



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

September 30, 2005

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 Hewlett-Packard 620-640 Page Mill Road
Superfund Site, Santa Clara, CA

Dear Mr. Wolfe:

The U.S. Environmental Protection Agency, Region 9 (EPA) has reviewed the Second Five-Year Review Report for the Hewlett-Packard 620-640 Page Mill Road Superfund Site, Santa Clara, CA, prepared by the California Regional Water Quality Control Board, San Francisco Bay Region, dated September 30, 2005. 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 March 1995 Record of Decision for the site. EPA concurs that the groundwater remedy for the Hewlett-Packard 620-640 Page Mill Road site currently protects human health and the environment because unacceptable risks are being controlled, and because there are institutional controls in place that are preventing exposure to, and the ingestion of contaminated groundwater. Also, current information available indicates that the vapor intrusion pathway is not complete at the site due to on-site building design, and is unlikely at the downgradient residential area due to levels found in the groundwater and other factors, such as hydraulic control of the plume. However, it is recommended that the groundwater monitoring program in the off-site area should continue, and potential vapor intrusion should be evaluated if concentrations in groundwater increase. Hydraulic control of the contaminated plume should continue until the groundwater cleanup goals area achieved. In addition, in-situ remedial technologies can be assessed in an effort to expedite the cleanup process, particularly in areas where the groundwater extraction and treatment system is not efficiently removing VOCs from the groundwater.

The next Five-Year Review for the Hewlett-Packard 620-640 Page Mill Road site will be due in 2010. EPA appreciates the opportunity to work with you on this report. If you have any questions, please feel free to contact Penelope McDaniel of my staff at 415-972-3178.

Sincerely,

A handwritten signature in black ink, appearing to read "Elizabeth Adams". The signature is fluid and cursive, with the first name "Elizabeth" written in a larger, more prominent script than the last name "Adams".

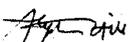
Elizabeth Adams
Chief, Site Cleanup Branch
Superfund Division, US EPA

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

Second Five-Year Review

**Hewlett-Packard 620-640 Page Mill Road
Palo Alto, Santa Clara County, California**

Digitally signed by Stephen Hill
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Report Approved by:  September 30, 2005
Stephen A. Hill **Date**
Chief, Toxics Cleanup Division
California Regional Water Quality Control Board
San Francisco Bay Region

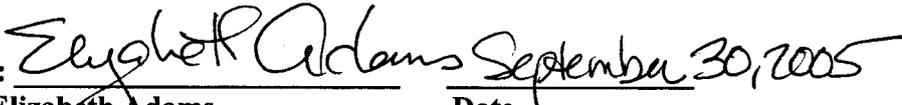
Report Concurred by:  September 30, 2005
Elizabeth Adams **Date**
Chief, Site Cleanup Branch
United States Environmental Protection Agency
Region 9

Table of Contents

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

Second Five-Year Review

**Hewlett-Packard 620-640 Page Mill Road
Palo Alto, Santa Clara County, California**

Report Approved by: _____ September 30, 2005
Stephen A. Hill **Date**
Chief, Toxics Cleanup Division
California Regional Water Quality Control Board
San Francisco Bay Region

Report Concurred by: _____ _____
Elizabeth Adams **Date**
Chief, Site Cleanup Branch
United States Environmental Protection Agency
Region 9

List of Abbreviations	3
Executive Summary	4
Five-Year Review Summary Form	5
I. Introduction	7
II. Site Chronology	8
III. Background	8
Physical Characteristics	8
Land and Resource Use	9
Hydrogeology	9
History of Contamination	10
Initial Response	10
Summary of Basis for Taking Action	10
IV. Remedial Actions	10
Remedy Selection	10
Remedy Implementation	12
System Operations/Operation & Maintenance	13
V. Progress Since Last Review	13
VI. Five-Year Review Process 14	
Administrative Components	14
Community Involvement	14
Document Review	14
Data Review	15
Site Inspection	16
VII. Technical Assessment	16
<u>Question A</u> : Is the remedy functioning as intended by the decision documents? .16	
<u>Question B</u> : Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy still valid?17	
<u>Question C</u> : Has any other information come to light that could call into question the protectiveness of the remedy?20	
Technical Assessment Summary	20
VIII. Issues	20
IX. Recommendations and Follow up Actions	21
X. Protectiveness Statement	21
XI. Next Review	22

