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EPA Superfund
Record of Decision:

NATIONAL SEMICONDUCTOR CORP. and MONOLITHIC MEMORIES
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SUNNYVALE, CA
09/11/1991

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Monolithic Memories (Advanced Micro Devices - Arques) (National Semiconductor), CA
First Remedial Action

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16. Abstract (Limit: 200 words)

The Monolithic Memories (MM) site is a former semiconductor manufacturing facility located in Sunnyvale and Santa Clara, California. Land surrounding the site is used for commercial and light industrial purposes. The site lies within the confined area of the Santa Clara Valley ground water basin, which consists of various upper and lower aquifer zones. Ground water from this basin provides up to 50 percent of the municipal drinking water for Santa Clara Valley residents. Remediation of the MM site has been combined with another National Priorities List (NPL) site, National Semiconductor (NSC), because both sites contribute to the same ground water contamination problem. The combined remediation has been divided into two Operable Units (Ous). This Record of Decision addresses OU1, which consists of three subunits. Subunit 1 includes the 60-acre NSC facility, which contains more than 20 buildings used for administrative offices, laboratories, and semiconductor manufacturing; and the 10-acre United Technology Corporation facility, which was used to develop and test rocket propellants. Subunit 2 includes the MM facility, currently owned by Advanced Micro Devices, and consists of buildings used for office space and semiconductor production facilities. Subunit 3 consists of the areas

(See Attached Page)

17. Document Analysis a. Descriptions

Record of Decision - Monolithic Memories (Advanced Micro Devices - Arques)
(National Semiconductor Corp.), CA
First Remedial Action
Contaminated Medium: soil, gw
Key Contaminants: VOCs (benzene, PCE, TCE, toluene, xylenes), other organics (PAHs, Phenols)

b. Identifiers/Open0Ended Terms

c. COSATI Field/Group

18. Availability Statement	19. Security Class (This Report) None	21. No. of Pages 50
	20. Security Class (This Page) None	22. Price

EPA/ROD/RO9-91/070
Monolithic Memories (Advanced Micro Devices - Arques)
(National Semiconductor Corp.), CA
First Remedial Action

Abstract (Continued)

downgradient from Subunits 1 and 2 and extends to the leading edge of the contaminant plume. Semiconductor manufacturing activities took place onsite at NSC beginning in 1967, and at MM in 1970, and continued until 1989. Virgin solvents and acids used in semiconductor manufacturing processes were stored in above-ground tanks and storage drums. Waste solvents were stored in underground and above-ground tanks, and acid wastes were treated in underground and above-ground tanks or underground neutralization sumps. In 1982, NSC and MM conducted preliminary assessments of soil and ground water near underground storage tanks and sumps, in response to a state-initiated storage tank leak detection program. As a result, both NSC and MM removed tanks, sumps, and soil from areas containing elevated concentrations of solvents. In addition, in 1984 and 1986, NSC installed offsite and onsite ground water extraction systems, and MM installed onsite extraction systems in 1986 and 1988. This Record of Decision (ROD) addresses remediation of contaminated soil on the facility property and ground water in the upper aquifer zone as OU1. OU2 will address remaining soil and ground water problems associated with the western portion of the ground water contaminant plume. The primary contaminants of concern affecting the soil and ground water are VOCs including benzene, PCE, TCE, toluene, and xylenes; and other organics including PAHs and phenols.

The selected remedial action for this site includes treating contaminated soil in Subunits 1 and 2 onsite using soil vapor extraction, with carbon adsorption to control emissions, if required; excavating and surface aeration of contaminated soil, if necessary; pumping and onsite treatment of contaminated ground water by expanding the existing extraction system and adding an ozone oxidation treatment system to the current air stripper treatment systems; controlling air emissions from the air strippers using carbon treatment, if necessary; discharging the treated ground water onsite to storm sewers; monitoring ground water; and implementing institutional controls including deed restrictions. The estimated present worth cost for this remedial action is $8,400,000, which includes a 30-year operation period. O&M costs were not provided.

PERFORMANCE STANDARDS OR GOALS: Chemical-specific clean-up goals for soil and ground water are based on the more stringent of State MCLs, Federal MCLs, non-zero MCLGs, and site-specific standards based on an HI < 1 and a calculated cancer risk of 10^{-6} to 10^{-4}. Chemical-specific goals for soil include total VOCs 1 mg/kg (site-specific) and PAHs 10 mg/kg (site-specific). Chemical-specific goals for ground water include benzene 1 ug/l (State), phenol 5 ug/l (State), PCE 5 ug/l (State), TCE 5 ug/l (State), and xylenes 175 ug/l (site-specific).

RECORD OF DECISION

JOINT SUPERFUND SITES
NATIONAL SEMICONDUCTOR AND
ADVANCED MICRO DEVICES - ARQUES (FORMERLY MONOLITHIC MEMORIES)

OPERABLE UNIT 1

SUNNYVALE AND SANTA CLARA, CALIFORNIA

SEPTEMBER, 1991

U.S. ENVIRONMENTAL PROTECTION AGENCY

REGION 9

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PART I. DECLARATION

1.0 SITE NAME AND LOCATION

National Semiconductor Corporation
2900 Semiconductor Drive
Santa Clara, California

Advanced Micro Devices - Arques (Formerly Monolithic Memories)
1165 and 1175 Arques Avenue
Sunnyvale, California

2.0 STATEMENT OF BASIS AND PURPOSE

This Record of Decision ("ROD") presents the selected remedial action for the National Semiconductor and Advanced Micro Devices - Arques Superfund sites, Operable Unit 1, in Sunnyvale and Santa Clara, California. This document was developed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), 42 U.S.C. Section 9601 et. seq., and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan, 40 C.F.R. Section 300 et. seq., ("NCP"). The attached administrative record index (Attachment B) identifies the documents upon which the selection of the remedial action is based. The State of California concurs with the selected remedy.

3.0 ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances from these sites, if not addressed by implementing the response action selected in this ROD, may present an imminent and substantial endangerment to public health, welfare, or the environment.

4.0 DESCRIPTION OF THE REMEDY

The entire area of groundwater contamination associated with these and other non-NPL sites (the Study Area) has been divided into two operable units. Operable Unit 1 represents the areas that have been thoroughly investigated, and for which enough information exists to select a final remedy. See section 1.2 of the attached Decision Summary for a complete site description. An RI/FS is underway for Operable Unit 2, and it will address the soil and groundwater problems associated with the western portion of the plume.

The selected final remedy for the National Semiconductor and Advanced Micro Devices-Arques sites (Operable Unit 1) includes the following elements:

- **Groundwater extraction,** to control further migration

of site chemicals in the contaminated aquifers and reduce chemical concentrations until cleanup standards have been achieved.

- **Treatment** of extracted groundwater with **air stripping or ozone oxidation** under Bay Area Air Quality Management District (BAAQMD) permit or pursuant to OSWER Directive 9355.0-28.

- Discharge of extracted and treated groundwater to storm sewers under National Pollutant Discharge Elimination System (NPDES) permits.

- **Soil Vapor Extraction** (SVE) will be employed where vadose zone soils present a potential continuing source of contamination to groundwater or where shallow soils represent a health risk due to direct contact. Shallow soils at the AMD site are contaminated with semi-volatile compounds and may require removal if they do not respond to SVE. SVE will be conducted under a BAAQMD permit.

- **Institutional Controls** prohibiting the use of the A and B aquifer groundwater and for controlling activities that could endanger the public health or the environment.

In order to implement this final remedy for Operable Unit 1, the currently operating extraction system will be expanded, and an ozone oxidation treatment system will be added to the current air stripper treatment systems. The air strippers and SVE will include air emissions control (carbon treatment) if emissions exceed levels currently permitted by the BAAQMD or requirements of QSWER Directive 9355.0-28. NPDES discharges will go to storm sewers which empty into the Calabazas Creek. Approximately 160 gallons per minute (gpm) will be treated by air stripping and approximately 80 gpm will be treated with ozone oxidation.

Vadose and shallow soil contamination at these sites will be addressed by SVE. Contingent upon the inability of SVE to address low volatility compounds, some excavation and surface aeration of contaminated soils will be performed. If it is determined that this additional effort is necessary, a permit from the BAAQMD, must be obtained.

5.0 STATUTORY DETERMINATIONS

The selected remedy is protective of human health and the environment. Contaminated groundwater and soils will be restored to health protective levels once cleanup standards have been achieved, and until that occurs, direct contact exposure to contaminated media will be prevented with institutional controls. The selected response actions comply with Federal and State requirements, that are legally applicable, or relevant and

appropriate; primarily the drinking water standards (Federal and State MCLs), Bay Area Air Quality Management District permit requirements for air emissions, and the National Pollutant Discharge Elimination System requirements for discharge of treated effluent.

These remedial actions address the principal risks at the National Semiconductor and Advanced Micro Devices - Arques sites (Operable Unit 1) by removing and treating the contamination in soils (primarily soil vapor extraction), and by removing and treating contaminants in ground water (extraction with air stripper and ozone oxidation treatment), thereby significantly reducing the toxicity, mobility or volume of hazardous substances in both media through treatment. Using soil vapor extraction and ozone oxidation treatment utilizes permanent solutions and alternative treatment technology to the maximum extent practicable and satisfies the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element. An evaluation of ihe alternatives considered shows the selected remedy to be a cost effective response.

Because the remedy may require 30 to 100 years to achieve cleanup standards, a five-year review, pursuant to CERCLA Section 121, 42 U.S.C. Section 9621, will be conducted at least once every five years after initiation of the remedial action to ensure that the ongoing remedial action continues to provide adequate protection of human health and the environment.

John Wise

John Wise
Deputy Regional Administrator

9-11-91

Date

PART II. DECISION SUMMARY

This Decision Summary provides an overview of the problems posed by the National Semiconductor and Advanced Micro Devices - Arques Superfund sites (Operable Unit 1). It also includes a description of the remedial alternatives considered, and the analysis of those alternatives against Federal criteria. This Decision Summary explains the rationale for the remedy selection and how the selected remedy satisfies the statutory requirements of CERCLA.

1.0 SITE NAMES, LOCATIONS, AND DESCRIPTIONS

1.1 SITE NAMES AND LOCATIONS

National Semiconductor Corporation
2900 Semiconductor Drive
Santa Clara, California

Advanced Micro Devices - Arques (Formerly Monolithic Memories)
1165 and 1175 Arques Avenue
Sunnyvale, California

1.2 SITE DESCRIPTIONS

The two sites, although listed separately on the National Priority List (NPL), contribute to the same groundwater problem, and for this reason, the investigation and evaluation of cleanup options has been combined.

The study area comprising the two Operable Units (see Figure 1, page 11) contains numerous sources of soil and groundwater contamination in western Santa Clara and eastern Sunnyvale. Figure 1 shows the lack of definition of the western extent of groundwater contamination. An RI/FS is underway for Operable Unit 2 and it will address the soil and groundwater problems associated with this area of the plume.

Operable Unit 1 has been divided into three subunits for ease of description, and to more efficiently address the unique aspects of remediation particular to each subunit. Figure 1 shows the extent of the plume in the study area and the areas that comprise the three subunits of Operable Unit 1. The following text describes each subunit.

Subunit One

The National Semiconductor (NSC) facility at 2900 Semiconductor Drive in Santa Clara occupies approximately 60 acres and contains over 20 buildings used for administrative offices, laboratories, and semiconductor manufacturing. The NSC site also includes the

former United Technologies Corporation (UTC) facility which adds another ten acres to the site and is located approximately 200 feet northwest of the NSC facility. (NSC assumed responsibility for cleanup of the UTC facility in 1987) These areas, and the area downgradient of the NSC facility boundary to Arques Avenue, have been designated as Subunit 1.

