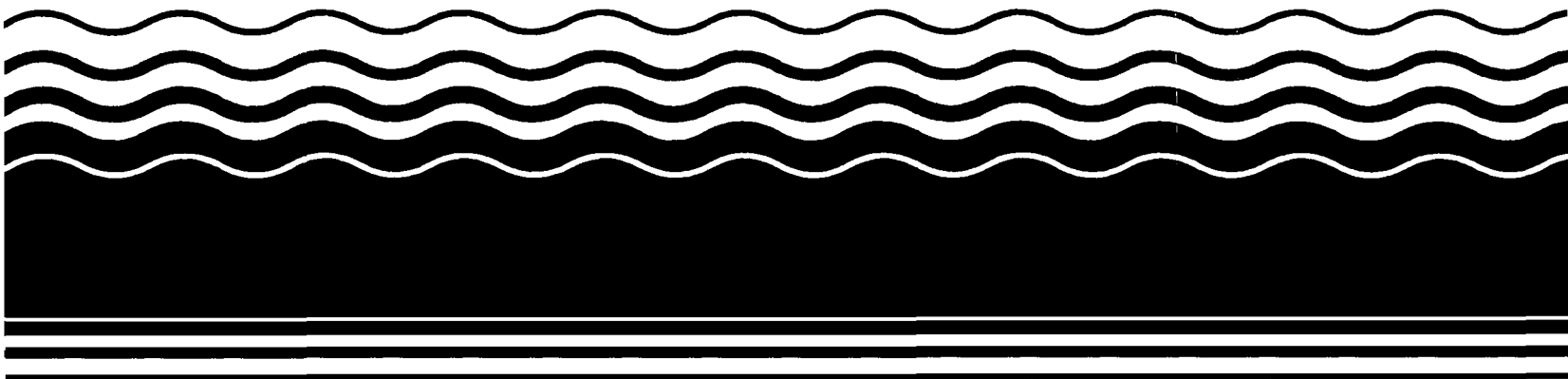




Superfund Record of Decision:

Westinghouse Electric
(Sunnyvale Plant), CA



NOTICE

The appendices listed in the index that are not found in this document have been removed at the request of the issuing agency. They contain material which supplement, but adds no further applicable information to the content of the document. All supplemental material is, however, contained in the administrative record for this site.

REPORT DOCUMENTATION PAGE		1. REPORT NO. EPA/ROD/R09-92/079	2.	3. Recipient's Accession No.
4. Title and Subtitle SUPERFUND RECORD OF DECISION Westinghouse Electric (Sunnyvale Plant), CA First Remedial Action - Final			5. Report Date 10/16/91	
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9. Performing Organization Name and Address			8. Performing Organization Rept. No.	
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15. Supplementary Notes PB93-964501			13. Type of Report & Period Covered 800/000	
			14.	
16. Abstract (Limit: 200 words) The 75-acre Westinghouse Electric (Sunnyvale Plant) site is an active industrial facility located in Sunnyvale, Santa Clara Valley, California. The site currently manufactures steam generators, marine propulsion systems, and missile-launching systems for the U.S. Government. The area around the site has been developed for light industrial, commercial, and residential uses. A building (Building 21) used for transformer manufacturing exists onsite. In the mid-1950s, Westinghouse Electric (Sunnyvale Plant) manufactured transformers containing both Inerteen, which is a dense, non-aqueous phase liquid (DNAPL) consisting of PCBs and trichlorobenzene, and mineral oil as thermal insulating fluids. The storage and use of Inerteen and mineral oil resulted in contamination of soil and two shallow aquifers beneath the site. In addition, general handling practices and the onsite use of Inerteen as a weed killer resulted in the release of PCBs into soil. In 1981, Westinghouse conducted site investigations. In 1984 and 1985, Westinghouse, under state orders, removed PCB-contaminated soil along fence lines and railroad spurs. During these investigations, evidence of fuel hydrocarbon leakage to soil and ground water was discovered coming from two underground fuel tanks. One tank was removed under state (See Attached Page)				
17. Document Analysis a. Descriptors Record of Decision - Westinghouse Electric (Sunnyvale Plant), CA First Remedial Action - Final Contaminated Media: soil, gw Key Contaminants: VOCs (benzene, TCE, toluene, xylenes), other organics (PCBs) b. Identifiers/Open-Ended Terms c. COSATI Field/Group				
18. Availability Statement		19. Security Class (This Report) None		21. No. of Pages 78
		20. Security Class (This Page) None		22. Price

Abstract (continued)

orders, and the remaining tank is slated for removal during the remedial action phase of site work. This ROD addresses remediation of the contaminated shallow ground water and soil, which pose the primary risks at the site. The primary contaminants of concern affecting soil and ground water are PCBs, solvents, and fuel compounds.

The selected remedial action for this site includes excavating approximately 400 cubic yards of contaminated soil containing greater than 25 mg/kg PCB; incinerating excavated soil at an offsite federally permitted facility; filling and capping excavated areas; permanent containment of contaminated ground water onsite where DNAPLs are detected, using extraction; treating contaminated ground water; discharging treated ground water onsite unless an alternative end-use for the treated effluent can be implemented; notifying EPA of any future intention to cease operations, abandon, demolish, or perform construction in Building 21; ground water monitoring; and implementing institutional controls, such as land use restrictions. A ground water treatment technology will be selected during the remediation design phase after treatability and bench-scale studies are performed. The ground water treatment process may include using phase separation with offsite incineration of any product phase recovered, membrane or carbon filtration with offsite incineration of spent carbon and/or filtration membranes, ultraviolet/chemical oxidation, air stripping, and a carbon polish.

PERFORMANCE STANDARDS OR GOALS: EPA is invoking an ARAR waiver of the requirement to meet the MCL for PCB-contaminated ground water in the source area where DNAPL is detected based upon the technical impracticability of remediation. Soil containing greater than 25 mg/kg PCB will be excavated to a depth of 8 feet, based on EPA guidance for PCB remediation at CERCLA sites with restricted access. The 25 mg/kg clean-up standard is a To Be Considered (TBC) criterion. Chemical-specific ground water clean-up goals are based on the more stringent of state or federal SDWA MCLs, including benzene 1 ug/kg (state), TCE 5 ug/kg (federal), toluene 1000 ug/kg (federal), xylenes 1750 ug/kg (state), and PCB 0.5 ug/kg (federal).

RECORD OF DECISION

**WESTINGHOUSE SUPERFUND SITE
Sunnyvale, California**

**U.S. Environmental Protection Agency
Region IX**

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Sunnyvale, California

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PART I. DECLARATION

1.0 SITE NAME AND LOCATION

Westinghouse Electric Corporation
401 E. Hendy Avenue
Sunnyvale, California

EPA ID# CAD001864081

2.0 STATEMENT OF BASIS AND PURPOSE

This Record of Decision ("ROD") presents the selected remedial action for the Westinghouse Electric Corporation Superfund site ("Westinghouse") in Sunnyvale, California.

This document was developed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), 42 U.S.C. § 9601 et seq., and, to the extent practicable, in accordance with the National Oil and Hazardous Substances Pollution Contingency Plan, 40 C.F.R. § 300 et seq., ("NCP"). The attached administrative record index (Attachment B) identifies the documents upon which the selection of the remedial action is based.

The State of California, through the California Regional Water Quality Control Board, concurs with the selected remedy.

3.0 ASSESSMENT OF THE SITE

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

4.0 DESCRIPTION OF THE REMEDY

The selected remedy, which addresses the primary risks posed by both soil contamination (which can be characterized as a principal threat at this site) and shallow groundwater contamination (which includes a detected, dense, non-aqueous phase liquid in the source area that may also be characterized as a principal threat), consists of the following components:

- (1) Permanent containment, by means of groundwater extraction, of contaminated groundwater in the source area where dense, non-aqueous phase liquids ("DNAPLs") are detected, using extraction;
- (2) Restoration of contaminated groundwater, using extraction, to the CDHS Action Level for 1,3-Dichlorobenzene, the proposed MCL for 1,2,4-Trichlorobenzene and the federal and state maximum contaminant levels ("MCLs"), with the exception of the standard for polychlorinated biphenyls ("PCB") in the onsite source area where DNAPL occurs;
- (3) Treatment of the extracted groundwater to meet all applicable or relevant and appropriate ("ARARs") identified in this ROD for this discharge, prior to discharge to the onsite storm sewer, unless an evaluation indicates that an alternative "end-use" for the treated effluent (such as use for facility process water) can be practicably implemented;
- (4) Removal of contaminated soil containing greater than 25 parts per million PCB to a depth of eight feet (approximately 400 cubic yards);
- (5) Offsite incineration of excavated soils at a federally permitted facility;
- (6) Institutional controls, such as land use restrictions, to prevent well construction (for water supply purposes) in source areas that remain contaminated. Excavation below the eight feet where soil has been removed will be restricted. Restrictions will also preclude excavation, other than temporary subsurface work in the upper eight feet and will require complete restoration of any disturbed fill or the asphalt cap once any such temporary work was completed;
- (7) A requirement that EPA receive notification of any future intention to cease operations in, abandon, demolish, or perform construction in (including partial demolition or construction) Building 21 (see facility map, Figure 2);
- (8) Permanent and ongoing monitoring of the affected aquifers to verify that the extraction system is effective in capturing and reducing chemical concentrations and extent of the aqueous phase plume and in containing aqueous phase contamination in the DNAPL source area.

The process steps for treatment of extracted groundwater may include phase separation (offsite incineration of any product phase recovered), either membrane or carbon filtration, ultraviolet/chemical-oxidation, air stripping, and a carbon polish. The components of the system will be determined during the project design and will be subject to modification during operation, based

upon the actual flow rates and chemistry of the extracted groundwater (both of which may vary significantly over time). Destruction of groundwater contaminants will be accomplished through (1) offsite incineration of any separated product phase, (2) offsite incineration of spent filtration membranes and/or spent carbon and (3) ultraviolet/chemical-oxidation.

5.0 STATUTORY DETERMINATIONS

5.1 Protectiveness

The selected remedy is protective of human health and the environment. Protection is achieved at this industrial site, and in the aquifers extending beyond the Westinghouse property, in the following ways:

- (1) The contaminated groundwater outside of the source area will be restored to health-based standards, thus preventing potential exposures, should these shallow aquifers ever be used for water supply purposes.
- (2) Hydraulic containment of the source area will prevent pollutant migration and further contamination of the shallow aquifers, which are potential drinking water supplies. This containment will be combined with a deed restriction to prevent construction of supply wells in the source area where dense non-aqueous phase liquid has been detected.
- (3) The extracted groundwater will be treated, prior to on-site discharge, to meet all ARARs identified for such discharges.
- (4) Contaminated soil containing greater than 25 parts per million PCB, which represents a 10^{-6} risk in an industrial setting, will be removed to a depth of eight feet, thereby preventing potential exposure at the surface, or in the shallow subsurface (e.g., utility line workers).
- (5) The removed soil, spent filtration membranes and spent carbon will be incinerated offsite, destroying the contamination and thereby preventing any further possibility of exposure to those contaminants.
- (6) Land use restrictions will prevent excavation, and therefore exposure, in the area where contaminated soils remain at depths greater than eight feet. Excavation in the upper eight feet of the area where contaminated soils have been removed will be restricted to temporary subsurface work and will require that any disturbance to the fill or the asphalt cap must be restored once such temporary work is completed.
- (7) Land use restrictions will also prevent any residential development in the source area, in order to reduce further any risk of exposure due to contact with soil contamination.

5.2 Applicable or Relevant and Appropriate Requirements

The selected response actions comply with federal and state requirements that are legally applicable, or relevant and appropriate, with the exception of the federal maximum contaminant level for PCB in the source area. A waiver of this standard (which is a "relevant and appropriate" standard) is justified in this case based upon EPA's determination that it is technically impracticable to meet it. This determination is made pursuant to CERCLA §121(d)(4)(c) and is based on the following: (1) the presence of spatially discontinuous, dense, non-aqueous phase PCB (Aroclor 1260) liquids in significant amounts; the heterogeneity of the subsurface combined with low permeabilities; and the characteristics of PCB (low solubility, high tendency to partition onto organic materials and high viscosity). EPA has determined that it is technically impracticable to meet the federal maximum contaminant level for PCB in the DNAPL source area and that this source area must be permanently contained.

5.3 Reduction of Toxicity, Mobility or Volume Through Treatment

Soil containing greater than 25 parts per million PCB will be excavated to a depth of eight feet and incinerated offsite, thereby reducing the toxicity, mobility and volume of site contamination by permanently destroying the PCBs with a treatment technology.

Toxicity, mobility and volume of groundwater contaminants will also be reduced as extracted groundwater is treated by the combination of phase separation (product phase will be incinerated), filtration (filters will be incinerated) and ultraviolet/chemical-oxidation (chemical destruction) steps.

The use of these treatment technologies as an integral part of the cleanup plan for both soil and groundwater demonstrates that the cleanup plan satisfies the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element.

5.4 Use of Permanent Solutions, Alternative Treatment or Resource Recovery Technologies

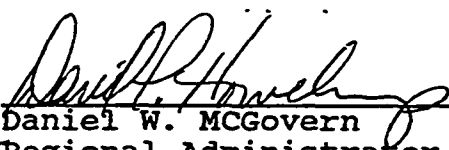
While some hazardous substances will remain on the Westinghouse property, contaminated soil that is removed will be incinerated rather than land disposed. The treatment technologies that are being applied to extracted groundwater will also destroy contaminants (incineration and ultraviolet/chemical-oxidation). The selection of these treatment technologies for soil and groundwater demonstrate that where it is practicable, the selected remedy includes permanent solutions.

Because removal or treatment of dense non-aqueous phase liquids at this site is considered technically impracticable, the remedy

requires long-term containment of the source area. Because this remedy will result in hazardous substances remaining onsite above health-based levels, a review will be conducted within five years after commencement of the remedial action, and every five years thereafter, to ensure that the remedy continues to provide adequate protection of human health and the environment.

5.5 Cost Effectiveness

The remedy is cost effective because maximum protection is achieved for the estimated cost of performance. The analysis contained in the Feasibility Study and this ROD demonstrates that additional remedial action and the cost associated with that action would not achieve a measurable reduction in risk, but that less effort and a lower cost would result in a measurably higher risk at the site.


for Daniel W. MCGovern
Regional Administrator

10/16/91
Date

PART II. DECISION SUMMARY

This Decision Summary provides an overview of the problems posed by the Westinghouse Superfund site. It also includes a description of the remedial alternatives considered, and the analysis of those alternatives against criteria set forth in the National Contingency Plan (NCP). This Decision Summary explains the rationale for the remedy selection and how the selected remedy satisfies the statutory requirements of CERCLA.

1.0 SITE NAME, LOCATION, AND DESCRIPTION

1.1 Site Name and Location

Westinghouse Electric Corporation
401 E. Hendy Avenue
Sunnyvale, California

1.2 Site Description

The Westinghouse Sunnyvale Plant is a heavy industrial facility which currently manufactures steam generators, marine propulsion systems and missile-launching systems for the U.S. Department of Defense. Headquartered in Pittsburgh, Pennsylvania, Westinghouse purchased the original plant property in Sunnyvale in 1947 and continued adding adjacent property until 1956. The property currently constitutes 75 acres and generally lies between Hendy Avenue, California Avenue, Fair Oaks Avenue, and N. Sunnyvale Avenue. A parking area across the street on California Avenue is also currently part of the plant property.