List of Abbreviations

ARAR	Applicable or Relevant and Appropriate Requirement
bgs	Below ground surface
BPHE	Baseline Public Health Evaluation
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COCs	Chemicals of concern
DCA	Dichloroethane
DCE	Dichloroethene
ESL	San Francisco Bay Region Water Quality Control Board Environmental Screening Levels
GAC	Granular activated carbon
GWET	Groundwater Extraction and Treatment
HI	Hazard index
MCL	Maximum Contaminant Level
mg/kg	milligram per kilogram
NCP	National Contingency Plan
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
PCE	Tetrachloroethene
PMR	Page Mill Road
ppb	Parts per billion
RfDs	Reference doses
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
SCR	Site Cleanup Requirement
SF	Slope Factor
SVE	Soil Vapor Extraction
SVET	Soil Vapor Extraction and Treatment
TCE	Trichloroethene
TCA	Trichloroethane
U.S. EPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound
Water Board	San Francisco Bay Region Water Quality Control Board

Executive Summary

The Hewlett-Packard 620-640 Page Mill Road site (640 PMR) is located south of Highway 101 in Palo Alto, California. Groundwater contamination from this site commingles with similar discharges from two nearby sites: HP 395 Page Mill Road, which is located to the north of 640 PMR; and Varian Medical Systems, Inc., 601 California Avenue site, which is located to the northwest. The offsite Volatile Organic Compound (VOC) plume of contaminated groundwater extends approximately 1,500 feet downgradient of the 640 PMR site. Remediation of offsite groundwater from the 640 PMR site, the HP 395 Page Mill Road site, and the Varian 601 California site is managed as a combined project.

The remedy for contamination, finalized in 1994, consists of soil vapor extraction and treatment, groundwater extraction and treatment, groundwater monitoring, and institutional controls. This is the second "Five-year" review for the 640 PMR site, and it covers remedial activities conducted between September 2000 and April, 2005. The first review covered activities between 1994 and 2000.

Remedial actions conducted at the site have been successful. The groundwater extraction and treatment systems continue to remove contaminants. The soil vapor extraction system is not currently operating due to high groundwater levels. The soil vapor extraction and treatment (SVET) system, which was completed in April 1994, operated full-time through 1994 and 1995. It was periodically shutdown and restarted during 1996 and the first half of 1997 to allow for VOC rebound and more efficient system operation. The SVET system has not operated for any significant time since August 1997 due to saturation of the deeper vapor extraction wells and the presence of low VOC concentrations in shallower vapor extraction wells. The SVET system at the 640 PMR site has likely completed remediation of the unsaturated shallow soils underlying the existing building to the 1 mg/kg soil cleanup standard based on the results of previous investigations and evaluations. Ongoing groundwater extraction in the area of the SVET system is being used to address the now-saturated soils that the lower zone wells of the SVET system were designed to treat. Onsite and offsite groundwater extraction and treatment (GWET) systems have continued to operate during this review period.

Until cleanup goals are achieved, the current remedy is protective of human health and the environment.

Five-Year Review Summary Form		
SITE IDENTIFICATION		
Site Name (from WasteLAN): Hewlett-Packard 620-640 Page Mill Road		
EPA ID (from WasteLAN): CAD009122540		
Region: 9	State: CA	City/County: Palo Alto/Santa Clara
SITE STATUS		
NPL status: Final		
Remediation Status: Operating		
Multiple OUs? No	Construction completion date: September 1997	
Has site been put into reuse? The site is in use and remedial operations continue.		
REVIEW STATUS		
Lead agency: State of California		
Author Name: Derek Whitworth		
Author title: Water Resources Control Engineer	Author affiliation: CA Regional Water Quality Control Board (Lead Agency)	
Review period: July 2000 to July 2005		
Date(s) of site inspection: July 19, 2005		
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): 09/14/2000		
Due Date (five years after triggering action date): September 14, 2005		

Five-Year Review Summary Form, continued**Issues:**

- Declining volatile organic compound (VOC) removal efficiency in most of the groundwater extraction wells.
- An effectiveness evaluation conducted in 1995 concluded that the soil vapor extraction and treatment (SVET) system influent concentrations had decreased by approximately 99 percent and that remediation goals for VOCs and acetone had likely been achieved in the upper zone soil. Rising groundwater levels have resulted in the re-saturation of soil surrounding the lower zone SVET wells. The SVET has not been operated for any significant time since August 1997 due to saturated conditions surrounding the lower zone SVET wells. Ongoing groundwater extraction in the area of the SVET system is being used to address the now-saturated soils that the lower zone wells of the SVET system were designed to treat.

Recommendations and Follow-up Actions:

- HP plans to assess whether in-situ remedial technologies would be a practical alternative to accelerate the remediation process, especially in onsite areas where the VOC removal efficiency of the groundwater extraction and treatment (GWET) system has significantly declined.
- HP will continue to operate the GWET system and monitor groundwater quality.

These actions are likely to occur within the next five years.