The NSC facility property is bounded by the Central Expressway on the north, the Lawrence Expressway on the east, Kifer Road on the south, and by a property line about 1000 feet east of Commercial Avenue on the west. NSC has manufactured semiconductors at this facility since 1967. Virgin solvents and acids used in semiconductor manufacturing processes were, or are, stored in aboveground tanks and storage drums. Waste solvents have been stored in underground and aboveground tanks; acid wastes have been

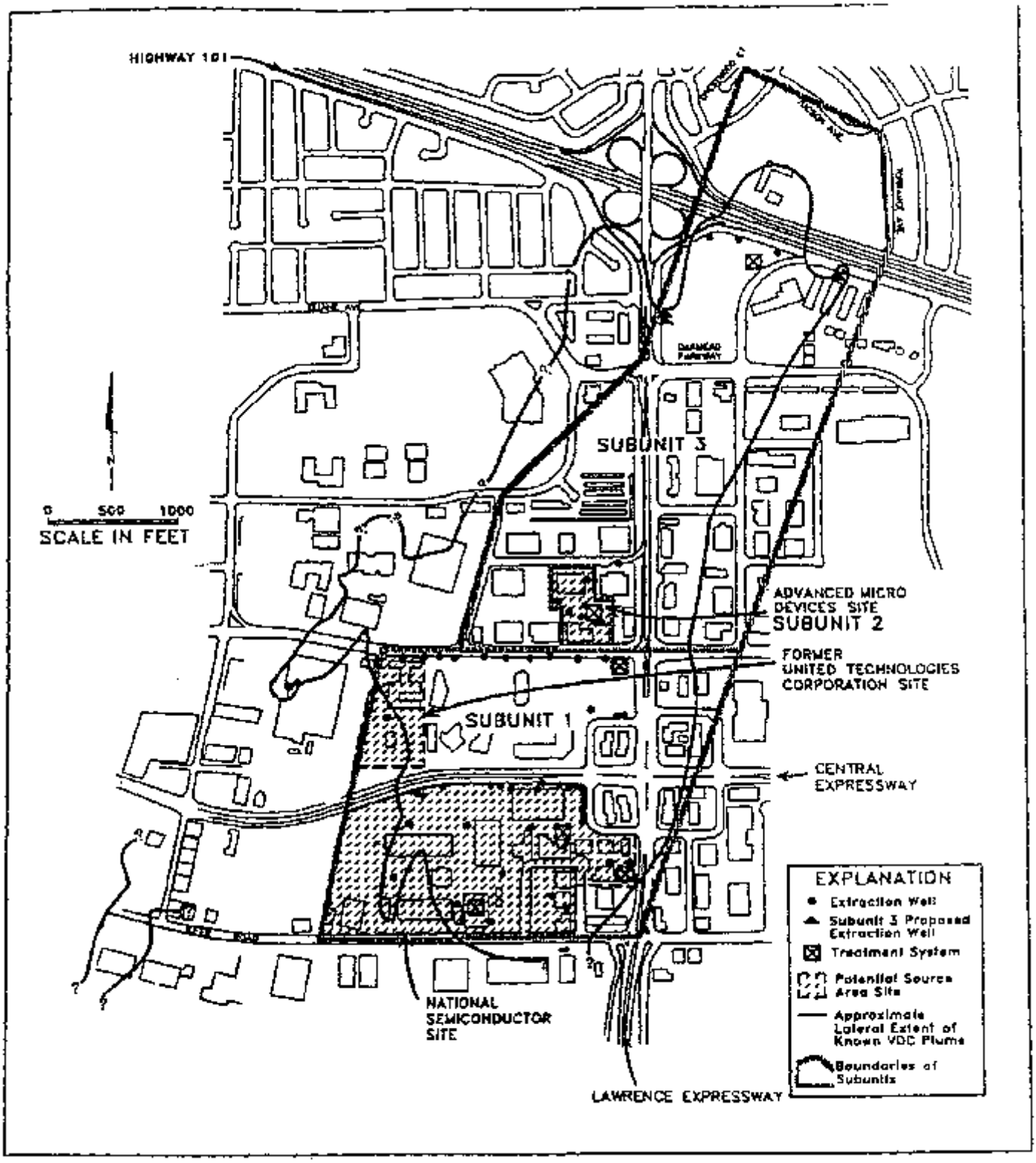


FIGURE 1. Subunits 1, 2, and 3 of operable Unit 1 for the Advanced Micro-devices-Arques and National Semiconductor Superfund Sites. Also shown is the approximate lateral extent of the known VOC plume, Operable Unit 1 extraction well and treatment locations.

treated in underground and aboveground tanks or underground neutralization sumps.

The former UTC facility, which is part of Subunit 1 and is northwest of the NSC property, is bounded by the Central Expressway on the south, Arques Avenue on the north, the Hewlett Packard (HP) property on the west, and the O'Donnell Brigham property to the east. The former UTC facility, which consisted of two buildings, was used for research, development, and small-scale testing of rocket propellants from 1960 to 1982. HP bought the property from UTC in 1982, and removed the UTC buildings and auxiliary facilities. HP subsequently constructed a park, conference facility, and parking facilities at that location.

Subunit 2

The Advanced Micro Devices (AMD-Arques) facilities, which have been designated as Subunit 2, consist of Buildings 1 and 2 on Arques Avenue, and Building 3 at 1160 Kern Avenue. The AMD property is bounded by Kern Avenue on the north, Arques Avenue on the south, and is approximately 200 feet west of the Lawrence Expressway. Semiconductor manufacturing operations were begun at the facility by Monolithic Memories (MMI) in 1970. AMD acquired MMI and their property in 1987 and assumed responsibility for continuing the soil and groundwater investigations and remediation program for the AMD facility. Buildings 1 and 2 were used as off ice space and semiconductor production facilities. Building 3 was originally constructed for Amdahl Corporation in 1972 and used to assemble computer components. MMI leased Building 3 in 1974 and remodeled it to hold offices and circuit-assembly laboratories. Semiconductor production ceased in 1989 and Buildings 1 and 2 have been unoccupied since then. Building 3 is currently used as a facility office.

Subunit 3

Subunit 3 consists of the areas downgradient from Subunits 1 and 2, and extends to the leading edge of the contaminant plume, which is approximately 1400 feet north of Highway 101.

1.3 REGIONAL TOPOGRAPHY

The study area is located in the Santa Clara Valley which is a gently sloping alluvial plain, flanked by the Diablo Range to the east-southeast and the Santa Cruz Mountains to the west- southwest. The study area is located toward the center of the valley. The Santa Cruz Mountains are located several miles southwest of the Study Area. San Francisco Bay is located approximately 6 miles north of the study area.

1.4 ADJACENT LAND USE

The study area is an industrial park setting, dominated by low rise industrial buildings common in the electronics industry of Santa Clara County. Mixed commercial and light industrial use is common in the, areas immediately surrounding the industrial park area. Residential property lies at the northern edge of the study area; some south of Highway 101 and west of Lawrence Expressway, and some north of Highway 101 and east of the Lawrence Expressway.

1.5 HYDROGEOLOGY

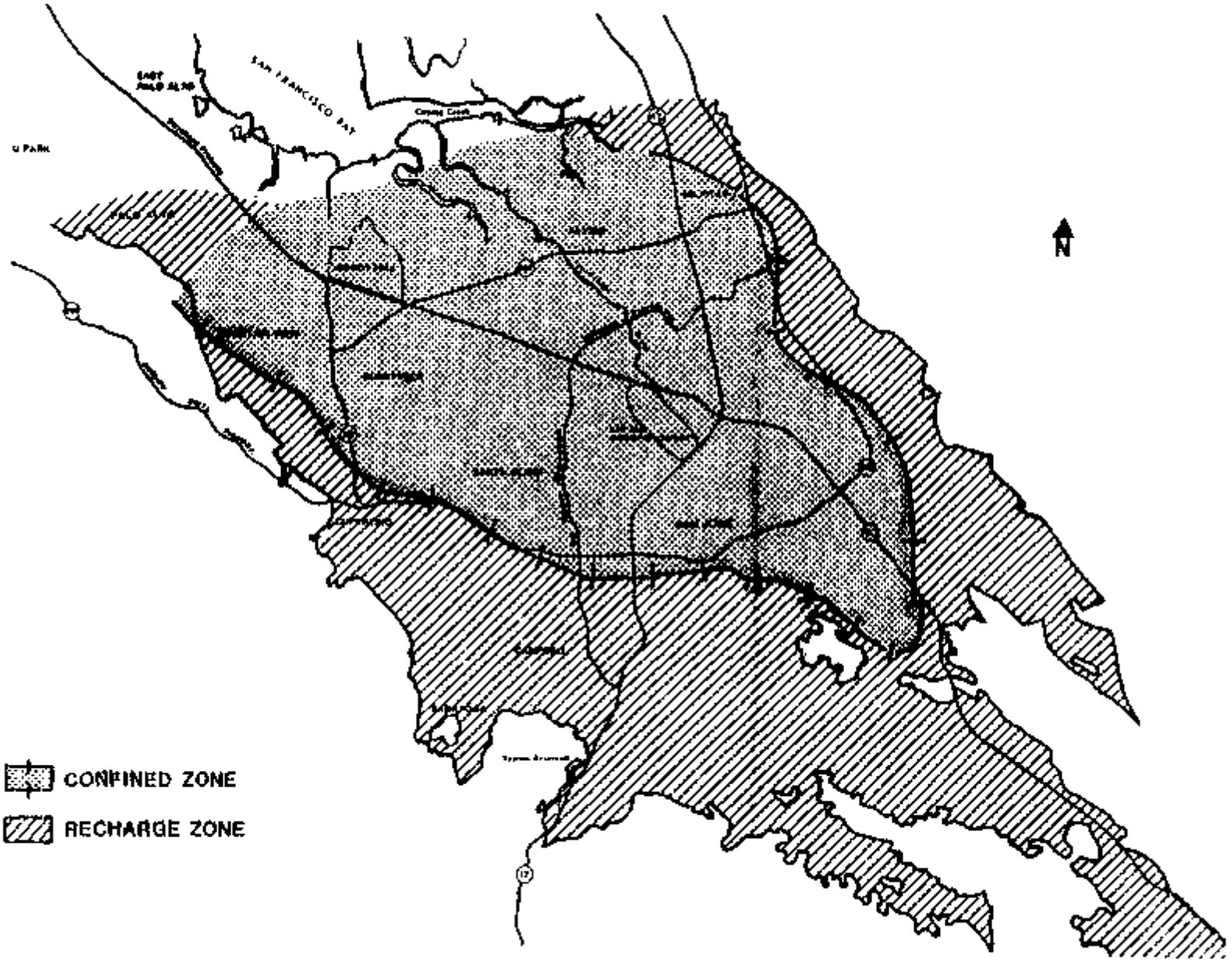
Regional - The study area is located in the Santa Clara Valley (see figure 2, page 14) which extends southeast of San Francisco Bay and is bounded by the Diablo Range on the northeast, and by the Santa Cruz and Gabilan Ranges on the southwest. The Santa Clara Valley is a large structural depression in the central Coastal Ranges of California. The valley is filled with alluvial and fluvial deposits from the adjacent mountain ranges. These deposits are up to 1500 feet in thickness. At the base of the adjacent mountains, gently sloping alluvial fans of the basin tributaries laterally merge to form an alluvial apron extending into the interior of the basin.