1.3 Topography

The facility is located in the Santa Clara Valley, approximately five miles northeast of the Santa Cruz Mountains and five miles south of San Francisco Bay. The regional topography slopes gently downward north-north-east toward the Bay.

1.4 Land Use

The area around the site was used primarily for agricultural purposes before it was developed. Since the 1950s and 1960s, it has been developed for light industrial, commercial, or residential use and was substantially landscaped or paved. Natural surface drainage features were straightened and leveed as part of the creation of the urban storm sewer drainage system.

While the site itself is zoned for industrial use, it is generally surrounded by residential properties. Some of these parcels abut the site, and others are as near as across a street (100 feet).

1.5 Location and Facility Layout

Figure 1 shows the location of the site in Sunnyvale. Figure 2 shows the locations of buildings at the current 75-acre property. Two below-grade, 566,000-gallon reservoirs in the southeast and northeast portions of the site provide water for fire protection at the facility.

1.6 Hydrogeology

The subsurface in the area of the Westinghouse site consists of alluvial sands and gravels with silt and clay layers. The hydrogeology of this area is characterized by a high degree of heterogeneity.

There are two shallow water-bearing units that have been affected by contamination in the Reservoir 2 area of the Westinghouse site. They have been designated as the A aquifer and the B aquifer and are separated by a less permeable feature that is known as the A/B aquitard. One or more water-bearing sands may occur within a particular aquifer zone.

The A aquifer extends from the water table at approximately 25 feet below ground surface to a depth of 45 to 50 feet below ground surface (Figure 3). The B1 aquifer zone occurs between approximately 50 to 70 feet below ground surface, and is separated from the A aquifer zone by the five to eight foot thick A/B aquitard.

The B aquifer zone is separated from the underlying C and deeper aquifers by the B/C aquitard. The B/C aquitard is reported to be approximately 50 to 100 feet thick and exists at depths ranging from 100 to 150 feet below ground surface.

There is currently no known potable use of water from the A and B aquifer zones on the Westinghouse property or in the surrounding area. Municipal and industrial water supplies are drawn from below the B/C aquitard.

2.0 SITE HISTORY AND ENFORCEMENT ACTIVITIES

2.1 Background on Contamination Problems at Westinghouse

In the mid-1950s, Westinghouse manufactured transformers in the southeast portion of the site near the Reservoir 2 area in Building 21 (Figure 2). The transformers contained Inerteen and mineral oil as thermal insulating fluids. Inerteen is a dense, non-aqueous phase liquid ("DNAPL") which consists of approximately 60 percent PCB Aroclor 1260 and 40 percent trichlorobenzene ("TCB"). Minor amounts of monochlorobenzene ("CB") and dichlorobenzene ("DCB") are also associated with Inerteen.

The storage and use of transformer fluids (Inerteen) and mineral oil resulted in contamination of soils and leakage into shallow groundwater (the A and B aquifers) in the Reservoir 2 area. Additionally, general handling practices and the onsite use of Inerteen as a weed killer resulted in the release of PCB into shallow soils along portions of the facility fenceline, in the northwest yard, in the northeast yard, and along the railroad tracks adjacent to Building 61.

In 1981, responding to the general public concern expressed regarding PCB, Westinghouse conducted a study to determine the nature and extent of PCB in the soils on site. Extensive shallow soil contamination was discovered, and in 1984 and 1985, under California Regional Water Quality Control Board Orders, Westinghouse removed the PCB contaminated soils along fencelines and railroad spurs.

The early 1980 investigations highlighted the area around Reservoir 2 as a more serious problem demanding further investigation. Deep vadose-zone soils and groundwater were affected by release of transformer fluids stored and handled in this area. In the course of the continuing investigations in the Reservoir 2 Area, sampling revealed evidence of fuel hydrocarbon leakage to soils and shallow groundwater from two underground fuel tanks. One of these tanks has been removed and the remaining fuel tank is not in use.

2.2 Regulatory and Enforcement History

From the time PCB contamination was reported in 1981, both the California Water Quality Control Board ("the Board") and the California Department of Health Services ("CDHS") were involved in overseeing the investigation and cleanup work done by Westinghouse at this facility. As mentioned above, Westinghouse conducted shallow soil removal actions in 1984 and 1985 under Board Orders.

The site was proposed for listing on the National Priority List on October 15, 1984, and final listing occurred on June 1, 1986. A Potential Responsible Party ("PRP") search was conducted in 1986, and the findings reported in a final document dated August 8, 1986. The Board took the lead agency oversight role until December of 1987. At that time the Board requested, due to resource and staffing limitations, that EPA assume the lead agency role.

EPA took over the lead, and issued General and Special Notice Letters on January 2, 1988 and March 31, 1988, respectively. An Administrative Order on Consent for the Remedial Investigation and Feasibility Study ("RI/FS") was signed on August 24, 1988.

For the next two and one-half years investigations were conducted in a phased approach until sufficient information was available to propose a remedy. The draft RI/FS report was submitted in November of 1990, and the final report was completed on June 11, 1991.

3.0 HIGHLIGHTS OF COMMUNITY PARTICIPATION

When EPA assumed the lead-agency oversight role from the Board and began negotiations with Westinghouse to conduct the RI/FS work, a Community Relations Plan was developed for the Westinghouse site. The first fact sheet announcing EPA's takeover of the lead and the upcoming investigations was hand delivered to residents surrounding the Westinghouse property and mailed to City officials and local groups identified in the Community Relations Plan in December 1988. The fact sheet generated little interest in the community.

Fact sheets were mailed to the community again in December 1990 and in June 1991. These fact sheets included information concerning the status of site investigations, the upcoming remedy selection process, and the availability of the Administrative Record in the City of Sunnyvale Public Library. The two fact sheets were mailed to approximately 10,000 households and businesses in an effort to reach as many community members as possible.

The June 1991 fact sheet presented the Proposed Plan and announced the public comment period of July 1 to August 29, 1991 (60 days), as well as the public hearing on the Proposed Plan on August 7, 1991. A press announcement in the Peninsula Times Tribune on June 30, 1991 and July 1, 1991 also contained this information, and on the day of the public hearing, a local television station announced the event.

The Proposed Plan public hearing was well attended (approximately 150 people attended), local news channels picked up the story, and many comments were received from many residents (approximately thirty) in the neighborhood near the Westinghouse site. These residents have since formed a neighborhood association with the focus of staying informed about Westinghouse cleanup issues and having a voice in the decision-making process.

4.0 SUMMARY OF SITE CHARACTERISTICS

4.1 Hydrogeology

The study area is underlain by alternating, discontinuous gravels, sands, silts and clays typical of the alluvial overbank and estuarine deposits of the region. The soils underlying the study area have highly variable percentages of clay, silt, sand, and gravel, and stratigraphic contacts between soil types vary from sharp to gradational. The coarse alluvial materials (sand and gravel) form a series of water-bearing units or aquifers, and the interlayered fine grained deposits (silt and clay) act as confining layers or aquitards which restrict vertical movement of groundwater between adjacent aquifers.

Aquifer zones in the vicinity of the facility are generally identified and correlated, with the shallowest water-bearing zone

designated as the A aquifer zone. The A aquifer zone is underlain by the B aquifer zone, which has been divided into the B1, B2, and B3 aquifer zones. The approximate depths below ground surface at which these aquifer zones occur in the vicinity of the Westinghouse facility are as follows: A, 0 to 50 feet; B1, 50 to 70 feet; B2, 75 to 90 feet; and B3, 90 to 115 feet. One or more water-bearing sands may occur within a particular aquifer zone.

Geologic cross sections through the Reservoir 2 area subsurface have been prepared as part of the Remedial Investigation, and the analysis of these indicate that the aquifer and aquitard materials can be laterally discontinuous. However, the A/B aquitard appears to be continuous under much of the Reservoir 2 area.

The regional groundwater flow is generally northward. In the A aquifer, the gradient, which flows to the northwest, is relatively flat and is estimated to be between 0.0005 to 0.010 ft/ft. Over most of the study area, groundwater in the B aquifer flows toward the north-northeast with a shallow hydraulic gradient of approximately 0.0014 ft/ft. Velocities have been estimated at 2.6 to 522 feet per year in the A aquifer, and from .7 to 73 feet per year in the B aquifer.

The main feature on the A aquifer groundwater elevation maps that have been prepared as a part of the Remedial Investigation is a groundwater mound centered to the north and northwest of Reservoir 2 (Figure 3). The presence of the groundwater mound is allegedly due to leakage from underground water piping associated with the pump house for the reservoir. Previous attempts to locate the source of the pipeline leakage and correct it were unsuccessful and additional studies to determine its source are ongoing. If the source cannot be eliminated, the presence of the mound will have to be factored in to the design of the extraction system.

4.2 Contaminant Source Areas

Since the shallow soil removal, completed in 1984 and 1985, and EPA's subsequent take-over of the lead agency role in oversight of the work, the investigation has focused on the remaining contamination in the southeast corner of the site where soils and shallow groundwater have been affected. Approximately 65 monitoring wells have been constructed to date, and numerous soil borings drilled. Figure 4 depicts the site monitoring well locations.

4.2.1 PCB and Chlorinated Benzenes

Westinghouse stored Inerteen, a dense, non-aqueous phase liquid ("DNAPL") mixture of PCB and TCB in a 7,000-gallon above-ground storage tank at the south end of Reservoir 2. The release of Inerteen from the tank or leakage from the associated underground pipelines in this area resulted in the infiltration of DNAPL

through the vadose zone and into the A aquifer (i.e., on top of the A/B aquitard). Prior to the initiation of DNAPL recovery from wells W38 and W48 in August of 1990, DNAPL thicknesses were measured between none detected to 0.17 feet, and 0.58 to 2.83 feet, respectively, in these wells.

The Inerteen tank was removed from the Reservoir 2 area in 1971. The associated underground piping remains in place and is no longer in use. The approximate extent of residual PCB in the vadose zone soil is shown in Figure 5. The approximate extent of DNAPL and aqueous phase PCB in the A aquifer is shown in Figure 6.

Inerteen was also released at several areas along the underground Inerteen pipeline as indicated by the presence of PCB in the soils along the pipeline. In addition, several inches of DNAPL were identified on top of the A/B aquitard in well W46 near the pipeline. The presence of DNAPL in this well is attributed to either leakage of Inerteen from the Inerteen pipeline or from the former transformer filling station located in Building 21. The detection of PCB and high-boiling-point hydrocarbons ("HBHCs") in the groundwater from well W53 suggest that some PCB may have been dissolved in the hydraulic fluid released from the adjacent former hydraulic testing sump.

These detections of PCB DNAPL in the A aquifer are significant because they are an extensive, persistent source of contamination to groundwater involving PCB.

Soil concentrations of PCB in the source area often exceed 500 parts per million (ppm) and are as high as ten or twenty thousand ppm in a number of soil samples. These concentrations do not attenuate appreciably with depth until the A/B aquitard is encountered. (Soils with concentrations of greater than 500 ppm PCB are considered a "principal threat," as defined by the August 1990 EPA Guidance on Remedial Action for Superfund Sites With PCB Contamination.)

Groundwater concentrations exceed the federal maximum contaminant level ("MCL") of 0.5 parts per billion ("ppb") in the source areas where DNAPL is detected and in the B aquifer. In several instances, concentrations actually exceed the solubility limits for PCB (2.7 ppb), indicating that some sort of facilitated transport is occurring.

Limited information is available on the concentration and distribution of PCB in soil beneath Building 21 where the transformer manufacture occurred. Relatively low concentrations of PCBs have been detected in one soil sample beneath the building (10.7 mg/kg from the boring from Well 53; no other contaminants of concern "COCs" were detected). Four wells have been installed in Building 21 and no DNAPL has been encountered. Enough information exists to indicate that soils beneath Building 21 do not serve as

a continuing source of contamination to the groundwater.

4.2.2 Gasoline and Related Compounds

Prior to 1986, Westinghouse stored gasoline in a 500-gallon underground tank west of Building 12A at the north end of Reservoir 2. Releases of gasoline from this tank contaminated the soil and groundwater beneath the tank.

The tank and surrounding gasoline-affected soils were removed in 1986, to a depth of 9 to 9.5 feet below ground surface. The area and depth of excavation were limited because of concerns for the structural integrity of Reservoir 2, Building 12A, and monitoring wells W20 and W21.

Although no residual gasoline-affected soils were detected by the analysis of soils from the boring for W41, soils containing residual gasoline may remain in this area; the subsequent detection of gasoline in the groundwater near the former tank indicates that gasoline infiltrated below the depth of the tank excavation. Gasoline concentrations in groundwater near the former tank (wells W34 and W41, monitoring the A-aquifer) have ranged from 280 to 6800 ppb.

Benzene, toluene, ethylbenzene and xylene are also detected in wells W34 and W41. Benzene detections have ranged in concentration from 0.7 to 800 ppb. Toluene concentrations in these two wells range from one to 98 parts per billion. For ethylbenzene, detected concentrations range from two to 540 ppb.

Gasoline, ethylbenzene, and xylene are also detected in the B-aquifer in well W61. The most recent sampling in April of 1991 shows concentrations at 18,000, 300, and 830 ppb respectively. The source of gasoline and related compounds in this well is uncertain and there is some indication that detections here are related to an upgradient source east of Fair Oaks Avenue from a property adjacent to the Westinghouse property. This source on the adjacent property is being investigated under the Underground Storage Tank program administered by the State of California.

4.2.3 High-Boiling-Point Hydrocarbons ("HBHCs")

The primary sources of releases of HBHCs at the site included three 13,000-gallon above-ground mineral oil storage tanks and a 20,000-gallon underground fuel storage tank at the south end of Reservoir 2, and the former hydraulic testing sump adjacent to well W53 in Building 21. The above-ground mineral oil tanks were removed from the Reservoir 2 area prior to 1974, and the hydraulic testing sump was backfilled and paved over with concrete prior to 1981. The 20,000-gallon fuel storage tank and associated piping remain in place and are no longer in use. Subsequent to their release, these HBHCs infiltrated through the vadose zone soils to the A aquifer.

Residual HBHCs occur in the vadose zone beneath these sources; and HBHCs in the form of a light, non-aqueous phase liquid floating on top of the water table are localized to the area of wells W36 and W38. Prior to the implementation of light non-aqueous phase liquid (LNAPL) recovery from wells W36 and W38 in August 1990, LNAPL thickness measurements ranged from none detected to 1.1 foot and none detected to 0.01 foot, respectively, in these wells.

While the presence of HBHCs has been investigated at this site, they are not considered contaminants of concern due to low toxic effects and no evidence of carcinogenicity. The selected remedy, which includes extraction and treatment components, will remediate these chemicals along with the more toxic and carcinogenic compounds of concern found at the site.