Protectiveness Statement:

The remedy is expected to be protective of human health and the environment upon attainment of groundwater cleanup goals. In the interim, exposure pathways that could result in unacceptable risks are being controlled and institutional controls are preventing exposure to, or the ingestion of, contaminated groundwater. Based on currently available information, the vapor intrusion pathway is not complete at the site due to the on-site building design, and is unlikely at the downgradient residential area due to the low levels of VOCs found in the groundwater there and other factors, such as on going hydraulic control of the plume. However, the groundwater monitoring program in the off-site area should continue, and the potential for indoor air intrusion should be evaluated if concentrations in groundwater increase significantly.

San Francisco Bay Region

Five-Year Review

**Hewlett-Packard 620-640 Page Mill Road
Palo Alto, Santa Clara County, California**

I. Introduction

The purpose of the five-year review is to determine whether the remedy at a site 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 identify recommendations to address them.

The Agency is preparing this Five-Year Review report 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 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 State of California Regional Water Quality Control Board conducted the five-year review of the remedy implemented at the Hewlett Packard Superfund Site in Palo Alto, Santa Clara County, California. This is the second five-year review for the Hewlett Packard 620-640 Page Mill Road (640 PMR) Site. The triggering action for this statutory review is the completion of the first five-year review on September 14, 2000. The five-year review is required due to the fact that hazardous substances, pollutants, or contaminants remain at the site above levels that allow for unlimited use and unrestricted exposure.

II. Site Chronology

Event	Date
Soil and groundwater investigations begin after discovery of a leaking underground solvent storage tank.	1981
Initial groundwater remediation.	1982
Soil excavations conducted.	1987-1992
Expanded groundwater remediation begins.	1987
Additional soil excavation conducted.	1994
Soil vapor extraction begins.	1994
Regional Board Order 94-130 approves remedies that include soil vapor extraction and treatment and groundwater extraction, treatment and discharge to sanitary sewer and surface water under NPDES permit.	Sept. 1994
U.S. EPA issues Record of Decision (ROD) for 640 PMR Site.	3/24/95
Five-Year Status Report and Effectiveness Evaluation.	6/1/2000
U.S. EPA Five Year Review.	9/14/2000

III. Background

Physical Characteristics

The 640 PMR Site is located near the corner of Page Mill Road and El Camino Real in Palo Alto. It is located south of Highway 101. Groundwater contamination from this site commingles with similar discharges from two nearby sites: HP 395 Page Mill Road, which is located to the north of 640 PMR; and Varian Medical Systems, Inc., 601 California Avenue site, which is located to the northwest. The offsite VOC plume extends approximately 1,500 feet downgradient of the 640 PMR site. The offsite groundwater plume from the 640 PMR site, the 395 PMR site, and the Varian 601 California site is managed as one commingled plume.

The Oregon Expressway Underpass (OEU) serves as a subsurface roadway beneath the Southern Pacific Railroad tracks, Alma Street and Park Boulevard. The underpass, built in 1958, extends twenty-four feet below ground surface into the A1 Zone. A dewatering system installed beneath the underpass controls natural groundwater inflow and surface runoff. This dewatering system affects groundwater flow to the north and acts to contain further migration of VOCs in groundwater.

Land and Resource Use

The property is owned by the Stanford University and leased by Hewlett-Packard until 2047. Hewlett-Packard Company first occupied the site in 1962. HP operations at the site ceased in 1986. Complete redevelopment of the site began in February 1992 with the demolition of the on-site buildings and construction of a new office building, which was occupied beginning in May 1994. This office building was constructed with potential vapor intrusion in mind. The majority of the building is underlain by a parking garage on the first floor, and the remaining portion of the building has a vapor barrier between the bottom level and native soil.

Land use in the vicinity and downgradient of the site is predominately commercial, with smaller areas of residential development. An outdoor soccer complex is being developed on the vacant land located immediately downgradient of the site at the northwest corner of Page Mill Road and El Camino Real and includes a portion of the 640 PMR site.

Hydrogeology

The Site is underlain by alluvial fan deposits associated with San Francisquito Creek to the west and Matadero Creek to the east. Two primary water-bearing aquifers have been identified within the alluvial fan deposits and are termed: the A aquifer, the saturated portion of which extends between approximate depths of 17 to 55 feet below ground surface (bgs); and the B aquifer, which is encountered at depths between 60 and 120 bgs within the study area. Frequently, distinct sand units are encountered in the A aquifer. Coarse grained sediments that comprise the A1 Upper Zone (A1U) are generally encountered between depths of about 10 to 30 feet bgs; however, the A1U is only saturated beneath the northeastern-most portion of the site (beneath the rest of the site, the A1U is unsaturated). The A1 Zone (A1) typically occurs 30 and 40 feet bgs, and the A2 Zone (A2) generally occurs between 40 and 55 feet bgs. Within the northern- and northeastern-most portion of the site, the A1 and A2 sands are in direct contact and form a single A1/A2 Zone. The relatively fine-grained aquitards between the sand units range from 1 to 22 feet in thickness, and seem to allow varying degrees of hydraulic communication between the sand units. The aquitard separating the A and B aquifers varies from approximately 12 to 23 feet in thickness. Thin sandy lenses that extend into the upper portion of the A/B aquitard have been designated A2 Deep (A2D) Zone.

