had been unoccupied and unventilated for over two years, allowing VOC vapors to accumulate inside the building. It is reasonable to assume that the VOC concentrations would be lower if the building's ventilation system were operational at the time samples were collected. To evaluate the range of indoor air VOC concentrations that might be present if the building were actively ventilated, Northrop Grumman conducted a second round of vapor intrusion sampling in April 2004. A temporary, mechanical ventilation system was designed and installed in the building and indoor air samples were collected with this system operating. Prior to installing the mechanical ventilation system, a round of baseline indoor air samples was collected.

The baseline samples collected prior to ventilation contained TCE at concentrations that ranged from 2.2 to 2.6 micrograms per cubic meter (ug/m³), PCE at concentrations between 0.38 and 0.52 ug/m³, and VC at concentrations that ranged from non-detectable to 0.067 ug/m³. The TCE and VC concentrations were significantly lower than concentrations detected in October 2003, while PCE concentrations were similar. The lower baseline sample concentrations on April 5 may reflect reductions in the concentrations of these chemicals in groundwater beneath the building since 2003. Nonetheless, each of these chemicals was present on April 5 in concentrations that exceeded the Water Board's indoor air screening levels.

The samples collected while the mechanical ventilation system was operating showed non-detectable concentrations of TCE and VC. PCE was detected at concentrations that were equivalent to outdoor air samples collected the same day.

From these data, RWQCB staff concluded that TCE concentrations can be reduced to levels that do not pose any additional risk to occupants of the building as long as adequate ventilation is maintained. Also, because the maximum TCE concentrations in groundwater beneath the building have been reduced to below drinking water standards in the former source area in the past year, it is possible that the vapor intrusion problem has been mitigated. Another round of indoor air sampling scheduled for October 2004 should help determine if vapor intrusion will remain a concern at the site.

Additional vapor intrusion sampling has been performed during 2003 and 2004 in the Offsite Operable Unit downgradient of the AMD, TRW, and Philips sites. To assess the vapor intrusion pathway over the commingled plume, Philips sampled soil gas at two private schools (Rainbow Montessori and King's Academy) that overlie the plume between the Philips site and Duane Avenue. Soil gas was also sampled at a multi-unit residential complex on the north side of Duane Avenue. Soil-gas concentrations at the

residential area were well below the RWQCB ESLs and no residential indoor air sampling was performed. Some of the soil-gas samples collected from the school properties contained TCE at concentrations that exceeded the RWQCB ESLs, however, and indoor air sampling was performed at both schools. Indoor air samples from the schools confirmed the presence of very low levels of TCE (below the RWQCB ESL for residential indoor air of 1.2 ug/m³) in most of the buildings sampled, suggesting (although not confirming) a vapor intrusion source. One building at Rainbow Montessori was found to contain TCE at levels slightly above the RWQCB ESL of 1.2 ug/m³. Further investigation determined that this building was not properly ventilated.

The evaluation of the vapor intrusion pathway and long-term human health risk assessment for the Offsite Operable Unit is not complete, but the available data indicate the absence of any short-term health risk from vapor-phase TCE. Proper ventilation may be capable of reducing long-term human health risks to acceptable levels.

Technical Assessment Summary

According to the data reviewed and the site inspection, the remedy is functioning as intended by the Record of Decision. There have no been changes in the physical condition or land use of the site that would reduce the protectiveness of the remedy. Reductions in groundwater concentrations achieved through site remediation have increased the protectiveness of the remedy.

VIII. Issues

Four issues identified during the review are:

- 1) Enhanced anaerobic biodegradation (EAB) appears to have greater potential towards achieving site cleanup goals than continuing groundwater extraction and treatment;
- 2) Migration of groundwater contaminants onto the subject property from upgradient sources threatens the long-term success of site remediation;
- 3) Resuming groundwater extraction at the site has the potential to induce migration of contaminants onto the property from adjacent sources, and would likely reverse much of the progress that has been achieved through EAB; and
- 4) Vapor intrusion from the groundwater plume into the overlying building has been documented, but appears manageable at levels that do not cause long-term human health risks as long as proper ventilation is maintained.

IX. Recommendations and Follow-up Actions

Northrop Grumman will continue to monitor groundwater quality for several years to assess the long-term success of the EAB program and to monitor migration of VOCs onto the site from upgradient sources. Northrop Grumman is considering expanding the EAB program into the area downgradient of the former VOC source area in an attempt to accelerate groundwater cleanup for the remainder of the site. VOC release sites upgradient of the former TRW site must ensure that plume control is maintained.

