CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN FRANCISCO BAY REGION

ORDER NO. 91-139

SITE CLEANUP REQUIREMENTS FOR:

ADVANCED MICRO DEVICES,
NATIONAL SEMICONDUCTOR CORPORATION,
UNITED TECHNOLOGIES CORPORATION,
HEWLETT-PACKARD, AND SHAHINIAN TRUST
SUBUNIT 2, OPERABLE UNIT 1
SUNNYVALE AND SANTA CLARA
SANTA CLARA COUNTY

The California Regional Water Quality Control Board, San Francisco Bay Region (hereinafter called the Board) finds that:

1. **Study Area, Operable Unit and Subunit Locations and Descriptions** A Study Area containing numerous sources of soil and ground water contamination in western Santa Clara and eastern Sunnyvale is shown in Figure 1. The Study Area is located in an area of low to flat relief about 6 miles south of San Francisco Bay (see Figure 2). This 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 immediately surrounding the industrial park area. Some residential property lies at the northern edge of the Study Area: south of Highway 101, west of Lawrence Expressway and north of Highway 101, east of Lawrence Expressway.

   This Study Area has been divided into Operable Units 1 and 2 because of additional field work necessary to define the ground water contaminant plumes originating from facilities in Operable Unit 2 and to determine the extent that these contaminant plumes may be commingled with those plumes originating from facilities in Operable Unit 1. Operable Unit 1 comprises the eastern portion of the Study Area as shown in Figure 1.

   The advantage of defining these two operable units is that facilities in Operable Unit 1 may proceed with final cleanup without awaiting the results of further characterization work in Operable Unit 2. The necessity for additional field work in Operable Unit 2 renders the boundaries of the Study Area incomplete and the boundaries of Operable Unit 1 inexact because additional information generated for Operable Unit 2 may alter the Units' boundaries. It is the Board's intent that the boundaries of the operable units be defined such that, commingling notwithstanding, facilities located in Operable Unit 1 are largely responsible for soil and ground water contamination in Operable Unit 1, and facilities located in Operable Unit 2 are largely responsible for soil and ground water contamination in Operable Unit 2. As additional information is generated for Operable Unit 2 and the Study Area, this intention may lead the Board to modify the Units' boundaries, this order, and the list of dischargers named in this order.

   Three facilities are located in Operable Unit 1 and for purposes of allocating responsibility for soil and ground water contamination among these facilities, Operable Unit 1 has been further subdivided into three subunits as shown in Figure 1. 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

(AMD) facility 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. As noted above, as additional information is generated for Operable Unit 2 and the Study Area, the Board may modify the Subunits' boundaries.

2. **Regulatory Status** Separate Board Orders have been prepared for each Subunit in Operable Unit 1. The three Board Orders combined comprise the final cleanup plans for Operable Unit 1. As described in Finding 1. above, the three subunits and corresponding three Board Orders facilitate the allocation of responsibility for soil and ground water contamination among the facilities in Operable Unit 1.

The Board will adopt a final Remedial Action Plan (RAP) for Operable Unit 1 after the Board issues a Nonbinding Preliminary Allocation of Responsibility (NBAR) for Operable Unit 1. With the exception of the NBAR requirement, the three Orders comply with all other requirements for a RAP.

As shown in Figure 1, the AMD facility, located in Subunit 2, is directly downgradient of the NSC and former UTC facilities, located in Subunit 1. Therefore, in Subunit 2, the ground water contaminant plumes emanating from the NSC and former UTC facilities are considered to be commingled with the ground water contaminant plume from the AMD facility. Therefore, NSC and UTC are also referred to as dischargers in this Board Order for Subunit 2. Furthermore, since the commingled plumes extend from Subunit 2 into Subunit 3, NSC, UTC, and AMD are referred to as dischargers in Subunit 3.

On September 14, 1987, NSC and UTC executed an agreement whereby NSC assumed soil and ground water cleanup responsibility for the former UTC facility. Hewlett-Packard (HP) has owned the former UTC facility since 1982. UTC, as the party who released contaminants to the soil and ground water at the former UTC facility, and HP, as the current owner of the former UTC facility, are both named as dischargers. However, NSC has assumed full responsibility to complete all necessary soil and ground water remedial action programs related to the former UTC facility and the ground water plume emanating from that facility.

NSC notified the Board on July 12, 1991 that one of the source areas at the NSC facility, Building 19, was owned by the Shahinian Trust (ST). ST was notified on July 26, 1991 that, as landowner of Building 19, ST is secondarily responsible for the cleanup of soil and ground water contamination emanating from NSC's Building 19 source area.

Therefore, UTC, HP, and ST are secondarily liable and have responsibility for the soil and ground water cleanup only in the event that NSC fails to comply with prohibitions, specifications, and provisions of this Board Order.

Semiconductor manufacturing operations were begun at the current AMD facility by Monolithic Memories (MMI) in 1970. AMD acquired MMI and their property in 1987 and assumed responsibility for continuing the soil and ground water investigations and remediation program for the AMD facility. Therefore, all previous Board Orders and other regulatory actions for MMI

now apply to AMD and AMD is named as the discharger for the AMD facility located in Subunit 2.

Pursuant to California Health and Safety Code Sections 25356.1 (c) and (d), the only identified responsible parties associated with the release of contaminants to the subsurface in Subunit 2 are AMD, NSC, UTC, HP, and ST. AMD, NSC, UTC, HP, and ST are hereinafter referred to as dischargers.

AMD and NSC are primarily responsible for this discharge for purposes of this Order. NSC shall not be held responsible for soil and ground water contamination emanating from surface activities at the AMD facility.

The purpose of final remedial actions in each subunit is to reduce additional migration of contaminants from soil into ground water and to control the migration of contaminated ground water from each subunit. The intent of actions required in this Order is to expedite cleanup of ground water in Subunit 2 and to prevent movement of contaminated ground water to other subunits and potential vertical migration into aquifers that currently serve as drinking water sources.

3. **Lead Agency** AMD and NSC are Superfund sites on the National Priorities List (NPL). Pursuant to the South Bay Multi-Site Cooperative Agreement (MSCA) and the South Bay Ground Water Contamination Enforcement Agreement, entered into on May 2, 1985 (as subsequently amended) by the Board, EPA, and the California Department of Health Services (DHS), the Board has been acting as the lead regulatory agency.

   This Order is intended to outline a proposed plan for the final remedial actions in Subunit 2 in Operable Unit 1 as required by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as amended by the Superfund Amendments and Reauthorization Act (SARA). If EPA concurs with the selected remedy, it will issue a Record of Decision. The Board will continue to regulate the dischargers' remediation and administer enforcement actions in accordance with CERCLA as amended by SARA, the California Water Code, California Health and Safety Code, and regulations adopted thereunder.

4. **Nonbinding Preliminary Allocation of Responsibility** NSC and AMD were requested to submit a joint draft nonbinding preliminary allocation of responsibility (NBAR) report that contained a percentage-based allocation of responsibility for cleanup of NSC's (which includes the contribution from the former UTC facility) and AMD's commingled plumes. In May 1991, NSC and AMD submitted separate draft NBAR reports which allocated responsibility very differently among NSC and AMD and also allocated some responsibility to other parties. These draft NBAR reports were deficient in that they were separate, rather than joint, reports that used differing assumptions to allocate responsibility. NSC's draft NBAR report, dated May 13, 1991, allocated responsibility to NSC, UTC, AMD, New England Mutual Life Insurance Company (NEM), M/A-COM Inc., Ametek Inc., and Bank of America. NSC's draft report discussed, but did not allocate responsibility to, parties associated with HP, Mohawk Laboratories, City of Sunnyvale Corporation Yard, Modern Machine Company, Proto Engineering Corporation, Western Precision, Mobil Oil

Corporation, and Arco Petroleum Products Company sites. AMD's draft NBAR report, dated May 13, 1991, allocated responsibility to NSC, UTC, and AMD. AMD's draft NBAR report identified but did not allocate responsibility to HP, NEM, InPrint Corporation, Mohawk Laboratories, and CAE-Link as Potentially Responsible Parties (PRP's). The Board will defer completion of the final NBAR determination until such time that the draft NBAR reports are revised pursuant to Provision C.2.n. to use similar assumptions, to apply any new information generated during further investigations in the Study Area, and incorporate any new guidance promulgated on the NBAR process.

The Board will adopt a final RAP for Operable Unit 1 after the Board issues an NBAR for Operable Unit 1. The Board acknowledges and intends that responsible parties for sites at which contaminants have been released and commingled with the Operable Unit 1 plume be included in the NBAR determination, regardless of whether such parties are named as dischargers on any order issued by the Board with respect to Operable Unit 1.

5. **Subunit 2 Regulatory Chronology** The dischargers have been regulated by Board Orders, as indicated herein:

a.	August 1986	Board adopted Waste Discharge Requirements for MMI
b.	August 1986	Board adopted Waste Discharge Requirements for NSC
c.	September 1986	Board adopted Waste Discharge Requirements for UTC
d.	July 1987	MMI and NSC added to the final NPL
e.	February 1988	Board adopted Site Cleanup Requirements for NSC
f.	April 1989	Board adopted Site Cleanup Requirements for AMD
g.	April 1989	Board adopted revised Site Cleanup Requirements for NSC
h.	February 1990	Board issued NPDES permit CA0029645 for discharge of extracted ground water from AMD's treatment system in Subunit 2

6. **Subunit 2 Facility Descriptions** The AMD facility consists of Buildings 1 and 2 on Arques Avenue and Building 3 at 1160 Kern Avenue. The AMD facility 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 MMI in 1970. AMD acquired MMI and their property in 1987 and assumed responsibility for continuing the soil and ground water investigations and remediation program for the AMD facility. Buildings 1 and 2 were used as office space and semiconductor production facilities while Building 3 was originally constructed for Amdahl Corporation in 1972 and was 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.

7. **Subunit 2 Investigation Histories** In early 1982, the Board 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 Board's leak detection program, MMI initiated subsurface investigations at the AMD facility in 1982 because of suspected leakage from several underground chemical solvent storage tanks, underground acid neutralization sumps, and chemical handling areas used for onsite storage. 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, MMI installed, as an interim remedial measure, an onsite A aquifer ground water extraction and treatment system. In 1988, AMD expanded the onsite extraction and treatment system to include ground water extracted from the deeper B aquifer.

8. **Remedial Investigation/Feasibility Study (RI/FS) Reports and Proposed Final Remedy** AMD submitted a final draft RI Report, April 1, 1991, and a final draft FS Report May 9, 1991. AMD's FS Report included a detailed screening of alternatives for soil and ground water remedial actions and a summary of the baseline public health assessment for Subunit 2.