The regional groundwater flow direction is generally northeasterly from the hills toward San Francisco Bay. However, local variations in groundwater flow direction have been observed and have been attributed to the effects of groundwater extraction or to preferential migration paths caused by relic fine- and coarse-grained buried stream channel deposits.

The dewatering system for the Oregon Expressway underpass has a substantial impact on groundwater flow in the vicinity of the site. The underpass beneath Alma Street and the railroad tracks extends approximately 24 feet bgs, into the A aquifer, and the dewatering system was constructed to control (prevent) flooding of the underpass from groundwater seepage and storm water accumulation. The dewatering system acts to contain the northward migration of VOCs in groundwater. Groundwater captured by the dewatering

system is treated using an air stripper to remove VOCs prior to discharge to Matadero Creek in accordance with an NPDES permit.

History of Contamination

Soil investigations began at the 640 PMR site in 1981 after a 1,000 gallon underground solvent storage tank was discovered to be leaking. The chemicals detected most frequently in soil were arsenic, gallium, TCE, TCA, 1,1-DCE, PCE, 1,2,4-trichlorobenzene, and phenol.

The groundwater under the 640 PMR site was also contaminated. The chemicals detected most frequently in the groundwater beneath the site were TCE, TCA, 1,1-DCE and PCE. Contamination is limited to the upper aquifers and has not impacted the deeper aquifers. Groundwater is not currently used as a source of potable water within the area of the groundwater plume. The deeper aquifers are used as a supply of drinking water elsewhere in Santa Clara County.

Initial Response

Soil excavations between 1987 and 1992 removed contaminated soil. Metal-contaminated soil at the site was excavated to background. All soils containing semi-VOCs above 10 ppm were excavated. Soils containing residual VOCs at the site were remediated with a soil vapor extraction system.

Groundwater remediation on-site was initiated in 1982 for seven months. Extraction was restarted in 1987, expanded in 1988 and 1992-96, and has continued.

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 640 PMR 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 was prepared along with a Remedial Investigation/Feasibility Study (RI/FS). These documents formed the basis of the remedial action plan. The Remedial Action Objectives for the site, as specified in the 1994 Feasibility Study, are as follows:

- Prevent human exposure by ingestion of groundwater containing chemicals of concern (COCs) in excess of Maximum Contaminant Levels (MCLs).

- Prevent human exposure by ingestion of, inhalation of, or dermal contact with groundwater for all COCs such that carcinogenic risks do not exceed 10^{-4} to 10^{-6} in aggregate for all COCs and such that the non-carcinogenic hazard index is less than 1.0 for all COCs. The MCLs are acceptable levels for protection of human health. Cumulative risk due to multiple chemical exposure from ingestion and showering was estimated to assure that risks from the hypothetical domestic use of groundwater would pose risks within the above-listed acceptable risk ranges.
- Mitigate migration of groundwater that contains COCs at concentrations above MCLs.

The Regional Board adopted Final Site Cleanup Requirements (SCR) Order No. 94-130 in September 1994 and the U.S. EPA adopted a Record of Decision on March 24, 1995. The final site cleanup remedy selected in the SCR for the site consisted of the following elements:

- 1) Soil vapor extraction and treatment
- 2) Groundwater extraction and treatment
- 3) Discharge of treated water under NPDES permit
- 4) Groundwater extraction and discharge to the sanitary sewer under City of Palo Alto permit for certain downgradient wells
- 5) Deed restriction prohibiting the use of contaminated groundwater for any use.

The SCR sets cleanup standards for both soil and groundwater. The soil cleanup standard is 1.0 mg/kg for total VOCs and 25 mg/kg for acetone.

For groundwater, cleanup standards are federal or state MCLs, whichever is lower, except for acetone. For acetone, the cleanup standard is based on the U.S. EPA reference dose and a hypothetical maximum exposure rate. These cleanup levels are:

Chemical	Cleanup Standard (ppb)
Acetone	3,500
Benzene	1
1,1-Dichloroethane (1,1-DCA)	5
1,2-Dichloroethane	0.5
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
Methylene Chloride	5

Chemical	Cleanup Standard (ppb)
Tetrachloroethene (PCE)	5
1,1,1-Trichloroethane (1,1,1-TCA)	200
1,1,2-Trichloroethane	3
Trichloroethene (TCE)	5
1,2-Dichlorobenzene	600
Trichlorobenzene (1,2,4-TCB)	70

Remedy Implementation

Groundwater extraction and treatment (GWET) systems and a soil vapor extraction and treatment (SVET) system were in place at the time the final SCR was adopted in 1994.