Northrop Grumman plans to perform an additional round of indoor air sampling in October 2004 to assess seasonal effects on the potential for vapor intrusion, and to determine if the reduced groundwater concentrations beneath the building have reduced the long-term potential for intrusion of vapors from groundwater.

X. Protectiveness Statement

Remedial actions conducted at the site until 2000 under the Final Site Cleanup Requirements Order functioned as designed and achieved positive results by maintaining hydraulic control of plume migration and reducing VOC concentrations in groundwater throughout the plume. Since 2000, the EAB program has accelerated the pace of groundwater remediation. Groundwater cleanup goals (MCLs) have been achieved for TCE and related VOCs in the former TRW source area. Continued monitoring is necessary for several more years to assess whether this success can be maintained without further treatment. It appears possible that cleanup goals can be achieved for the remainder of the TRW plume within five years. The remedy is currently protective of human health and the environment in terms of limiting ingestion of contaminated water through institutional controls prohibiting the use of shallow groundwater.

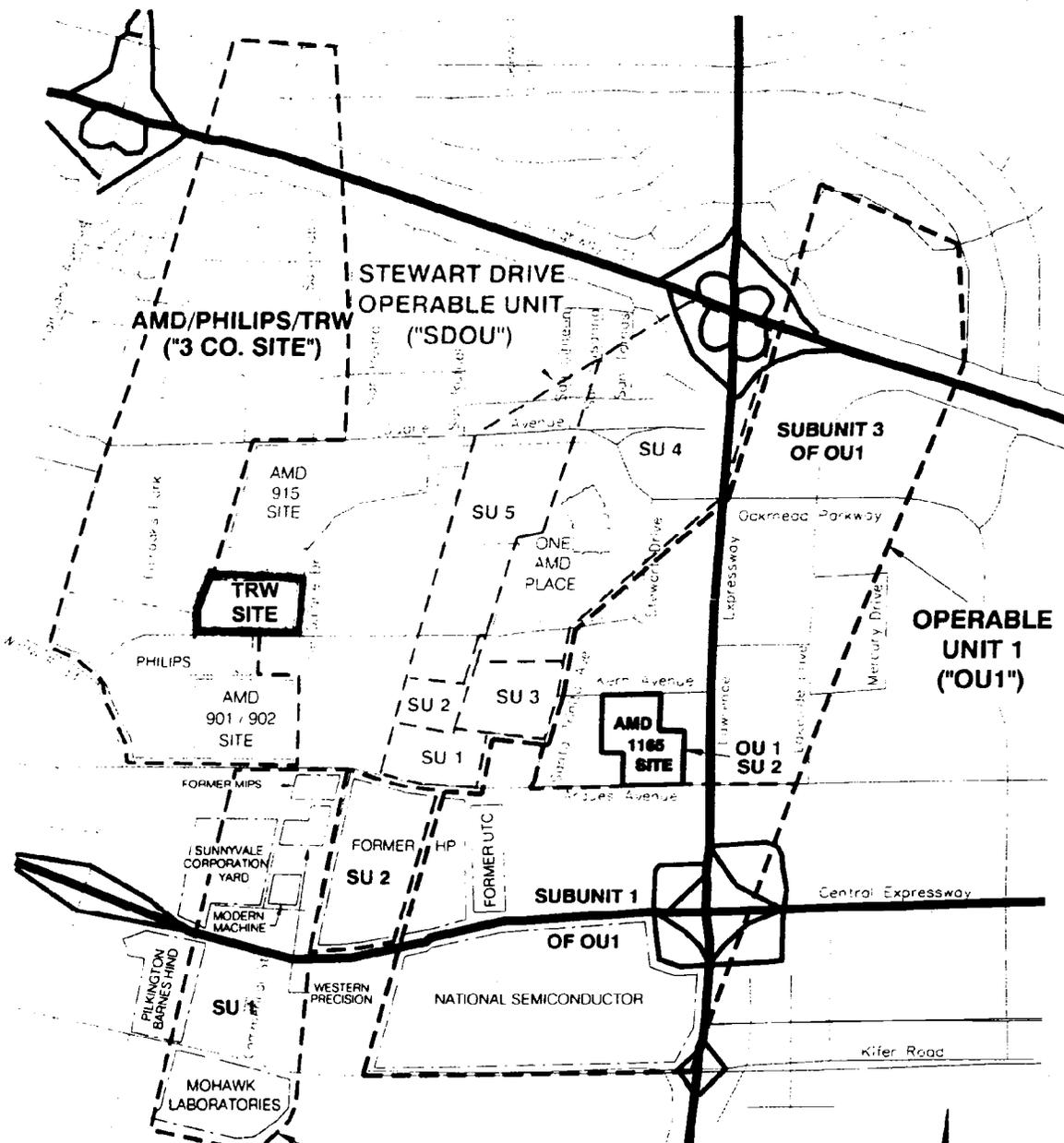
The vapor intrusion threat at the site has been assessed, and has been mitigated to some extent by reduction of groundwater VOC concentrations beneath the building. The results of indoor air sampling indicate that while vapor intrusion pathways exist, proper ventilation of the building can maintain indoor air concentrations of TCE at levels that do not cause unacceptable, long-term human health risks. The remedy is currently protective of human health and the environment.