4.2.4 Volatile Organic Compounds

Concentrations of one or more volatile organic compound ("VOCs") (excluding fuel hydrocarbons and DCB) were detected in the A aquifer groundwater samples from eight monitoring wells located near Building 21. The sporadic distribution and relatively low concentrations of VOCs in the A aquifer (total VOC concentration range: 0.7 to 131 parts per billion) suggests that these VOCs entered the groundwater in an aqueous phase. Although a specific source for these VOCs has not been identified, the distribution of VOCs in the A aquifer indicates that the VOCs are localized near Building 21.

4.3 Transport of Site Chemicals

4.3.1 Transport Mechanisms

This section discusses the transport of site contaminants of concern ("COCs") and the factors that may have influenced chemical migration.

Volatilization - Volatilization is considered to be a potential transport mechanism possibly resulting in the loss of chlorinated benzenes and VOCs in shallow soil to the atmosphere. PCBs are essentially nonvolatile and therefore are expected to enter the vapor phase only in negligible amounts.

Water Solubility and Partitioning - Chlorinated benzenes and VOCs generally show increasing water solubility with decreasing chlorination. As a whole, they are more soluble in water than PCBs and will be transported by water in both vadose-zone and aquifer soils to a larger extent. Chlorobenzenes and VOCs have relatively low K_{oc} and K_{ow} values and thus are not strongly adsorbed to particulate matter.

PCB does not readily dissolve in water and is strongly adsorbed onto soils. The following discussion presents the technical

assumptions made in predicting transport. They are a mathematical representation of the factors which govern how PCB may travel in the aquifer, allowing the calculation of a prediction for how fast and how far the contamination will travel.

Assuming a bulk density of 1.5 kilograms per liter, an estimated porosity of 20 percent, a K_{oc} value of 530,000 ml/g (based on Aroclor 1254 in the absence of specific data for Aroclor 1260), and an average organic carbon content of 0.2 percent in the A aquifer, the retardation factor for aqueous PCB transport is estimated to be approximately 7950. The actual retardation factor for Aroclor 1260 may be much higher than the estimated value because the K_{oc} value is likely to be much larger than that of Aroclor 1254 due to its lower aqueous solubility. Using this retardation factor, an average A aquifer groundwater gradient of 0.025, and a range of aquifer permeability from 10^{-2} cm/sec to 10^{-4} cm/sec, it is estimated that PCB Aroclor 1260 should not have migrated as an aqueous solute more than 0.08 to 8.2 feet from the residual DNAPL in the aquifer matrix over the past fifty years in the absence of any facilitated transport mechanism (i.e., cosolvent effects or colloidal transport).

Because PCBs have been detected at distances (200 to 350 feet from the source) much greater than would be predicted based on idealized Darcian flow and adsorption/desorption kinetics, the transport of PCBs in the groundwater may have been facilitated by either colloid transport or cosolvent effects. The groundwater mound (see Section 4.2) may have also contributed to the current distribution of PCB in the A and B aquifers.

Colloid Transport - Colloid transport could be a potential mechanism for facilitating migration of PCB at the site because PCB Aroclor 1260 has a high K_{oc} and K_{ow} (these numbers represent the tendency of a compound to attach to soil or other organic particles in preference for dissolving in water or some other solvent), and is thus strongly adsorbed on soil, colloids, and other particulates. The presence of silty and clayey sands within some portions of the A aquifer zone, however would act as a fine grained filter material which may effectively negate this transport mechanism. Similarly, in the absence of a preferential pathway between the A and B1 aquifers, such as poorly sealed deep borings or an incompetent feature in the aquifer (e.g., ancient root holes or sand stringers), the potential for colloid transport through the A/B1 aquitard is considered questionable because the silty clay aquitard would be likely to filter out the colloids. However, there is some evidence from the comparison of filtered and unfiltered samples to indicate that colloidal transport may have occurred.

Cosolvent Effects - Cosolvent effects may also be a mechanism for facilitating the transport of PCB at the site because PCB Aroclor 1260 has a high affinity for hydrocarbon solvents (i.e., HBHCs and

gasoline). PCBs have been detected at concentrations in excess of the maximum aqueous solubility (i.e., 2.7 ppb) in wells W39 (8.1 ppb), W54 (7 to 25 ppb), and W61 (3.3 ppb). The increase in apparent aqueous solubility may be the result of cosolvent effects because these elevated PCB concentrations are coincident with the highest concentrations of dissolved HBHCs and gasoline detected in the site's monitoring wells (i.e., 6,200 ppb HBHCs in well W39, 17,000 ppb HBHCs in well W54, and 20,000 ppb gasoline in well 61). However, the gasoline in Well 61 is thought to be from an offsite source, rather than from the source area where PCB occurs. Therefore there is some question about the hypothesis for this well.

While TCB initially facilitated the transport of PCB through the vadose zone due to its solvent effects, it does not appear to have any current significant cosolvent effects for the transport of PCB through the groundwater. The highest concentrations of TCB in the groundwater are located in or near areas containing DNAPL (i.e., wells W22, W46, and W56). TCB was not detected in the majority of the wells in which PCB was detected.

Preferential Pathways - While no direct evidence from the investigation indicates that a preferential pathway exists to facilitate chemical migration, this transport mechanism has not been discounted. A preferential pathway is a more permeable pathway through the aquifer material. These subsurface features contain more sand or gravel and may have been ancient river channels. Groundwater or contamination may be transported more quickly through these old river channels than would be expected given the regional flow rates.

Regardless of the transport mechanisms involved for PCB transport in the groundwater, the techniques used for investigating the extent of PCB migration and the technologies for remediating PCBs in the groundwater are the same.

4.3.2 Persistence

Highly chlorinated PCBs (e.g., Aroclor 1260) are relatively resistant to biodegradation. Biodegradation of nonchlorinated VOCs (benzene, toluene, ethylbenzene, xylene - often referred to as BTEX - and acetone) is generally slow and not typically an important environmental process, although fuel hydrocarbons can be biodegraded under proper conditions. Biodegradation data for chlorinated VOCs are generally lacking for vadose-zone conditions, but it is thought to occur very slowly in saturated conditions. Oxidation, hydrolysis, and photolysis of PCBs, chlorinated benzenes, and VOCs are all generally insignificant processes in natural environments.

4.3.3 Transport Pathways

DNAPL (PCB and TCB) - A conceptual cross section showing the pathways for the transport of PCB and TCB from the former Inerteen storage tank area through the vadose zone and groundwater is shown in Figure 7. PCB and TCB infiltrated into the site soils in the form of a DNAPL. As noted above in the section on transport mechanisms, TCB acted as a solvent to reduce the viscosity of the PCB and facilitated the transport of PCB through the vadose zone. The release of Inerteen in the former storage tank area was of sufficient magnitude to exceed the specific retention capacity (the ability of the soil to hold a liquid as a sponge holds liquids) of the soils and allow Inerteen to infiltrate to the water table. Another release resulting in the infiltration of Inerteen to the water table occurred from the Inerteen pipeline near Building 21 or from the former transformer filling station in Building 21.

Because of the long period of time which has passed since the Inerteen was used in the Reservoir 2 area, the PCB retained in the vadose zone is considered to be held as specific retention. TCB is no longer detected in these soils and it is assumed that, as a more mobile constituent of Inerteen, it passed on through the vadose zone leaving PCB behind. Gravity drainage of PCB is not considered a current transport mechanism for the transport of PCB through the vadose zone.

Upon reaching the A/B aquitard, the DNAPL spread laterally until (1) it settled in small depressions along the top of the aquitard, (2) the amount of DNAPL available for lateral migration was dissipated by the retention of DNAPL within the soil pores at the base of the aquifer, or (3) the DNAPL pore pressure no longer exceeded the minimum displacement pressure required for DNAPL entry into water-filled soil pores of the aquifer.

The residual DNAPL in the aquifer matrix and the DNAPL located on top of the A/B aquitard constitute an ongoing source of PCB and chlorobenzenes in the groundwater. These compounds slowly (over years) dissolve into the aquifer and are transported in the groundwater in the same direction as the groundwater flow. Since the creation of the groundwater mound at the north end of Reservoir 2, groundwater flow within the area affected by the groundwater mound is outward from the center of the mound. The presence of the mound has caused the distribution of PCBs in the groundwater to be more widespread in the A aquifer than would have been expected in the absence of the mound. The reversal in the groundwater gradient in the southern portion of the site due to the mound has resulted in the detection of some PCB at wells W39 and W10 located south (i.e., in the original upgradient direction) of the former Inerteen tank.

Groundwater flow in the B aquifer is to the north-northeast, and the orientation of the PCB and TCB plume in this aquifer is

consistent with the groundwater flow direction (Figure 8). As noted in the section on transport mechanisms, the presence of PCB and TCB in the B aquifer may be attributed to the migration of these compounds through poorly sealed deep soil borings or some incompetent feature in the A/B1 aquitard (i.e., ancient root holes or sand stringers). The presence of PCBs in the B aquifer south of the former Inerteen tank (i.e., at wells W49 and W25) indicates that some of the PCB which had migrated to the south in the A-aquifer had subsequently migrated across the A/B aquitard due to the downward gradient between the A and B aquifers. As noted earlier, the detection of PCB (3.3 ppb) above the aqueous saturation limit (2.7 ppb) for this compound in well W61 in conjunction with the detection of 20,000 ppb gasoline suggests that cosolvent effects may be facilitating the transport of PCB in the groundwater at the site.

Gasoline - The extent of dissolved gasoline in the groundwater of the A aquifer is limited to the area containing wells W20, W41, and W34 (Figure 9). These wells are near or adjacent to the location of the former underground gasoline tank at the north end of Reservoir 2. No LNAPL has been detected in these wells. The leakage of gasoline from the former tank resulted in the infiltration of gasoline to the groundwater table where it dissolved into the groundwater. Because the former tank location is approximately coincident with the center of the groundwater mound, dissolved gasoline would be expected to flow somewhat radially away from the tank site.

Gasoline was detected in the B aquifer well W61 east of Fair Oaks Avenue. The transport of gasoline in the B aquifer is toward the north to northeast consistent with the regional gradient. The source of gasoline in the B aquifer at well W61 is uncertain because (1) a hydraulic connection between the gasoline detected in the A aquifer wells at the north end of Reservoir 2 (i.e., wells W34 and W41) and the gasoline detected in well W61 in the B aquifer is not apparent from the groundwater monitoring data, and (2) the gasoline may be related to an upgradient source east of Fair Oaks Avenue.

High-Boiling-Point Hydrocarbons ("HBHCs") - Releases of HBHCs to the soils and groundwater are associated with the three former aboveground mineral oil storage tanks and the 20,000-gallon underground tank at the south end of Reservoir 2 and the former hydraulic testing sump adjacent to well W53 in Building 21. Again, Figure 9 presents the distribution of these compounds along with the gasoline compounds. Dissolved HBHCs have been detected in the groundwater near these sources (i.e., wells W23, W24, W25, W39, W47, W49, and W53). HBHCs in the form of LNAPL have only been detected floating on the groundwater in wells W36 and W38. Approximately 1.1 foot of LNAPL was detected in well W36 in February 1990 and approximately 0.1 foot of LNAPL was detected in well W38 in January 1990. These were the maximum thicknesses of

LNAPL detected in these wells during the remedial investigation ("RI"). After three months of product recovery from these wells the LNAPL thickness in each well was reduced to approximately 0.001 foot. Because of the limited extent of LNAPL at the site, LNAPL transport has not been considered a significant transport mechanism at the site.

Dissolved HBHCs have been detected in the groundwater samples from several monitoring wells in both the A and B1 aquifers. The HBHCs in the groundwater will travel through the aquifers in the same direction as the groundwater. However, as mentioned earlier, these compounds are not considered as contaminants of concern in the risk evaluation. They are being monitored and they will be addressed by the groundwater extraction and treatment system during cleanup.

Volatile Organic Compounds ("VOCs") - Concentrations of one or more VOCs (excluding fuel hydrocarbons and DCB) were detected in the A aquifer groundwater samples from eight monitoring wells located near Building 21 (Figure 10). No halogenated VOCs were detected in the B aquifer. The sporadic distribution and relatively low concentrations of VOCs in the A aquifer (total VOC concentration range: 0.7 to 131 ppb) suggests that these VOCs entered the groundwater in an aqueous phase. The distribution of VOCs in the A-aquifer indicates that the VOCs are localized near Building 21. The VOCs are dissolved in the groundwater and flow in the same direction as the groundwater.

4.3.4 Potential Exposure Points

Surface and subsurface soils containing COCs to depths of five to eight feet below ground surface are considered potential exposure points for workers or future onsite residents. (Future onsite residential use has been evaluated in the Risk Assessment as a hypothetical case. The remedy selected in this ROD includes institutional controls such as land use restrictions to prevent residential development.) The onsite groundwater would be considered a potential exposure point in the event that the Reservoir 2 area were converted to residential use in the future and that groundwater was extracted from the A and B aquifers for domestic use at these residences. The groundwater is considered a potential exposure point for offsite residences with existing wells if the COCs at the site migrate toward these wells and if a conduit exists for the transport of COCs into these wells.

Well surveys identified six wells that could potentially receive COCs from site groundwater. These wells are described as follows:

- (1) A domestic and irrigation well (well 14) located downgradient about 6,900 feet to the northeast of Reservoir 2;
- (2) A municipal well (well 82) located downgradient about 2,900 feet northwest of the facility;

- (3) A deep well (depth greater than 500 feet below ground surface) located in the center of the facility, about 1200 feet west of Reservoir 2;
- (4) Three domestic water supply wells (wells 157, 156, and 183) located approximately 4,200 feet west-northwest, 4,300 feet west-northwest, and 7,000 feet northwest of Reservoir 2, respectively. A complete description of the well survey conducted during the RI for the site and regional groundwater use is included in Appendix G of the final RI/FS Report.

None of these six wells have been affected by Westinghouse chemicals. For perspective, the nearest downgradient well is 2500 feet from the Westinghouse plume, which has traveled 350 feet from the point of release in a 30- to 50-year time frame.

5.0 SUMMARY OF SITE RISKS

5.1 Human Health Risks

This section summarizes the potential present and future human health risks associated with exposure to the contaminants of concern ("COCs") in site soils and groundwater at the Westinghouse site. The risk analysis has been conducted in order to evaluate what risk the site currently poses, and what risk it may pose in the future if no remediation occurs. This results of the risk assessment serve as the rationale for the cleanup of the site.

The following chemicals constitute the COCs, for the Westinghouse site:

Contaminants of Concern at Westinghouse

Benzene*

Chlorobenzene (CB)

1,2-Dichlorobenzene (1,2-DCB)

1,3-Dichlorobenzene (1,3-DCB)

1,4-Dichlorobenzene (1,4-DCB)

1,2-Dichloroethane (1,2-DCA)

1,1-Dichloroethene (1,1-DCE)

cis-1,2-Dichloroethene (cis-1,2-DCE)

Ethylbenzene*

Polychlorinated biphenyls (PCBs)

Toluene*

1,2,4-Trichlorobenzene (1,2,4-TCB)

1,1,1-Trichloroethane (1,1,1-TCA)

Trichloroethene (TCE)

Xylene(s)*

* Benzene, Toluene, Ethylbenzene, and Xylene, fuel components, are often referred to as a group with the acronym BTEX

The above list of chemicals includes all chemicals detected during the RI with the exception of the high-boiling-point-hydrocarbons (HBHCs) and acetone. The extent and distribution of HBHCs and acetone has been characterized. The selected remedy, which includes extraction and treatment components, will remediate these compounds. However, the HBHCs are not considered contaminants of concern or COCs due to low toxicity and the lack of evidence of carcinogenicity. Acetone was detected twice at concentrations of less than 10 parts per billion (cleanup levels are set at 3500 parts per billion) and is not considered a COC due to its infrequency of detection and low concentration.