   Board staff has determined that the technical information contained in AMD's RI and FS Reports is acceptable for developing a final cleanup plan; however, the Board and other agency staff do not accept all interpretations and recommendations contained in AMD's RI and FS Reports. The Board finds that these issues are resolved in an Agency Addendum to AMD's RI and FS Reports, rather than in another revised version of AMD's RI and FS Reports. This Agency Addendum is included as Attachment A of this Order.

   One issue resolved in the Agency Addendum concerns AMD's position of responsibility for cleanup of A aquifer ground water under the AMD facility (Subunit 2) only. In Board Order No. 89-061, adopted April 19, 1989, the Board found that the vertical extent of AMD chemicals was restricted to the A aquifer. However, as described in the Agency Addendum, the Board hereby finds that there is not a preponderance of evidence to support AMD's position. As such, AMD is jointly responsible for ground water cleanup in the A and B aquifers in Subunit 2 and 3.

   The technical information contained in the RI/FS Reports and the Board's Proposed Plan Fact Sheet is consistent with the Health and Safety Code requirements for a final RAP and the National Contingency Plan requirements for a RI/FS. The RI/FS Reports contain an evaluation of applicable or relevant and appropriate requirements (ARARs), the interim remedial actions, final remedial alternatives, and proposed remedial standards.

9. **Regional Hydrogeology** Subunit 2 is located in the Santa Clara Valley which extends southeast from 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 forebay, and 2) the confined area, where Subunit 2 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.

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.

10. **Subunit 2 Hydrogeology** Stratigraphy in the area surrounding Subunit 2 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 a thick persistent 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 (A 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 next 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 5 and 25 feet below ground surface (bgs). The B1 aquifer is encountered between 30 and 45 feet bgs, the B2 aquifer between 50 and 65 feet bgs, and the B3 aquifer between 70 and 90 feet bgs. The ground water gradient in all identified water-bearing aquifer zones is in a general north-northeast direction.

11. **State Board Resolution 88-63** On March 30, 1989, the Board incorporated the State Board Policy of "Sources of Drinking Water" into the Basin Plan. The policy provides for a Municipal and Domestic Supply designation for all waters of the State with some exceptions. Groundwaters of the State are considered to be suitable or potentially suitable for municipal or domestic supply except where: 1) the total dissolved solids in the groundwater exceed 3000 mg/L, and/or 2) the water source does not provide sufficient water to supply a single well capable of producing an average, sustained yield of 200 gallons per day. Based on data submitted by AMD, the Board

finds that neither of these two exceptions apply to the A and B aquifers in the Study Area. Thus, the A and B aquifers in Subunit 2 are considered to be potential sources of drinking water.

12. **Vertical Conduit Study** Studies to determine the locations and status of potential vertical conduit wells in the Study Area were conducted in 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 were considered to be non-risk wells, because they: 1) exist well outside the plume area, 2) are relatively shallow (less than 100 feet deep) and do not penetrate the deep aquifers, or 3) have been documented as properly constructed or decommissioned.

The 1989 study, conducted by NSC, revealed that 22 of the identified wells could be 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 ground water 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 appears to be from a shallow metallic object and not a metallic well casing. As such, it appears that vertical conduit wells are no longer a problem in the Study Area.

13. **Non-Conduit Deep Wells** Two deep water production wells exist within the Study 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, 10 to 20 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 which extends from ground surface to a depth of 110 feet. The City of Santa Clara performs monthly well water analyses on Well CWW 20-02. Cis-1,2-DCE has been detected at concentrations ranging from 0.5 to 0.7 ppb from May 1986 through June 1989. This chemical was also detected in November and December, 1989, at 0.5 ppb, and has been detected in September 1990 and October 1990 at 0.7 and 0.5 ppb, respectively.

A second deep production well, the Hilton Well, is owned by the Oakmead Lake Industrial Properties Company and was installed in March 24, 1976. The well is located, in Subunit 3, at the Sunnyvale Hilton Inn on Lakeside Drive, near Highway 101. The well operates infrequently 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 VOCs have been detected since then.

14. **AMD Source Investigation** Soil sampling programs at AMD began in 1982 and have been conducted as recently as November 1989, to identify source areas for soil and ground water contamination. Potential source areas investigated have included a variety of acid neutralization sumps and solvent tanks, leaks in chemical piping, and chemical storage areas. The RI identified three general source areas that are included for remediation. The principal organic chemicals detected in the soil at the AMD facility are PCE, TCE, 1,2-DCE, xylenes, chlorobenzene, phenols, and polynuclear aromatic chemicals (PNAs) such as naphthalene and pyrene.

15. **Extent of Ground Water Contamination in Subunit 2** The largest concentrations of organic chemicals are found in the A and B1 aquifers, although organic chemicals have been detected in the B2 aquifer. Analytical data indicate that organic chemicals are not present in the B3 aquifer in Subunit 2. The chemicals found in the ground water are halogenated and aromatic VOCs. PCE, TCE, cis-1,2-DCE, chlorobenzene and xylenes are used as indicators for the VOC plume in Subunit 2 because they are detected in a large number of wells and have elevated concentrations. TCE and cis-1,2-DCE are present in the A, B1 and B2 aquifers in Subunit 2 and downgradient in Subunit 3.

As described in Finding 8 above, the Agency Addendum (Attachment A) has resolved the issue of the extent of AMD's responsibility for cleanup of groundwater in Subunits 2 and 3. The Board finds that AMD is jointly responsible for the ground water cleanup in the A and B aquifers in Subunits 2 and 3.

The highest current levels of groundwater contamination in Subunit 2 are about 950 ppb of TCE and 1,100 ppb of 1,2-DCE. Currently, the ground water contamination in Subunit 2 extends to a depth of up to 65 feet.

16. **Baseline Public Health Evaluation** A Baseline Public Health Evaluation (BPHE) is conducted at every Superfund site to evaluate the risk posed by the site in its existing condition. The BPHE examines the chemicals present at the site and the possible routes of exposure to humans and animals. Once the potential risk or hazard from the site is established, judgments can be made as to which environmental laws and standards are applicable to the situation and what cleanup standards are appropriate.

A BPHE was completed April 1991, by Canonie Environmental Services for Subunit 2. Using very conservative assumptions regarding concentration, distribution, toxicity, and potential routes of exposure, the BPHE identified 13 organic chemicals of concern for ground water and 24 organic

chemicals (8 VOCs and 16 PNAs) and 4 metals as chemicals of concern for soil in Subunit 2. Further evaluation of the soil data in the FS has resulted in the elimination of all the metals as "chemicals of potential concern". The chemicals of concern for Subunit 2 are listed in Table 1.

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. Domestic use is a hypothetical case since shallow groundwater in the A and B aquifers is not currently used for water-supply purposes and local ordinances currently prohibit such practice. According to the BPHE, potential future exposure routes at the AMD facility may include ingestion of groundwater containing the chemicals of potential concern, inhalation of VOC vapors from groundwater during showering or other domestic uses, and inhalation of VOC vapors originating from the groundwater.

The BPHE assumes that there will be no continued or further cleanup in order to evaluate the need for further cleanup. Based on the potential risk identified by the BPHE it is appropriate to cleanup the groundwater. AMD has been cleaning up contaminated ground water in Subunit 2 since 1986. This Order and actions taken by the Board and other agencies will provide that these efforts will continue.

17. **Chemicals Of Concern** The BPHE identified chemicals of concern for the area encompassing Subunit 2, based on toxicity and frequency of detection for soil and groundwater data. Chemicals of concern identified for ground water in Subunit 2 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).

18. **Interim Remedial Actions, Soils** Interim remedial actions in Subunit 2 have included removal and disposal of underground storage tanks, acid neutralization sumps, and soil with elevated concentrations of VOCs.

19. **Interim Remedial Actions, Groundwater** In 1986, extraction and treatment of A aquifer ground water from wells in Subunit 2 was implemented as an interim remedial measure by AMD. In 1988, AMD added three extraction wells which pump water from the B1 and B2 aquifers to the existing extraction and treatment system. Currently, seven A aquifer wells and three B aquifer wells are pumping water to AMD's treatment system in Subunit 2. Treated ground water from this system is discharged to the storm drain under NPDES Permit CA0029645.

20. **Data Quality** Development of the Board's final cleanup plan was based on four criteria: 1) data was collected following an approved sampling and analysis plan, 2) random sample splits were collected by Board staff to confirm the validity of data generated by AMD, 3) AMD's data was

validated by the Department of Health Services and found to be at least qualitatively acceptable, and 4) there has been reasonable repeatability of the data based on nine years of monitoring. Thus the Board finds that there is sufficient acceptable data to make cleanup decisions.

21. **Summary of Remedial Alternatives** AMD's Feasibility Study initially screened numerous remedial action technologies for Subunit 2. These technologies were screened based on implementability, effectiveness, and cost criteria. The remedial technologies that passed the screening were assembled into a group of alternatives as follows for Subunit 2:

Remedial Alternative 1 - No Further Action

Remedial Alternative 1 is a "no further action" alternative, retained for baseline comparison purposes in accordance with CERCLA/SARA guidance. This alternative involves taking no further action to treat, contain, or remove any of the contaminated soil or ground water in Subunit 2. As such, Remedial Alternative 1 consists of the following elements:

- Deed restriction
- Ground water monitoring

Time to achieve final cleanup standards = > 200 years
Total present worth cost[1] = $ 768,000

Remedial Alternative 2 - Soil Remediation by Excavation and/or Vapor Extraction and Expanded Extraction and Treatment System

Remedial Alternative 2 consists of the following elements:

- Deed restriction
- Excavation and/or in-situ soil vapor extraction of areas with soil contamination
- Offsite disposal or aeration of excavated, contaminated soil on the AMD facility
- Ground water monitoring
- Expand network of extraction wells in Subunit 2
- Air stripping of extracted ground water from current and additional extraction wells with current treatment system in Subunit 2
- Discharge of treated water to surface water under existing NPDES permits CA0029645

Time to achieve final cleanup standards = 50 - 100 years
Total present worth cost[1] = $ 2,450,000

Remedial Alternative 3 - Soil Remediation by Vapor Extraction and Expanded Extraction and Treatment System

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[1] Total present worth costs have been calculated using a 10% discount rate and assuming 30 years of operation.