XI. Next Review

The next five-year review for the former TRW Superfund site is required by September 30, 2009. In order to re-synchronize the five-year reporting schedule between RWQCB and USEPA, the responsible party should submit its next Five-Year Summary Report to RWQCB by March 30, 2009 rather than September 30, 2006.

Issues and Recommendations

<i>Issue</i>	<i>Recommendation and Follow-Up Action</i>	<i>Responsible Party</i>	<i>Oversight Agency</i>	<i>Date</i>	<i>Affects Protectiveness (Yes/No)</i>
Enhanced anaerobic bioremediation (EAB) appears more capable of achieving site cleanup goals than groundwater extraction and treatment	Discharger should evaluate the feasibility of expanding EAB into the area where VOC concentrations still exceed site cleanup goals	Northrop Grumman	RWQCB	2005	Yes
Migration of groundwater contaminants onto the subject property from upgradient sources threatens the long-term success of site remediation	Adjacent AMD and Philips sites must maintain plume control to prevent off-site migration of VOCs onto the former TRW site	AMD and Philips	RWQCB	2005	Yes
Resuming groundwater extraction at the site has the potential to induce migration of contaminants onto the property from adjacent sources	Northrop Grumman should consider implementing <i>in situ</i> bioremediation as the final remedy for the site. The ROD will need to be amended if there is a permanent change in remedy from GWET to EAB	Northrop Grumman	RWQCB	2005	Yes
Vapor intrusion from the groundwater plume into the overlying building has been documented	Northrop Grumman will perform an additional round of indoor air sampling in October 2004	Northrop Grumman	RWQCB	October 2004	Yes

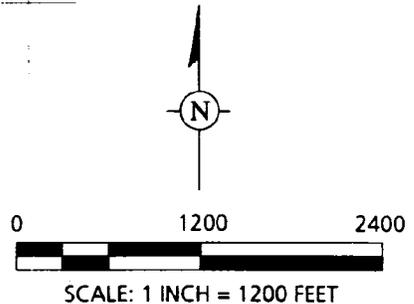


COMMERCIAL STREET OPERABLE UNIT ("CSOU")

LEGEND

- OPERABLE UNIT BOUNDARIES
- PROPERTY LINES

All locations are approximate.
 Source: Advanced Micro Devices.