5.1.1 Exposure Assessment

The exposure assessment identifies potential exposure pathways and segments of the population that may be exposed to site-related COCs via those pathways.

Potential Human Receptors - For the last 85 years the Westinghouse site has been used only for industrial purposes (the property was used industrially for many years prior to Westinghouse ownership) and is expected to be used for such purposes in the future. Access to the facility is controlled and the property is surrounded by a high security fence. Future exposures to COCs at this site are expected to be consistent with those arising from a limited access industrial setting.

Exposure to soil containing COCs may occur among two types of outdoor workers (defined as adults 18 years of age or older) involved in activities in the onsite area containing COCs in soil: those engaged only in surface activities (surface workers), and those engaged in subsurface construction activities (subsurface workers) such as installation or maintenance of underground utilities. The risk from incidental ingestion of soil and dermal contact with soils are evaluated for both the surface and subsurface workers. Inhalation risk for surface workers was considered minimal because of the small surface area (fifty-foot diameter at the surface) and its paved status. For subsurface workers inhalation risks were factored into the evaluation.

The risk analysis also analyzed the risks which would exist if the site were developed residentially. For this hypothetical future scenario, where residential development and consequent exposures would occur at this site, risks from ingestion and dermal absorption of soil is evaluated for two receptor groups: children aged one to six, and adults 18 years of age or older.

Because of the limited distribution of COCs in soil, the risk evaluation addresses only soil in those area of concern where contact with COCs may potentially take place. The following two onsite areas are the only locations where such exposure is likely (Figure 5):

- (1) The roughly 650 square feet to the south of Reservoir 2 in the former location of the aboveground Inerteen tank;
- (2) Soil associated with the underground Inerteen pipeline with which subsurface workers may come into contact during excavation activities.

Because the groundwater is classified as a potential source of drinking water, the hypothetical future residential scenario also considers potential exposure to COCs in the groundwater via domestic water use in the event that a groundwater well that

intercepts shallow groundwater were installed and used at the site. The exposure routes considered are the ingestion, dermal contact, and inhalation of VOCs and PCB associated with residential exposure scenarios.

While there are currently residences in close proximity to the Westinghouse property, the exposure assessment indicates that these neighborhoods do not constitute potential receptors. Soil contamination is confined to a localized area completely within Westinghouse property boundaries and is paved over with asphalt. A mechanism to transport soil-borne COCs from the site does not exist, and no domestic groundwater wells receive water impacted by site COCs. High security fencelines and controlled entry to the facility preclude any plausible scenarios for current exposure to nearby residents.

5.1.2 Potential Exposure Pathways

Soil, groundwater, and air can serve as exposure media for the potential receptor populations. This section discusses potential exposure media and exposure routes for both the current-use and future-use exposure scenarios.

The compounds that have been detected on site and are considered in the following evaluation are as follows: For soil - PCB, three DCB isomers, and three TCB isomers; for groundwater - PCB, three DCB isomers, three TCB isomers, BTEX, TCA, 1,2-DCA, 1,1-DCA, CB 1,1-DCE, cis-1,2-DCE, TCE, and acetone.

Soil - PCB and TCB are the primary COCs detected in soils on the site. There are three possible routes of exposure to contamination in these soils: ingestion, dermal contact, and inhalation.

Groundwater - PCB, DCB, TCB, and VOCs have been detected in at least one of the two water-bearing zones on and off the site (contaminant plumes are presented in Figures 9, 10, 11, and 12). Exposure to groundwater COCs could occur if groundwater in the contaminated areas of the A and B aquifers were used as a source of water supply. There is currently no known use of water from these two aquifers near the area of the Westinghouse contamination. However, a hypothetical scenario involving such use has been included in the exposure assessment. If the contaminated groundwater from the A and B aquifers were used as a domestic water supply, exposure could occur through ingestion, dermal contact, inhalation, or ingestion of fruits and vegetables irrigated with chemical-bearing groundwater. These aquifers are classified as potential sources of drinking water.

5.1.3 Intake Assessment

This section integrates receptor populations, current and potential future site activities, and exposure pathways into exposure

scenarios representing reasonable maximum exposure ("RME") and typical exposure conditions, enabling the evaluation of human health risks.

Two exposure scenarios are evaluated in the intake assessment. Scenario one, the worker exposure scenario, applies to exposures attributable to potential soil-related worker activities. Scenario two addresses potential exposures to hypothetical future residents.

To evaluate potential worker exposures to soil at the site, Scenario one addresses typical and reasonable maximum exposures (RME) to a surface worker and a subsurface worker over a period of 9 and 30 years, respectively. The specific subsurface construction activity evaluated was installation and maintenance of utility trenches. The soil exposure scenarios were used to estimate the potential adverse health effects to surface and subsurface worker populations via ingestion, inhalation, and dermal contact.

Scenario two addresses soil- and groundwater-related exposures assuming the Westinghouse property were to be converted to residential use at some time in the future. In this scenario, ingestion and dermal absorption of COCs from exposure to contaminated soil, and oral, dermal, and inhalation exposure to groundwater is evaluated for adults 18 years of age or older and children aged one to six years. (The inhalation pathway for soil was considered minimal for this scenario because landscaping or pavement would generally prevent airborne transport of contaminated particles, the fifty-foot diameter area at issue is small, and the risk for this pathway would be eclipsed by the ingestion and dermal absorption pathways; i.e., there would be no measurable increase in the total risk from this pathway.)

Tables 1 through 5 present pathway-specific equations, intake parameters, and the references or rationale for selecting the values used in estimating the chronic daily intakes ("CDIs"). Common to all the scenarios are fixed-receptor body weights and the estimation of averaging times. The typical body weight used for workers is 70 kilograms (kg). The typical body weight used for adult residential receptors is also 70 kg. The typical body weight for a one- to six-year-old was 16 kg.

Table 9 includes toxicity and carcinogenicity information for each of the COCs, i.e., chronic reference doses and cancer potency factors.

5.1.4 Risk Characterization

This section discusses the potential adverse noncarcinogenic health effects and excess carcinogenic risks (i.e., additional cancer risks above expected current background cancer risks) associated with ingestion, dermal and inhalation exposures to the COCs identified in soils and groundwater at the site. It should be

noted that both the A and B aquifers are classified as potential drinking water sources.

Noncarcinogenic health effects resulting from exposure to a single compound, or a combination of compounds, are evaluated by calculating a hazard quotient ("HQ"). The HQ is the ratio of estimated chemical intake (i.e., CDI) for a particular route of exposure to a reference dose ("RfD"). An RfD for chronic exposure is an EPA-established value that represents chemical-specific, exposure-route-specific doses to which nearly all populations may be exposed for a period of up to 365 days per year for 70 years without experiencing adverse health effects. For any single chemical, or combination of chemicals where the HQ exceeds unity (1.0), potential health risks may be a concern. The sum of HQs for all pertinent chemicals over all pertinent exposure routes (e.g., ingestion, dermal, or inhalation) is the total hazard index ("HI"). The HI represents the total adverse health effect associated with exposure to noncarcinogenic compounds of a particular exposure scenario (e.g., typical exposure for a surface worker). As with the HQ, an HI less than unity (1.0) is considered to be indicative of no adverse health effects.

5.1.4.1 Soil Exposure

Noncarcinogenic Risk - PCB and TCBs were the COCs considered for potential soil exposures. Because there are no RfDs associated with PCB, 1,2,3-TCB, or 1,3,5-TCB, noncarcinogenic risks associated with exposure to soil could not be evaluated for these compounds. The RfD for 1,2,4-TCB was used to calculate the risk of exposure to this isomer in soils.

Table 6 presents the calculated HIs associated with exposure to soils in the area of concern for both the current industrial-use scenario and the hypothetical future residential-use scenario. The HIs for workers or hypothetical future residents do not exceed one (1.0), thus no adverse, noncarcinogenic health effects are associated with these exposures.

Carcinogenic Risks - The results of calculations for exposures to PCB- and TCB-containing soil via ingestion and dermal contact are summarized in Table 6 for the onsite surface and subsurface worker populations and hypothetical future residential populations.

The excess cancer risks for both the typical and RME scenarios for all receptor populations exceed the ten to the minus six to ten to the minus four (10^{-6} to 10^{-4}) range considered acceptable by the EPA (see the National Contingency Plan, 40 C.F.R. §300.430(e)(2)(i)(A)(2)). The primary exposure pathway contributing to the excess risk appears to be the direct contact with PCB-containing soil through dermal exposure.

5.1.4.2 Groundwater Exposure

Noncarcinogenic Risks - As shown in Table 6, the HI associated with hypothetical future use of the A aquifer as a sole source of domestic water exceeds 1.0 for both the typical and reasonable maximum exposure scenarios for children (19 and 57, respectively) and for adults (8.5 and 26, respectively). 1,2,4-TCB is the primary contributor to these HIs.

For the B aquifer, as shown in Table 6, the HIs associated with hypothetical use of the B aquifer as a sole source of domestic water do not exceed 1.0 for the typical or reasonable maximum exposure scenarios for adults or children. Therefore, no adverse, noncarcinogenic health effects are associated with the use of groundwater from the B aquifer for domestic purposes.

Carcinogenic Risks - As shown in Table 6, the total estimated excess cancer risks associated with the use of the A aquifer as a sole source of domestic water are outside the range considered acceptable by the EPA [10^{-6} to 10^{-4} , pursuant to the National Contingency Plan, 40 C.F.R. §300.430(e)(2)(i)(A)(2)]. The potential exposure to PCB through ingestion of contaminated groundwater was primarily responsible for these excess risks. Under the longer exposure period modeled under the RME scenarios, dermal contact and inhalation of benzene and 1,1-DCE also contributed to the total excess cancer risk.

Total excess cancer risks associated with use of the B aquifer as a sole source of domestic water are 2.73×10^{-5} and 1.88×10^{-5} for the typical scenarios of a child and an adult, respectively. Total excess cancer risks of 4.33×10^{-5} and 9.89×10^{-5} were associated with the RME to children and adults, respectively. These risk levels, for both age groups, are within the 10^{-6} to 10^{-4} range of acceptable human health risks for Superfund sites (see the National Contingency Plan, 40 C.F.R. §300.430(e)(2)(i)(A)(2)). The potential ingestion of PCB is primarily responsible for the risk levels calculated for these scenarios.

5.2 Environmental Evaluation

Wildlife that may be present in the vicinity of the site includes raccoons, gophers, ground squirrels, rats, field mice and a variety of birds, including burrowing owls. The State of California Department of Fish and Game has listed the burrowing owl (Athene curicularia) as a "species of special concern." The burrowing owl's primary habitat is grassland and open prairie. Neither of these habitats exist in the immediate area of the site. Because the site is covered with pavement or structures, access to the site is restricted by a fence and sources of food are essentially nonexistent, direct-contact exposures to COCs in soil on the site by wildlife are unlikely. Wildlife exposure to COCs in surface

water offsite is also not likely to occur because surface drainage at the site is controlled by storm sewers. For these reasons, impact to wildlife is expected to be minimal.

5.3 Uncertainty Analysis

The risk evaluation for the Westinghouse site is based on data collected at the site over a period of approximately three years. Use of these data introduces uncertainty into the risk evaluation regarding the degree that the data accurately represent typical (average) and RME (reasonable maximum exposure) concentrations of the COCs. For example, much of the data from the area of concern was collected to identify "hot spots," areas of uncharacteristically high concentrations. Because these data were used to derive average concentrations at specified depths upon which "typical" exposure scenarios were based, the resulting concentrations probably tend to overestimate such conditions. Additionally, these calculated risk estimates are based on data collected from the relatively small area near the Reservoir 2 and should not be inferred to apply to the entire Westinghouse property.

5.4 Conclusions

Because the excess upper bound lifetime cancer risks associated with exposure to soils in the area of concern and contaminated groundwater in the A aquifer exceed the risk range considered acceptable by the EPA, 10^{-6} to 10^{-4} , remedial action is appropriate for the Westinghouse site. Additionally, although the risk levels calculated for the B aquifer fall within the acceptable range, concentrations of COCs that exceed MCLs occur in several wells, thus necessitating remediation of the B aquifer.

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

6.0 DESCRIPTION OF ALTERNATIVES

6.1 Introduction

EPA has evaluated four alternatives in selecting the final cleanup plan for the Westinghouse site. These alternatives were developed from an evaluation that began by setting cleanup objectives, and included studying the universe of applicable response actions and technologies that might address the Westinghouse site contamination. This evaluation and screening process is documented in detail in the Feasibility Study.

Table 7 presents the alternatives that were developed. Briefly, the key features of each are outlined as follows:

Alternative A - No Action

Alternative B - No excavation
Capping
Groundwater Treatment and Containment

Alternative C - Excavation to Eight Feet
Offsite Disposal (C1) or Treatment (C2)
Capping
Groundwater Treatment and Containment

Alternative D - Excavation to Thirty-two Feet
Offsite Disposal (D1) or Treatment (D2)
Capping
Groundwater Treatment and Containment

Alternative A is the "no action" alternative. Alternatives B, C and D all address groundwater with the same extraction and treatment system. The only differences among these three "action alternatives" is in how each of them addresses soil contamination. Alternative B considers capping only as an option. Alternatives C and D are excavation options (eight feet and 32 feet). These two excavation options (C and D) consider offsite disposal versus offsite incineration of the excavated soils in sub-alternatives C1, C2, D1, and D2.

The federal or state (whichever is more stringent) maximum contaminant levels ("MCLs") for drinking water are relevant and appropriate requirements to be met in the A and B aquifers, with the exception of the source area covered by the waiver of the PCB standard as described below. The cleanup standards that have been set for groundwater are presented in Table 8. The cleanup level selected for 1,3-DCB is a State Action Level (130 ppb), which is not an ARAR but is a "to be considered" or TBC criteria. Additionally, the level selected for 1,2,4-Trichlorobenzene is a proposed value and is expected to be promulgated in March of 1992 making it a TBC criteria along with the 1,3-DCB value. These levels are set as a cleanup standards in the absence of a federal or state promulgated drinking water standards and must also be met in the A and B aquifers.

Soil cleanup has been set at 25 ppm, which is consistent with soil cleanup standards for PCB spills at industrial facilities as described in the Guidance on Remedial Actions for Superfund Sites With PCB Contamination (OSWER Directive No. 9355.4-01, August 1990). This guidance is a TBC criteria. TBCs are considered in determining the necessary levels of cleanup for protection of health or the environment.

The groundwater cleanup standards and the soil cleanup standard have been selected based on protectiveness criteria and the requirements of law. Note that although the contaminated shallow

A and B aquifers are not currently used as a source of supply, they are classified as a potential source of drinking water. State Water Resources Control Board Resolution 88-63 has incorporated Board policy "Sources of Drinking Water" into the Basin Plan, which is an ARAR for this site. Under this policy, the A and B aquifers are potential sources of drinking water.