Soil Vapor Extraction

Construction of the SVET system at the site was completed in April 1994 with full-time operation beginning on April 18, 1994. The SVET system includes a total of 28 soil vapor extraction (SVE) wells that, when installed, were screened in the unsaturated vadose zone: 10 SVE wells were screened in an upper coarse-grained unit, 13 were screened in a lower coarse-grained unit, and 5 were screened in an intermediate fine-grained unit located between the upper and lower. VOCs were removed from extracted vapors by vapor-phase granular activated carbon (GAC). An effectiveness evaluation conducted in 1995 concluded that the SVET system influent concentrations had decreased by approximately 99 percent and that remediation goals for VOCs and acetone had likely been achieved in the upper zone soil. Recommendations were made to operate the SVET system using only the lower zone wells; however, rising groundwater levels have resulted in the re-saturation of soil surrounding the lower zone SVET wells. The SVET has not been operated for any significant time since August 1997 due to saturated conditions surrounding the lower zone SVET wells. The SVET system removed 71 pounds of VOCs. Ongoing groundwater extraction in the area of the SVET system is being used to address the now-saturated lower zone soils.

Groundwater Extraction

The GWET has operated continuously during this five-year review period with the exception of periodic maintenance and repairs. Treated groundwater is discharged under an NPDES permit to a storm drain that ultimately discharges to Matadero Creek.

Institutional Controls

An institutional control, consisting of a covenant and environmental restriction on the property, was made as of May 28, 2003 by the Board of Trustees of the Leland Stanford Junior University, the property owner, pursuant to the SCR. The Covenant requires that “all uses and development of The Property shall be consistent with any then existing

operative Regional Board Order or Risk Management Plan.” The covenant requires that no owners or occupants of the property shall construct a well for the purpose of extracting contaminated water for any use, unless expressly permitted in writing by the Water Board. The covenant also requires that the owners or occupants of the property must notify the Water Board of (1) “any disturbance to any remedial measures taken or remedial equipment installed, and any groundwater monitoring system installed on The Property pursuant to the requirements of the Regional Board, of which it becomes aware, which could affect the ability of such remedial measures, remedial equipment, or monitoring system to perform their respective functions and (2) the type and date of repair of such disturbance, if known.”

Systems Operation/Operation & Maintenance

Groundwater extraction and treatment has been conducted continuously during the reporting period, except for periodic repair and maintenance. HP submitted quarterly NPDES reports and periodic self-monitoring reports (semi-annually in 1999, and annually thereafter).

V. Progress Since Last Review

The last 5-year review was completed in 2000, and concluded that the remedy selected for this site remained protective of human health and the environment. The report recommended evaluation of alternative approaches for completing remediation of deeper soils in the area of SVE wells that had become saturated.

Since the last 5-year review, VOC concentrations in the former source area continued to decline in the A1 zone and have generally remained stable in the A2 zone at relatively low levels (about 49 ppb TCE). VOC concentrations in the A1 and A2 Zones across most of the on-site portion of the plume have remained stable or have declined somewhat. VOC concentrations have increased in one localized onsite area, around well EW-7; this increase is attributed to groundwater from the source area being drawn into the existing extraction well. VOC concentrations in monitoring wells located offsite along the downgradient or perimeter edges of the plume have remained relatively stable at low levels (TCE concentrations below the 5 ppb cleanup standard), demonstrating that hydraulic control of the VOC plume has been achieved.

During the period from 2000 through 2004, 68.4 million gallons of groundwater were extracted from the onsite extraction wells, from which 561 pounds of VOCs were removed. Mass removal efficiency has declined in three of the four onsite extraction wells from an average of about 3.4 pounds of VOCs per million gallons of water extracted (lbs/MG) in 2000 to 2 lbs/MG in 2004. Mass removal efficiency of one onsite extraction well (EW-7), which appears to be capturing VOC mass from the former source area, has increased from about 18 lbs/MG in 2000 to 123 lbs/MG in 2004.

Operation of the SVET system likely has resulted in remediation goals for VOCs and acetone having been achieved in the upper zone soils. The SVET was not operated during the reporting period due to saturated conditions surrounding the lower zone SVET wells (these saturated conditions have persisted since 1997). The SVET system removed 71 pounds of VOCs before being taken out of service in August 1997. The SVET system was not operated during this reporting period because saturated conditions have persisted. Ongoing groundwater extraction in the area of the SVET system was used throughout the reporting period to address the now-saturated lower zone soils.

VI. Five-Year Review Process

Administrative Components

The Hewlett-Packard 620-640 Page Mill Rd Five-Year Review team was led by Derek Whitworth of the RWQCB and included Water Board staff with expertise in hydrogeology and risk assessment. Dana Barton and Penelope McDaniel of the U.S. EPA assisted in the review as the representatives for the support agency.