The Santa Clara Valley ground water basin is divided into two broad areas: (1) the recharge zone or forebay, and (2) the confined area, where the study area is located. The forebay occurs along the elevated edges of the basin where the basin receives its principal recharge. The confined area is located in the flatter interior portion of the basin and is stratified or divided in individual beds separated by significant aquitards. The confined area is divided into the upper and lower aquifer zones. The division is formed by an extensive regional aquitard that occurs at depths ranging from about 100 feet, near the confined area's southern boundary, to about 150 to 250 feet in the center of the confined area and beneath San Francisco Bay. Thickness of this regional aquitard varies from about 20 feet to over 100 feet.

Local - Stratigraphy in the local study area is characterized by interbedded and interfingering sands, silts and clays. These soils were deposited in complex patterns by fluvial alluvial systems draining the uplands to the south; sediments were deposited as the streams flowed north toward the Bay.

The nomenclature applied to the water-bearing zones in the study area is representative of the hydrogeology within the Santa Clara Groundwater Basin. A number of shallow water-bearing zones are separated from deeper zones by the thick persistent regional aquitard. The shallow zones may be subdivided into a variety of zones depending upon depth, lithology and lateral persistence. These zones are frequently labeled as A and B aquifer zones or A

FIGURE 2



SANTA CLARA VALLEY

HYDROGEOLOGIC FEATURES

and B aquifers. The deeper aquifer is commonly referred to as the C aquifer and the clay layer separating the upper and lower water-bearing aquifers is commonly referred to as the B-C aquitard. Within the study area the shallowest water-bearing aquifer has been identified as the A aquifer. The deeper water-bearing aquifer within the study area has been subdivided into three water-bearing aquifers, B1 through B3, based on the depths at which major sand units are encountered. The A aquifer occurs between five and 25 feet below ground surface (bgs). The B1 aquifer is encountered between 30 and 45 feet bgs, the B2 between 50 and 65 bgs, and the B3 aquifer between 70 and 90 feet bgs. The groundwater gradient in all identified aquifer zones is in a north-northeast direction.

1.6 WATER USE

Groundwater from this basin provides up to 50% of the municipal drinking water for the 1.4 million residents of the Santa Clara Valley. In 1989, groundwater accounted for approximately 128,000 of the 315,000 acre feet of drinking water delivered to Santa Clara Valley Water District customers. Municipal water supply wells are generally perforated in the lower aquifer zone.

Both the National Semiconductor and AMD-Arques sites were listed on the National Priorities List (NPL) primarily because of the potential threat from chemical releases to the quality of this valuable resource. The major concern associated with these sites stems from the potential migration of contaminants in the upper aquifer zones down to the lower aquifer zone through abandoned or poorly sealed wells or natural conduits through aquitard material.

Vertical Conduit Studies - Studies to determine the locations and status of potential vertical conduit wells in the study area were conducted 1986, 1987, and 1989. As a result of the 1986 and 1987 studies, a total of 113 public and private wells that do, or did, exist in a geographical area, which includes the entire study area, were identified. Of the 113 identified wells, the vast majority exist outside the area of groundwater contamination, are relatively shallow (less than 100 feet deep) and do not penetrate the deep aquifers, or documentation exists showing proper construction or decommissioning.

The 1989 study, conducted by NSC, revealed that 22 of the identified wells are considered potential vertical conduits. Of these 22 identified wells, property owner or third party contacts were completed for 11 of the wells; however, none of these contacts yielded information about the existence or locations of wells. A field program was performed to identify the locations of any buried well casings. A visual reconnaissance identified that only 11 of the 22 wells appeared to be located in areas within the extent of the groundwater plume and accessible for geophysical surveys. A surface geophysical survey was performed to assess the existence and locations of the 11 wells. Only one surface anomaly was

detected and a downhole geophysical survey was conducted to verify whether the anomaly was indicative of a well casing. The measured data from this survey indicated that the magnetic anomaly appeared to be from a shallow metallic object and not a metallic well casing. As such, it appears that vertical conduit wells cannot be identified as a problem in the study area.

Non-Conduit Deep Wells - Two deep water production wells exist within the plume area: Well CWW 20-02 and the Hilton Well. The City of Santa Clara owns and operates water production well CWW 20-02, located near the intersection of Semiconductor Drive and Tahoe Way, on the NSC facility. During the work week (Monday through Friday), the well supplies water to NSC's deionized water system; however, ten to twenty percent of the water produced by the well goes to the City of Santa Clara and is used to supplement the City water supply. According to the City of Santa Clara, water from Well CWW 20-02 is blended with water from 20 other wells in the distribution system.

Well CWW 20-02 was installed in October 1980. The well extends from ground surface to a depth of 660 feet and is screened in eight places across aquifers that range in depth from 265 to 639 feet. The well has a sanitary seal that extends from ground surface to a depth of 110 feet. The City of Santa Clara performs monthly analyses on Well CWW 20-02. Cis-1,2 DCE has been detected at concentrations ranging from 0.5 to 0.7 parts per billion (ppb) from May 1986 through June 1989. This chemical was also detected in November and December of 1989 at 0.5 ppb, and has been detected in September 1990 and October 1990 at 0.7 and 0.5, respectively.

A second deep production well, the Hilton Well, is owned by the Oakmead Lake Industrial Properties company and was installed on March 24, 1976. The well is located in Subunit 3 at the Sunnyvale Hilton Inn on Lakeside Drive, near Highway 101. The well is operated infrequently and serves to provide water to an artificial lake adjacent to the Hilton Inn. The well is 260 feet deep and is screened across aquifers between 115 and 260 feet deep, with a sanitary seal from ground surface to a depth of 50 feet. The well was sampled annually from February 1982 to May 1989 and has since been sampled quarterly. In 1985, ethylbenzene, xylenes, and PCE were detected at concentrations of 10, 14, and 7 ppb, respectively. In 1987 and 1988, cis-1,2-DCE was detected at concentrations of 8.5 and 4.9 ppb, respectively, and in May and July 1990, Freon 113 and cis-1,2-DCE were detected at concentrations ranging from 0.8 to 1 ppb. No volatile organic compounds (VOCs) have been detected since then.

The Regional Water Quality Control Board (RWQCB) Basin Plan identifies potential beneficial uses of the shallow ground water underlying and adjacent to the NSC and AMD-Arques Sites. These beneficial uses include industrial process water supply, industrial service water supply, municipal and domestic water supply and

agricultural water supply. These are the same as the existing and potential beneficial uses of the ground water in the Lower Aquifer Zone.

2.0 SITE HISTORY AND ENFORCEMENT ACTIVITIES

2.1 REGULATORY AND ENFORCEMENT HISTORY

State Regulation of Sites - Contamination was discovered at the National Semiconductor (NSC) and Advanced Micro Devices - Arques (AMD-Arques) sites in 1982. Investigation and source control measures were implemented early on by the Companies under California Regional Water Quality Control Board (Region Two) direction. State orders regulating Potentially Responsible Party (PRP) activities at the sites were issued or amended in August 1986, September 1986, February 1988, and April 1989. National Pollutant Discharge Elimination System (NPDES) permits were issued by the RWQCB in March 1987 (NSC's treatment system) and in February 1990 (AMD's treatment system). These permits set treatment standards for the effluent discharges from the groundwater extraction and treatment systems that have been installed to control migration of chemicals in the subsurface.

Listing History and Ongoing Federal Partnership With State - Both sites were proposed to the National Priority List (NPL) on October 15, 1984, and both sites were listed July 22, 1987. The Regional Water Quality Control Board (RWQCB) has remained the lead agency for oversight of PRP work at these sites. These sites are two of approximately twenty NPL sites in the Santa Clara Valley that are regulated under. RWQCB-lead pursuant to the South Bay Multi-Site Cooperative Agreement with EPA (EPA Assistance Agreement: #V009403), which was established in October 1985. Under this agreement EPA and the RWQCB have implemented a major cooperative effort involving the affected industries, local governments, and state regulatory agencies in multiple PRP investigations and cleanups at South Bay NPL sites.

Identification of Potentially Responsible Parties - Pursuant to the California Health and Safety Code Sections 25356.1(c) and (d), the State currently identifies the following Potentially Responsible Parties (PRPs) associated with the release of contaminants to the subsurface at Operable Unit 1: NSC, AMD-Arques, HP (Hewlett Packard), and UTC (United Technologies Corporation). Other potentially responsible parties may be identified by the State in the future. EPA has not performed a PRP search for these sites.

Agreements Among Potentially Responsible Parties - NSC reports that on September 14, 1987, NSC and UTC executed an agreement whereby NSC assumed soil and groundwater cleanup responsibility for the former UTC facility.

2.2 HISTORY OF SITE INVESTIGATIONS

Subunit 1 - In early 1982, the RWQCB initiated a leak detection program to define the extent of leakage from underground storage tanks and pipes in the South Bay area. In response to the RWQCB's leak detection program, NSC initiated a preliminary assessment of soil and groundwater near its facility's underground solvent storage tanks and acid neutralization sumps. After the preliminary assessment was completed, NSC removed some of the tanks and sumps and soil from some of the areas having elevated concentrations of solvents. Additional tanks and sumps have been removed at the facility since that time.

Soil sampling programs at the NSC facility began in 1982 and have been conducted as recently as December 1990 under RWQCB oversight, to identify source areas for soil and ground water contamination. In 1984 NSC installed an offsite extraction and treatment system to control migration of site chemicals. Then in 1986 NSC installed another extraction and treatment system approximately 1200 feet downgradient of the NSC facility for additional control of chemical migration in the subsurface. Treatment of extracted groundwater consisted of air stripping under BAAQMD permit. This 1986 effort was regulated under RWQCB orders and includes wells located on the former UTC facility.

At the former UTC facility, which is part of Subunit 1, UTC used several outdoor areas for chemical drum storage and/or rocket propellant testing. In addition, three underground flow-through acid neutralization sumps were used. Investigations have been performed between 1982 and 1986 under RWQCB direction on former UTC property to identify potential source areas. In 1990 further soil investigation identified the former locations of one acid neutralization sump abd two chemical storage areas which remain source areas.

Subunit 2 - Monolithic Memories (subsequently AMD-Arques) also responded to the 1982 South Bay leak detection program. They initiated subsurface investigations at their facility in 1982 because of suspected leakage from several underground chemical solvent storage tanks and chemical handling areas used for onsite storage and/or treatment of waste solvents. Monolithic Memories (MMI) subsequently removed soil from some of the areas having elevated concentrations of solvents as well as some of the sumps and tanks.

In 1986, AMD installed an onsite A aquifer groundwater extraction and treatment system to control contaminant migration in the subsurface. In 1988 AMD expanded the onsite extraction and treatment system to include groundwater extracted from the deeper B aquifer in order to further control contaminant transport. The treatment of extracted groundwater consists of air stripping under BAAQMD permit.

soil sampling programs at AMD-Arques began in 1982 and have been conducted as recently as November 1989, under RWQCB oversight, to identify source areas for soil and groundwater contamination.

Subunit 3 - Subunit 3 does not contain any facilities that are known sources of the solvent groundwater plume that emanates from Subunits 1 and 2. Historically, NSC has taken responsibility for the investigation of the extent of the commingled plume in Subunit 3. The investigation effort in this downgradient portion of the contaminated area has been an ongoing part of the investigations begun by NSC in 1982.

Besides the NSC, AMD-Arques, and former UTC facilities, there are other facilities in the area that may have contributed to the groundwater pollution in Subunit 3 (see Figure 1). Operable Unit 2, with investigations currently underway, will address this aspect of the study area contamination.

3.0 COMMUNITY RELATIONS

A community relations program has been ongoing for all Santa Clara Valley Superfund sites, including National Semiconductor and the AMD-Arques sites. The RWQCB published a notice in the Mercury News on June 12, 1991, announcing the Proposed Plan and the opportunity for public comment at the Board Hearing of June 19, 1991 in Oakland. The notice also announced the opportunity for public comment at an evening public meeting held at the Fairwood Elementary School in Sunnyvale on June 27, 1991. A presentation of the proposed final cleanup plan was made at both meetings. A 30-day comment period was announced that would run from June 19, to July 19, 1991. As a result of a request from a member of the public, the comment period was extended until August 19, 1991 to allow more time for public review.