The following sections discuss the treatment, containment and other general components of the four alternatives. The discussion is organized into two parts: Section 5.2 presents the components of the groundwater remedies and Section 5.3 presents the components of the soil remedies. See Table 7 for cost summary information for each alternative.

6.2 Groundwater Remedies

The federal or state (whichever is more stringent) maximum contaminant levels ("MCLs") for drinking water are ARARs to be met in the A and B aquifers. The cleanup level for 1,3-DCB is a State Action Level (130 ppb), which is not an ARAR but is a TBC criteria. Additionally, the proposed federal MCL for 1,2,4-Trichlorobenzene is TBC. These TBC standards are set in the absence of a promulgated federal or state drinking water standards and must be met in the A and B aquifers. The MCL standards, which are derived from the Safe Drinking Water Act, are considered relevant and appropriate to the groundwater portion of the remedy (NCP, 40 C.F.R. § 300.430(e)(2)(i)(C)) and are to be met in the affected aquifers. However, the remedy does not include a requirement that the federal MCL for PCB be met in the source area of the A aquifer. For this limited area, for which all action alternatives considered require permanent containment, (see section 6.2.2.2) an ARAR waiver is invoked based upon technical impracticability, in accordance with CERCLA Section 121(d)(4)(C).

The substantive discharge standards under the Clean Water Act are applicable requirements for discharge of any effluent from the groundwater treatment system to the storm sewers; therefore, NPDES-derived criteria will be the criteria for the discharge. Substantive discharge requirements under the California Porter-Cologne Act also apply to such discharges.

The California Regional Water Quality Control Board's Basin Plan is also an ARAR, including the State of California's "Statement of Policy With Respect to Maintaining High Quality of Waters in California," Resolution 68-16, incorporated therein. This deals with the maintenance of high quality waters in California. Additionally, Resolution 88-63 is also incorporated into the Basin Plan and applies to the classification of the shallow aquifers as potential sources of drinking water.

Other specific laws or regulations which apply or are relevant and appropriate to particular treatment technologies are discussed

below in section 5.2.2.1, for each technology described.

6.2.1 No Action - Groundwater

The "no action" alternative represents a baseline against which the other alternatives can be compared. It does not include remediation of the groundwater. Only a monitoring program would be implemented. This alternative assumes no capital costs for active remediation, but only minor capital costs for expanding the monitoring well network. As shown in Table 7, these capital costs have been estimated at \$62,000. Annual operation and maintenance ("O & M") is estimated at \$160,000, and total present worth (based on thirty years) is estimated to be \$3,700,000 (Table 10).

6.2.2 Action Alternatives B, C and D - Groundwater

Alternatives B, C and D all employ the same extraction and treatment system. Because the contaminant plumes are small (300 feet long in the A Aquifer, and 500 feet long in the B aquifer; see Figures 9-12) and because the aquifer yields are low (estimated less than 50 gallons per minute), it was not practical to vary the extraction system appreciably in any way (e.g., using different pumping rates to achieve different cleanup time frames). Additionally, because the source area where dense non-aqueous phase liquid ("DNAPL") occurs demanded a containment approach, the extraction system design for each alternative needed to address containment.

The extraction and treatment system will be designed to reduce the extent of the aqueous phase plume until cleanup standards have been met throughout the A and B aquifers (with the exception of the PCB standard in the DNAPL source area) and to contain permanently the source area such that aqueous phase contaminants will be prevented from migrating beyond the source area. The following subsections discuss the various components of the extraction and treatment system, including the compliance points at the perimeter of the DNAPL source area that is to be contained permanently.

6.2.2.1 Treatment Components for Groundwater

The treatment options will be selected during the design phase based on treatability study results. The groundwater treatment system must effectively remove PCB, VOCs, and petroleum hydrocarbons (gasoline, diesel, and related compounds). These chemicals have different physical and chemical characteristics potentially requiring more than one technology. For example, air stripping is effective for volatile petroleum and halogenated compounds but not for semivolatile and nonvolatile compounds, which can be effectively removed by carbon adsorption. Other options are membrane technologies and ultraviolet-chemical oxidation. Physico-chemical pretreatment for nonhazardous inorganics may also be required.

Additionally, it is expected that the chemistry of the treatment system influent may alter appreciably over time. It will be important to retain the flexibility to add, subtract or adjust the components of the process train as this occurs. The underlying feature of the treatment system that must be maintained, whatever the actual components of the process train are, is the use of destruction treatment technologies to reduce permanently the toxicity, mobility and volume of COCs in the extracted groundwater.

The process train will be selected during the remediation design phase after treatability and bench-scale studies are performed. Product recovered by the extraction wells, or during initial phase-separation steps, can be temporarily stored and then transported offsite for incineration consistent with the laws applicable at the time of such offsite transport. Modifications to the process train may be necessary as the chemistry of the influent may alter significantly over time.

Treated effluent will be discharged to the storm sewer, unless an evaluation indicates that an alternative "end-use" (such as use as facility process water or reinjection into the aquifer) can be practicably implemented.

Treatability Studies - Treatability studies will be conducted to identify a cost-effective technology for treating the extracted groundwater. Groundwater chemistry data will be used to assess the general water quality and to calculate approximate concentrations of contaminants in the treatment system influent. Aquifer test data will be used to calculate approximate extraction flow rates. Treatment performance will be based on surface-water discharge criteria.

The overall objective of the treatability studies is to provide sufficient data to select and design a groundwater treatment system that can effectively achieve the performance standards in a cost-effective manner.

The treatability studies will be performed in two phases. The first phase will consist of bench-scale studies of GAC (granular activated carbon) adsorption, ultraviolet (UV)-chemical oxidation and membrane filtration. Air stripping will be evaluated by modeling the process. In Phase I, standard tests of the remedial technologies will be used to (1) identify the differences in process efficiencies and (2) examine the effects of process variables on effluent chemical concentrations. The objective of Phase I is to determine whether these technologies perform satisfactorily for site conditions. The Phase I studies will be used to select one or more processes that will be examined in further detail in Phase II.

Phase II will be one or more pilot-scale studies. The objective of Phase II is to (1) identify an "optimal" process, (2) evaluate the

scale-up of the process and process design parameters, (3) statistically compare removal efficiencies with discharge criteria, and (4) estimate capital and operation and maintenance costs.

The following sections describe each of the technologies to be tested in Phase I.

Granular Activated Carbon (GAC) Adsorption - Adsorption of COCs onto activated carbon occurs selectively when contaminated water flows through a bed of carbon granules. For the extracted groundwater at this site, expected adsorption would be high for PCB, medium for TCB, and low for VOCs. However, if PCB is present in colloidal form, GAC may not be as effective as expected based on the chemical properties of PCB alone. If GAC is implemented at this site, the used carbon must be sent offsite to a TSCA-permitted incinerator to destroy the adsorbed COCs. Used carbon is typically regenerated, but no carbon regeneration facility has a TSCA permit. The incineration cost will be considered in the evaluation of this technology.

Ultraviolet-Chemical Oxidation - Ultraviolet light in combination with hydrogen peroxide or ozone can be used to destroy completely organic molecules to form carbon dioxide, water, and inorganic salts. This advanced oxidation process has proven effective for the full range of COCs found at the site. Pretreatment to remove particles may be required because large particles may lessen the treatment effectiveness. Acid may be added to control alkalinity. If ozone is used, air emission control (pursuant to substantive requirements of the Bay Area Air Quality Management District's regulations) is required and will be considered in the evaluation of this technology.

Air Stripping - Air stripping will transfer volatile organic compounds from the water phase to the gas phase using countercurrent flow in a packed tower. For the extracted groundwater at this site, an air stripper is expected to be very effective for the low concentrations of chlorinated VOCs and gasoline-related compounds and moderately effective for DCBs because they are not as volatile as most of the VOCs, but not effective for PCB or diesel fuel. Pretreatment may be required, such as removing suspended solids and adjusting pH or adding a sequestriant to reduce scaling on the packing material. Both the effluent gas (regulated by Bay Area Air Quality Management District rules) and effluent water from the tower may be subjected to further treatment by GAC in order to meet performance criteria.

Membrane Filtration - Ultrafiltration and reverse osmosis are the two membrane filtration processes that will be evaluated during the Phase I treatability studies. Ultrafiltration ("UF") depends on a pressure driving force and a semipermeable membrane to separate solutes, generally macromolecules with molecular weights above 500, from water. Although the molecular weights of the COCs at the site

are less than 500, field filtration of one groundwater sample through a 0.45-micron filter removed 100 percent of the PCB and 30 to 50 percent of the TCB (DCB was not removed). Thus UF may be effective for concentrating and reducing the volume of COCs needing treatment.

Osmosis is the spontaneous flow of a solvent (e.g., water) across a semipermeable membrane from a dilute solution to a concentrated solution. Reverse osmosis ("RO") uses differential pressure across a membrane to cause water to flow in reverse from the concentrated solution (concentrate) to the dilute solution (permeate). RO is similar to UF but uses higher applied pressures and different membranes, and can separate even low-molecular-weight species from water.

Preliminary evaluation of both UF and RO will be performed to determine the number and type of membranes to be evaluated during bench scale tests.

6.2.2.2 Containment Component for Groundwater

While the extraction system will be designed to reduce the aqueous phase concentrations of COCs and the extent of the plume in the A and B aquifers, it will also be designed to prevent further migration of COCs in both aquifers through gradient control. In particular, a key objective will be permanent containment of the DNAPL source area in the A aquifer such that aqueous phase contaminants will be prevented from migrating beyond specified compliance points. This key objective will be met using a densely spaced line of groundwater extraction wells north of Building 21 (Figure 11).

All groundwater cleanup standards must be achieved in both the A and B aquifers with the exception of the PCB standard in the DNAPL source area of the A aquifer in the area where EPA has determined that it is technically impracticable to meet this standard. This area is defined by the wells outside the perimeter of the known or suspected extent of DNAPL, and permanent containment of this area is required.

EPA's current intent is to use the following monitoring wells to define the compliance points for meeting all cleanup standards in the A aquifer: W10, W24, W26, W30, W57, CCG-2, W58, W60, W31, W44, W43, W63, W64, W65, W54, W55, W66. However, these points may be adjusted, based upon information generated during remedial design of the extraction system. The selected wells will serve as compliance points where all standards must be met, including the PCB standard. All points outside of this perimeter must also achieve the cleanup standards for groundwater in the A and B aquifers. Figure 6 depicts the extent of PCB contamination in the A aquifer and the locations of the monitoring wells that are named here as compliance points.

6.2.2.3 General Components for Groundwater

Monitoring of water levels and water quality will be an integral part of the extraction and treatment system. The monitoring program will be designed to ensure that gradients are controlled and that satisfactory capture of aqueous phase contamination is maintained. The monitoring program will also verify aqueous phase plume reductions and achievement of cleanup standards, as well as provide information that may be used to adjust the extraction and treatment systems for optimum cost-effective performance over time.

Institutional controls such as land use restrictions will be applied to the DNAPL source area within the compliance perimeter to prevent water supply well construction here.

EPA is concerned that PCB in the B aquifer has been detected at distances greater than would normally be predicted (see Section 4.3.1 on transport mechanisms for site chemicals) for their migration from the source area. The State and local agencies, the City of Sunnyvale and the neighborhood residents have all expressed similar concerns. While the risk to receptors does not increase measurably over the next few years, or in any way constitute an emergency, the threat from the groundwater does constitute an imminent and substantial endangerment, and EPA believes that the time to implementation of the remedial action should be as short as practicable within the legal constraints of CERCLA. From the time an enforcement mechanism, such as a consent decree or an order, becomes effective, it is estimated that time to full-scale start-up of the groundwater extraction and treatment system would be approximately two years.

Table 7 presents cost summaries of the alternatives. The direct capital costs for groundwater remediation will be \$850,000 including a 20 percent contingency. Indirect capital costs, including a 15 percent contingency are \$440,000. Operation and maintenance costs (15 percent contingency included) are \$60,000 for the first year, and \$29,000 for each year thereafter.

6.3 Soil Remedies

This section continues the discussion of the treatment, containment and other general components of the four alternatives. The previous section, 6.2, focused on the groundwater remediation. The focus of this section is soil remediation.

As has been described, approximately 1450 cubic yards of vadose-zone soils contaminated with greater than 500 ppm PCB extend from the surface down to the water table at 32 feet (Figures 6 and 8).

Subpart D of the Toxic Substance Control Act ("TSCA") PCB regulations, which specify treatment, storage, and disposal requirements for PCB, applies to excavated soils at the site. The

Resource Conservation and Recovery Act ("RCRA") does not apply to soil cleanup activities at Westinghouse because PCB is exempt from RCRA (because it is regulated under TSCA). The California storage requirements for soils containing greater than 50 ppm PCB, contained in C.C.R. Title 26, §22-66371 and §22-66508, are ARARs for the storage of hazardous waste at the site. Additionally, the Bay Area Air Quality Management District's (BAAQMD) Regulation 8, Rule 40 is an ARAR for excavation activities at the site. This Rule deals with volatilization of COCs.

It should be noted that the RI/FS Report estimates the volume of PCBs in this 32-foot column of soil to be about 30 percent of the total mass of PCB in the source area. PCB DNAPL contamination in the A aquifer represents the remaining 70 percent of contaminant mass.

As explained earlier, alternative A is the "no action" alternative. Alternatives B, C and D all address groundwater contamination in the same manner, differing only in the ways in which soil contamination is addressed. Because the DNAPL in the A aquifer outweighs soil contamination as an ongoing significant source of contamination to groundwater (by virtue of its greater mass and immediate proximity), removal of contaminated soil does not measurably reduce the threat of further contamination of groundwater. However, containment of contaminated soil does prevent direct contact with these soils at the surface, and removal of shallow soil prevents direct contact exposure to subsurface workers in shallow soils. The approaches to soil remediation in Alternatives B, C and D reflect varying degrees of protection from direct contact exposure.

Alternative B requires capping. Alternatives C and D are excavation options (eight feet and 32 feet). These two excavation options (C and D) consider offsite disposal versus offsite incineration of the excavated soils in sub-alternatives C1, C2, D1 and D2. Table 7 provides cost summary information for each alternative and includes breakout information on the soil options considered.

6.3.1 No Action - Soil

The "no action" alternative represents a baseline against which the other alternatives can be compared. It does not include any remediation of the contaminated soils at the site. The costs associated with this alternative are those outlined in section 6.2.1 for groundwater monitoring only (Table 7).

6.3.2 Alternative B - Soil Capping

Alternative B does not consider any treatment components for soil.

It is a containment remedy for soils, using an asphalt cap. The purpose of the cap is to prevent direct contact with PCB-contaminated soils at the ground surface, to eliminate air-borne transport of contaminated soil particles, and to prevent infiltration of water through the contaminated soils so that PCB will not migrate to the groundwater. As discussed earlier, the prevention of direct contact is the most significant protection offered by the cap. Although the cap does prevent infiltration of water that may transport PCB to groundwater, the groundwater is already seriously affected by DNAPL. The extraction system, also a part of Alternative B, addresses groundwater contamination.