From June 1 to September 29, 2005, the review team established the review schedule whose components included:

- Community Involvement;
- Document Review;
- Data Review;
- Site Inspection; and
- Five-Year Review Report Development and Review.

Community Involvement

On August 6, 2005, a public notice was placed in the Palo Alto Daily News newspaper notifying the public that a five-year review was being conducted and comments can be directed to the RWQCB. No comments were received from the public. No interviews were planned or conducted.

Document Review

This five-year review consisted of a review of relevant documents including semi-annual and annual groundwater self monitoring reports, quarterly NPDES reports, and the document titled "Work Plan for Chemical Oxidation and Decommissioning of Groundwater Monitoring and Extraction Wells at the Former Mayfield School Site and Northeast end of the 640 Page Mill Road Site, Palo Alto, California" dated November 16, 2004.

Data Review

Groundwater

Groundwater monitoring data collected from 1999 through 2004 were reviewed to evaluate progress in remediating the groundwater pollutant plume. During this time, the GWET system has continued to be successful in removing VOC mass from saturated soils (including the lower portion of the SVET system, which has been saturated since 1997), in controlling migration of the plume, and reducing concentrations of VOCs in groundwater in most areas of the site.

Between 2000 and 2004, 68.4 million gallons of groundwater were extracted and treated by the on-site GWET system, resulting in the removal of 561 pounds of VOCs.

Remedial efforts have reduced VOC concentrations in the source area and across much of the plume. After over 20 years of groundwater extraction, the rate of VOC mass being removed from most of the extraction wells has stabilized or declined, and concentrations in groundwater may be stabilizing at levels significantly above the cleanup levels in these areas. TCE concentrations in groundwater near the source area are approximately 1,100 ppb.

Mass removal efficiency has declined in three of the four onsite extraction wells from an average of about 3.4 pounds of VOCs per million gallons of water extracted (lbs/MG) in 2000 to 2 lbs/MG in 2004. Mass removal efficiency of one onsite extraction well (EW-7), which appears to be capturing VOC mass from the former source area, has increased from about 18 lbs/MG in 2000 to 123 lbs/MG in 2004.

An initial significant reduction in VOC concentrations followed by a leveling off of the reduction in VOC concentrations has been found to occur at many other sites in the area and around the country. That VOC concentrations in groundwater remain significantly above cleanup objectives is probably due to the predominance of lenses of low permeability soils causing a low rate of desorption of the VOCs from the soil matrix to the groundwater.

A review of the monitoring well data shows that the groundwater pollutant plume is generally stable with concentrations decreasing in the source areas. Localized increased concentrations have been observed in monitoring wells in one on-site area as groundwater from the source area is drawn into an existing onsite extraction well (EW-7). At the perimeter of the plume, which is located offsite, downgradient of the site boundaries, there has been little change in the location of the VOC concentration contours. Wells just upgradient of the leading edge of the plume, have generally been declining since 1999 and range from around 160 ppb to below the 5 ppb cleanup standard for TCE. Contour maps completed in 2003 for the A1U, A1 and A2 zones and compared with contour maps completed in 1999 indicate that the plume has contracted to a limited extent. Contamination remains confined to the A zones and has not migrated vertically to the deeper B zone.

Vapor Intrusion

In 2003 and 2004, the Water Board considered the effect of groundwater contamination on the residential area around Sheridan Avenue, Grant Avenue and Birch Street based on the data from 2000, 2001 and 2003. The average TCE concentration in the groundwater beneath the residences was 16 ppb at a depth of 20 feet. Based on this concentration and the depth, the Water Board concluded that the concentrations of contaminants in the groundwater in the area are very low and would not be expected to cause indoor air contamination. The Water Board also noted that the residences in the area were for the most part apartment buildings with either ground level or underground parking areas beneath the first residential floor. The Water Board stated that the collection of ambient indoor and outdoor air samples was not warranted. (Water Board letter of March 5, 2004)

The VOC concentrations detected in groundwater samples collected on the 620-640 Page Mill Road site during the reporting period from the first saturated zone beneath the onsite building ranged between 82 ppb and 4,800 ppb (TCE). Depth to groundwater beneath the building ranges from about 15 to 25 feet below grade. These concentrations were below corresponding Water Board Environmental Screening Levels (ESLs) of 6,900 ppb for potential vapor intrusion concerns for commercial land use sites underlain by moderate-to low-permeability soils.

By-products

No potentially toxic or mobile transformation products have been identified during sampling that were not present at the time of the Record of Decision, and therefore cleanup standards specified in the Site Cleanup Requirements still apply.

Site Inspection

Water Board staff conducted a site inspection on July 19, 2005. No activities that could interfere with cleanup of the site were observed. The institutional controls that are in place include a prohibition on the installation of any wells at the site unless permitted by the Water Board. No activities were observed that would have violated the institutional controls.