Proposed Plan Fact Sheets were mailed in June (prior to the public comment period) and hand-delivered to interested residents, local government officials, and media representatives. The Proposed Plan Fact Sheet described the site problems, the cleanup alternatives that were evaluated, and explained the reasons for selecting the proposed remedy. The Fact Sheet also announced the opportunity for public comment at the Board Hearing in Oakland on June 19, 1991 and at the Public Meeting in Sunnyvale on June 27, 1991. In addition, this fact sheet described the availability of further information at the Information Repository.

A Responsiveness Summary was prepared to address significant comments received during the public comment period and appears in Part III of this ROD. A future fact sheet will explain the Final Cleanup and Abatement Order adopted by the RWQCB.

4.0 SCOPE AND ROLE OF THE RESPONSE ACTION

4.1 SCOPE OF THE RESPONSE ACTION

The remedy selected and described in this ROD incorporates existing groundwater extraction systems which have served to control contaminant migration, and will expand the system to meet the cleanup objectives for a final remedy. An evaluation of sump, tank, and contaminated soil removal activities following discovery shows that these early source control measures helped to prevent migration of contaminants and that they are consistent with the objectives of the final selected remedy.

Current Ongoing Groundwater Extraction - The NSC groundwater extraction system is comprised of 45 A and B aquifer extraction wells in Subunit 1. However, some of these wells are dry because of water level declines. As of January 1991, 29 A and B aquifer extraction wells were pumping water to the three NSC treatment systems (air strippers) at a total rate of 115 gpm.

At AMD there are seven A aquifer extraction wells that were constructed in 1986, and three B aquifer wells that were constructed in 1988, which now are pumping groundwater to AMD's treatment system (air stripper) in Subunit 2 at a total rate of 45 gpm.

In Subunit 3 NSC has installed three extraction wells along Lakeside Drive, near Highway 101. These wells are not operating at this time, but will deliver 80 gpm, or extracted groundwater to the ozone oxidation treatment system that is part of this selected remedy.

All current groundwater extraction activities have been implemented under RWQCB authority with the goal of controlling further contaminant migration while ongoing site investigations continued to collect the data necessary for final remedy selection.

4.2 SELECTED RESPONSE ACTION

The selected final remedy for the National Semiconductor and Advanced Micro Devices - Arques Operable Unit 1 includes the following elements:

- **Groundwater extraction,** to control further migration of site chemicals in the aquifers and reduce chemical concentrations until cleanup standards have been achieved.

- Treatment of extracted groundwater with **air stripping or ozone oxidation** under Bay Area Air Quality Management District BAAQMD permit or pursuant to OSWER Directive 9355.0-28.

- **Discharge** of extracted and treated groundwater to storm sewers under National Pollutant Discharge Elimination System (NPDES) permits, with some treated groundwater **recycled** as facility process water.

- **Soil Vapor Extraction** (SVE) will be employed where vadose zone soils present a potential continuing source of contamination to groundwater or where shallow soils represent a health risk due to direct contact. Shallow soils at the AND facility are contaminated with semi-volatile compounds and may require removal if they do not respond to SVE. SVE will be conducted pursuant to a BAAQMD permit.

- **Institutional Controls** prohibiting the use of the A and B aquifer groundwater and for controlling activities that could endanger the public health or the environment.

In order to implement this final remedy for operable Unit 1, the currently operating extraction system will be expanded, and an ozone oxidation treatment system will be added to the current air stripper treatment systems. The air strippers and SVE will include air emissions control (carbon treatment) if emissions exceed levels currently permitted by the BAAQMD or if required by QSWER Directive 9355.0-28. NPDES discharges will go to storm sewers which empty into the Calabazas Creek.

Vadose and shallow soil contamination at these sites will be addressed by SVE. Contingent upon the inability of SVE to address low volitility compounds, some excavation and surface aeration of contaminated soils will be performed. If it is determined that this additional effort is necessary, a permit from the BAAQMD must be obtained.

4.3 ROLE OF THE RESPONSE ACTION

The selected remedy for Operable Unit 1 addresses VOC (Volatile Organic Compounds) contaminated groundwater in the Upper Aquifer Zone and contaminated soils (mainly VOCs) on facility properties. The primary concerns are:

- further lateral migration of the contaminant plume into previously uncontaminated area of a potential drinking water supply;

- potential vertical migration of contaminated ground water into the Lower Aquifer Zone that serves as a current source of drinking water;

- direct contact with contaminated soil;

- and an ongoing chemical source from contaminated soils to

groundwater.

The objective of the selected remedy is to remove and permanently destroy the contaminants from both soils and groundwater or to significantly reduce the toxicity, mobility or volume of hazardous substances in both media. Contaminated groundwater at the site represents the primary risk at the site, and the remedy is intended to return groundwater to its beneficial uses within a reasonable period of time. Soil contamination at the site represents a continuing source of groundwater contamination and represents the principal threat at the site. This principal threat will be addressed by the remedy. These response actions will greatly reduce the possibility of contamination of current and potential water supplies.

5.0 SUMMARY OF SITE CHARACTERISTICS

5.1 SOIL AND GROUNDWATER

As previously described in Section 1.2, of the Declaration, Operable Unit 1 has been subdivided into three subunits as shown in Figure 1 on page 11:

- Subunit 1 consists of the National Semiconductor Corporation (NSC) facility at 2900 Semiconductor Drive, Santa Clara and the former United Technologies Corporation (UTC) facility at 1050 Arques Avenue, Sunnyvale, and all downgradient areas to Arques Avenue.

- Subunit 2 consists of the Advanced Micro Devices - Arques (AMD-Arques) facility, formerly Monolithic Memories, at 1165 and 1175 Arques Avenue, Sunnyvale.

- Subunit 3 consists of the downgradient area from Subunits 1 and 2 to the extent of the plume and Operable Unit 1, approximately 1400 feet north of Highway 101.

The following sections on soil and groundwater highlight the sources of contamination, the soil areas targeted for cleanup, and the characterization of the aquifer contamination in the three subunits of Operable Unit 1.

Soils - Soil contamination in Operable Unit 1 has been attributed to chemical releases from storage areas; leaks from sumps, pipelines, and tanks; and chemical handling practices. Potential source areas investigated have included a variety of acid waste sumps and solvent tanks, leaks in chemical piping, and chemical storage areas.

At the NSC facility (Subunit 1), investigations have identified 11 source areas that are included in the selected remedy for cleanup. The principal organic chemicals detected in the soil at the NSC

facility follow. The maximum historical values cited are orders of magnitude higher than present conditions.

PCE	9,600 ppb	1,1,1-TCA	150,000 ppb	TCE	850 ppb
1,2-DCE	930 ppb	xylenes	3,300 ppm	ethylbenzene	18,000 ppm

At the former UTC facility (Subunit 1) one acid neutralization sump and two chemical storage areas have been identified as potential sources of soil and groundwater contamination. These areas have been included in the plans for cleanup also. The principal organic chemicals detected in the soil at the former UTC facility follow:

1,1,1-TCA	1.9 ppm	TCE	4.6 ppm

At the AMD-Arques facility (Subunit 2), three source areas that are included for cleanup in the final plans have been identified. The principal organic chemicals detected in the soil at the AMD facility are solvents at a total concentration up to 400 ppm.

PCE	TCE	1,2-DCE
xylenes	chlorobenzene	

In addition to the solvents, aromatic chemicals (PNAs) such as naphthalene, pyrene, and phenol have been identified at the AMD site up to 270 ppm. These PNAs are thought to have been imported with fill material during past construction activities at the site. They are detected in soils between two and five feet below surface.

Groundwater - Groundwater contamination in Operable Unit 1 is believed to have been the result of chemical transport through shallow and vadose zone soils from the various points of release, or source areas, outlined in the previous section. The State of California has determined that the contaminated aquifers are a potential drinking water supply. The chemicals found in Operable Unit 1 include halogenated and aromatic VOCs. Each subunit varies with respect to the particular subset of these chemicals identified. The approximate lateral extent of the Volatile Organic Compound (VOC) plume is shown in Figure 1 on page 11.

In Subunit 1, the following indicator chemicals are identified for tracking the VOC plume:

- cis-1,2-DCE
- 1,1,1-TCA
- TCE
- Freon 113

They are used as indicators for the VOC plume because they are detected in a large number of wells, have elevated concentrations, and are also found in wells downgradient of Subunit 1. These four indicator chemicals are, or have been, present in the A, B1, and B2 aquifers. Aromatic VOCs are present in the A and B1 aquifers in

Subunit 1 and immediately downgradient. Phenols are present in a few A aquifer wells in Subunit 1. Analytical data indicate that organic chemicals are not present in the B3 aquifer.

The highest current levels of groundwater pollution in Subunit 1 are listed below:

TCE	4200 ppb
1,2-DCE	6800 ppb
Freon 113	2000 ppb
ethylbenzene	9900 ppb
xylenes	11,000 ppb

Currently the groundwater pollution in Subunit 1 extends to a depth of up to 65 feet.

In Subunit 2, the following indicator chemicals are used for tracking the VOC plume:

PCE
TCE
cis-1,2-DCE
chlorobenzene
xylenes

These chemicals are used as indicators for the VOC plume because they are detected in a large number of wells at elevated concentrations. TCE and cis-1,2-DCE (also indicators for Subunit 1) are present in the A, B1 and B2 aquifers in Subunit 2 and downgradient in Subunit 3.

The highest current levels of groundwater pollution in Subunit 2 are listed below:

TCE	950 ppb
1,2-DCE	1100 ppb

Currently, the groundwater contamination in Subunit 2 extends to depths of up to 65 feet.

The same indicators used for Subunit 1 are used for Subunit 3 (cis-1,2-DCE, 1,1,1-TCA, TCE and Freon 113). These chemicals are detected in a large number of wells at elevated concentrations. Analytical data indicate that organic chemicals are not present in the B2 or B3 aquifer in Subunit 3. The four indicator chemicals are, or have been, present in the A and B1 aquifers.

The highest current levels of groundwater pollution in Subunit 3 are reported as follows:

TCE	510 ppb
1,2-DCE	1200 ppb

Currently, the lateral and vertical extent of groundwater contamination in subunit 3 is approximately 1400 feet north of Highway 101 and 45 feet below ground surface.

5.2. AIR

Volatilization of groundwater contaminants and migration through the vadose zone and into residential spaces was modeled as a part of the Baseline Public Health Evaluation. The modeling predicted an average 1 in 10 million and a maximum 1 in 1 million cancer risk from this exposure pathway. Although the models do not predict that the volatilization pathway poses any risk to the community, soil gas sampling was performed in order to validate the model predictions. There are several other VOC contaminated groundwater Superfund sites in the Santa Clara Valley where the same concerns have been raised by community members and are being addressed similarly with collection of empirical data for model validation. This pathway will be reevaluated as part of the five year review.

The sampling for this site showed the model to be conservative in its assumptions; no detectable levels of contamination were found.

Emissions from the air strippers that are currently used as part of the interim remedial action are regulated under a permit issued by the BAAQMD.

6.0 SUMMARY OF SITE RISKS

6.1 HUMAN HEALTH RISKS

Two Baseline Public Health Evaluations (BPHE) have been conducted for Operable Unit 1. One of them addresses Subunits 1 and 3, and the other addresses Subunit 2. Both of these BPHEs have undergone EPA review and approval.