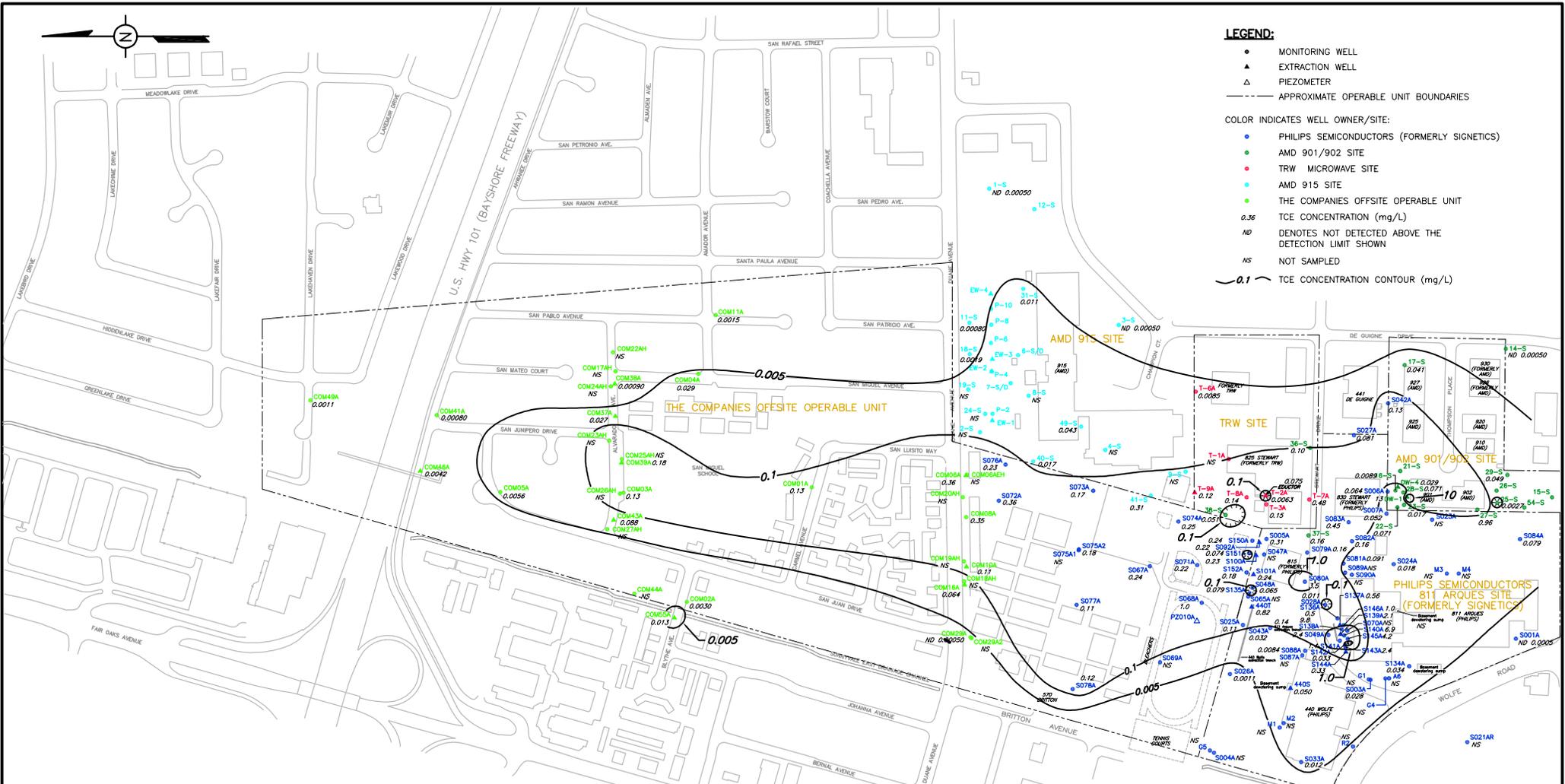


EASTERN SUNNYVALE STUDY AREA

Former TRW Microwave Site
 825 Stewart Drive
 Sunnyvale, California



- LEGEND:**
- MONITORING WELL
 - ▲ EXTRACTION WELL
 - ▲ PIEZOMETER
 - APPROXIMATE OPERABLE UNIT BOUNDARIES
- COLOR INDICATES WELL OWNER/SITE:**
- PHILIPS SEMICONDUCTORS (FORMERLY SIGNETICS)
 - AMD 901/902 SITE
 - TRW MICROWAVE SITE
 - AMD 915 SITE
 - THE COMPANIES OFFSITE OPERABLE UNIT
- 0.36 TCE CONCENTRATION (mg/L)
 ND DENOTES NOT DETECTED ABOVE THE DETECTION LIMIT SHOWN
 NS NOT SAMPLED
- 0.1 — TCE CONCENTRATION CONTOUR (mg/L)

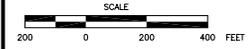


**"A" AQUIFER
 TCE CONCENTRATION CONTOURS
 OCTOBER–NOVEMBER 2003
 811 EAST ARQUES AVENUE SITE
 SUNNYVALE, CALIFORNIA**

PREPARED FOR
**PHILIPS
 SEMICONDUCTORS**

- REFERENCES:**
1. BASE MAP FROM KIER AND WRIGHT, NOVEMBER 1997.
 2. EMCON DRAWING NO. EXGWE-A, FEBRUARY 1998.

23 JAN 04	ISSUED FOR REPORT	VZC	GRG	JWH	
No.	DATE	ISSUE / REVISION	DWN. BY	CK'D BY	AP'D BY



DRAWING NO. 99-014-E224
 FIGURE 8