

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

Third Five-Year Review

**Applied Materials
Building 1
3050 Bowers Avenue
Santa Clara, California**

I. Introduction

The purpose of five-year reviews is to determine whether the remedy for the Applied Materials Building 1 (AM1) Site at 3050 Bowers Avenue in Santa Clara, California is protective of human health and the environment. The methods, findings, and conclusions of reviews are documented in Five-Year Review reports. In addition, Five-Year Review reports identify issues found during the review, if any, and recommendations to address them.

The Agency is preparing this Five-Year Review pursuant to CERCLA §121 and the National Contingency Plan (NCP). CERCLA §121 states:

If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such review it is the judgment of the President that action is appropriate at such site in accordance with section [104] or [106], the President shall take or require such action. The President shall report to the Congress a list of facilities for which such review is required, the results of all such reviews, and any actions taken as a result of such reviews.

The agency interpreted this requirement further in the National Contingency Plan (NCP); 40 CFR §300.430(f)(4)(ii) states:

If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after the initiation of the selected remedial action.

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 (USEPA) and the RWQCB. Pursuant to its 1990 Site Cleanup Requirements (RWQCB Order No. 90-134), Applied Materials evaluated the remedial activities performed at the site to determine if the selected cleanup plans are working.

This report is the third five-year review for the site. The first Five-Year Review was presented to the RWQCB in a Five-Year Status Report and Effectiveness Evaluation submitted in October 1994. This was the basis for the Five-Year Review Report signed by USEPA in 1995. The second Five-Year Status Report and Effectiveness Evaluation was submitted in October 1999 and the second Five-Year Review was approved by USEPA in July 2000. The Five-Year Review is required because the cleanup response at this site is a remedial action that, upon completion, will not leave hazardous substances, pollutants, or contaminants on site above levels that allow for unlimited use and unrestricted exposure, but requires five or more years to complete.

II. Site Chronology

Applied Materials investigates underground tank locations	Nov 1983
Well AM1-1 installed near the tank area	Nov 1983
Monitoring wells AM1-2, AM1-3, AM1-4 and AM1-5 are installed	June 1984
USEPA proposes the AM1 site for the National Priorities List (NPL)	Oct 1984
Applied Materials starts groundwater extraction at AM1-1	Nov 1984
Monitoring well AM1-5B and extraction well AM1-5E are installed	Jan 1985
Interim Remedial Measures implemented, including tank removal, soil excavation, and construction of extraction pit and well AM1-EP	Jan 1985
RWQCB adopts Waste Discharge Requirements (Order No. 85-70)	June 1985
AM1 site added to the final NPL	July 1987
USEPA and RWQCB accept Remedial Investigation/Feasibility Study report	June 1989
RWQCB issues Site Cleanup Requirements (Order No. 89-167)	Sept 1989
RWQCB issues Site Cleanup Requirements amendment (Order No. 90-134)	Sept 1990
USEPA and RWQCB approve ROD for groundwater remediation	Sept 1990
RWQCB issues Site Cleanup Requirements amendment (Order No. 93-056)	June 1993
USEPA approves ROD for soil and groundwater remediation	Aug 1993
First Five-Year Status Report and Effectiveness Evaluation submitted to RWQCB	Sept 1994
First Five-Year Review Signed	April 1995
RWQCB approves shut down of A-Zone extraction wells	June 1999
Second Five-Year Status Report and Effectiveness Evaluation submitted to RWQCB	Sept 1999
Second Five-Year Review Signed	July 2000
RWQCB approves shut down of all extraction wells	Dec 2002
Third Five-Year Status Report and Effectiveness Evaluation submitted to RWQCB	Sept 2004

III. Background

Physical Characteristics

The AM1 Site is located at 3050 Bowers Avenue, a light industrial and commercial area of Santa Clara. A large industrial building occupies most of the site. Most buildings in the vicinity are low-rise developments containing office space and research and development facilities.

Site Operational History

The AM1 site was constructed in about 1970. The facility has been used to manufacture equipment for the fabrication of semiconductor wafers from 1974 to the present. During the 1970s, VOCs were used as industrial solvents for cleaning and degreasing. Acids, caustics, and other chemicals were also used at the facility.

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.

The shallow groundwater at the AM1 site can be characterized into 3 fairly distinct zones. The A-Zone contains interbedded pockets of sand, silty sand and clay. It extends to about 30' below ground surface (bgs). A 3-5' thick aquitard layer separates the A-Zone from the A2-Zone which is about 30-40' bgs. Another aquitard of similar thickness lies below the A2-Zone and separates it from the deeper B-Zone. Groundwater generally flows to the north-northeast.