Remedial Alternative 3 consists of the following elements:

- Deed restriction
- In-situ soil vapor extraction of areas with soil contamination
- Ground water monitoring
- Expand network of extraction wells in Subunit 2
- Air stripping of extracted ground water from current and additional extraction wells with current treatment system in Subunit 2
- Discharge of treated water to surface water under existing NPDES permit CA0029645

Time to achieve final cleanup standards = 50 - 100 years
Total present worth cost[1] = $ 2,460,000

22. **Summary of Evaluation Criteria** This section summarizes the nine evaluation criteria required by EPA to be used to compare the alternatives in the RI/FS. The alternatives were evaluated in detail in AMD's FS Report. A summary of this detailed analysis is shown on Table 2.

a. Overall Protection of Human Health and the Environment addresses whether a remedy provides adequate protection of human health and the environment.

b. Compliance with Applicable or Relevant and Appropriate Requirements (ARARs) addresses whether a remedy will meet all of the ARARs or other Federal and State environmental laws.

c. Long-term Effectiveness and Permanence refers to expected residual chemical concentrations after cleanup standards have been met and the ability of a remedy to maintain reliable protection of human health and the environment over time.

d. Reduction of Toxicity, Mobility, or Volume through Treatment refers to the anticipated performance of the treatment technologies a remedy may employ.

e. Short-term Effectiveness addresses the period of time needed to achieve cleanup and any adverse impacts on human health and the environment that may be posed during the construction and implementation period, until cleanup standards are achieved.

f. Implementability refers to the technical and administrative feasibility of a remedy.

g. Cost includes the present worth value of estimated capital and operation and maintenance costs.

h. Regulatory Agency Acceptance evaluates the administrative and technical issues, regulatory agencies, including the Board and EPA, may have concerning each alternative.

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[1] Total present worth costs have been calculated using a 10% discount rate and assuming 30 years of operation.

i. Community Acceptance evaluates the public's input and anticipated public reaction to each alternative.

23. **Selected Remedy for Subunit 2** Based on an evaluation of the alternatives described in Finding 21. against the nine criteria described in Finding 22., the selected remedy for Subunit 2 is Alternative No. 2. It is estimated that it will take 50 to 100 years to achieve ground water cleanup standards at a cost of $ 2,450,000.

Based primarily on information submitted by AMD in the RI/FS Reports, this Order provides for a final remedy for Subunit 2 that includes:

a. Institutional constraints in the form of a deed restriction. The purpose of the deed restriction is to control site access, prevent the installation of water supply wells in the shallow water-bearing zones, and provide a warning for any subsurface construction activities. The deed restriction would be designed to "run with" the AMD facility to ensure that any potential future site occupants would be aware of the past contamination at this facility.

b. Excavation and/or in-situ vapor extraction of areas within Subunit 2 with soil contamination and offsite disposal or onsite aeration of excavated, contaminated soil.

c. Completion of soil remediation in Subunit 2, to achieve the proposed cleanup level of 1 part per million (ppm) total VOCs and 10 ppm total PNAs within five years of adoption of this Order.

d. Continued ground water monitoring in Subunit 2 during the cleanup period. Water samples will continue to be collected to verify that cleanup is proceeding and that there is not migration of VOCs, above cleanup standards, into the deeper B3 aquifer. Detailed sampling and reporting requirements will be contained in a revised Field Sampling Plan, to be approved by the Executive Officer.

e. Expansion of the network of extraction wells in Subunit 2 to maintain hydraulic containment of the ground water plume in Subunit 2 and to prohibit the further vertical and horizontal migration of the ground water contamination beyond Subunit 2. This requirement shall remain in effect until cleanup standards are achieved.

f. Air stripping of extracted ground water from current and additional extraction wells with current treatment system in Subunit 2.

g. Discharge of treated water to Calabazas Creek, under existing NPDES permit CA0029645. The Board finds that the beneficial uses of Calabazas Creek will not be affected by continuing this discharge.

24. **Cleanup Standards** The cleanup standards must meet all applicable, relevant, and appropriate requirements (ARARs) and be protective of human health and the environment. There are no

ARARs for soil cleanup. The presence of VOCs and PNAs at high concentrations would present a continued threat to water quality. The Board has proposed a cleanup standard in the soil of 1 ppm total VOCs and 10 ppm total PNAs for vadose zone soils. As an alternative to this cleanup level AMD was given the option of providing a technical demonstration that levels of VOCs greater than 1 ppm and PNAs greater than 10 ppm could remain in place in the soil without partitioning from soil into groundwater at levels above groundwater cleanup standards. The latter has not been demonstrated for this site.

Cleanup standards for groundwater are defined in Specification B.3. and listed in Table 3. In general, these standards are based on adopted or proposed Federal maximum contaminant levels (MCLs), State MCLs, and State Action Levels, whichever is the lowest, when available. In some cases, cleanup standards were set below MCLs. In these cases, standards were set so that the cumulative risk associated with the cleanup standards would be within EPA's acceptable levels.

25. **Risk Associated With Cleanup Standards** The proposed remedy is protective of human health and the environment, as required by Section 121 of CERCLA, in that contamination in groundwater is treated to at least MCLs and falls within EPA's acceptable carcinogenic risk range and noncarcinogenic Hazard Index. EPA's acceptable carcinogenic risk range for cleanup standards selected for a site is 10^{-4} to 10^{-6}. If the noncarcinogenic Hazard Index is less than one, EPA considers the combined intake of chemicals unlikely to pose a health risk.

The total carcinogenic risk, summed across the potential future exposure pathways of ingestion and inhalation of VOCs from ground water in Subunit 2, associated with the cleanup standards for the chemicals of concern listed in Table 1, is 2.3×10^{-5}. This risk was calculated using a potential future use scenario with a 30 year exposure duration, per EPA guidance.

The noncarcinogenic Hazard Index associated with the cleanup standards is 0.93. The method and assumptions used to obtain the carcinogenic risk and the Hazard Index associated with the cleanup standards are contained in the AMD BPHE and FS Reports. A number of assumptions have been made in the derivation of these values, many of which are intentional overestimates of exposure and/or toxicity. The actual incidence of cancer is likely to be lower than these estimates and may even be zero. The cleanup standards for the site are protective of human health, have a carcinogenic risk that falls within a range of 10^{-6} to 10^{-4}, and a Hazard Index of less than one.

26. **Uncertainty in Achieving Cleanup Standards** The goal of the final remedy is to restore ground water to its beneficial uses. Based on information obtained during the RI and on a careful analysis of all remedial alternatives, the Board believes 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 levels in the aquifer zones. The Board recognizes that operation of the selected extraction and treatment systems may demonstrate the technical impracticability of reaching health-based ground water quality standards using this approach. If it becomes apparent, during implementation or operation of the systems, that contaminant levels have ceased to decline and are remaining constant at levels higher than the cleanup standard(s), these standard(s) and the remedy may be reevaluated.

However, any changes to the cleanup standards or remedy will require Board and EPA approval.

27. **Future Changes to Cleanup Levels** If new information indicates cleanup standards cannot be attained or can reasonably be surpassed, the Board will decide if further final cleanup actions, beyond those completed, shall be implemented at this site. If changes in health criteria, administrative requirements, site conditions, or remediation efficiency occur, the dischargers will submit an evaluation of the effects of these changes on cleanup standards as defined in Specification B.3.

The Board recognizes that AMD has already performed extensive investigative and remedial work in Subunit 2 and that the dischargers are being ordered hereby to perform additional remedial tasks. It is in the public interest to have the dischargers undertake such remedial actions promptly and without prolonged litigation or the expenditure of public funds. The Board recognizes that an important element in encouraging the dischargers to invest substantial resources in undertaking such remedial actions is to provide the dischargers with reasonable assurances that the remedial actions called for in this Order will be the final remedial actions required to be undertaken by the dischargers. On the other hand, the Board also recognizes its responsibility to protect water quality, public health, and the environment, and that future developments could indicate that some additional remedial actions may be necessary.

The Board has considered and balanced these important considerations, and has determined that the remedial actions ordered herein represent the Board's best, current judgment of the remedial actions to be required of the dischargers. The Board will not require the dischargers to undertake additional remedial actions with respect to the matters previously described herein unless: (1) conditions in Subunit 2, previously unknown to the Board, are discovered after adoption of this Order, or (2) new information is received by the Board, in whole or in part after the date of this Order, and these previously unknown conditions or this new information indicates that the remedial actions required in this Order may not be protective of public health and the environment. The Board will also consider technical practicality, cost effectiveness, State Board Resolution No. 68-16 and other factors evaluated by the Board in issuing this Order in determining whether such additional remedial actions are appropriate and necessary.

28. **Community Involvement** An aggressive Community Relations program has been ongoing for all Santa Clara Valley Superfund sites, including Operable Unit 1. The Board published a notice in the San Jose Mercury News on June 12, 19, and 26, 1991, announcing the proposed final cleanup plan for Operable Unit 1 and opportunity for public comment at the Board Hearing of June 19, 1991 in Oakland, and announcing the opportunity for public comment at an evening public meeting held at the Fairwood Elementary School Cafeteria, 1110 Fairwood Avenue, in the City of Sunnyvale on Thursday, June 27, 1991. Public comment was received during a 60-day period from June 19, 1991 through August 19, 1991.

Fact Sheets for Operable Unit 1 were mailed to interested residents, local government officials, and media representatives. Fact Sheet 1, mailed in April 1990, summarized the contamination problem, the results of investigations to date, and the interim remedial actions in Subunits 1 and 3. Fact Sheet 2, mailed in June 1991, described the cleanup alternatives evaluated, explained the

proposed final remedy for Subunits 1, 2, and 3, announced opportunities for public comment at the Board Hearing of June 19, 1991 in Oakland and the Public Meeting of June 27, 1991 in Sunnyvale and described the availability of further information at the Information Repository at the Board offices. The Responsiveness Summary provides responses to significant comments received during the public comment period. Fact Sheet 3, to be mailed in September 1991, will explain the adopted cleanup plan contained in this and the other Orders comprising the final cleanup plans for Operable Unit 1.

29. **State Board Resolution No. 68-16, "Statement of Policy with Respect to Maintaining High Quality Waters in California"** On October 28, 1968, the State Water Resources Control Board adopted Resolution No. 68-16, "Statement of Policy with Respect to Maintaining High Quality Waters in California". This policy calls for maintaining the existing high quality of State waters unless it is demonstrated that any change would be consistent with the maximum public benefit and not unreasonably affect beneficial uses. The original discharges of waste in Subunit 2 and in Subunit 1, which impacted ground water in Subunit 2, were in violation of this policy; therefore, the groundwater quality needs to be restored to its original quality to the extent reasonable. For the purpose of establishing cleanup objectives, the shallow groundwater in Subunit 2 is designated a potential source of drinking water (see Finding 11.).

Cleanup of groundwater to below the MCLs for the chemicals of concern such as TCE, vinyl chloride, 1,1-DCA, PCE, and 1,2-DCE may not be achievable due to the technical difficulties in restoring aquifers by the removal of low concentrations of any VOC. This is due to the slow desorption of VOCs adsorbed to the inner pore spaces of soil particles which make up the aquifer material and VOCs adsorbed to clays and organic matter in the aquitard. Cleanup to MCL levels for chemicals such as TCE, vinyl chloride, 1,1-DCA, PCE, and 1,2-DCE would protect the primary beneficial use of the groundwater as a potential source of drinking water. For these reasons, the cleanup standards were accepted as concentrations which meet the intent of Resolution No. 68-16.