Long-term maintenance of the asphalt cap, land use restrictions, and ongoing monitoring are also part of this alternative. Approximately 1450 cubic yards of shallow and vadose zone soils contaminated with greater than 500 ppm PCB are left in place. These contaminated soils extend from the surface down to the water table at 32 feet (Figures 5 and 7).

The estimated capital costs associated with capping the soil total \$37,000 (Table 10).

6.3.3 Alternative C - Soil Excavation to Eight Feet

Alternative C evaluates removal of soils containing greater than 25 ppm PCB to a depth of eight feet (approximately 400 cubic yards or ten percent of the total contaminant mass, including DNAPL, in the source area). Removed soils are replaced with clean fill and the excavated area is capped with an asphalt cover to prevent infiltration of water through contaminated soils below eight feet.

Again, as in Alternative B, long-term maintenance of the cap, land-use restrictions, and ongoing monitoring are part of Alternative C. Approximately 1050 cubic yards of soil containing PCB at concentrations greater than 500 ppm are left in place. These are, however, considered low threat soils because they exist at depth where direct contact activities are not envisioned, because PCB in these soils is very immobile, and because they do not pose a significant threat to groundwater.

Sub-alternatives C1 and C2 weigh offsite disposal versus offsite incineration of the excavated soils, respectively. Both of these sub-alternatives must comply with TSCA requirements governing transport and disposal or incineration of PCB wastes. Sub-alternative C2 is consistent with the recommendation in guidance that "principal threats" should be treated (Guidance on Remedial Actions for Superfund Sites With PCB Contamination, August 1990, which has been identified as TBC criteria). Sub-alternative C2 also combines treatment and containment components.

The capital costs associated with soil removal to eight feet and offsite disposal (C1) are \$430,000. The capital costs of removal

and incineration (C2) are \$1,800,000.

6.3.4 Alternative D - Soil Excavation to 32 Feet

Alternative D evaluates removal of PCB-contaminated soils to a depth of 32 feet. In the upper eight feet, soil containing greater than 25 ppm PCB will be removed. Below eight feet and down to 32 feet, soil containing greater than 500 ppm will be removed. This constitutes approximately 1450 cubic yards of soil and represents about 30 percent of the estimated total mass of PCB contamination in the source area. DNAPL contamination in the A aquifer represents the remaining 70 percent of estimated contaminant mass.

Sub-alternatives D1 and D2 weigh offsite disposal versus offsite incineration, respectively. Both of these sub-alternatives must comply with TSCA requirements governing transport and disposal or incineration of PCB wastes. Sub-alternative D2 is consistent with the recommendation in guidance that "principal threats" should be treated (Guidance on Remedial Actions for Superfund Sites With PCB Contamination, August 1990). Sub-alternative D2 also combines treatment and containment components.

The capital costs for removal of 32 feet of soil and offsite disposal (D1) are estimated to be \$1,400,000. The capital costs for removal to 32 feet and offsite incineration are estimated to be \$6,400,000.

7.0 SUMMARY OF THE COMPARATIVE ANALYSIS OF ALTERNATIVES

This section documents the key advantages and disadvantages among the alternatives in relation to the nine criteria set forth in the National Contingency Plan ("NCP"). The evaluations of the alternatives are based on continued industrial use of the site. Table 7 contains a summary presentation of the four alternatives in relation to the nine criteria. The following nine sections correspond to the nine criteria and each section contains a discussion of all four alternatives with respect to that criterion.

7.1 Overall Protection of Human Health and the Environment

Alternatives B, C and D all provide equal protection from exposure to contaminated groundwater because they all employ the same groundwater extraction and treatment system. This system combines containment and restoration of the contaminated A and B aquifers. All three of these alternatives (B, C, and D) require the groundwater to be cleaned up to the state or federal MCLs (whichever are more stringent), with the exception of the PCB MCL in the source area of the A aquifer (see Section 6.2.2.2). Additional cleanup levels to be met in the affected aquifers for 1,3-Dichlorobenzene and 1,2,4-trichlorobenzene are based on TBC criteria (a proposed federal MCL and a State of California Action Level, respectively) in the absence of promulgated criteria. Also,

these three alternatives include the same groundwater monitoring program for verifying system performance, the same discharge criteria for the extracted and treated groundwater, and the same land use restrictions preventing water supply well construction. These measures will prevent exposure to contaminants in the A and B aquifers, which are classified as potential sources of drinking water.

Alternatives B, C and D all prevent exposure to PCB-contaminated soils. These soils are limited to a 50-foot diameter area south of the Reservoir 2 and one smaller shallow (less than five feet deep) area along the Inerteen pipeline, all of which are on the Westinghouse property, as described in Section 4.2.1 (Figure 5). Much of this soil contains concentrations of PCB greater than 500 ppm, which makes it, by definition, a "principal threat" (Guidance on Remedial Actions For Superfund Sites With PCB Contamination, August 1991). All three alternatives require capping with asphalt and maintenance of the cap. Land use restrictions would prevent excavation below the eight feet where soil is removed for any of these three alternatives. In Alternatives C and D, clean fill would replace the removed soil. Land use restrictions will permit temporary subsurface work in the clean fill areas, but complete restoration of any disturbance to the fill, or the asphalt cap, will be required once the work is completed. Alternative D requires removal of all contaminated soil down to the water table at 32 feet below ground surface. Alternative C requires removal of soil from the surface to a depth of eight feet. Alternative B does not require any removal of soil, relying entirely upon the cap and land use restrictions to prevent exposures to contaminated soil.

It should be noted that the DNAPL in the A aquifer, which is generally located directly below the soil contamination and results from the same release, eclipses the soils as a contaminant source to the groundwater, i.e., removal of any amount of soil would not accomplish a measurable reduction in the risk of further contaminating groundwater because the DNAPL provides a far more significant source of contamination. Protection from exposure to groundwater contamination is addressed by the groundwater extraction and treatment system discussed above.

Alternative A, no action, does not prevent exposure to contaminated site soils or groundwater in any way. Neither does it prevent continued migration of site contaminants in the uppermost aquifers, which may pose a risk should these aquifers ever be used as a source of supply water in the future. (Although there is no current use of these aquifers, they are classified as a potential source of drinking water.)

7.2 Compliance With Applicable or Relevant and Appropriate Requirements (ARARs)

The Maximum Contaminant Levels ("MCLs") are relevant and

appropriate requirements to be met in the affected aquifers (NCP, 40 C.F.R. §300.430(e)(2)(i)(C). These are presented in Table 8. Also presented in Table 8 are two cleanup levels to be met in the affected aquifers that are based on TBC criteria in the absence of any promulgated standard for those chemicals (1,3-Dichlorobenzene and 1,2,4-Trichlorobenzene). Alternative A cannot meet the MCLs in the affected aquifers. Alternatives B, C, and D comply with these requirements everywhere in the A and B aquifers with the exception of the A aquifer source area, where EPA has determined that it is technically impracticable to meet the MCL for PCB. This limited portion of the A aquifer is defined by specific compliance points as discussed in Part II, Section 6.2.2.2 of this ROD. The technical impracticability waiver of the "relevant and appropriate" PCB MCL is based upon the presence of spatially discontinuous, dense, non-aqueous phase liquids (PCB Aroclor 1260) in significant amounts; the heterogeneity of the subsurface combined with low permeabilities; and the characteristics of PCB (low solubility, high tendency to partition onto organic materials and high viscosity).

ARARs for soil cleanup levels have not been established. However, a 25 ppm soil cleanup level for PCB contaminated soils at industrial sites is consistent with Guidance on Remedial Actions For Superfund Sites With PCB Contamination, OSWER Directive No. 9355.4-01, August 1990, which is a TBC criteria. The 25 ppm number is based upon a risk analysis and includes a consideration of the depth of contamination. It is not necessarily appropriate, according to the guidance, to apply it to deep vadose-zone soils. Both Alternatives C and D meet this criterion from the surface to a depth of eight feet. Alternative D also removes all soil containing greater than 500 ppm PCB from eight feet to 32 feet. Alternatives A and B leave all contaminated soils in place.

The substantive discharge standards under the Clean Water Act are applicable requirements for discharge of any effluent from the groundwater treatment system to the storm sewers. The substantive discharge requirements under the California Porter-Cologne Act (California Water Code, Division 7, Section 13000, et seq.) also apply to such discharges. Alternatives B, C and D all comply with these requirements. Alternative A does not include a discharge component.

The California Regional Water Quality Control Board's Basin Plan is also an ARAR, including the State of California's "Statement of Policy With Respect to Maintaining High Quality of Waters in California," Resolution 68-16, incorporated therein. Alternatives B, C and D all comply with these requirements, which deal with maintenance of high quality waters in California. Alternative A does not.

Alternatives B, C and D all include a groundwater extraction and treatment system. Therefore the same ARARs apply in each

alternative to the various components of the extracted groundwater treatment system. If granular activated carbon adsorption is implemented as part of the treatment process, Subpart D of TSCA is an ARAR for the storage and treatment of spent carbon. The same law is an ARAR for spent filtration membranes if they are included in the treatment process. If ozone is used for the ultraviolet-chemical oxidation process, or if an air stripper is added to the process train, Bay Area Air Management District's Regulation 8, Rule 47 is an ARAR for air emissions from either of these treatment process components. Alternatives B, C and D comply with these requirements. Alternative A does not employ any action that would trigger these ARARs.

The Bay Area Air Management District's Regulation 8, Rule 40, which deals with contaminant air emissions during excavation, is an ARAR for Alternatives C and D, both of which employ excavation as a component of the remedy. Alternatives C and D comply with this requirement. Alternatives A and B do not require any excavation and therefore do not trigger these requirements.

Subpart D of the TSCA, which specifies treatment, storage, and disposal requirements for PCB, applies to excavated site soils. Alternatives C and D each require excavation and short-term storage of excavated soils. Sub-alternatives C1 and D1 require offsite disposal of soil and trigger the TSCA disposal requirements. Sub-alternatives C2 and D2 trigger the TSCA treatment requirements. Alternatives C and D (inclusive of the sub-alternatives) comply with these requirements concerning treatment, storage, and disposal. Alternatives A and B do not trigger these requirements.

The storage requirements for soils containing greater than 50 ppm PCB contained in the California Code of Regulation, Title 26, §22-66371 and §22-66508, are ARARs for the storage of hazardous wastes at the site. Both Alternatives C and D, which include excavation of soils, comply with these requirements. Alternatives A and B do not employ any actions that trigger these requirements.

It should be noted that RCRA is not an ARAR for the treatment storage or disposal of the Westinghouse soils because PCB is not a RCRA waste, and no RCRA wastes are mixed with the PCB-contaminated soils. Nor does EPA believe the situation at this site is sufficiently similar to that addressed by these RCRA requirements to justify a determination that they are relevant and appropriate to this cleanup.

7.3 Long-Term Effectiveness and Permanence

Groundwater - Because removal or treatment of PCB DNAPL, which occur in the shallow A aquifer, is considered technically impracticable at this site, all three of the "action alternatives," B, C and D, require long term containment through hydraulic control of the portion of the aquifer where DNAPL occurs (see Section

5.2.2.2). In addition to containment of PCB within the area where DNAPL occurs, the extraction and treatment system, (which is common to all three of these alternatives) will effectively restore the groundwater to all other MCLs. Outside of the contained area all MCLs, the CDHS Action Level for 1,3-Dichlorobenzene, and the proposed federal MCL for 1,2,4-Trichlorobenzene must be met in the affected aquifers. Included in the system are groundwater monitoring, treatment of extracted groundwater to discharge limits, and land use restrictions to prevent water supply well construction in the contained area of the aquifer. While remediation of all of the contaminated groundwater is technically impracticable and there is an area of the A aquifer that will require long-term management, the groundwater extraction and treatment system required in Alternative B, C and D would be effective in preventing exposure to contaminated groundwater.

The treatment technologies that are being applied to extracted groundwater in Alternatives B, C and D will permanently destroy contaminants through offsite incineration of spent filtration membranes and/or spent carbon, or through ultraviolet chemical-oxidation of extracted groundwater.

Soil - As noted earlier, the three "action alternatives," B, C and D, are different from one another in the ways each addresses soil contamination. The permanence and long-term effectiveness of each of the soil options is discussed in the following paragraphs .

Alternative D requires removal of all soil containing PCB above 500 ppm, from the surface down to the water table at a depth of 32 feet. Additionally, soil containing more than 25 ppm PCB must be removed in the upper eight feet of the excavation. This action would result in the permanent removal of vadose zone soils contaminated above these levels at the Westinghouse property. However, permanence is also defined by the disposition of the removed soil. As noted above, Sub-alternatives D1 and D2 require offsite disposal and offsite incineration, respectively. Incineration is the more permanent option for excavated soils because the PCB is destroyed.

Alternative C requires removal of all soil containing PCB above the cleanup standards, from the surface down to a depth of eight feet. Again, these soils would be permanently removed from the Westinghouse property, but their final disposition would determine any additional permanence achieved, with incineration (Sub-alternative C2) being a more permanent action than land disposal (Sub-alternative C1). Also, Alternative C is a less permanent solution than Alternative D in that contaminated soils remain in place below a depth of eight feet. For Alternative C, protection is achieved with land use restrictions that prevent excavation work below eight feet, allows only temporary excavation above eight feet, and by capping.

Alternative B, which requires capping with no soil removal or treatment, represents a "containment only" approach to contaminated soils. Of the three "action alternatives," it is the least permanent solution. In addition to the cap, land use restrictions and the facility fence are required for prevention of exposure to contaminated soils at the site.

Alternative A, no action, does not provide permanent or effective protection from site contamination.

7.4 Reduction of Toxicity, Mobility or Volume Through Treatment

The groundwater extraction and treatment system, which is common to Alternatives B, C and D, treats extracted groundwater with permanent destruction technologies. Recovered product phases, filtration membranes, and activated carbon filters will be incinerated offsite. Ultraviolet/chemical-oxidation will destroy contaminants by oxidizing them. Destruction results in a reduction of the toxicity, mobility and volume of site contaminants.

Sub-alternatives C2 and D2 require incineration of PCB-contaminated soils that have been removed from the site. This treatment results in a reduction of the toxicity, mobility and volume of soil contaminants. D2 provides the greatest reductions because more soil is removed and incinerated.

Alternative B, sub-alternatives C1 and D1 do not require treatment of soils, therefore these alternatives do not achieve reductions in toxicity, mobility or volume of soil contaminants.

Alternative A does not achieve reductions in toxicity, mobility or volume for soil or groundwater contaminants.

7.5 Short-Term Effectiveness

Alternatives C and D require soil excavation, which introduces some risk of soil exposure to excavation workers through potential inhalation, ingestion, and dermal contact; this risk is greater for Alternative D, the deeper excavation, because the exposure time is greater. Dust control measures coupled with proper health and safety procedures, including protective clothing, can mitigate the risks posed during excavation work. Alternative B introduces a small short-term exposure risk to the workers installing the cap over the affected soils; however, this risk is easily mitigated by health and safety procedures. Alternatives B through D include groundwater extraction well construction, which introduces a small short-term risk to workers that can be mitigated through standard health and safety procedures. It is not anticipated that any short-term risks of exposure are posed to nearby residents by implementation of any of the four alternatives. There are no short-term risks associated with implementing Alternative A, the no action option.