VII. Technical Assessment

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

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, removing VOCs from groundwater, maintaining plume control, and reducing VOC concentrations in groundwater. The contamination is confined to the shallow aquifers and has not impacted the deeper zone that is a drinking water source. The current groundwater-monitoring program is sufficient to track the plume, as well as track the effectiveness of remedial actions.

The overall goal of the remedy, as described in the Feasibility Study, is to protect human health and the environment by restoring groundwater that the Water Board has classified as a potentially usable drinking water supply and protecting groundwater that does not contain VOCs from degradation. The goal as stated in the SCR is to restore groundwater to its beneficial uses.

The institutional controls in place include a prohibition on the installation of any wells at the site unless permitted by the Water Board. 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 640 PMR 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 Applicable or Relevant and Appropriate Requirements (ARARs) since selection of the Site remedy.

Changes in Site Conditions

The original HP 640 PMR building was demolished and site redevelopment with the construction of a new office building began in 1992. There have been no changes in on-site conditions since 1992.

The use of the downgradient area under which the groundwater plume has migrated remains predominately commercial, with smaller areas of residential development, essentially unchanged during the reporting period.

A soccer complex is being developed on the vacant land located at the northwest corner of Page Mill Road and El Camino Real and includes a portion of the 640 PMR site. Under a plan approved by the Water Board on February 14, 2005, extraction wells and associated piping and monitoring wells that would be under the soccer field will be removed. The groundwater extraction system will be replaced by an in situ chemical oxidation approach using potassium permanganate as the oxidizing agent. Before the development of the soccer field, injection points will be advanced into the groundwater zones with the highest levels of contamination. Permanganate will then be injected on a one-time basis in quantities calculated to significantly reduce the levels of contaminants. Both temporary and new permanent monitoring wells will be installed to measure the impact of the treatment on contaminant levels in the groundwater. The impact of the permanganate injection will be monitored over a 12 month period. Future actions will be considered after a 12-month performance report. Remedial actions to minimize migration of groundwater contaminants from the 640 PMR site to the soccer complex will continue.

Changes in Exposure Pathways

A baseline human health risk assessment for the site was prepared by U.S. EPA in September 1992. 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 evaluated four exposure pathways: (1) inhalation of VOCs in indoor air; (2) ingestion of ground water; (3) dermal contact with ground water while showering; and (4) inhalation of VOCs while showering. At the site and its downgradient area, groundwater is not used as a source of potable water or for domestic purposes. Current institutional controls have prevented installation of wells in the affected area. This has controlled the exposure pathways for ingestion of ground water; dermal contact with ground water while showering; and inhalation of VOCs while showering. Thus the only potentially complete pathway was the inhalation of VOCs from the groundwater in indoor air.

In September 2002, U.S. EPA'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. U.S. EPA considers many factors in determining whether there is a potential for vapor intrusion from groundwater contamination, including depth to groundwater, soil type and concentration of contaminant. A protective concentration in groundwater is very site specific but generally concentrations within twice the MCLs are usually considered protective.

The RWQCB uses Environmental Screening Levels (ESLs) to determine if contaminants in groundwater or soil pose a potential health threat by exposure through contact, ingestion or by vapor intrusion. Based on these screening numbers, the contaminants at this site would not pose a threat via vapor intrusion. The screening level for trichloroethylene in groundwater under residential property would be 360 ppb.

Given the TCE concentrations in groundwater (6 to 28 $\mu\text{g/L}$), the soil type and depth to groundwater (18 to 22 feet) in the downgradient plume underneath the residential area around Sheridan Avenue, Grant Avenue and Birch Street, it has been determined that there is an unlikely potential for groundwater contamination to impact indoor air.

VOC concentrations detected in water samples collected during the reporting period from the first saturated zone beneath the onsite building were below corresponding Water Board Environmental Screening Levels (ESLs) for potential vapor intrusion concerns for commercial land use sites underlain by moderate- to low-permeability soils.

Irrespective of the screening level numbers used by the State or by U.S. EPA, the current vapor intrusion pathway is incomplete due to the design and construction of the sole building on the property. However, in the future, if groundwater contamination levels do not decrease below screening levels, the vapor intrusion pathway should be re-evaluated in conjunction with future construction.

Changes in Toxicity Values

Since the Baseline Public Health Evaluation (BPHE) submitted by ICF Technology Incorporated in 1992, there have been a number of changes to the toxicity values for certain COCs at the Hewlett-Packard 640 PMR site. However, these changes have not affected the protectiveness of the remedy.

For carcinogenic effects, revisions to the toxicity values for 1,1-DCE indicate a reduced excess cancer risk associated with potential exposure to this compound than previously considered (oral and inhalation slope factors [SFs] were withdrawn). New SFs for benzene (oral), 1,1-DCA, and PCE (both oral and inhalation based on Cal-EPA values) may indicate higher excess cancer risk than previously considered.