The cleanup standards meet current applicable health criteria and restore the quality of the ground water to the extent reasonable given technical and economic constraints. These constraints include the high additional incremental costs for removal of small amounts of additional chemicals and the need to minimize the removal of ground water due to the drought to achieve acceptable remedial standards.

30. **Groundwater Conservation** AMD has considered the feasibility of reclamation, reuse, or discharge to a publicly owned treatment works (POTW) of treated, extracted groundwater from Subunit 2, as specified in Board Resolution No. 88-160. Based on AMD's evaluation, the Board concurs that ground water reclamation, reuse, or discharge to a POTW in Subunit 2 is not feasible.

31. **Administrative Record** The Administrative Record has been prepared in accordance with EPA Guidance, has been made available for public review, and provides the backup documentation for the recommendations of staff and decisions by the Board.

32. **Basin Plan** The Board adopted a revised Water Quality Control Plan for the San Francisco Bay Basin (Basin Plan) on December 17, 1986. The Basin Plan contains water quality objectives and beneficial uses for South San Francisco Bay and contiguous surface and ground waters.

33. **Beneficial Uses** The existing and potential beneficial uses of the groundwater underlying and adjacent to Subunit 2 include:

    a. Industrial process water supply
    b. Industrial service water supply
    c. Municipal and Domestic water supply
    d. Agricultural water supply

34. The selected Remedial Action Plan for Subunit 2 was chosen in accordance with the Health and Safety Code Section 25356.1, CERCLA/SARA, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), California Water Code Section 13304, and pursuant to MSCA. This decision is based on the Administrative Record for Operable Unit 1.

35. The dischargers have caused or permitted, and threaten to cause or permit waste to be discharged or deposited where it is or probably will be discharged to waters of the State and creates or threatens to create a condition of pollution or nuisance. Containment and cleanup measures need to be continued to alleviate the threat to the environment posed by the continued migration of the ground water plume of contaminants.

36. This action is an order to enforce the laws and regulations administered by the Board. This action is categorically exempt from the provisions of the CEQA pursuant to Section 15321 of the Resources Agency Guidelines.

37. The Board has notified the dischargers and interested agencies and persons of its intent under California Water Code Section 13304 to prescribe Site Cleanup Requirements for the discharge and has provided them with the opportunity for a public hearing and an opportunity to submit their written views and recommendations.

38. The Board, in a public meeting, heard and considered all comments pertaining to the discharge.

39. This Order supersedes and rescinds Site Cleanup Order No. 89-61, adopted by the Board April 19, 1989.

IT IS HEREBY ORDERED, pursuant to Section 13304 of the California Water Code and Section 25356.1 of the California Health and Safety Code, that the dischargers, their agents and assigns or successors,

shall cleanup and abate the effects described in the above findings as follows:

A. PROHIBITIONS

1. The discharge of wastes or hazardous materials in a manner which will degrade water quality or adversely affect the beneficial uses of the waters of the State is prohibited.

2. Further significant migration of contaminants through subsurface transport to waters of the State is prohibited.

3. Activities associated with the subsurface investigation and cleanup which will cause significant adverse migration of contaminants are prohibited.

B. SPECIFICATIONS

1. The storage, handling, treatment or disposal of soil or groundwater containing contaminants shall not create a nuisance as defined in Section 13050(m) of the California Water Code.

2. The dischargers shall conduct monitoring activities according to a program as described in the Field Sampling Plan, approved January 1990, until such time as a revised Field Sampling Plan is approved by the Executive Officer. The monitoring activities are to define the current local hydrogeologic conditions, and the lateral and vertical extent of ground water contamination. Should monitoring results show evidence of contaminant migration, additional characterization of contaminant extent may be required.

3. Final cleanup standards for all wells in Subunit 2 shall not be greater than the levels described in Finding 24. and listed on Table 3.

4. The dischargers shall implement the final cleanup plan described in Finding 23.

C. PROVISIONS

1. The dischargers shall submit to the Board acceptable monitoring program reports containing results of work performed according to a program as described in the Field Sampling Plan, approved January 1990, until such time as a revised Field Sampling Plan is approved by the Executive Officer.

2. The dischargers shall comply with the Prohibitions and Specifications above, in accordance with the following tasks and compliance time schedules:

   REVISED FIELD SAMPLING PLAN

   a. TASK 1 - REVISED FIELD SAMPLING PLAN: Submit a technical report acceptable

to the Executive Officer containing a proposed revised Field Sampling Plan, as described in CERCLA/SARA guidance. This plan should include a schedule for groundwater sampling to satisfy the criteria described in Finding 23.e. and Specification B.2. The revised Field Sampling Plan should also include a proposal for verification sampling for the soil remediation (excavation and vapor extraction) and a schedule for soil sampling that will follow the attainment of soil cleanup standards. This plan should also include analysis by appropriate EPA series 8000 analysis techniques.

COMPLETION DATE: January 31, 1992

INSTITUTIONAL CONSTRAINTS

b. TASK 2 - PROPOSED CONSTRAINTS: Submit a technical report acceptable to the Executive Officer documenting procedures to be implemented by the dischargers, including a deed restriction prohibiting the use of the A and B aquifer ground water as a source of drinking water, and for controlling activities at the AMD facility that could endanger the public health or the environment due to exposure to VOCs and PNAs. Constraints shall remain in effect until groundwater cleanup standards have been achieved and contaminant levels have stabilized in the A and B aquifers in Subunit 2.

COMPLETION DATE: October 30, 1991

c. TASK 3 - CONSTRAINTS IMPLEMENTED: Submit a technical report acceptable to the Executive Officer documenting that the proposed and approved constraints have been implemented.

COMPLETION DATE: 60 days after Board staff approval of Task 2.

UPDATING ADMINISTRATIVE RECORD

d. TASK 4 - PROPOSED UPDATE: Submit a technical report acceptable to the Executive Officer containing an updated index for the Administrative Record for the period June 19, 1991 through September 30, 1991.

COMPLETION DATE: October 15, 1991

e. TASK 5 - UPDATE ADMINISTRATIVE RECORD: Submit a technical report acceptable to the Executive Officer containing the updated Administrative Record documents for the period June 19, 1991 through September 30, 1991.

COMPLETION DATE: December 1, 1991

SOIL REMEDIATION

f. TASK 6 - SOIL EXCAVATION: Submit a technical report acceptable to the

Executive Officer describing the soil excavation in Subunit 2 including a proposed implementation schedule, and name, permit number, and location for offsite soil disposal. This report shall also include analytical limits on soil disposal for chemicals of concern.

COMPLETION DATE: June 30, 1992

g. TASK 7 - SOIL VAPOR EXTRACTION: Submit a technical report acceptable to the Executive Officer containing the proposed plan of soil vapor extraction for all areas to be remediated by this method. This report should include the proposed implementation schedule and specific system layout for each area. The proposed implementation schedule must allow a sufficient amount of time for evaluation of the effectiveness of the system, Board staff review of the required system modification, if necessary, and additional operating time; and should lead to total completion of soil remediation by September 30, 1996.

COMPLETION DATE: January 31, 1992

h. TASK 8 - VAPOR EXTRACTION CURTAILMENT CRITERIA AND PROPOSAL: Submit a technical report acceptable to the Executive Officer containing a proposal for curtailing pumping from any soil vapor extraction well(s) or piping in Subunit 2 and the criteria used to justify such curtailment. This report shall include a proposal indicating the locations of borings and sampling intervals to determine concentrations of organic chemicals remaining in soil. The proposal may include the temporary termination of vapor extraction well operation for an extended period of time to study the effects on chemical migration prior to well abandonment.

If the dischargers claim that it is not practicable to achieve soil cleanup standards through continued soil vapor extraction in all or any portion of the soil plume area in Subunit 2 and that significant quantities of chemicals are not being removed through soil vapor extraction, the dischargers shall evaluate the reductions in chemical concentrations and the alternative soil cleanup standards that can be practically achieved. The report shall evaluate alternative means of achieving soil cleanup standards and whether conditions for waiving these standards are met (e.g., that meeting the soil cleanup standards is technically impracticable from an engineering perspective) and that the alternative soil cleanup standards proposed will be protective of human health and the environment.

COMPLETION DATE: 90 days prior to proposed curtailment of any soil vapor extraction well or treatment system.

i. TASK 9 - COMPLETION OF SOIL REMEDIATION: Document in a technical report the completion of the necessary tasks identified in the technical report submitted for Tasks 6 and 7. This Report should include the results of chemical analyses of appropriate samples from the excavation(s) and source areas in Subunit 2.

COMPLETION DATE: One month following the completion of all soil remediation activities but no later than October 31, 1996.

EXPANSION OF GROUND WATER EXTRACTION AND TREATMENT SYSTEM

j. TASK 10 - INSTALLATION OF ADDITIONAL EXTRACTION WELLS IN SUBUNIT 2: Submit a technical report acceptable to the Executive Officer documenting the installation of additional extraction wells in Subunit 2 and the connection of these wells to the existing treatment system in Subunit 2. This report shall also contain the first two weeks of monitoring data after connection of the additional extraction wells.

COMPLETION DATE: February 19, 1992

k. TASK 11 - EVALUATE EFFECTIVENESS OF EXPANDED EXTRACTION AND TREATMENT SYSTEM IN SUBUNIT 2: Submit a technical report acceptable to the Executive Officer which evaluates the effectiveness of the expanded extraction and treatment system. Such an evaluation should include, but not be limited to, an estimation of the capture zone of the extraction wells, establishment of the cones of depression by field measurements, and presentation of chemical monitoring data. A map shall be included that superimposes the capture zone on the pollutant plume for all affected aquifer zones. Specific modifications to the system and an implementation time schedule shall be proposed in the event that the system is demonstrated not to be effective in containing and removing the ground water contaminants.

COMPLETION DATE: Ninety days after Board staff approval of the technical report required by Task 10.

CURTAILING GROUND WATER EXTRACTION

l. TASK 12 - SUBUNIT 2 WELL PUMPING CURTAILMENT CRITERIA AND PROPOSAL: Submit a technical report acceptable to the Executive Officer containing a proposal for curtailing pumping from groundwater extraction well(s) in Subunit 2 and the criteria used to justify such curtailment. This report shall include data to show that cleanup standards for chemicals of concern have been achieved and have stabilized or are stabilizing, and that the potential for contaminant levels rising above cleanup standards is minimal. This report shall also include an evaluation of the potential for contaminants to migrate downwards to the B3 and lower aquifers in Subunit 2. If the dischargers claim that it is not technically feasible to achieve cleanup standards, the report shall evaluate the alternate standards that can be achieved. Cessation of pumping will require the concurrence of the Board and EPA. Should either party not concur, continued pumping will be required.