7.6 Implementability

All alternatives are administratively feasible. No problems are anticipated regarding the availability of material to perform remediation in accordance with any of the alternatives.

All alternatives are technically feasible. The technologies required in each alternative are practical and proven. Alternative A is the easiest to implement. Groundwater remediation is equally implementable for Alternatives B, C and D. Soil remediation is relatively easy for Alternative B, more difficult for Alternative C, and most difficult for Alternative D.

7.7 Cost

Table 7 presents cost information at the bottom of the table for each alternative. Alternative A, which only involves expansion of the existing monitoring program is the least expensive. The present worth of capital and operations and maintenance ("O & M") costs for thirty years is \$3.7 million.

Alternatives B, C and D have the same O & M and direct costs for groundwater remediation, but differ in capital costs for soil remediation. Rounded capital costs for Alternative B are \$1.3 million, the majority of which is for groundwater remediation. Alternatives C and D include soil excavation, and the sub-alternatives using disposal are considerably less expensive than those using incineration. Capital costs of sub-alternatives using disposal are \$1.7 million for C1, and \$2.7 million for D1. Capital costs of sub-alternatives using incineration are as follows: C2, \$3.1 million; D2, \$7.7 million.

The approximate present worth cost for thirty years for each alternative is listed below:

- o Alternative A - \$3.7 million
- o Alternative B - \$6.5 million
- o Alternative C - C1, \$6.9 million; C2, \$8.3 million
- o Alternative D - D1, \$7.8 million; D2, \$12.9 million

Alternative C, by removing ten percent of the PCB-containing soils requires thirty percent (C1) to 135 percent (C2) more in capital costs than Alternative B. Alternative D, by removing twenty percent more of the PCB-containing soils than in Alternative C, requires 56 percent (D1) to 150 percent (D2) more in capital costs than Alternative C.

Sensitivity Analysis - Because the treatment system for extracted groundwater is not fully defined, costs for extraction, treatment, and monitoring were approximated using the available data. To evaluate the cost sensitivity of the design assumptions, specific components of the remediation scheme were varied to generate a

range of costs. Design assumptions were varied for items with a high uncertainty and items for which a slight change significantly impacted the overall costs.

The sensitivity analysis is discussed in detail in Section 12.5.7 of the Remedial Investigation and Feasibility Study Report. Table 10 summarizes the results of the analysis. The no action alternative is the most sensitive on a percentage basis (24 percent) because the overall capital costs are low. Sensitivity decreases as capital costs increase (from an average of ten percent for Alternative B to an average of two percent for Alternative D2). In contrast, for O & M costs, there is a difference of five percent for Alternatives A, B, C, and D. Present worth costs vary between three and seven percent from the median for all four alternatives.

7.8 State Agency Acceptance

The California Regional Water Quality Control Board ("the Board") commented on the Proposed Plan and stated that it was in general concurrence with it. The Board's stated concerns focus on the waiver of the drinking water standard for PCB in the source area and the associated permanent loss of a potential drinking water supply. However, the State concurs with the technical basis for the waiver and states that it "believes that the potential drinking water source loss may be allowable in this specific case." A full response to comments received from the RWQCB can be found in the attached Responsiveness Summary, Attachment A.

7.9 Community Acceptance

As discussed in Part I of this ROD in Section 3.0, Highlights of Community Participation, the Proposed Plan public hearing was well attended and approximately thirty comment letters were received during the sixty-day public comment period.

There were many concerns raised by community members at the public hearing and in the written comments received. The major concern was with waiving the relevant and appropriate maximum contaminant level (MCL) for PCB in the A aquifer source area where DNAPL occurs. Some commenters indicated that all contamination should be removed from the site. None of the comments received provided EPA with any technical or health risk justifications for not invoking the waiver. EPA remains convinced that removal of the DNAPL is technically impracticable and that there is merit in acknowledging so with the technical impracticability waiver. This action provides a clear basis for the requirement to permanently contain the source area. The permanent containment component is a significant feature of the remedy designed to provide ongoing protection of the surrounding aquifers. EPA believes that the technical impracticability waiver coupled with the requirement to contain permanently and to monitor the area covered by the waiver provides a significant protection from exposure to contaminated

groundwater.

Another key concern voiced by the community is related to the potential for health effects to residents and workers. While the concerns raised regarding health effects were broader than are typically addressed in the process leading to a selection of a cleanup remedy, the Agency for Toxic Substances and Disease Registry ("ATSDR") and California Department of Health Services ("CDHS") are currently conducting a health assessment which does consider possible health effects to both onsite workers and offsite residents. This health assessment may or may not recommend further health activities such as "health studies" based upon the data evaluated. Based on the location and limited extent of contamination in addition to the lack of evidence that any exposures are occurring, EPA believes that the risks associated with the site are very low. However, in order to facilitate communication between community members and the agencies performing the health assessment, EPA is taking several measures which are outlined in the Responsiveness Summary. One of these measures is a request to CDHS that a notice of the availability of the draft health assessment be mailed to all persons who commented on the Westinghouse Proposed Plan.

Additional concerns raised by the community are addressed in detail in the attached Responsiveness Summary, Attachment A.

7.10 Comparative Evaluation Conclusions

Based on the comparative analysis EPA selects Alternative C2 as the alternative that represents the best balance of the nine criteria. Alternative A is unacceptable because it does not provide adequate protection of human health and the environment. Alternatives B, C, and D provide the equal protection of human health and the environment regarding groundwater exposure, and the cost for groundwater cleanup is the same for all three alternatives.

Alternatives B, C and D differ by the degree of soil remediation required. The lateral area of contaminated soil is small (50-foot diameter), but the concentrations are high. The decision to remove soil in this area to a maximum depth of eight feet, rather than capping it in place (Alternative B) less expensively, is reasonable given the plausible scenarios for shallow excavation activities which might occur on this industrial property in the future. Removing all contaminated soil to the depth of the water table at 32 feet (Alternative D) does not achieve a measurable reduction in risk due to direct contact exposure because there is no plausible expectation that subsurface work would occur below the eight-foot level. Therefore, the much higher additional cost for this alternative is not justified. Land use restrictions preventing subsurface work below eight feet would provide adequate protection in these circumstances. Additionally, it has been explained that DNAPL contamination in the A aquifer outweighs the deep vadose-zone

soils as an ongoing contributing source of contamination to groundwater such that soil removal does not result in any measurable reduction in risk to groundwater. The selection of incineration (C2) over land disposal (C1) is based upon the statutory preference for remedies that employ treatment and use more permanent solutions to the extent practicable.

8.0 The Selected Remedy

8.1 Description of the Selected Remedy

The selected remedy, which addresses the primary risks posed by both soil contamination (which can be characterized as a principal threat at this site) and shallow groundwater contamination (which includes detected DNAPL in the source area that may also be characterized as a principal threat), consists of the following components: . . .

- (1) Permanent containment of contaminated groundwater in the source area where DNAPL is detected, using extraction;
- (2) Restoration of contaminated groundwater, using extraction, to the CDHS Action Level for 1,3-Dichlorobenzene, the proposed MCL for 1,2,4-Trichlorobenzene and the federal and state maximum contaminant levels ("MCLs"), with the exception of the standard for polychlorinated biphenyls ("PCB") in the onsite source area where DNAPL occurs (these cleanup levels are presented in Table 8);
- (3) Treatment of the extracted groundwater to meet all ARARs identified for this discharge prior to discharge to the on-site storm sewer, unless an evaluation indicates that an alternative "end-use" for the treated effluent (such as use for facility process water) can be practicably implemented;
- (4) Removal of contaminated soil containing greater than 25 parts per million PCB to a depth of eight feet (approximately 400 cubic yards);
- (5) Off-site incineration of excavated soils at a federally permitted facility;
- (6) Institutional controls, such as land use restrictions, to prevent well construction (for water supply purposes) in source areas that remain contaminated. Excavation below the eight feet soil has been removed will be restricted. Restrictions will also preclude excavation, other than temporary subsurface work in the upper eight feet and will require complete restoration of any disturbed fill or the asphalt cap once any such temporary work was completed;

- (7) A requirement that EPA receive notification of any future intention to cease operations in, abandon, demolish, or perform construction in (including partial demolition or construction) Building 21 (see facility map, Figure 2);
- (8) Permanent and ongoing monitoring of the affected aquifers to verify that the extraction system is effective in capturing and reducing the size and contaminant concentration of the aqueous phase plume and in containing aqueous phase contamination in the DNAPL source area.

The process steps for treatment of extracted groundwater may include phase separation (offsite incineration of any product phase recovered), either membrane or carbon filtration, ultraviolet/chemical-oxidation, air stripping, and a carbon polish. The components of the system will be determined during the project design and will be subject to modification during operation, based upon the actual flow rates and chemistry of the extracted groundwater (both of which may vary significantly over time). Destruction of groundwater contaminants will be accomplished through (1) offsite incineration of any separated product phase, (2) offsite incineration of spent carbon and/or filtration membranes and (3) ultraviolet/chemical-oxidation.

It is estimated that once the remedy is completed and the groundwater meets the required cleanup standards, total carcinogenic risk from ingesting groundwater from this site will be 8.5×10^{-5} . The noncarcinogenic hazard index for ingestion of site groundwater meeting the cleanup criteria (MCLs) is equal to 0.34. Because the remedy eliminates the risk pathways associated with residual contamination left on site (the DNAPL source area and the contaminated soils below eight feet), the risk of exposure to this contamination is effectively eliminated.

The points of compliance defining the groundwater source area are described in Section 6.2.2.2. They consist of monitoring wells at the perimeter of the groundwater source area, within which the waiver for the requirement to meet the PCB MCL in groundwater will be invoked, and for which permanent containment is required. The selected remedy requires all MCLs, the CDHS Action Level for 1,3-Dichlorobenzene, and the proposed MCL for 1,2,4-Trichlorobenzene (these last two cleanup standards are based on TBC criteria in the absence of promulgated standards) to be met at the points of compliance.

The total capital costs of this remedy are estimated at \$3.1 million. The present worth cost of this remedy over thirty years is estimated to be \$8.3 million. The annual O & M costs are estimated at \$225,000.

8.2 Statutory Determinations

8.2.1 Protectiveness

The selected remedy is protective of human health and the environment. Protection is achieved at this industrial site, and in the aquifers extending beyond the Westinghouse property, in the following ways:

- (1) Groundwater will be restored to health-based standards for all contaminated groundwater outside of the source area (the source area is characterized by a dense, non-aqueous phase liquid), thus preventing potential exposures, should these shallow aquifers ever be used for water supply purposes.
- (2) Permanent hydraulic containment of the source area will prevent pollutant migration and further contamination of the shallow aquifers, which are potential drinking water supplies. This containment will be combined with land use restrictions to prevent construction of supply wells in the source area where dense non-aqueous phase liquid has been detected.
- (3) The extracted groundwater will be treated, prior to onsite discharge, to meet all ARARs identified for such discharges.
- (4) Contaminated soil containing greater than 25 parts per million PCB which represents a 10^{-6} risk in an industrial setting will be removed to a depth of eight feet, thereby preventing potential exposure at the surface, or in the subsurface (e.g., utility line workers).
- (5) The removed soil, spent filtration membranes and spent carbon will be incinerated offsite, resulting in the destruction of these contaminants and thereby preventing further possibility of exposure to them.
- (6) Land use restrictions will prevent excavation, and therefore exposure, in the area where contaminated soils remain at depths greater than eight feet.
- (7) Land use restrictions will also prevent any residential development in the source area, in order to further preclude any risk of exposure due to contact with soil contamination.

8.2.2 Applicable or Relevant and Appropriate Requirements

Chemical-Specific ARARs - ARARs for the groundwater are the current state or federal (whichever are more stringent) maximum contaminant levels (MCLs) to be met in the affected aquifers (NCP, 40 C.F.R. §300.430(e)(2)(i)(C)). These relevant and appropriate requirements are presented in Table 8. Included in Table 8 are two cleanup standards that are based on TBC criteria in the absence of

promulgated standards and they must also be met in the affected aquifers. These are 1,3 Dichlorobenzene and 1,2,4-Trichlorobenzene. Alternative C2 complies with these requirements everywhere in the A and B aquifers with the exception of the A aquifer source area, where EPA has determined that it is technically impracticable to meet the MCL for PCB and has invoked a waiver for this requirement pursuant to CERCLA §121(d)(4)(C). Permanent containment of this limited portion of the A aquifer, which is discussed further in Section 6.2.2.2 of this ROD, is required. The technical impracticability waiver of the relevant and appropriate PCB MCL is based upon the presence of spatially discontinuous, dense, non-aqueous phase liquid (PCB Aroclor 1260) in significant amounts; the heterogeneity of the subsurface combined with low permeabilities; and the characteristics of PCB (low solubility, high tendency to partition onto organic materials and high viscosity).

ARARs for soil cleanup levels have not been established. However, a 25 ppm soil cleanup level for PCB contaminated soils at industrial sites is consistent with Guidance on Remedial Actions For Superfund Sites With PCB Contamination, OSWER Directive No. 9355.4-01, August 1990, which is a TBC criteria. The selected remedy complies with the 25 ppm soil cleanup level from the surface to a depth of eight feet.

Action-Specific ARARs - The substantive discharge standards under the Clean Water Act are applicable requirements for discharge of any effluent from the groundwater treatment system to the storm sewers. The substantive discharge requirements under the California Porter-Cologne Act also apply to such discharges. The selected remedy requires compliance with these applicable requirements.

The California Regional Water Quality Control Board's Basin Plan is also an ARAR, including the State of California's "Statement of Policy With Respect to Maintaining High Quality of Waters in California," Resolution 68-16, incorporated therein. The selected remedy requires compliance with these applicable requirements, which deal with maintenance of high quality waters in California.

Certain ARARs are applicable to the various components of the extracted groundwater treatment system. If granular activated carbon adsorption is implemented as part of the treatment process, Subpart D of TSCA is an ARAR for the storage and treatment of spent carbon. The same requirement is an ARAR for spent filtration membranes if they are included in the treatment process. If ozone is used for the ultraviolet-chemical oxidation process, or if an air stripper is added to the process train, Bay Area Air Management District's Regulation 8, Rule 47 is an ARAR for air emissions from either of these treatment process components. The selected remedy requires compliance with these applicable requirements.

The Bay Area Air Management District's Regulation 8, Rule 40, which deals with contaminant air emissions during excavation is an ARAR for the selected remedy, which employs excavation as a component of the remedy. The selected remedy requires compliance with this applicable requirement.

Subpart D of TSCA, which specifies treatment, storage, and disposal requirements for PCB, applies to excavated site soils. The selected remedy requires excavation and short-term storage of excavated soils. The selected remedy requires compliance with the TSCA treatment requirements and those requirements concerning storage, all of which are applicable.

The storage requirements for soils containing greater than 50 ppm PCB found in C.C.R. Title 26, §22-66371 and §22-66508 are ARAR for the storage of hazardous wastes at the site. The selected remedy, which includes excavation of soils, requires compliance with these applicable requirements.

It should be noted that RCRA is not an ARAR for the treatment storage or disposal of the Westinghouse soils because PCB is not a RCRA waste and no RCRA wastes are mixed with the PCB-contaminated soils. Nor does EPA believe the situation at this site is sufficiently similar to that addressed by these RCRA requirements to justify a determination that they are relevant and appropriate to this cleanup.