History of Contamination

Groundwater at the AM1 site is contaminated with Volatile Organic Compounds (VOCs), primarily of 1,1,1-trichloroethane (1,1,1-TCA), 1,1-dichloroethane (1,1-DCA), and 1,1-dichloroethene (1,1-DCE). In November 1983, VOCs were discovered in a monitoring well down gradient from three Underground Storage Tanks (USTs) on the west side of the building.

Initial Response

Site investigation began shortly after the contamination was discovered. Groundwater monitoring and extraction wells were installed and groundwater extraction began in November 1984. In January 1985, Applied Materials removed the tanks, excavated the contaminated soils, and constructed a groundwater extraction pit.

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 AM1 site became a Superfund site primarily because of the past chemical releases' potential threat to this valuable groundwater resource.

IV. Remedial Actions

Remedy Selection

The first Remedial Investigation/Feasibility Study (RI/FS) was approved by USEPA and the RWQCB in June 1989. The RWQCB adopted Site Cleanup Requirements (SCR) Order No. 89-167 in June 1989. A Record of Decision (ROD) was issued by USEPA in September 1990. The remedy selected in the SCR and the ROD consisted of the following elements:

- 1) groundwater extraction and treatment
- 2) 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 current groundwater cleanup levels are:

Chemical	Cleanup Standard (ug/L)
1,1-dichloroethane (1,1-DCA)	5
1,2-dichloroethane (1,2-DCA)	0.5
1,1-dichloroethene (1,1-DCE)	6
cis-1,2-dichloroethene (cis-1,2-DCE)	6
trans-1,2-dichloroethene (trans-1,2-DCE)	10
tetrachloroethylene (PCE)	5
1,1,1-trichloroethane (1,1,1-TCA)	200
1,1,2-trichloroethane (1,1,1-TCA)	3
trichloroethene (TCE)	5
Freon 113	1,200
Freon 11	150
chloroform	6
vinyl chloride	0.5

A second Remedial Investigation/Feasibility Study was conducted in 1992 for the soil source areas. A no-action ROD for the soils was signed by USEPA in August 1993.

Remedy Implementation

The groundwater extraction and treatment system and the groundwater monitoring program were fully implemented at the time the final SCR was adopted in 1989. A deed restriction was prepared for the property and recorded with the Santa Clara County Records Office on June 9, 1992. The deed restriction prohibits the use of groundwater from the shallow aquifer as a source of drinking water.

Groundwater extraction began at the AM1 site in November 1984, removing approximately 253 kg of VOCs from the 8.5 million gallons of groundwater extracted. This has resulted in significant reductions in the VOC concentrations. Groundwater extraction was terminated in 2002 with Regional Board approval due to declining concentrations.

O&M Costs

Applied Materials has spent approximately \$637,000 between August 1999 and September 2004 including O&M, reporting requirements and monitoring.

V. Progress Since Last Review

When the last Five-Year Review Status Report and Effectiveness Evaluation was submitted to RWQCB in September 2004, Applied Materials had stopped extracting groundwater. Between 1999 and 2002, approximately 2 million gallons of groundwater were extracted from the A2-Zone, removing about 1.4 kg of VOCs. Groundwater extraction was discontinued from the A2-Zone with RWQCB approval in 2002. Subsequent monitoring indicates that VOC concentrations are stable and relatively low. In January 2004, the highest concentrations reported were 12 µg/l for 1,1-DCE, 6 µg/l for 1,1-DCA, and 9.6 µg/l for 1,1,1-TCA. The maximum concentration limits for drinking water for these chemicals are 6 µg/l, 5 µg/l, and 200 µg/l, respectively.

VI. Five-Year Review Process

Administrative Components

The Applied Materials Five-Year Review team was led by Vince Christian of RWQCB, Remedial Project Manager (RPM) for the Applied Materials Site, and included members from the Regional Technical Advisory staff with expertise in hydrology, biology, and risk assessment. Dana Barton of USEPA assisted in the review as the representative for the support agency and included members from USEPA Technical Support Team.

Community Involvement

On August 24, 2005, a public notice was placed in the Santa Clara Weekly newspaper notifying the public that a five-year review was being conducted and comments can be directed to the RWQCB.

No interviews were planned or conducted.