In addition, the dischargers may request curtailment of pumping based on submittal of a technical report acceptable to the Executive Officer that includes a

demonstration that all chemicals originating from sources on their sites have been removed or cleaned up to the levels required by this Board Order and that any chemicals that remain above the standards required by this Board Order originate from other sources.

COMPLETION DATE: 90 days prior to proposed extraction well pumping curtailment in Subunit 2.

m. TASK 13 - IMPLEMENTATION OF SUBUNIT 2 WELL PUMPING CURTAILMENT: Submit a technical report acceptable to the Executive Officer documenting completion of the necessary tasks identified in the technical report submitted for Task 12.

COMPLETION DATE: 30 days after the Board approves the proposal for extraction well pumping curtailment in Subunit 2.

NONBINDING PRELIMINARY ALLOCATION OF RESPONSIBILITY (NBAR) COMPLETION:

n. TASK 14 - SUBMIT UPDATED, REVISED NBAR REPORT: Submit a technical report acceptable to the Executive Officer containing an updated and revised proposed NBAR report, based on the Executive Officer's comments on NSC's and AMD's May 1991 draft NBAR reports and any guidance provided by the Executive Officer for completion of the NBAR reports. This report shall be sent by certified mail to all companies named in the report.

COMPLETION DATE: 60 days after request made by the Executive Officer.

STATUS REPORT

o. TASK 15 - FIVE-YEAR STATUS REPORT AND EFFECTIVENESS EVALUATION FOR SUBUNIT 2: Submit a technical report acceptable to the Executive Officer containing the results of any additional investigation in Subunit 2 including the soil remediation study; an evaluation of the effectiveness of installed final cleanup measures and cleanup costs; additional recommended measures to achieve final cleanup objectives and standards, if necessary; a comparison of previous expected costs with the costs incurred and projected costs necessary to achieve cleanup objectives and standards; and the tasks and time schedule necessary to implement any additional final cleanup measures.

This report shall evaluate and document the cleanup of contaminated groundwater, and evaluate and document the removal and/or cleanup of contaminated soil. If safe drinking water levels, through the removal of the chemicals for which this Order specifies cleanup standards, have not been achieved in Subunit 2 and are not expected to be achieved through continued groundwater extraction and/or soil remediation, this report shall also contain an evaluation addressing whether it is technically feasible to achieve drinking-water

quality in Subunit 2, and if so, a proposal for procedures to do so.

COMPLETION DATE: September 18, 1996

NEW HEALTH CRITERIA

p. TASK 16 - EVALUATION OF NEW HEALTH CRITERIA: Submit a technical report acceptable to the Executive Officer which contains an evaluation of how the final plan and cleanup standards would be affected, if the concentrations as listed in Specification B.3. and Table 3, change as a result of changes in source-document conclusions or promulgation of drinking water standards, maximum contaminant levels or action levels.

COMPLETION DATE: 60 days after request made by the Executive Officer.

3. AMD is responsible for and shall comply with all tasks and compliance time schedules in Provision C.2. above. NSC is responsible for and shall comply with all tasks that are related to the commingled plume of ground water contamination in Subunit 2 and soil contamination that may have resulted from such ground water contamination. NSC is not responsible for soil and ground water contamination emanating from surface activities at the AMD facility. Specifically, NSC and AMD shall jointly comply with Tasks 1 and 10 through 16 and associated compliance time schedules of Provision C.2. above, as they relate to the commingled plume of ground water contamination.

   If NSC fails to comply with any of the provisions of this Order for which it is responsible, within sixty (60) days of the Executive Officer's determination and actual notice, UTC, HP, and ST shall comply with the provisions of this Order as noticed.

4. All Technical reports submitted must be acceptable to the Executive Officer. The submittal of technical reports evaluating final remedial measures shall include a projection of the cost, effectiveness, benefits, and impact on public health and the environment of each remedial measure. If any additional remedial investigations and feasibility studies are found to be necessary, they shall be consistent with the guidance provided by Subpart F of the National Oil and Hazardous Substances Pollution Contingency Plan (40 CFR Part 300); Section 25356.1(c) of the California Health and Safety Code; CERCLA guidance documents with reference to Remedial Investigations, Feasibility Studies, and Removal Actions; and the State Water Resources Control Board's Resolution No. 68-16, "Statement of Policy with Respect to Maintaining High Quality of Waters in California".

5. If the dischargers are delayed, interrupted or prevented from meeting one or more of the completion dates specified in this Order, the dischargers shall notify the Executive Officer prior to the deadline for the completion date.

6. Technical reports summarizing the status of compliance with the Prohibitions, Specifications, and Provisions of this Order shall be submitted on a quarterly basis, according to the schedule below, commencing with the report for the fourth quarter 1991,

due January 31, 1992.

QUARTER	First	Second	Third	Fourth
PERIOD	Jan.-March	April-June	July-Sept.	Oct.-Dec.
DUE DATE	April 30	July 31	October 31	January 31

The quarterly reports shall include;

a. a summary of work completed since the previous quarterly report, and work projected to be completed by the time of the next quarterly report,
b. appropriately scaled and labeled maps showing the location of all monitoring wells, extraction wells, and existing structures,
c. updated water table and piezometric surface maps for all affected water bearing zones, and isoconcentration maps for key contaminants in all affected water bearing zones, to be included at a minimum in the reports for the second and fourth quarters, or in the event of significant changes,
d. a summary tabulation of all groundwater levels and chemical analysis results for Subunit 2 monitoring wells as specified in the revised Field Sampling Plan,
e. a summary tabulation of volume of extracted groundwater and chemical analysis for all Subunit 2 groundwater extraction wells,
f. a status summary of soil remediation at all source areas, including the actual or projected date of vapor extraction system installation, an evaluation of the effectiveness of the vapor extraction system based on operational and monitoring data, and proposed modifications to the system, if necessary, to achieve soil cleanup standards,
g. an estimate of volume or mass of contaminants removed by each remedial system in the quarter and a cumulative tabulation of the total volume or mass of contaminants removed (total and lbs/day),
h. identification of potential problems which will cause or threaten to cause noncompliance with this Order and what actions are being taken or planned to prevent these obstacles from resulting in noncompliance with this Order, and
i. in the event of noncompliance with the Provisions and Specifications of this Order, the report shall include written justification for noncompliance and proposed actions and schedule to achieve compliance.

7. On an annual basis beginning on July 31, 1992, or as required by the Executive Officer, the dischargers' July 31 progress reports shall include, but need not be limited to, an evaluation of the progress of cleanup measures and the feasibility of meeting ground water cleanup standards established in this Order. This report shall include a discussion of the efficiency of the existing ground water extraction wells at removing ground water contamination during the previous year. If

significant reductions in ground water contamination levels are not being achieved, then the report shall propose construction of new and/or alternative extraction wells in order to increase the efficiency of the ground water extraction systems. If the dischargers propose that it is not technically feasible to meet the cleanup standards established by this Order, the report shall also contain an evaluation of maximum cleanup levels that could be achieved.

The Executive Officer may approve reduction of the scope of the above report based on a demonstration that the contaminant levels in the groundwater have stabilized and that the predicted change in groundwater quality is insignificant over a one year period.

8. All hydrogeological plans, specifications, reports, and documents shall be signed by or stamped with the seal of a registered geologist, engineering geologist or professional engineer.

9. All samples shall be analyzed by State certified laboratories or laboratories accepted by the Board using approved EPA methods for the type of analysis to be performed. All laboratories shall maintain Quality Assurance/Quality Control records for Board review.

10. The dischargers shall maintain in good working order, and operate, as efficiently as possible, any facility or control system installed to achieve compliance with the requirements of this Order.

11. Copies of all correspondence, reports, and documents pertaining to compliance with the Prohibitions, Specifications, and Provisions of this Order, shall be provided to the following agencies:

    a. Santa Clara Valley Water District
    b. Santa Clara County Health Department
    c. City of Santa Clara
    d. City of Sunnyvale
    e. U. S. EPA Region IX

    The Executive Officer may additionally require copies of correspondence, reports and documents pertaining to compliance with the Prohibitions, Specifications, and Provisions of this Order to be provided to a local repository for public use.

12. The dischargers shall permit the Board or its authorized representative, in accordance with Section 13267(c) of the California Water Code:

    a. Entry upon premises in which any contamination sources exist, or may potentially exist, or in which any required records are kept, which are relevant to this Order.
    b. Access to copy any records required to be kept under the terms and conditions of this Order.

c. Inspection of any monitoring equipment or methodology implemented in response to this Order.

d. Sampling of any groundwater or soil which is accessible, or may become accessible, as part of any investigation or remedial action program undertaken by the dischargers.

13. AMD shall file a report on any changes in site occupancy and ownership associated with the AMD facility described in this Order.

14. If any hazardous substance is discharged to any waters of the state, or discharged and deposited where it is, or probably will be discharged to any waters of the state, the dischargers shall report such discharge to this Board, at (415) 464-1255 on weekdays during office hours from 8 a.m. to 5 p.m., and to the Office of Emergency Services at (800) 852-7550 during non-business hours. A written report shall be filed with the Board within five (5) working days and shall contain information relative to: the nature of waste or contaminant, quantity involved, duration of incident, cause of spill, Spill Prevention, Control, and Countermeasure Plan (SPCC) in effect, if any, estimated size of affected area, nature of effect, corrective measures that have been taken or planned, and a schedule of these activities, and persons/agencies notified.

15. Pursuant to Water Code Section 13304(c), the dischargers are hereby notified that the Board is entitled to and may seek reimbursement for all reasonable staff oversight costs incurred relating to cleanup of wastes in Subunit 2, abating the effects thereof, or taking other remedial action.