Risks were characterized in each of the BPHEs for pathways involving soil, groundwater and air. As described in the National Contingency Plan, the EPA acceptable cancer risk range is 1×10^{-4} to 1×10^{-6} for exposure to known or suspected carcinogens at concentration levels that represent an excess upper bound lifetime cancer risk to an individual. For noncarcinogenic effects, the Hazard Index (HI) provides a useful reference point for gauging the potential significance of multiple contaminant exposures within a single medium or across media. EPA considers an HI of 1.0 or less to be acceptable. A summary of each BPHE follows in the next sections.

A summary of the carcinogenic and non-carcinogenic risks for the three subunits can be found in Tables 3 through 5.

Subunits 1 and 3: BPHE Summary - The RWQCB BPHE for Subunits 1 and 3 identified, the following "chemicals of concern": 23 organic

compounds for groundwater, 14 organic compounds and 6 metals for soil, and 18 organic compounds for air. Further evaluation of the soil data in the FS has resulted in the elimination of all the metals as "chemicals of concern" because detected concentrations fell within ranges that are considered background.

The "chemicals of concern" for soil and groundwater in Subunit 1 are listed in Table 1, and include the following compounds:

benzene	vinyl chloride
chloroform	1,4-dichlorobenzene
1,1-DCA	PCE
TCE	pentachlorophenol
1,1-DCE	chloromethane
1,2-DCE	1,1,1-TCA
Freon 113	1,2-Dichlorobenzene
xylenes	ethylbenzene

All of these chemicals are potentially toxic above certain concentrations. Benzene and vinyl chloride are categorized as known human carcinogens (EPA class A). Chloroform, 1,4-dichlorobenzene, 1,1-DCA, PCE, TCE, and pentachlorophenol are considered to be potential or probable human carcinogens (EPA class B1 and B2).

The BPHE developed current and future exposure scenarios. The only identified potential for a current complete exposure pathway was indoor exposure to vapors migrating from the contaminated groundwater in Subunit 3. This pathway was evaluated for residents at the northern edge of the study area. These cancer risks and health hazard assessments are based on estimates of the indoor air concentrations of the chemicals of concern as predicted by mathematical models. The predicted carcinogenic risk to residents is estimated to be approximately one in ten million for the average case and one in one million for the plausible maximum case. These risks fall within the acceptable range of carcinogenic risk delineated in EPA regulation. The model does not predict any noncarcinogenic toxic effects from this exposure. Actual data collected to support the model conclusions showed that no detectable volatilization from groundwater to the surface is occurring.

For the reasonable maximum exposure scenario, it was assumed that Subunits 1 and 3 would be developed in the future for residential use and that the groundwater in the A and B aquifers would be used for domestic purposes. According to the BPHE, potential future exposure routes in Subunit 3 might include ingestion of groundwater containing the "chemicals of concern" (2 liters per day for 75 inhalation of VOC vapors from groundwater during showering or other domestic uses, and inhalation of VOC vapors originating from the groundwater.

Table 1

CHEMICALS AND MEDIA OF CONCERN

Subunits 1 and 3, Operable Unit 1
Santa Clara and Sunnyvale, Santa Clara County

Chemical Name	Groundwater	Soil	Air
Acetone		x	x
Benzene	x	x	x
Chloroform	x		x
Chloromethane	x		x
4-Chloro-3-Methylphenol	x		
1,2-Dichlorobenzene	x		x
1,4-Dichlorobenzene	x		x
1,1-Dichloroethane	x	x	x
1,1-Dichloroethene	x	x	x
cis-1,2-Dichloroethene	x	x	x
trans-1,2-Dichloroethene	x		x
2,4-Dimethylphenol	x		
2,4-Dinitrophenol	x		
Ethylbenzene	x	x	x
Freon 113	x	x	x
2-Methyl-4,6-Dinitrophenol	x		
4-Nitrophenol	x		
Pentachlorophenol	x		
Phenol	x	x	x
Tetrachloroethene	x	x	x
Toluene		x	
Trichlorobenzene		x	
1,1,1-Trichloroethane	x	x	x
Trichloroethene	x	x	x
Vinyl Chloride	x		x
Xylenes (total)	x	x	x

Source: California Regional Water Quality Control Board, San Francisco Bay Region Site Cleanup Requirements For National Semiconductor Corporation and Advanced Micro Devices, Subunit 1, Operable Unit 1.

Table 2

CHEMICALS AND MEDIA OF CONCERN

Subunits 1 and 3, Operable Unit 1
Santa Clara and Sunnyvale, Santa Clara County

Chemical Name	Groundwater	Soil
Chlorobenzene	x	x
1,2-DCA	x	
1,2-DCB	x	x
1,1-DCE	x	
1,2-DCE	x	x
Ethyl Benzene	x	x
Freon 113	x	
PCE	x	x
TCA	x	x
TCE	x	
Toluene	x	x
Vinyl Chloride	x	
Xylenes	x	x
Polynuclear Aromatic Hydrocarbons (PNAs)		x

Source: California Regional Water Quality Control Board, San Francisco Bay Region Site Cleanup Requirements For Advanced Micro Devices and National Semiconductor Corporation, Subunit 2, Operable Unit 1.

TABLE 3
SUMMARY OF POTENTIAL HEALTH RISKS
NATIONAL SEMICONDUCTOR CORPORATION SITE

Scenario	Potential Upperbound Excess Lifetime Cancer Risks		Hazard Index	
	Average	Plausible Maximum	Average	Plausible Maximum
CURRENT-USE SCENARIOS				
Inhalation of VOCs migrating from off-site groundwater into residences:				
- - north of 101	3×10^{-7}	5×10^{-6}	<1	<1
- - south of 101	4×10^{-7}	3×10^{-6}	<1	<1
FUTURE-USE SCENARIOS				
Ingestion of groundwater - - Aquifer A	2×10^{-3} (1×10^{-3})[a]	9.6×10^{-1} (1×10^{-1})[a]	>1	>1
Inhalation of VOCs - - in groundwater Aquifer A	5×10^{-4} (4×10^{-4})[a]	4×10^{-1} (1×10^{-1})[a]	<1	>1
Ingestion of groundwater - - Aquifer B	3×10^{-5}	1×10^{-3}	<1	>1
Inhalation of VOCs - - from groundwater Aquifer B	4×10^{-5}	2×10^{-3}	<1	<1
Inhalation of chemicals migrating from on-site groundwater into residences	7×10^{-5} (4×10^{-5})[a]	x 10^{-4} (2×10^{-4})[a]	<1	<1
Inhalation of VOCs migrating from off-site groundwater into residences	8×10^{-5} (8×10^{-5})[a]	4×10^{-3} (4×10^{-3})[a]	<1	<1

[a] Total potential upperbound cancer risks omitting vinyl chloride possible outlier value.

TABLE 4

(Agency Addendum for Advanced Micro Devices' RI & FS Reports, Page 8 of 10)

CARCINOGENIC RISKS ASSOCIATED WITH PROPOSED GROUND WATER CLEANUP STANDARDS

Advanced Micro Devices and National Semiconductor Corporation

Subunit 2, Operable Unit 1

Sunnyvale and Santa Clara, Santa Clara County

CHEMICAL	CLEANUP STANDARD[(1)] [mg/l]	CHRONIC DAILY INTAKE (CDI)[(2)] [mg/kg/day]	ORAL CANCER POTENCY FACTOR (CPF_*) [$(mg/kg/day)^{-1}$]	INHALATION CANCER POTENCY FACTOR (CPF_*) [$(mg/kg/day)^{-1}$]	INGESTION RISK ($CDI*CPF_*$)	INHALATION RISK ($CDI*CPF_*$)	TOTAL CARCI-NOGENIC RISK
1,1-Dichloroethane	5	5.71E-05	0.091	----	5.2E-06	----	5.2E-06
Tetrachloroethene	5	5.71E-05	0.051	0.0033	2.9E-06	1.9E-07	3.1E-06
Trichloroethene	5	5.71E-05	0.011	0.017	6.3E-07	9.7E-07	1.6E-06
Vinyl chloride	0.5	5.71E-06	1.90	0.295	1.1E-05	1.7E-06	1.3E-05
TOTAL RISKS	----	----	----	----	2.0E-05	2.9E-06	2.3E-05

(1) All cleanup standards are set at federal or California MCLs, whichever are lower.

(2) CDI = (cleanup standard [mg/l] ingestion rate [l/day] * exposure duration [yrsl * exposure frequency [days/yr]) / (body wght [kg] * avging time [days])
CDI = (cleanup standard [mg/l] * 2 * 30 * 365) / (70 * 27,375)

TABLE 5

(Agency Addendum for Advanced Micro Devices' RI & FS Reports, Page 9 of 10)

NON-CARCINOGENIC RISKS ASSOCIATED WITH PROPOSED GROUND WATER CLEANUP STANDARDS

Advanced Micro Devices and National Semiconductor Corporation

Subunit 2, Operable Unit 1

Sunnyvale and Santa Clara, Santa Clara County

CHEMICAL	CLEANUP STANDARD[1] [mg/l]	CHRONIC DAILY INTAKE (CDI)[3] [mg/kg/day]	ORAL REFERENCE DOSE (RfD_*) [mg/kg/day]	INHALATION REFERENCE DOSE (RfD_*) [mg/kg/day]	INGESTION HAZARD (CDI/RfD_*)	INHALATION HAZARD (CDI/RfD_*)	TOTAL HAZARD QUOTIENT
Chlorobenzene	30	8.58E-04	0.02	----	0.429	----	0.429
1,2-Dichloroebenzene	60[2]	1.71E-03	0.09	0.04	0.019	0.043	0.062
1,1-Dichloroethane	5	1.43E-04	0.10	0.10	0.014	0.001	0.015
1,1-Dichloroethene	6	1.71E-04	0.0009[4]	----	0.190	----	0.190
cis-1,2-Dichloroethene	6	1.71E-04	0.01	----	0.017	----	0.017
trans-1,2-Dichloroethene	10	2.86E-04	0.02	----	0.014	----	0.014
Ethylbenzene	68[2]	1.94E-03	0.10	0.286	0.019	0.007	0.026
Freon 113	1200	3.43E-02	30	7.70	0.001	0.004	0.005
Tetrachloroethene	5	1.43E-04	0.01	----	0.014	----	0.014
1,1,1-Trichloroethane	200	5.71E-03	0.09	0.30	0.063	0.019	0.082
Trichloroethene	5	1.43E-04	0.0074	----	0.019	----	0.019
Xylenes (total)	175[2]	5.00E-03	2.00	0.087	0.003	0.057	0.060
TOTAL HAZARD INDEX	----	----	----	----	0.802	0.131	0.933

[1] All cleanup standards are set at federal or California MCLs, whichever are lower, except for those noted with a superscript 2 [2].

[2] Cleanup standards are set at one-tenth the federal or California MCLs, whichever are lower.

[3] CDI = (cleanup standard [mg/l] * ingestion rate [l/day] * exposure duration [yrs] * exposure frequency [days/yr]) / (body wght [kg] * avging time [days])

CDI = (cleanup standard [mg/l] * 2 * 30 * 365) / (70 * 10,950)

[4] This value is one-tenth the oral reference dose for 1,1-Dichloroethene ($RfD_*/10 = 0.009/10 = 0.0009$)

The calculated total risk for Subunits 1 and 3 is 2.6 x 10^{-3} carcinogenic risk (exceeding EPA's acceptable risk range) and a noncarcinogenic hazard index exceeding 1 (indicating the potential for adverse health effects to occur). The rationale underlying the decision to take action to clean up Subunits 1 and 3 is based on the potential human health risks that Subunits 1 and 3 pose.