Document Review

This five-year review consisted of a review of relevant documents including the Five-Year status report (*Five-Year Status Report and Effectiveness Evaluation*, Weiss Associates, September 28, 2004) and annual groundwater monitoring reports.

Data Review

Groundwater monitoring data collected from 1999 to 2004 were reviewed to evaluate progress in remediating the groundwater pollutant plume. All groundwater VOC concentrations have remained stable or declined over this time period. During this period, when the extraction pumps were off, the gradient remained consistent with its historic direction (northeast) and the water levels increased slightly.

EPA performed an evaluation of the ecological risk for this five year review in August 2005 (Memo: Evaluation of ecological risk for the Five Year Review of Applied Materials, EPA ID #CAD042728840, Ned Black, August 24, 2005). It concluded that "No complete exposure pathways to ecological receptors exist at this site and therefore there is no ecological risk."

Site Inspection

No site inspections were performed from 1999 to 2004.

VII. Technical Assessment

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

Yes. VOC concentrations in the groundwater have declined dramatically as a result of the remedial system. The major VOC mass has been removed, and only residual concentrations still exist.

The institutional controls that are in place include prohibitions on the use of groundwater until cleanup levels are achieved. These institutional controls are established through the Deed Restriction. The date and location of the recorded deed restrictions have not been verified. However, this will be verified for the next Five Year Review.

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 AM1 site remains protective of human health and the environment, this section discusses changes in the following: site conditions, exposure pathways, toxicity values, remedial action objectives, and ARARs since selection of the Site remedy.

Changes in Site Conditions

The AM1 site has been occupied continuously by Applied Materials since 1970. The use of the area adjacent to the site remains commercial, light industrial, office space, and residential. There is no adjacent residential property at this time. Site conditions have not changed appreciably in the past decade. The protectiveness of the remedy has not been affected by any changes since the last review period.

Changes in Exposure Pathways

While exposure to VOC vapors from migration to indoor air inside buildings has become more of a concern in recent years, this pathway is very unlikely at the AM1 site because the soil and groundwater concentrations are very low. USEPA's draft Vapor Intrusion Screening Guidance issued November 2002 states that the vapor intrusion pathway should be investigated if the levels of 1,1-DCE exceed 190 ppb¹ in shallow groundwater and/or if the levels of 1,1-DCA exceed 2200 ppb. The maximum levels of 1,1-DCE and 1,1-DCA are 12 ppb and 6 ppb, respectively. The only pathway of concern at the AM1 site is potential exposure to drinking water. However, the deed restriction prohibits groundwater extraction for drinking water.

Changes in Toxicity Values

The toxicity values and carcinogenicity assessment for 1,1-DCE was revised in August 2002, as part of USEPA's IRIS reassessment program. The reassessment resulted in changes to the health-based screening levels for assessing potential health impacts of 1,1-DCE levels in groundwater and soils. The new Preliminary Remediation Goals (PRG) for 1,1-DCE is 340 ppb. This change has not been adopted into ARAR standards. These changes for the chemicals at the site do not affect the protectiveness of the remedy.

Changes in Remedial Action Objectives

No changes to the Remedial Action Objectives are proposed at this time.

Changes in ARARs

The Applicable or Relevant and Appropriate Requirements (ARARs) and cleanup levels for soil contamination at the AM1 site have been met in accordance with the Final Site Cleanup Order. There have been no changes in ARARs affecting the operations or 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 VOCs in groundwater beneath the building are far below the RWQCB's residential screening levels for potential indoor air risk.

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

¹ Table 2 (c) Generic Groundwater Screening Table, draft Vapor Intrusion Screening Guidance

No.

Technical Assessment Summary

According to the data reviewed, the remedy is functioning as intended by the ROD. There have been no 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 in reducing exposure to groundwater contamination.

VIII. Issues

While VOC concentrations are relatively low, they are not declining any further. It could take a long time to achieve cleanup goals through natural attenuation processes alone. Discharger should consider other remedial option to cleanup residual VOC concentrations. Further information is needed to determine that the deed restrictions are in place and properly recorded.

IX. Recommendations and Follow-up Actions

Applied Materials should continue to monitor groundwater, and consider other alternative remedies such as in-situ bioremediation. Applied Materials should develop a proposal and timeline for State and Agency review that outlines how the site will achieve the clean-up goals. The deed restriction date and location need to be verified in the next Five Year Review.

X. Protectiveness Statement

Because the remedial actions are protective, the site is protective of human health and the environment in the short- and long-term.

XI. Next Review

The next five-year review for the AM1 Superfund site is required by September 2010.