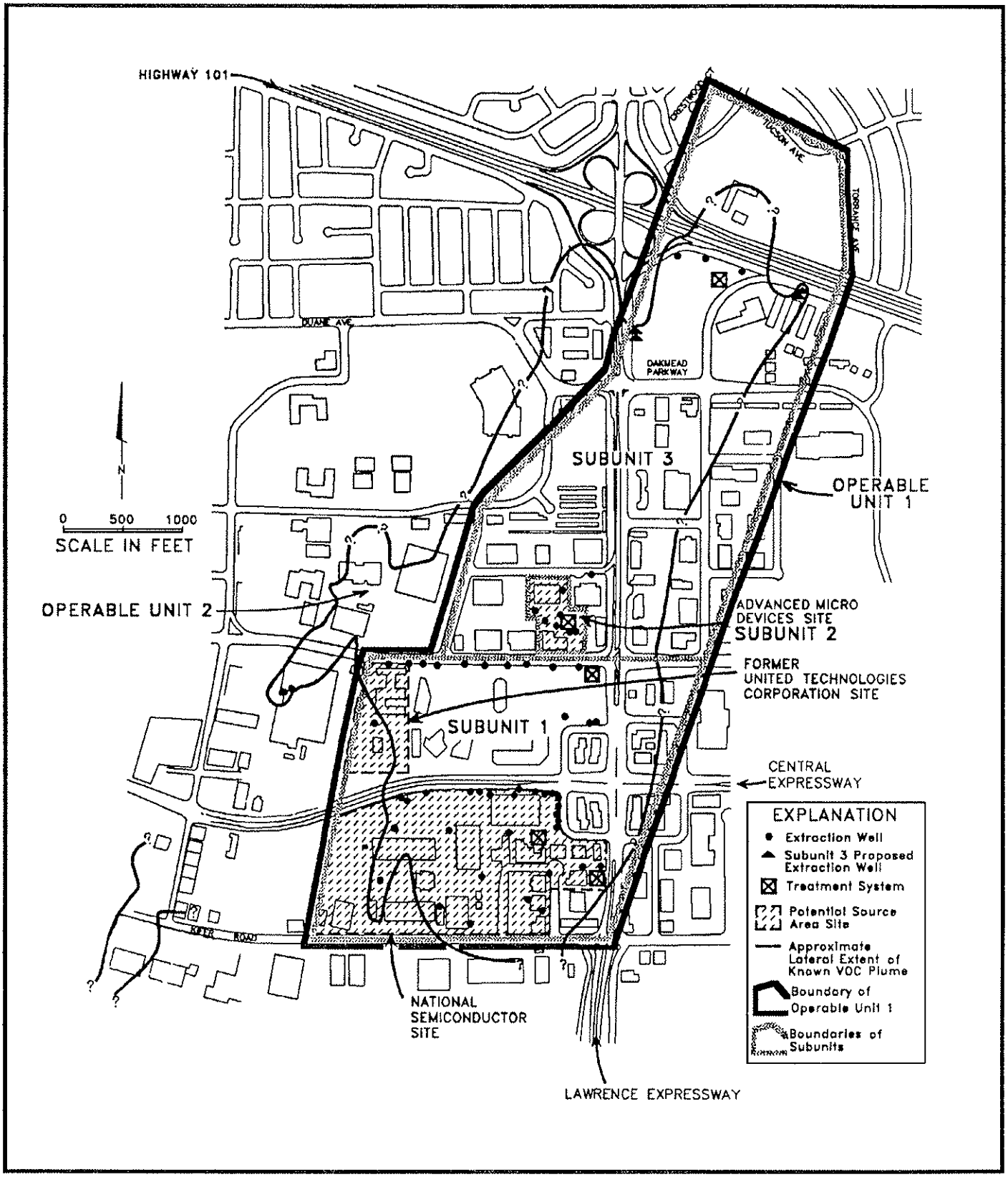
16. The Board will review this Order periodically and may revise the requirements when necessary.

I, Steven R. Ritchie, Executive Officer, do hereby certify that the foregoing is a full, true and correct copy of an Order adopted by the California Regional Water Quality Control Board, San Francisco Bay Region, on September 18, 1991.

Steven R. Ritchie
Executive Officer

Attachments: Figure 1: Study Area Map
Figure 2: General Location Map
Table 1: Chemicals of Concern for Subunit 2
Table 2: Remedial Alternatives Summary for Subunit 2
Table 3: Ground Water Cleanup Standards for Subunit 2
Attachment A: Agency Addendum to AMD's RI and FS Reports

Figure 1 - Map of Study Area



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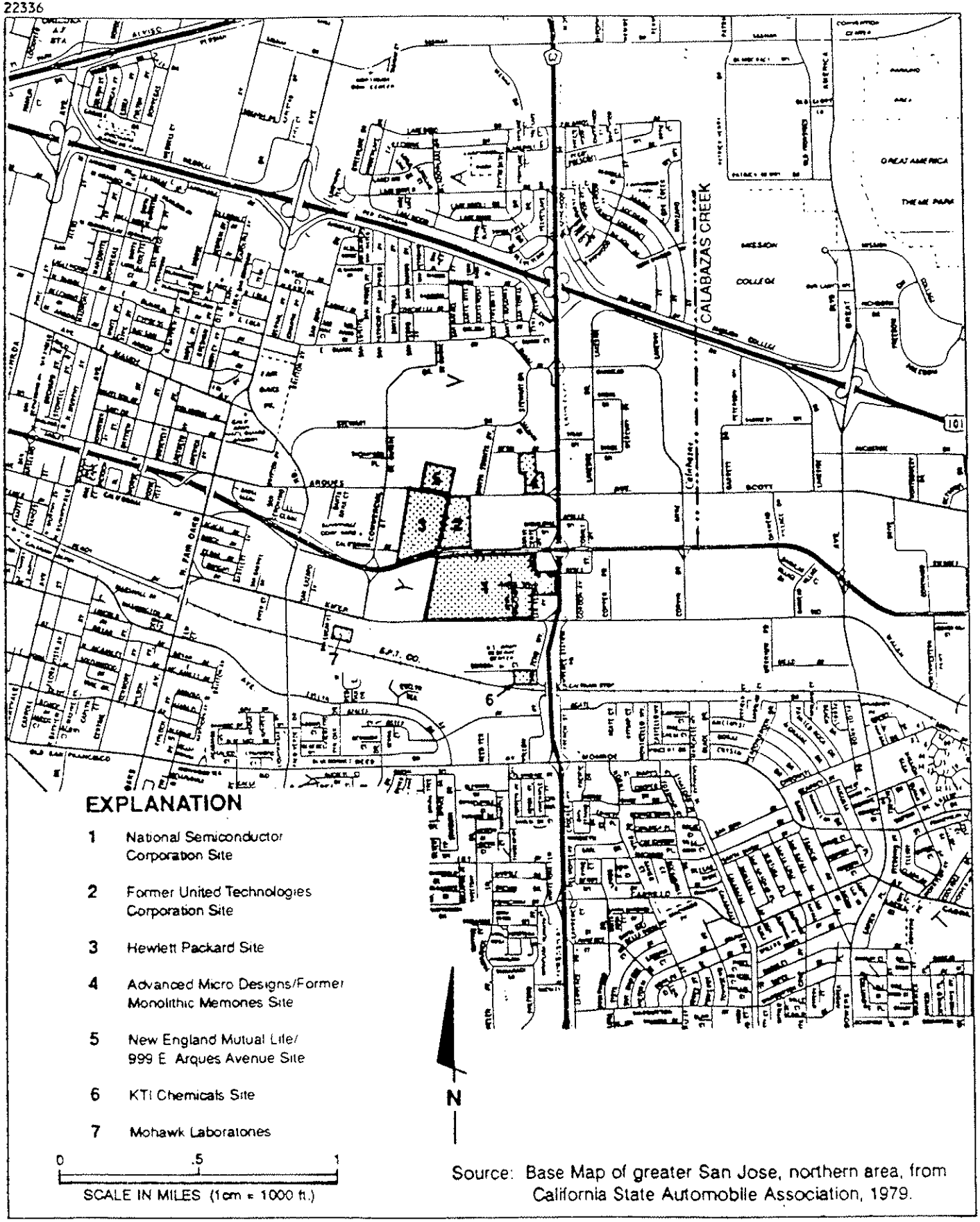

Source: Base Map of greater San Jose, northern area, from California State Automobile Association, 1979.

FIGURE 2

General Location Map

TABLE 1

CHEMICALS OF CONCERN

Advanced Micro Devices & National Semiconductor Corporation
Subunit 2, Operable Unit 1
Sunnyvale and Santa Clara, Santa Clara County

Chemicals	Medium	
Organic Chemicals	Groundwater(a)	Soil(b)
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

Table 2 Comparison of Remedial Alternatives for Subunit 2

Alternative	Protection of Human Health and the Environment	Compliance with ARARs	Long-term Effectiveness	Reduction in Toxicity, Mobility, and Volume	Short-term Effectiveness	Implementability	Cost Present Value (millions)
1 No Action	Not Protective CRR = 2.6×10^{-3} HI = 1^{+}	No	Not Effective	No Reduction of T, M, or V	Not Effective GCT > 200 years	Implementable	$ 0.8
2 Maintain Existing Groundwater Extraction Systems	Protective CRR = 2.3×10^{-5} HI = 0.93	No	Not Effective	Reduction of T, M, and V of groundwater. No Reduction of T, M, and V of soil	Effective GCT = 50 - 100 years	Implementable (systems currently in place)	$ 2.5
3 Maintain Existing Groundwater Extraction Systems and Remediate Soil	Protective CRR = 2.3×10^{-5} HI = 0.93	Yes	Effective	Reduction of T, M, and V	Effective GCT = 50 to 100 years	Implementable	$ 2.5

CRR = Carcinogenic Risk Range
HI = Hazard Index
GCT = Groundwater Cleanup Time to cleanup to Regional Board standards

TABLE 3

GROUNDWATER CLEANUP STANDARDS
Advanced Micro Devices & National Semiconductor Corporation
Subunit 2, Operable Unit 1
Sunnyvale and Santa Clara, Santa Clara County

(all values in $\mu g/l$)

COMPOUND	FEDERAL MCLG	FEDERAL MCL	CA ACTION LEVEL	CA MCL	CLEANUP STANDARD
Chlorobenzene	100	100	--	30	30
1,2-Dichlorobenzene	600	600	130	--	60
1,1-Dichloroethane	--	--	--	5	5
1,1-Dichloroethene	7	7	--	6	6
cis-1,2-Dichloroethene	70	70	--	6	6
trans-1,2-Dichloroethene	100	100	--	10	10
Ethylbenzene	700	700	--	680	68
Freon 113	--	--	--	1200	1200
Tetrachloroethene	0	5	--	5	5
1,1,1-Trichloroethane	200	200	--	200	200
Trichloroethene	0	5	--	5	5
Vinyl Chloride	0	2	--	0.5	0.5
Xylene (total)	10,000	10,000	--	1750	175

MCLG Maximum Contaminant Level Goal
MCL Maximum Contaminant Level
-- no criteria

ATTACHMENT A

AGENCY ADDENDUM FOR

ADVANCED MICRO DEVICES'
REMEDIAL INVESTIGATION AND FEASIBILITY STUDY REPORTS

Advanced Micro Devices (AMD) submitted a final draft Remedial Investigation (RI) Report on April 1, 1991, and a final draft Feasibility Study (FS) Report on May 9, 1991. Board Staff has determined that the technical information contained in these Reports is acceptable for developing a final cleanup plan. However, Board and other agency staff do not accept all interpretations and recommendations contained in these Reports. These areas of disagreement are discussed in this Agency Addendum. Furthermore, Board staff finds that certain sections of AMD's FS Report have not included information, discussions and calculations requested by Board staff in various comments on previous drafts of the FS Report. For brevity, some of these items are only mentioned below while the critical items which are essential for development of the proposed cleanup plan have been prepared by Board staff and included in this Agency Addendum. AMD's final draft RI and FS Reports, as amended and expanded by this Agency Addendum, constitute the final RI and FS Reports for the AMD facility and Subunit 2.