Subunit 2: BPHE - The BPHE conducted for Subunit 2 (the AMD facility) identified the following "chemicals of concern": 13 organic compounds for groundwater, and 24 organic compounds (eight VOCs and sixteen polynuclear aromatics or PNAs) and four metals for soil. These were identified based on toxicity and frequency of detection for soil and groundwater data. Further evaluation of the soil data in the FS has resulted in the elimination of all the metals as "chemicals of concern" because detected concentrations are within the range that is considered background for this area.

The "chemicals of concern" for soil and groundwater in Subunit 2 are listed in Table 2, and include vinyl chloride, 1,1-DCA, PCE, TCE, 1,1-DCE, 1,2-DCE, 1,1,1-TCA, Freon 113, 1,2-Dichlorobenzene, xylenes, ethylbenzene, chlorobenzene, and toluene. All of these chemicals are potentially toxic above certain concentrations. Vinyl chloride is categorized as a known human carcinogen (EPA class A). 1,1-DCA, PCE, and TCE are considered to be potential or probable human carcinogens (EPA class B1 and B2).

The BPHE did not identify any current potential for completed exposure pathways in Subunit 2. For the hypothetical future exposure scenarios, it was assumed that the AMD facility would be developed for residential use and that the groundwater in the A and B aquifers would be used for domestic purposes. According to the BPHE, potential future exposure routes at the AMD facility may include ingestion of groundwater containing the chemicals of concern, inhalation of VOC vapors from groundwater during showering or other domestic uses, and inhalation of VOC vapors volatilizing from the groundwater.

The calculated total risk for Subunit 2, is 4.0 X 10^{-3} carcinogenic risk (exceeding EPA's acceptable risk range) and a noncarcinogenic hazard index equal to nine (indicating the potential for adverse health effects to occur). The rationale underlying the decision to take action to clean up Subunit 2 is based on the potential risks that Subunit 2 poses.

6.2 ENVIRONMENTAL RISKS

Wildlife that may be present in the vicinity of the site includes raccoons, gophers, ground squirrels, rats, field mice, and a variety of birds, including burrowing owls. The State of California Department of Fish and Game has listed the burrowing owl as a "species of special concern." The burrowing owl's primary

habitat is grassland and open prairie. Neither of these habitats exist in the immediate area.

Two endangered species are reported to use South San Francisco Bay. The California clapper rail and the salt marsh harvest mouse are reported to exist in the tidal marshes of the Bay and Bay shore, located approximately 5 miles north of the NSC and AMD-Arques sites. The endangered California brown pelican is occasionally seen in the Bay Area, but does not nest in the South Bay. Ranges of the endangered American peregrine falcon and southern bald eagle include the Bay Area. The southern bald eagle does not use bay and bayshore habitats, but the peregrine falcon has started to make a comeback at some northern locations in San Francisco Bay.

The AMD-Arques and National Semiconductor sites do not constitute critical habitat for endangered species nor do they include or affect any "wetlands." Because the facilities are covered with pavement or structures, direct-contact exposures to contaminants of concern in soil on these sites by wildlife are unlikely. Impacts to wildlife are expected to be minimal.

6.3 CONCLUSION

If not addressed by implementing the response action selected in this ROD, the actual or threatened releases of hazardous substances from the Advanced Micro Devices - Arques and National Semiconductor Superfund sites may present an imminent and substantial endangerment to the public health, welfare, or environment. Given that a variety of the contaminants detected at the site pose significant health risks as carcinogens or as noncarcinogens and that complete exposure pathways are possible under future use scenarios, EPA has determined that remediation is warranted.

7.0 DESCRIPTION AND CONSIDERATION OF ALTERNATIVES

7.1 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS) FOR ALTERNATIVES CONSIDERED AT AMD-ARQUES AND NSC

The following sections detail the ARARs which are referenced as part of the Alternative descriptions in Section 7.2 below. The key ARARs for this site are the drinking water standards, the State anti-degradation policy, regulations governing volatile air emissions from treatment operations, and Federal regulations governing disposal of hazardous wastes. The groundwater and soil cleanup standards that have been set as protective for Operable Unit 1 of the AMD-Arques and NSC sites are presented in Table 3 on page 38.

Section 1412 of the Safe Drinking Water Act, 42 U.S.C. Section 300g-1

Under Section 1412 of the Safe Drinking Water Act, EPA is required to set Maximum Contaminant Level Goals (MCLGs) for ground and surface water. Under CERCLA, MCLGs that are set at levels above zero shall be attained by remedial actions for ground or surface water that are current or potential sources of drinking water, where the MCLGs are relevant and appropriate under the circumstances of the release based on the factors in §300.400 (g)(2).

The appropriate remedial goal for each indicator chemical in ground water is the MCLG (if not equal to zero), the federal MCL, or the State MCL, whichever is most stringent.

California Department of Health Services Drinking Water Action Levels (DWALs)

California Department of Health Services (DHS) DWALs are health-based concentration limits set by the DHS to limit public exposure to substances not yet regulated by promulgated standards. They are advisory standards that apply at the tap for public water supplies. ARARs with more stringent requirements take precedence over these DWALs. Phenol and 2,4-dimethylphenol are the only compounds present in Operable Unit 1 for which a DWAL will be applied. These compounds have no current federal or state promulgated standards.

California's Resolution 68-16

California's "Statement of Policy With Respect to Maintaining High Quality of Waters in California," Resolution 68-16, has been determined by EPA to be an ARAR. The policy requires maintenance of existing water quality unless it is demonstrated that a change will benefit the people of the State, will not unreasonably affect present or potential uses, and will not result in water quality less than that prescribed by other State policies.

For Operable Unit 1 at the AMD-Arques and NSC sites, the affected aquifers have been classified as potential sources of drinking water. Generally, EPA has considered that anti-degradation policies, such as Resolution 68-16, require prevention of further degradation of beneficial use of the groundwater, during and at completion of the response action. In this case, Resolution 68-16 would require control of the plume to prevent further degradation of uncontaminated areas in the aquifer, and cleanup to drinking water standards before remediation could be considered complete.

National Pollutant Discharge Elimination System (NPDES)

NPDES substantive permit requirements and/or RWQCB Waste Discharge Requirements (WDRs) are potential ARARs for effluent discharges.

The effluent limitations and monitoring requirements of an NPDES permit or WDRs legally apply to point source discharges such as those from a treatment system with an outfall to surface water or storm drains. The RWQCB established effluent discharge limitations and permit requirements are based on Water Quality Standards set forth in the San Francisco Bay Regional Basin Plan.

There will be five treatment systems with discharges to storm drains at the AMD-Arques and NSC sites they will be regulated under NPDES permits.

EPA Office of Solid Waste and Emergency Response (OSWER) Directive 9355.0-28

OSWER Directive 9355.0-28 "Control of Air Emissions from Superfund Groundwater Air Strippers at Superfund Groundwater Sites" applies to future remedial decisions at Superfund sites in ozone non-attainment areas. "Future remedial decisions" include Records of Decisions (RODs), Significant Differences to a ROD and Consent Decrees. AMD-Arques and NSC are in an ozone non-attainment area. This directive requires such sites to control total volatile organic compound emissions from air strippers and soil vapor extractors to fifteen pounds per day per facility. This directive is not an ARAR, but is a TBC. ARARs with more stringent requirements take precedence over the directive.

Bay Area Air Quality Management District (BAAQMD) Regulation 8, Rule 47

Bay Area Air Quality Management District Board of Directors adopted Regulation 8, Rule 47. This rule is entitled "Air Stripping and Soil Vapor Extraction Operations" and applies to new and modified operations. The rule consists of two standards:

- **N** Individual air stripping and soil vapor extraction operations emitting benzene, vinyl chloride, perchloroethylene, methylene chloride and/or trichloroethylene are required to control emissions by at least ninety percent by weight. Operations emitting less than one pound per day of these compounds are exempt from this requirement if they pass a District risk screen.

- **"** Individual air stripping and soil vapor extraction operations emitting greater than fifteen pounds per day of organic compounds other than those listed above are required to control emissions by at least ninety percent by weight.

Regulation 8, Rule 47 is an ARAR for the implementation of the remedy at the AMD-Arques and NSC sites, which will both employ air stripping and soil vapor extraction technologies.

Bay Area Air Quality Management District (BAAQMD) Regulation 8, Rule 40

Bay Area Air Quality Management District Board of Directors adopted Regulation 8, Rule 40. This rule is entitled "Aeration of Contaminated Soil and Removal of Underground Storage Tanks." Since surface aeration of contaminated soils is considered in one of the AMD-Arques site cleanup alternatives as a contingency measure pending the unsuccessful operation of Soil Vapor Extraction in certain shallow soils that are contaminated with lower volatility compounds, this ARAR may potentially apply if the contingency is implemented. This regulation would limit the emission of organic compounds from soil.

Resource Conservation Recovery Act (RCRA) Land Disposal Restrictions.

The contaminants in groundwater and soil at the AMD-Arques and NSC sites include spent solvents that are RCRA listed wastes. Adsorbents and other materials used for remediation of groundwater VOCs, such as activated carbon, chemical-adsorbing resins, or other materials used in the treatment of ground water or air will contain the chemicals after use. RCRA land disposal restrictions are not applicable, but are relevant and appropriate to disposal of treatment media due to the presence of constituents which are sufficiently similar to RCRA wastes.

Additionally, if "placement" of excavated soil occurs at these sites, the Land Disposal Restrictions (LDRs) will apply. Alternative 3 considers excavation and surface aeration of contaminated soils as a contingency if soils are unresponsive to SVE treatment. If the surface aeration is conducted within the area of contamination (areal extent of contiguous contamination), the LDRs are not triggered. However, if excavated soil is moved to another location, they will apply, and the soil will have to be managed as a hazardous waste.

7.2 OPERABLE UNIT 1 ALTERNATIVES FOR THE AMD-ARQUES AND NSC SITES

The following sections describes the remedial alternatives that were considered for addressing contamination within Operable Unit 1 of the AMD-Arques and NSC sites. The three alternatives consist of the following:

- Alternative 1 - No Action
- Alternative 2 - Site-wide Groundwater Extraction and Treatment, Soil Vapor Extraction (SVE) in Subunit 2
- Alternative 3 - Site-wide Groundwater Extraction and Treatment, Soil Vapor Extraction (SVE) in

Subunits 1 and 2, With a Contingency to Excavate and Aerate Shallow Soils Unresponsive to SVE

The site-specific cleanup standards set for the groundwater and soils are presented in Table 6. Shown also are the state and federal drinking water standards. Note that several of the site-specific cleanup standards are lower than the state and federal standards. These numbers have been reduced to address risk of exposure from multiple contaminants, i.e., to achieve a protective Hazard Index that is equal to, or less than 1, and a calculated cancer risk within the acceptable risk range of 10^{-6} to 10^{-4}.

A discussion of the uncertainty in achieving the cleanup standards is presented in Section 7.3 following this section.

7.2.1 Alternative 1 - No Action

General Description - The "No Action" alternative assumes that the groundwater extraction and treatment efforts initiated in 1982, and conducted to date, are an adequate response. The groundwater extraction and treatment system currently in operation would be shut down. Contaminant concentrations would be reduced by natural attenuation as the plume continued to migrate towards San Francisco Bay. Groundwater monitoring would continue in order to track chemical migration and to evaluate the effectiveness of the "No Action" alternative. Institutional controls and deed restrictions would be required to prevent well construction in areas of the contaminated aquifers where an unnaceptable risk of exposure to polluted groundwater remains.

How Well Does the Alternative Meet ARARs/Cleanup Objectives - Modeling conducted in the evaluation of this alternative shows that it would require more than 200 years for natural attenuation to achieve the cleanup standards (Table 3, page 39) for the AMD-Arques and NSC Operable Unit 1. Chemical specific Applicable or Relevant and Appropriate Requirements (ARARs) - the Federal and State MCLs - would not be met within an acceptable time period, and the State's anti-degradation policy, Resolution 68-16 (which is an ARAR at this site) will be violated by allowing further degradation of a potential drinking water supply.