For non-carcinogenic effects, revisions to the toxicity values for acetone, 1,1-DCE, and 1,1,1-TCA indicate a reduced hazard index (HI) from exposure to these chemicals than previously considered. New reference doses (RfDs) for benzene, 1,2-DCA, 1,2,4-trichlorobenzene, and TCE (oral only) may indicate an increased cumulative HI than previously considered.

In 2001, U.S. EPA released a draft toxicity evaluation for TCE following the current cancer guidelines and incorporating current data and physiological/biochemical understanding. This review concluded TCE was "highly likely to produce cancer in humans." With this determination, a range of cancer slope factors were developed, some of which would result in more stringent cleanup levels than the current MCL. This toxicity evaluation is under review by several external scientific panels. This issue will need to be updated in subsequent 5 year reviews.

The following on-line references are available for more information regarding the TCE toxicity issue:

Draft 2001 ORD TCE Health Risk Assessment:
<http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=23249>

Science Advisory Board's review of the 2001 draft TCE Health Risk Assessment:
<http://www.epa.gov/sab/pdf/ehc03002.pdf>

TCE toxicity reassessment updates:
<http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=119268>

Changes in Remedial Action Objectives

The Final Remedial Action Plan for the 640 PMR site approved by the Water Board and U.S. EPA in 1994 (Site Cleanup Requirements, Order No. 94-130) focused on reducing both levels of contaminants in groundwater and the concentration of contaminants in the soil source area. The goal is to restore groundwater to its beneficial uses. No change to the remedial action objective is required.

Changes in ARARs and Cleanup Standards

Groundwater cleanup standards contained in the SCR were reviewed. The California MCL for 1,2,4-Trichlorobenzene was changed from 70 ug/l to 5 ug/l on June 12, 2003. There have been no other changes in the cleanup standards contained in the SCR.

With the exception of groundwater cleanup standards, ARARs have been met in accordance with the Final Site Cleanup Requirements. There have been no changes in ARARs that would affect operations or the protectiveness of the remedy.

The Water Board has developed risk-based Environmental Screening Levels (ESLs) for a variety of exposure routes including vapor intrusion into buildings from underlying groundwater contamination. The current levels of VOCs in groundwater beneath the onsite building are below the ESLs.

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

At the time of this review there is no information available that would question the effectiveness of the remedy.

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.

VIII. Issues

- Declining VOC removal efficiency in most of the groundwater extraction wells.
- An effectiveness evaluation conducted in 1995 concluded that the SVET system influent concentrations had decreased by approximately 99 percent and that remediation goals for VOCs and acetone had likely been achieved in the upper zone soil. Rising groundwater levels have resulted in the re-saturation of soil surrounding the lower zone SVET wells. The SVET has not been operated for any significant time since August 1997 due to saturated conditions surrounding the lower zone SVET wells. Ongoing groundwater extraction in the area of the SVET system is being used to address the now-saturated soils that the lower zone wells of the SVET system were designed to treat. The design of the existing building on the site should be adequate to maintain long-term protectiveness with respect to vapor intrusion until clean-up levels are achieved.

IX. Recommendations and Follow-up Actions

- HP plans to assess whether in-situ remedial technologies would be a practical alternative to accelerate the remediation process, especially in areas where the VOC removal efficiency of the GWET system has significantly declined.
- HP will continue to operate the GWET system and monitor groundwater quality.

These actions are likely to occur within the next five years.

Issue	Recommendation	Responsible Party	Oversight Agency	Date	Affects Protectiveness
Declining VOC removal efficiency in most of the extraction wells.	Hewlett Packard plans to assess whether in-situ remedial technologies would be a practical alternative to accelerate the remediation process, especially in onsite areas where the VOC removal efficiency of the GWET system has significantly declined.	Hewlett Packard	RWQCB	2010	Short-term: No Long-term: No
Rising groundwater levels have re-saturated soils that the lower zone wells of the SVET system were designed to treat.	HP will continue to operate the GWET system and monitor groundwater quality.	Hewlett Packard	RWQCB	2010	Short-term: No Long-term: No

X. Protectiveness Statement

The remedy is expected to be protective of human health and the environment upon attainment of groundwater cleanup goals. In the interim, exposure pathways that could result in unacceptable risks are being controlled and institutional controls are preventing exposure to, or the ingestion of, contaminated groundwater. The vapor intrusion pathway is not complete at the site due to the design of the on-site building, and is unlikely at the downgradient residential area due to low contamination levels found in the groundwater and other factors.

XI. Next Review

The next five-year review for the 640 PMR site is required by September 2010. The responsible party should submit its next Five-Year Summary Report to RWQCB by June 30, 2010.