Specific section numbers discussed in this Agency Addendum correspond to sections of AMD's RI or FS Reports, as appropriate.

RI Report

As noted in Board staff's February 13, 1991, comment letter on the previous version of the RI Report (submitted August 17, 1990), Board staff did not concur with AMD's arguments of complete plume separation from National Semiconductor Corporation's (NSC's) "regional" contaminant plume. No new technical information has been included in the April 1991 final draft RI Report nor in AMD's April 1, 1991, "response to comments" letter, to further support AMD's arguments. Based on the current technical information available, Board staff feels there is not a preponderance of evidence to support AMD's position of responsibility for cleanup of A aquifer ground water under the AMD facility (Subunit 2) only. Therefore, AMD has been named a discharger in the Board Orders for Subunits 2 and 3 and is jointly responsible for the ground water cleanup in the A and B aquifers in Subunits 2 and 3. Board staff arrived at this conclusion based on the following reasons, which have been stated in previous verbal and written comments to AMD:

1. TCE and 1,2-DCE, constituents which AMD attributes to upgradient sources, namely NSC, have been detected in some shallow soil samples from the AMD facility. Although the levels have been low, they are consistent with levels found at other semiconductor sites in the Santa Clara Valley (among them, NSC) that are confirmed sources of TCE. As AMD acknowledges in its RI Report, these levels of TCE and 1,2-DCE may be the products of the biotransformation of PCE, which was known to have originated from the AMD facility. Because the release of PCE may have occurred more than 10 years ago and PCE has a biotransformation half-life of 0.7 years, it is unclear, based on current soil samples, how much PCE was released to the soil, how much PCE was transformed to TCE and 1,2-

DCE, and how much PCE, TCE, and 1,2-DCE was released to the ground water. Furthermore, AMD's argument that the TCE and 1,2-DCE measured in shallow soils have "likely resulted from the ground water as suggested by the pattern of increasing soil contamination with depth approaching the ground water table" is contradicted by data from Borings CCB-5, CCB-15, and CCB-25. In these borings TCE and 1,2-DCE were detected in shallow samples but not detected in deeper samples from the same borings.

2. With regard to the A aquifer, the RI Report acknowledges that PCE has degraded into TCE and 1,2-DCE in the A aquifer. By looking at historical ground water data prior to 1986, when the ground water extraction and treatment system was initiated, there is insufficient evidence that this TCE and 1,2-DCE remained onsite within AMD's property boundaries. Even if PCE was never detected in ground water monitoring wells immediately downgradient from the AMD site, this does not prove that PCE's degradation products, TCE and 1,2-DCE, both more mobile compounds, did not leave the AMD facility. AMD has stated that since the log octanol/water partitioning coefficient (K_{ow}) of PCE and TCE is 2.53, both chemicals have equal mobility tendencies. Therefore, because PCE has not been detected downgradient from the AMD facility, AMD feels that this is evidence that AMD did not contribute TCE to the area downgradient of the facility. Board staff acknowledges that comparison of the log K_{ow} of two chemicals provides an indication of which chemical will travel faster in the ground water (i.e., the chemical with the smaller K_{ow} will travel faster). However, the value of 2.53 for both PCE and TCE is from only one reference. Numerous references, (including the *Health Effects Assessment for PCE and TCE, U.S. EPA, 1985* which gives a log K_{ow} of 2.6 for PCE and a log K_{ow} of 2.38 for TCE) consistently list greater values for PCE than for TCE, which indicates that TCE is a more mobile compound. Furthermore, AMD does not discuss 1,2-DCE, a degradation product of TCE and PCE in this context. Like TCE, 1,2-DCE has a smaller log K_{ow} than PCE.

3. With regard to the B aquifer, although there is some evidence from pump tests performed by Canonie Environmental in 1988 that the A/B aquitard is hydraulically competent onsite, there is also some evidence from pump tests performed by Woodward Clyde Consultants in 1985 that the A/B aquitard is hydraulically incompetent onsite. Since the two pump tests measured responses from two different sets of wells, we cannot discount one based on results of another. Secondly, as CDM has pointed out in their previous comments, results of Canonie's pump tests may be interpreted differently as well as the well logs used in their cross sections for the site. Finally, even though the A/B aquitard may be competent onsite, not enough data (few wells and no pump tests) exists regarding the area immediately downgradient from the site. As pointed out above, degradation products of PCE may have travelled offsite in the A aquifer. Given the heterogeneous nature of the formations in the South Bay, these degradation products may have entered the B aquifer downgradient.

Some typographical errors and incomplete data discussions and tables persist in the RI Report. A major error that directly affects the proposed cleanup plan for Subunit 2 is found in Figure 37

of the RI Report. The extent of Area 1 which is to be remediated for VOCs and PNAs is incorrect as shown. The correct extent is shown in Figure 8 of the final draft (May 1991) FS Report.

FS Report

Sections 1.6.1.2, 5.11.4.5, & 5.11.4.7 (B Aquifer Remedial Unit & Remedial Unit Alternative IV): AMD references the model, used by NSC, in their final FS Report for remediation of the B aquifer. AMD acknowledges that the placement, number of wells (which includes the three B aquifer extraction wells on the AMD facility), and modeling performed in NSC's FS Report is a "logical preliminary" design for the remediation of the B aquifer. AMD further states that continued operation of the AMD extraction and treatment system will provide remediation of the B aquifer in Subunit 2 within 30 years. The basis for this 30 year B aquifer cleanup estimate is unclear. The modeling presented by AMD in Appendix B of their FS Report was done only for the A aquifer so the 30 year B aquifer cleanup estimate was not based on any modeling done by AMD. The estimated cleanup time presented for the B aquifer in NSC's FS Report is 50-100 years. Since Board staff finds the model used by NSC to be reasonable and it was the only model used for the B aquifer remediation, 50-100 years is thus taken as the estimated time to cleanup for the B aquifer.

Section 2.3.1.1: AMD states that "In its guidance, EPA has chosen to apply Maximum Contaminant Levels (MCLs) rather than MCLGs as the cleanup level for drinking water sources unless special circumstances require a more stringent standard." This is incorrect because EPA has stated that for cleanup of ground water that is or may be used for drinking, MCLGs greater than zero generally will be the cleanup standards, where relevant and appropriate. When the MCLGs equal zero (generally for carcinogens), the corresponding MCLs will be used as the cleanup levels where relevant and appropriate (*National Contingency Plan: preamble, pages 243-248; rule, page 516*). As such, AMD's statement should not be considered a part of the final FS Report.

Section 2.3.1.3: In the first two sentences of this section, AMD states that "The San Francisco Bay RWQCB has interpreted Resolution 68-16 to require maintenance of as many beneficial uses as is reasonably possible. Under this interpretation, cleanup of ground water is to proceed to the level at which the incremental cost of removing additional chemicals becomes unreasonable when measured against the incremental degree of cleanup achieved." These statements are inaccurate and previous Board staff comments have requested they be deleted from the report. Resolution 68-16 calls for maintaining the existing high quality of State waters unless it is demonstrated that any change would be consistent with the maximum public benefit and not unreasonably affect beneficial uses. As such, AMD's statement regarding Resolution 68-16 should not be considered a part of the final FS Report.

Chapter 3.0: Previous Board staff comments requested major revisions to this chapter, particularly with regard to the discussions on Remedial Action Objectives and Cleanup Standards. This chapter remains deficient because these comments have been ignored and the revisions not incorporated. The following discussion serves to "fill-in" some of these deficiencies with essential information that must be included in the final FS Report.

Remedial Action Objectives (Section 3.1): One primary remedial action objective that should be included in the text is that the aggregate carcinogenic risk (summed across simultaneous routes of exposure (i.e., ingestion, inhalation, etc.)), associated with a site which has been remediated should fall within the excess cancer risk range of 10^{-4} to 10^{-6}. Secondly, the aggregate non-carcinogenic risk, summed across simultaneous routes of exposure, should have a Hazard Index of less than 1.0 to be protective of public health. AMD's remedial action objective #3 to "Remediate contaminated ground water in the A and B aquifers to meet promulgated MCLs" is incorrect and reflects confusion between remedial action objectives and cleanup standard setting.

Cleanup Standards: Previous Board staff comments have outlined a very specific process for developing proposed cleanup standards for soil and ground water which are protective of human health and the environment. Use of this process results in the development of proposed cleanup standards that comply with CERCLA/SARA regulations and guidelines. This process was not discussed nor was it followed in AMD's FS Report. Therefore, this process is outlined and applied in this Agency Addendum.

As a first cut, proposed cleanup standards should be set at concentrations to comply with Applicable or Relevant and Appropriate Requirements (ARARs) (in this case, state and federal MCLs for ground water). In cases where attaining ARARs may still result in a cumulative excess lifetime upperbound cancer risk in excess of 10^{-4} due to additivity of the risk and/or when ARARs are not health-protective to this risk level, or when ARARs are not available, concentrations should be reduced to levels that will result in a total cancer risk, summed for all indicator chemicals across all exposure pathways, within EPA's acceptable range of 10^{-4} to 10^{-6}. Furthermore, the total exposures to indicator chemicals, summed for all chemicals across all exposure pathways, should result in an EPA acceptable non-carcinogenic Hazard Index of less than 1.0. Lastly, cleanup levels which correspond to a total carcinogenic risk of 10^{-6} should also be calculated, so as to comply with EPA guidance.

The discussion in the text of cleanup standards should also include the assumptions and formulas used for the calculations of the cumulative carcinogenic and non-carcinogenic risks. The results of these calculations should be contained in a table in the text, not in an appendix, and discussed in the text.

In Appendix H of the FS Report, AMD has provided three sets of possible cleanup standards for ground water along with the attendant risks from the ingestion and inhalation pathways associated with the use of ground water with these levels of

chemicals. The discussion on page H-2 states that for the risk analyses, it is assumed that domestic water supply wells would be installed in the A aquifer and that only the A aquifer is addressed. This is inappropriate because cleanup standards should apply to all contaminated ground water which would include both the A and B aquifers. Furthermore, ethylbenzene was not included in the risk calculations even though it is listed as an indicator chemical on Table 3 of the FS Report.