Risk Evaluations and Cleanup Time - Under this alternative, the baseline risk of 4×10^{-3} and the Hazard index (HI) of 9 in Subunit 2 is not appreciably reduced in a reasonable time frame. And the baseline risks of 3×10^{-3} and HI > 1 are not reduced effectively in Subunits 1 and 3 within reasonable time periods.

Costs - Total present worth cost (using a 10% discount rate and assuming 30 years of operation) for the "No Action" alternative is approximately $3.2 million.

Table 6
Cleanup Standards and ARARs[1]
AMD/Arques and NSC Sites Operable Unit 1

Chemical Name	Federal MCLG[2] (ppb)[3]	Federal MCL[4] (ppb)	State MCL or AL[5]	Site Cleanup Std.[6]
Groundwater				
Benzene	0	5	1	1
Chlorobenzene	100	100	30	30
Chloroform	N/A	100	N/A	5
Chloromethane	N/A	N/A	110	5
4-Chloro-3-methylphenol	N/A	N/A	N/A	7
1,2-Dichlorobenzene	600	600	130[7]	60
1,1-Dichloroethane	N/A	N/A	5	5
1,1-Dichloroethylene	7	7	6	6
cis-1,2-Dichloroethylene	70	70	6	
trans-1,2-Dichloroethylene	100		10	
2,4-Dimethylphenol	N/A	N/A	400[7]	46
2,4-Dinitrophenol	N/A	N/A	N/A	5
Ethylbenzene	700	700	680	68[6]
Freon 113	N/A	N/A	1200	1200
2-Methyl-4,6-dinitrophenol	N/A	N/A	N/A	1
Pentachlorophenol	0	1	30[7]	1
Phenol	N/A	N/A	5[7]	5
Tetrachloroethylene	0	5	5	5
Trichloroethylene	0	5	5	5
Vinyl Chloride	0	2	0.5	0.5
Xylene (total)	10,000	10,000	1,750	175[6]
1,4 Dichlorobenzene	75		5	
1,1,1-Trichloroethane	200			
Soil				
Total VOCs	N/A	N/A	N/A	1ppm
Polynuclear Aromatic Hydrocarbons (PNAs)	N/A	N/A	N/A	10ppm

N/A Not Available
1 California State Water Resources Control Board Policy Number 68-16 is also ARAR
2 MCLG - Maximum Contaminant Level Goals
3 ppb = parts per billion
4 MCL = Maximum Contaminant Level, Current or Proposed
5 AL = California Action Level (TBC)
6 Site Specific Health Protective Standards set considering ARARs and calculated cancer risks and Hazard Indices.
7 This number is a California Action Level

7.2.2 Alternative 2 - Groundwater Extraction and Treatment, Soil Vapor Extraction (SVE) in Subunit 2

General Description - This alternative combines the following major components: (1) expansion of the current groundwater extraction and air stripping system, (2) soil remediation in Subunit 2 only, using Soil Vapor Extraction (SVE), (3) groundwater monitoring to track effectiveness of extraction system, and (4) deed restrictions preventing access to contaminated groundwater and soil during remediation. The expanded groundwater system would be designed to capture and reduce groundwater contamination in Operable Unit 1 until cleanup standards have been met. Included in this plan is the capture of the downgradient end of the plume, which currently is uncontrolled.

This alternative would contain migration of contaminants in the polluted aquifers, and it would treat soils in Subunit 2 that would otherwise provide an ongoing source of groundwater contamination. However, contaminated soils would remain untreated in Subunit 1.

How Well Does Alternative 2 meet ARARs/Cleanup Objectives - Modeling shows that the estimated time to meet the groundwater cleanup standards for the AMD-Arques and NSC sites, is greater than 100 years under this alternative (despite the fact that Subunit 2 might be able to meet the standards much sooner - 30 to 100 years). The cleanup standards (which are set for protectiveness and to meet federal and state requirements) would not be met within an acceptable time period except within Subunit 2 (the AMD facility). The State's anti-degradation policy, Resolution 68-16 (which is an ARAR for these sites) is met, however, because further degradation of a potential drinking water supply will be prevented.

This Alternative can meet ARARs for air emissions (See Section 7.1). If meeting the BAAQMD permit levels requires emissions control such as activated carbon, disposal of spent carbon (if not regenerated) will have to be managed in accordance with Resource Conservation Recovery Act (RCRA) Land Disposal Restrictions (LDRs) Carbon used as the final stage of the ozone oxidation groundwater treatment system in Subunit 3 will also fall in this category of materials that must be managed as a RCRA waste.

National Pollutant Discharge Elimination System (NPDES) substantive permit requirements and/or RWQCB Waste Discharge Requirements (WDRs) are ARARs for effluent discharges. Effluent from the groundwater treatment systems employed in this alternative is subject to both of these ARARs which include regulation of discharge limits, points of compliance, and monitoring frequencies.

Risk Evaluations and Cleanup Time - Under this alternative, the baseline risk of 4×10^{-3} and the HI of 9 in Subunit 2 may be reduced to 2×10^{-5} and an HI = 0.93, in a 30 - 100 year time frame. But, in Subunits 1 and 3, the baseline risks of 3×10^{-3} and HI >

1 will not be appreciably reduced within an acceptable time frame (greater than 100 years).

To summarize, Alternative 2 can provide a cleanup that achieves acceptable risk levels within a reasonable period of time for only one portion of Operable Unit 1. Other areas of Operable Unit 1 remain above acceptable risk levels for greater than 100 years.

Costs - The present worth cost of Alternative 2 (using a 10% discount rate and assuming 30 years of operation) is $5.5 million.

7.2.3 Alternative 3 - Groundwater Extraction and Treatment, Soil Vapor Extraction (SVE) in Subunits 1 and 2, With a Contingency to Excavate and Aerate Shallow Soils Unresponsive to SVE

General Description - This alternative combines the following major components: (1) expansion of the current groundwater extraction and treatment system, (2) soil remediation in Subunits 1 and 2, using Soil Vapor Extraction (SVE), (3) groundwater monitoring to track effectiveness of extraction system, and (4) deed restrictions preventing access to contaminated groundwater and soil during remediation. The expanded groundwater system (identical to Alternative 2) would be designed to capture and reduce groundwater contamination in Operable Unit 1, including the downgradient end of the plume that is currently uncontrolled, until cleanup standards have been met.

The only difference between Alternatives 2 and 3 is that soils in Subunit 1 will be treated in addition to those in Subunit 2. Note that this difference significantly reduces cleanup time from greater than 106 years to a 50 - 100 year range for Operable Unit 1.

Just as with Alternative 2, this alternative would contain migration of contaminants in the polluted aquifers. It goes further than Alternative 2 in that it would treat soils in both Subunits 1 and 2 that would otherwise provide an ongoing source of groundwater contamination.

How Well Does Alternative 3 Meet ARARs/Cleanup Objectives - The key ARARs with which Alternative 3 must comply are almost the same as those for Alternative 2 since the only difference between the two alternatives is an expansion of the areas of soil to be treated, rather than a difference in technologies being applied. However, if certain shallow soils that are contaminated with lower volatility compounds do not respond well to SVE, there is a contingency plan to excavate and aerate these soils at the surface. If this occurs, air emissions during excavation and aeration will be regulated under the BAAQMD Regulation 8, Rule 40 and UNACCEPTABLE restrictions will apply if "placement" of contaminated soil occurs (see page 34, RCRA Land Disposal Restrictions).

Modeling shows that the estimated time to meet the groundwater cleanup standards for the AMD-Arques and NSC sites if Alternative 3 is implemented, is within 50 to 100 years. The cleanup standards would be met within an acceptable time period. The State's anti-degradation policy, Resolution 68-16 (which is an ARAR for these sites) is also met because further degradation of a potential drinking water supply will be prevented.

This Alternative can meet ARARs for air emissions (See Section 7.1). If meeting the BAAQMD permit levels requires emissions control such as activated carbon, disposal of spent carbon (if not regenerated) will have to be managed in accordance with Resource Conservation Recovery Act (RCRA) Land Disposal Restrictions (LDRs). Carbon used as the final stage of the ozone oxidation groundwater treatment system in Subunit 3 will also fall in this category of materials that must be managed as a RCRA waste.

National Pollutant Discharge Elimination System (NPDES) substantive permit requirements and/or RWQCB Waste Discharge Requirements (WDRs) are ARARs for effluent discharges. Effluent from the groundwater treatment systems employed in this alternative is subject to both of these ARARs which include regulation of discharge limits, points of compliance, and monitoring frequencies.

Risk Evaluations and Cleanup Time - In Subunits 1 and 3, the baseline risks of 3×10^{-3} and HI > 1 may be reduced to 3×10^{-5} and an HI = .87, in a 50 - 100 year time frame if Alternative 3 is implemented.

To summarize, Alternative 3 can provide a cleanup that achieves an acceptable risk level within a reasonable period of time (50 - 100 years).

Costs - The present worth cost of Alternative 3 (using a 10% discount rate and assuming 30 years of operation) is $8.4 million.

7.3 UNCERTAINTY IN ACHIEVING CLEANUP STANDARDS

The goal of the final remedy is to restore groundwater to its beneficial uses by meeting the cleanup standards presented in Table 3. Based on information obtained during the Remedial Investigation and on a careful analysis of all remedial alternatives, EPA and the RWQCB believe that the selected remedy will achieve this goal. However, studies suggest that groundwater extraction and treatment will not be, in all cases, completely successful in reducing contaminants to health-based groundwater quality standards using this approach. It may become apparent, during implementation or operation of the groundwater extraction system and its modifications, that contaminant levels have ceased to decline and are remaining constant at levels higher than the cleanup standards over some portion of the plume. In such a case, the system

performance standards and/or the remedy may be reevaluated by EPA. Additional discussion pertaining to this issue occurs in Section 9.2.

8.0 COMPARATIVE ANALYSIS OF ALTERNATIVES

The alternatives were evaluated using nine component criteria. These nine criteria are derived from requirements contained in the National Contingency Plan (NCP) and CERCLA Sections 121(b) and 121(c). A comparative discussion of how the alternatives perform when measured against each of the nine criteria follows.

1. PROTECTION OF HUMAN - HEALTH AND THE ENVIRONMENT

Alternative 1, the "No Action" alternative does not achieve protectiveness within an acceptable timeframe (i.e., it would take more than two hundred years for natural attenuation to meet standards). Without active site restoration efforts, potential drinking water supplies are threatened with levels of contamination that exceed acceptable risks. Additionally, soils in Subunit 2 that contain Polynuclear Aromatic (PNAs) chemicals would constitute a potential for unnaceptable cancer risk due to direct contact if the site is not cleaned up and is then developed for residential use.

Alternative 2 addresses soil contamination through treatment in Subunit 2 and thereby reduces the potential for direct contact risk posed by PNAs at the site. Pump and treat systems contain and reduce the groundwater contamination, mitigating some of the threat to potential drinking water supplies. However, without further soil remediation than is contemplated by this alternative, contaminated soils in Subunit 1 will continue to serve as an ongoing source of contamination to the affected aquifers, extending the cleanup time to longer than 100 years. Hydraulic control of the plume reduces the risk of further contamination of the groundwater, however unacceptable levels of risk remain in a potential drinking water supply for a long time.

Alternative 3 actively addresses both soil and groundwater contamination at the sites through treatment such that risk due to direct contact with these media is reduced to acceptable levels within 50 to 100 years.