AMD's first set of proposed cleanup standards considers remediation of all indicator chemicals to their respective state or federal MCLs (whichever are lower). The associated carcinogenic risk was found to be 1.4×10^{-4} and the noncarcinogenic Hazard Index was found to be 1.22 (excluding ethylbenzene). Since the carcinogenic and noncarcinogenic risks are outside the acceptable risk ranges, cleanup standards set only to MCLs are not acceptable. Although AMD does not state in Appendix H of the FS Report that MCLs are the set of cleanup standards that they are proposing, there are many references in the text, tables, and other appendices that MCLs are the proposed cleanup standards. References such as those found on pages 24, 25, 33, 34, 77, 82, and 86 of the FS Report are inappropriate, again because cleanup standards only equal to MCLs are outside the acceptable risk ranges.

The second set of proposed cleanup standards considers cleanup to reduce all Group B carcinogens (TCE, PCE, and 1,1-DCA) to a total target risk of 10^{-5}. The corresponding cleanup standard for TCE was found to be 10.5 ppb which is greater than the MCL level of 5 ppb which is considered an ARAR. Therefore, regardless of the cumulative risk associated with this set of cleanup standards, ARARs have not been met, which implies that this set of cleanup standards is inappropriate.

AMD's third set of proposed cleanup standards considers cleanup to reduce vinyl chloride to its detection limit of 0.5. The cleanup standards for the remaining indicator chemicals were arrived at by assuming these chemicals will be proportionately reduced along with vinyl chloride. The cleanup standard for 1,2-DCE was found to be 6.2 ppb which is greater than its MCL of 6.0 ppb. Again, these cleanup standards do not meet ARARs. Furthermore, cleanup standards of 0.13 ppb for 1,1-DCA, 0.09 ppb for 1,1-DCE, and 0.19 for 1,1,1-TCA which are all well below the detection limit for these chemicals, may be unrealistically low and unachievable. Therefore, this set of cleanup standards is inappropriate.

Because AMD's FS Report does not contain one set of proposed cleanup standards that complies with CERCLA/SARA guidance, Board staff has reviewed the list of indicator chemicals, redone some of the calculations, and developed the set of cleanup standards (which includes ethylbenzene) contained in Table 3 of the proposed plan for Subunit 2. These cleanup standards do meet ARARs and have a total carcinogenic risk of 2.3×10^{-5} and a noncarcinogenic Hazard Index of 0.93 which are both within EPA's acceptable carcinogenic and non-carcinogenic risk ranges. Tables A-1 and A-2 show the calculations involved in arriving at these risk numbers.

Table A-1 shows that 1,1-DCE, which is classified as a Class C carcinogen (possible carcinogen), has been removed from the list of carcinogenic indicator chemicals. EPA's practice with respect to risk assessment and setting cleanup levels is to treat Class C carcinogens on a case-by-case basis, choosing either a modified-RfD approach or quantitative cancer risk assessment. The modified-RfD approach is similar to the RfD calculation normally used for assessment of non-cancer toxicity; an additional 10-fold safety factor is introduced to take into account the carcinogenic potential of Class C carcinogens. Thus for assessment of carcinogenic risk potential, the estimated daily intake (ingested dose) for 1,1-DCE should be compared to its oral RfD divided by the additional safety factor of 10; a value less than 1.0 for this ratio is interpreted as indicating no significant risk and confirms the appropriateness of not considering 1,1-DCE as a carcinogen. Furthermore, the safety factor of 10 should be used in the calculations of the noncarcinogenic Hazard Index for the indicator chemicals (see Table A-2). EPA's Region 9 Superfund program feels the available data for 1,1-DCE in ground water support the modified-RfD approach to setting cleanup levels. This approach is appropriate for those Class C carcinogens where the evidence for carcinogenicity is especially weak, such as for 1,1-DCE.

Table A-2 also shows that for xylenes, ethylbenzene, and 1,2-dichlorobenzene, whose MCLs are high compared with such chemicals as TCE, 1,2-DCE, and chlorobenzene, cleanup standards have been set at one-tenth the state or federal MCLs (whichever are lower). This was appropriate to lower the noncarcinogenic risk contribution to the overall Hazard Index from these chemicals. The lower cleanup standards for these three chemicals are considered achievable because the cleanup standard for chlorobenzene, a similar chemical, is set at 30 ppb, which is lower than the cleanup standards for any of the three chemicals.

Lastly, Table A-3 contains cleanup standards which would achieve a total carcinogenic risk of 1×10^{-6}. Tables A-1, A-2, and A-3 shall be considered a part of the final FS Report.

Sections 3.4, 3.6 & 3.7: As Board staff has commented before, there are more process options listed in Tables 10 and 11 than are described in these sections. Therefore, Tables 10 and 11 are incorrect and should not be considered a part of the final FS Report.

Chapter 5.0: Previous Board staff comments have requested that Alternatives be assembled such that general response actions and the process options chosen to represent the various technology types for each medium are combined to form alternatives for the AMD facility as a whole. AMD's Remedial Unit Alternatives II, III, and IV, listed on page 66 of AMD's FS Report, do not constitute facility-wide alternatives because they incorporate a separation of the ground water under the facility into A and B aquifer water with Alternative IV addressing only the B aquifer ground water. True facility-wide alternatives should address all contaminated soil and ground water. Therefore, Board staff has incorporated AMD's Alternative IV into AMD's Alternatives II and III

to form two facility-wide alternatives. These two alternatives combined with the no-action alternative (AMD's Alternative I) form the three facility-wide alternatives described in Table 2 of the Board Order for Subunit 2. Furthermore, once these three facility-wide alternatives are formed, the estimated cleanup time for the B aquifer determines the overall cleanup time associated with each alternative. That is, the estimated cleanup time for Alternatives 2 and 3 for Subunit 2 is 50-100 years, not 17 years which is based on AMD's model for the A aquifer only. (See discussion on Section 1.6.1.2 presented previously in this Agency Addendum.)

Another change that was made to AMD's Remedial Unit Alternatives is described below under Section 5.11.2.

Section 5.11.2: AMD's Remedial Unit Alternative No. II calls for partial excavation and in-situ aeration of soil. AMD proposes under this alternative to excavate contaminated soil, aerate it on site to the soil cleanup levels of 1 ppm total VOCs and 10 ppm total PNAs, and backfill the "clean" soil. All other contaminated soil would be treated by in-situ soil aeration which uses vacuum extraction wells. Because PNAs are considered to be semi-volatile chemicals, Board staff has some concerns whether the onsite aeration and vacuum extraction will be effective in achieving the 10 ppm total PNA concentrations. Therefore, Board staff, in defining Alternative 2 in the Board Order for Subunit 2, has included excavation with offsite treatment and/or disposal as an option for any areas where the soil cleanup levels are found to be un-achievable. The cost estimates contained in Table 2 of the Board Order for Subunit 2 reflect this additional option.

Sections 5.11.2.3, 5.11.3.3, & 5.11.4.3: The bases of the carcinogenic risk numbers and non-carcinogenic Hazard Indices presented on these pages is unclear. They do not match any of the numbers presented in Appendix H of AMD's FS Report. In any event, because Board staff has derived the cleanup standards for Subunit 2, as described above, appropriate risk numbers associated with Alternatives 2 and 3 are presented in Table 2 of the Board Order for Subunit 2.

Sections 5.11.2.6 & 5.11.3.6: AMD's Remedial Unit Alternatives II and III call for an expansion of the existing extraction system on the AMD Facility by the addition of two additional extraction wells. These two sections are incorrect in stating that these alternatives will use the existing extraction wells only. As such, these statements should not be considered a part of the final FS Report.

Section 5.11.4.6: AMD's Remedial Unit Alternative IV requires continued operation of the existing B aquifer extraction (three wells) and treatment system (one air stripper) on the AMD facility in Subunit 2. This section is incorrect in stating that this alternative requires seven new extraction wells and one new air-stripper system to be implemented. As such, these statements should not be considered a part of the Final FS Report.

TABLE A-1
(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] [µg/l]	CHRONIC DAILY INTAKE (CDI)[2] [mg/kg/day]	ORAL CANCER POTENCY FACTOR (CPF_o) [(mg/kg/day)$^{-1}$]	INHALATION CANCER POTENCY FACTOR (CPF_i) [(mg/kg/day)$^{-1}$]	INGESTION RISK ($CDI*CPF_o$)	INHALATION RISK ($CDI*CPF_i$)	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 [yrs] * exposure frequency [days/yr]) / (body wght [kg] * avging time [days])
CDI = (cleanup standard [mg/l] * 2 * 30 * 365) / (70 * 27,375)

TABLE A-2
(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] [µg/l]	CHRONIC DAILY INTAKE (CDI)[3] [mg/kg/day]	ORAL REFERENCE DOSE (RfD_o) [mg/kg/day]	INHALATION REFERENCE DOSE (RfD_i) [mg/kg/day]	INGESTION HAZARD (CDI/RfD_o)	INHALATION HAZARD (CDI/RfD_i)	TOTAL HAZARD QUOTIENT
Chlorobenzene	30	8.58E-04	0.02	----	0.429	----	0.429
1,2-Dichlorobenzene	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 ($RfD_o/10$ = 0.009/10 = 0.0009)

TABLE A-3
(Agency Addendum for Advanced Micro Devices' RI & FS Reports, Page 10 of 10)

HYPOTHETICAL GROUND WATER CLEANUP STANDARDS NECESSARY TO ACHIEVE A TOTAL CARCINOGENIC RISK OF 1 X 10^{-6}
Advanced Micro Devices and National Semiconductor Corporation
Subunit 2, Operable Unit 1
Sunnyvale and Santa Clara, Santa Clara County

CHEMICAL	CLEANUP STANDARD[1] [µg/l]	CHRONIC DAILY INTAKE (CDI)[2] [mg/kg/day]	ORAL CANCER POTENCY FACTOR (CPF_o) [(mg/kg/day)$^{-1}$]	INHALATION CANCER POTENCY FACTOR (CPF_i) [(mg/kg/day)$^{-1}$]	INGESTION RISK (CDI*CPF_o)	INHALATION RISK (CDI*CPF_i)	TOTAL CARCI-NOGENIC RISK
1,1-Dichloroethane	0.23	2.63E-06	0.091	----	2.39E-07	-----	2.4E-07
Tetrachloroethene	0.23	2.63E-06	0.051	0.0033	1.34E-07	8.68E-09	1.4E-07
Trichloroethene	0.23	2.63E-06	0.011	0.017	2.89E-08	4.47E-08	7.4E-08
Vinyl chloride	0.023	2.63E-07	1.90	0.295	5.00E-07	7.76E-08	5.8E-07
TOTAL RISKS	----	----	----	----	9.0E-07	1.3E-07	1.0E-06

[1]All cleanup standards are set at 0.04545 of the federal or California MCLs (0.04545 * MCL), whichever are lower. This calculation assumes that chemical concentrations in the ground water are proportionately reduced to achieve a total carcinogenic risk of 1E-06.
[2]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 * 27,375)