2. COMPLIANCE WITH ARARS

Both Alternatives 2 and 3 would attain all pertinent ARARS identified in Section 7. The Safe Drinking Water Act MCLs and California Department of Health Services DWALs would be achieved by extracting ground water contaminated above these levels. NPDES permit requirements would be met by proper design and operation of the treatment systems. ARARs that are related to air emissions from the soil vapor extraction, air strippers, or excavation

activities can be met with proper system design and implementation. The RCRA land disposal restrictions would apply to the spent carbon from Alternatives 2 and 3, if stripper or vapor extraction emissions control involving gas-phase activated carbon is required. They would also apply if the excavation contingency is implemented and "placement" of contaminated soil occurs.

The drinking water ARARS would not be attained by Alternative 1 for an unacceptably long period of time. Compliance with Resolution 68-16 would not be achieved since the groundwater contaminants would unreasonably affect the potential uses of the upper aquifers. RCRA land disposal restrictions, NPDES requirements, BAAQMD Regulation 8, and OSWER Directive 9355.0-28 would not apply to Alternative 1 since it does not employ any treatment.

3. REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT

Both Alternatives 2 and 3 have the potential to reduce the toxicity, mobility, and volume of soil and groundwater contaminants by removing them and treating them. If air emissions require controls, contaminants would be destroyed during carbon regeneration, making any future release of the removed contaminants impossible. If emissions controls are not required (they would have to be low enough to meet BAAQMD permit requirements for this to be the case), contaminants will be transferred to the air where their toxicity, mobility, and volume actually increase. It should be noted that a risk evaluation is performed as part of the permit decision to require controls on air emissions.

Both Alternatives 2 and 3 employ an ozone oxidation treatment system which will treat a portion (80 gpm) of the extracted groundwater. (The rest, 160 gpm, is treated with air strippers.) This technology, which will be combined with a carbon filtration at the final stage of the treatment train, will achieve complete destruction of the contaminants extracted from the A and B aquifers in Subunit 3.

Alternative 2 would take a longer time to achieve these reductions in toxicity, mobility, and volume through treatment than would Alternative 3 (up to 50 years longer).

Alternative 1 does nothing to reduce toxicity, mobility, or volume through treatment.

4. LONG-TERM EFFECTIVENESS AND PERMANENCE

Alternatives 2 and 3 include groundwater extraction which is intended to reduce the level of contamination in the A and B Aquifer Zones to the cleanup standards indicated in Table 3 on page 38. Thus, potential risks to the community are minimized. To ensure that the magnitude of residual risks are minimized, the performance

of the groundwater extraction system would be monitored on a regular basis and adjusted as warranted by the performance data collected during operation for both of these alternatives.

Treatment by air stripping provided by Alternatives 2 and 3 is reliable for the long-term removal of VOCs from the ground water. Treatment by ozone-oxidation, as is planned in Alternatives 2 and 3, is also reliable and considered even more permanent since nearly complete destruction of the contaminants would be achieved. It should be noted again, of course, that if air stripper emissions exceed threshold levels in the BAAQMD regulations, emissions controls will be required. Carbon adsorption would constitute the control technology, and the carbon regeneration process would provide complete destruction through thermal treatment.

Alternative 1, "no action," does not provide long-term effectiveness.

5. SHORT-TERM EFFECTIVENESS

There are no anticipated adverse impacts on human health and the environment that are posed during the construction and operation of the remedies that are part of Alternatives 2 and 3. Institutional controls will preclude residential development in areas where soil is contaminated, as well as preventing construction of water supply wells in the affected aquifers. These institutional controls will prevent direct contact with contaminants in groundwater and soils. Air emissions from the treatment systems will be regulated by BAAQMD permit and controlled with carbon if required. NPDES requirements will ensure that discharged effluent from treatment systems meets permit requirements as well.

6. IMPLEMENTABILITY

There are no technical concerns regarding the implementability of Alternatives 2 and 3. Institutional controls required in Alternatives 1, 2, and 3 are administratively feasible.

7. COST

Alternative 1, the "no action" option, which does include long term groundwater monitoring and deed restrictions but no active remediation work, has a present worth of $3.2 million.

Alternative 2, which actively addresses groundwater contamination and some of the soils in Operable Unit 1, in addition to long-term monitoring and deed restrictions, has a present worth of $5.5 million.

Alternative 3, actively addresses groundwater contamination and soil contamination at each of the facilities in Subunits 1 and 2 in Operable Unit 1 (also includes monitoring and deed restriction),

has a present worth of $8.4 million.

It can be seen that as more protective measures are taken in each successive alternative, that the cost increases incrementally. The groundwater cleanup is the same for Alternatives 2 and 3, therefore the additional soil cleanup work in Alternative 3 increases the cost accordingly. It may be noted that this cost is the cost associated with a significant reduction in the time needed to achieve cleanup standards (Alternative 2 takes more than 200 years at $9.9 million; Alternative 3 takes from 50 to 100 years at $11.6 million).

These present worth costs have been calculated assuming a 30-year operation period and a ten percent discount rate.

8. SUPPORT AGENCY ACCEPTANCE

The Regional Water Quality Control Board (RWQCB) has maintained the lead agency for oversight of PRP work at the Advanced Micro Devices - Arques and National Semiconductor sites. EPA has actually played the support agency role throughout the RI/FS process. These sites are two of approximately twenty NPL sites in the Santa Clara Valley that are regulated under RWQCB-lead pursuant to the South Bay Multi-Site Cooperative Agreement with EPA (EPA Assistance Agreement: #V009403), which was established in October 1985. Under this agreement EPA and the RWQCB have worked in a close partnership to develop the proposed plan for the AMD-Arques and NSC sites. The RWQCB has recommended the plan, which EPA has reviewed and considered in selecting this final remedy.

9. COMMUNITY ACCEPTANCE

The Proposed Plan was presented to the communities of Santa Clara and Sunnyvale in a fact sheet and at a public meeting. [No technical comments were submitted regarding the alternatives. Other comments received are addressed in the Responsiveness Summary.]

9.0 THE SELECTED REMEDY

9.1 DESCRIPTION

The selected final remedy for the National Semiconductor and Advanced Micro Devices - Arques Operable Unit 1 includes the following elements:

- **Groundwater extraction,** to control further migration of site chemicals in the contaminated aquifers and reduce chemical concentrations until cleanup standards have been achieved (Carcinogenic Risk = 3×10^{-5}; HI < 1).

- Treatment of extracted groundwater with **air stripping or ozone oxidation** under a Bay Area Air Quality Management District BAAQMD permit or pursuant to OSWER Directive 9355.0-28.

- **Discharge** of extracted and treated groundwater to storm sewers under National Pollutant Discharge Elimination System (NPDES) permits.

- **Soil Vapor Extraction** (SVE) with carbon adsorption to control emissions if required under BAAQMD permit requirements or OSWER Directive 9355.0-28 will be employed where vadose zone soils present a potential continuing source of contamination to groundwater or where shallow soils represent a health risk due to direct contact. Some shallow soils are contaminated with less volatile compounds and may require removal and surface aeration if they do not respond to SVE.

- Institutional Controls prohibiting the use of the A and B aquifer groundwater and for controlling activities that could endanger the public health or the environment.

In order to implement this final remedy for Operable Unit 1, the currently operating extraction system will be expanded, and an ozone oxidation treatment system will be added to the current air stripper treatment systems. The air strippers will include air emissions control (carbon treatment) if emissions exceed levels currently permitted by the BAAQMD (one pound per day). NPDES discharges will go to storm sewers which empty into the Calabazas Creek.

Vadose and shallow soil contamination at these sites will be addressed by SVE. Contingent upon the success of the SVE effort in areas that contain lower volatility compounds, some excavation and surface aeration of contaminated soils will be performed. If it is determined that this additional effort is necessary, a permit from the BAAQMD must be obtained.

It should be noted that the expanded groundwater extraction system which is a part of the remedy for Operable Unit 1, will be designed to capture all downgradient plume migration that may be coming from both Operable Units 1 and 2.

9.2 Uncertainty in the Remedy

The goal of this remedial action is to restore the groundwater to its beneficial use, which is, at this site, a potential source of drinking water. Based on information obtained during the RI and on a careful analysis of all remedial alternatives, EPA and the RWQCB believe that the selected remedy will achieve this goal. It may become apparent, during implementation or operation of the

groundwater extraction system and its modifications, that contaminant levels have ceased to decline and are remaining constant at levels higher than the cleanup standards over some portion of the plume. In such a case, the system performance standards and/or the remedy may be reevaluated by EPA.

The selected remedy will include groundwater extraction for an estimated period of 50 to 100 years, during which the system's performance will be carefully monitored on a regular basis and adjusted as warranted by the performance data collected during operation. Modifications may include any or all of the following:

a) at individual wells where cleanup standards have been attained, pumping may be discontinued;

b) alternating pumping at wells to eliminate stagnation points;

c) pulse pumping to allow aquifer equilibration and to allow adsorbed contaminants to partition into ground water; and

d) installation of additional extraction wells to facilitate or accelerate cleanup of the contaminant plume.

To ensure that cleanup standards continue to be maintained, the aquifer will be monitored at those wells where pumping has ceased on an occurrence of every 5 years following discontinuation of groundwater extraction.

10.0 STATUTORY DETERMINATIONS

The selected remedy will comply with Section 121 of CERCLA. The selected remedy is protective of human health and the environment. Contaminated groundwater and soils will be restored to health protective levels once cleanup standards have been achieved, and until that occurs, direct contact exposure to contaminated media will be prevented with institutional controls. The selected response actions comply with Federal and State requirements that are legally applicable, or relevant and appropriate; primarily the drinking water standards (Federal and State MCLs), Bay Area Air Quality Management District permit requirements for air emissions, and the National Pollutant Discharge Elimination System requirements for discharge of treated effluent.

These remedial actions address the principal risks at the National Semiconductor and Advanced Micro Devices - Arques sites (Operable Unit 1) by removing and treating the contamination in soils (primarily soil vapor extraction), and by removing and treating contaminants in ground water (extraction with air stripper and ozone oxidation treatment), thereby significantly reducing the toxicity, mobility or volume of hazardous substances in both media through treatment. Using ozone oxidation treatment satisfies the statutory preference for permanent solutions and remedies that

employ treatment as a principal element.

An evaluation of the alternatives considered shows the selected remedy to be a cost effective response. Although the cost of the selected remedy is $1.7 million more than the other active remediation alternative considered, that additional cost reduces the time necessary to achieve cleanup standards from more than 100 years to a 50 to 100-year time frame.

Because the remedy may require 50 to 100 years to achieve cleanup standards, a five-year review, pursuant to CERCLA Section 121, 42 U.S.C. Section 9621, will be conducted at least once every five years after initiation of the remedial action to ensure that the ongoing remedial action continues to provide adequate protection of human health and the environment.

11.0 DOCUMENTATION OF SIGNIFICANT CHANGES

There were no significant changes between the preferred alternative and the Record of Decision.

PART III. RESPONSIVENESS SUMMARY

1.0 INTRODUCTION

This section of the Record of Decision contains agency responses to all significant verbal and written comments submitted to RWQCB or EPA staff during the 60-day public comment period and at the Community Meeting held Jun 27, 1991. This ROD does not contain any significant changes to the remedy that was made available for public comment and described in the Proposed Plan Fact Sheet and the RWQCB orders.

The public comment period began with a public meeting of the executive board of the RWQCB on June 19, 1991 and ended 60 days later on August 19, 1991.

2.0 RESPONSES TO COMMENT

The RWQCB is the lead agency for the Advanced Micro Devices - Arques and National Semiconductor sites and, as the lead, received public comment. RWQCB and EPA have worked together in the preparation of the Responsiveness Summary (Attachment A) and EPA has approved all of the Responses.