Location-Specific ARARs - There have been no location-specific requirements identified that are ARARs for the cleanup of the Westinghouse site.

8.2.3 Cost Effectiveness

The remedy is cost effective because maximum protection is achieved for the estimated cost of performance. The comparative analysis of the alternatives (see Section 7.7 of this ROD) demonstrates that additional remedial action and the cost associated with that action would not achieve a measurable reduction in risk, but that less effort and a lower cost would result in a measurably higher risk at the site.

8.2.4 Use of Permanent Solutions, Alternative Treatment or Resource Recovery Technologies to the Maximum Extent Practicable

The selected remedy, which combines containment and treatment components, requires cleanup which allows for continued industrial use of this site. In the absence of a technically practicable technology for treating or removing the DNAPL contamination in the A aquifer, this area of the aquifer will be permanently contained. The containment method is hydraulic control, i.e., extraction, and

the extracted groundwater will be treated using technologies that result in destruction of the contaminants. Outside of the source area, both the A and B aquifers will be restored to the MCLs, the CDHS Action Level for 1,3-Dichlorobenzene and the proposed MCL for 1,2,4-Trichlorobenzene through extraction. All extracted groundwater will be treated by the same treatment system.

Among the options considered for addressing contaminated soils, the best balance of the nine criteria set forth in the NCP is achieved by the selected remedy. Soils which do not represent a principal threat due to their location at depths greater than eight feet and their inability to significantly affect groundwater are left in place. Eight feet of clean fill soil, an asphalt cap and land use restrictions further prevent potential contact with these soils. Temporary subsurface work in the upper eight feet in the clean fill areas is permitted under the land use restrictions, but complete restoration of the fill material and asphalt cap will be required once any work is completed. Deeper excavation and soil removal does not reduce the risk measurably, but costs much more. Capping, with no soil removal, (containment only), is significantly less expensive, but there is a much higher risk in relying entirely on land use restrictions and fencing to prevent any potential exposure to the principal threat soils below the cap.

Incineration has been selected over land disposal for the excavated soils. This decision to select a significantly more expensive option is based upon the strong statutory preference for treatment. Additionally, these soils are classified as principal threat soils and there is an expectation that such wastes will be treated rather than land disposed wherever practicable (see NCP, 40 C.F.R. §300.430(a)(1)(iii)).

The selection of the treatment technologies for soil and groundwater discussed above demonstrate that, where it is practicable, the selected remedy will include permanent solutions.

However, because removal or treatment of dense non-aqueous phase liquids at this site has been determined to be technically impracticable, the remedy requires long-term containment of the source area. Because this remedy will result in hazardous substances remaining on-site above health-based levels, a review will be conducted within five years after commencement of the remedial action, and every five years thereafter, to ensure that the remedy continues to provide adequate protection of human health and the environment.

8.2.5 Preference for Treatment as a Principal Element

Soil containing greater than 25 parts per million PCB will be excavated to a depth of eight feet and incinerated offsite, reducing the toxicity, mobility and volume of site contamination by permanently destroying the PCBs in the excavated soils with a

treatment technology.

Toxicity, mobility and volume of groundwater contaminants will also be reduced as extracted groundwater is treated, by the combination of phase separation (product phase will be incinerated), filtration (filters will be incinerated) and ozone oxidation (chemical destruction) steps.

The selection of these treatment technologies as an integral part of the cleanup plan for both soil and groundwater demonstrates that the cleanup plan satisfies the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element.

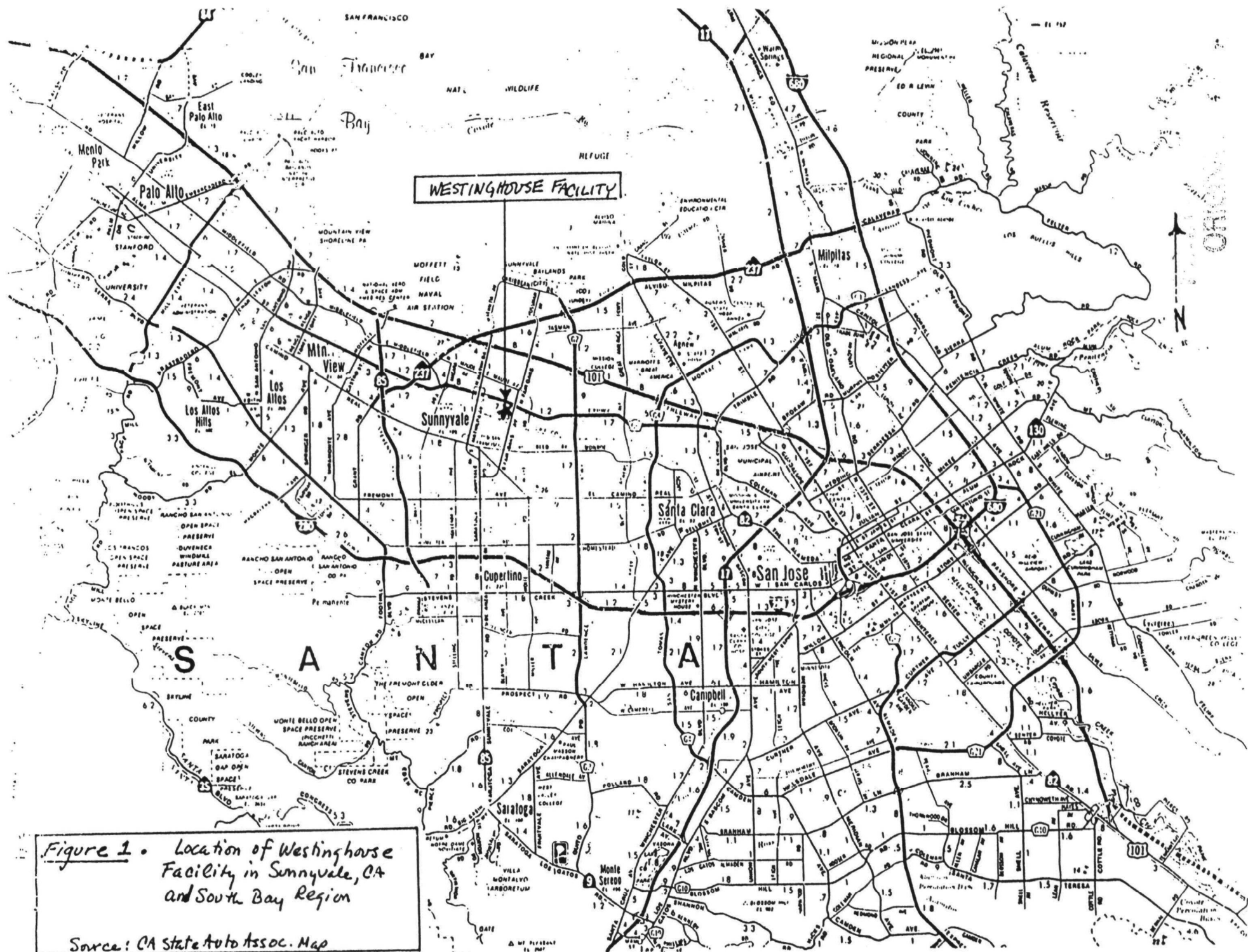
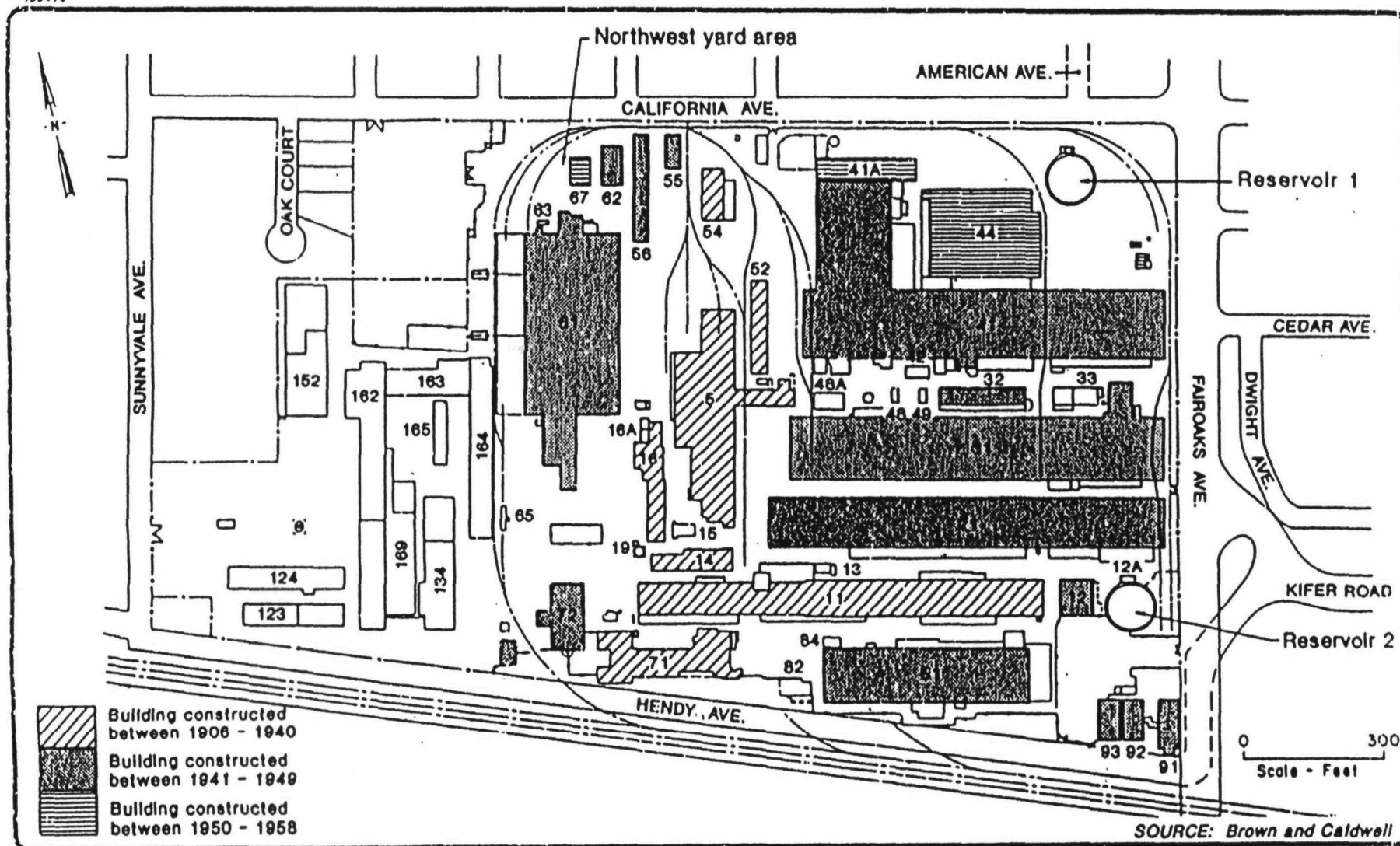


Figure 1. Location of Westinghouse Facility in Sunnyvale, CA and South Bay Region

Source: CA State Auto Assoc. Map



WESTINGHOUSE ELECTRIC CORPORATION
MARINE DIVISION
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
SUNNYVALE, CALIFORNIA

Figure 2.

FACILITY MAP

FIGURE 3. General Sketch
of Groundwater Mound;
Contours in A Aquifer.

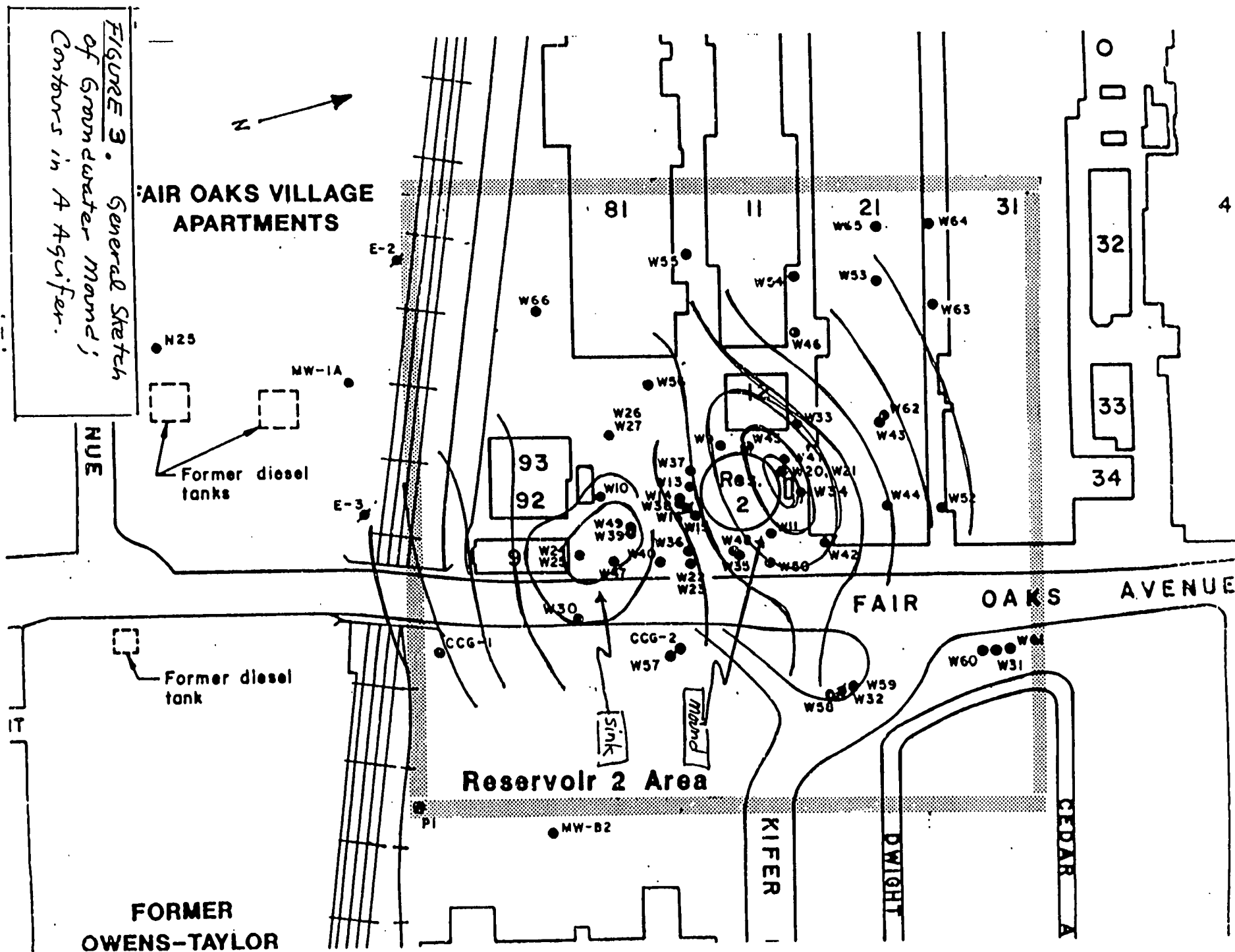
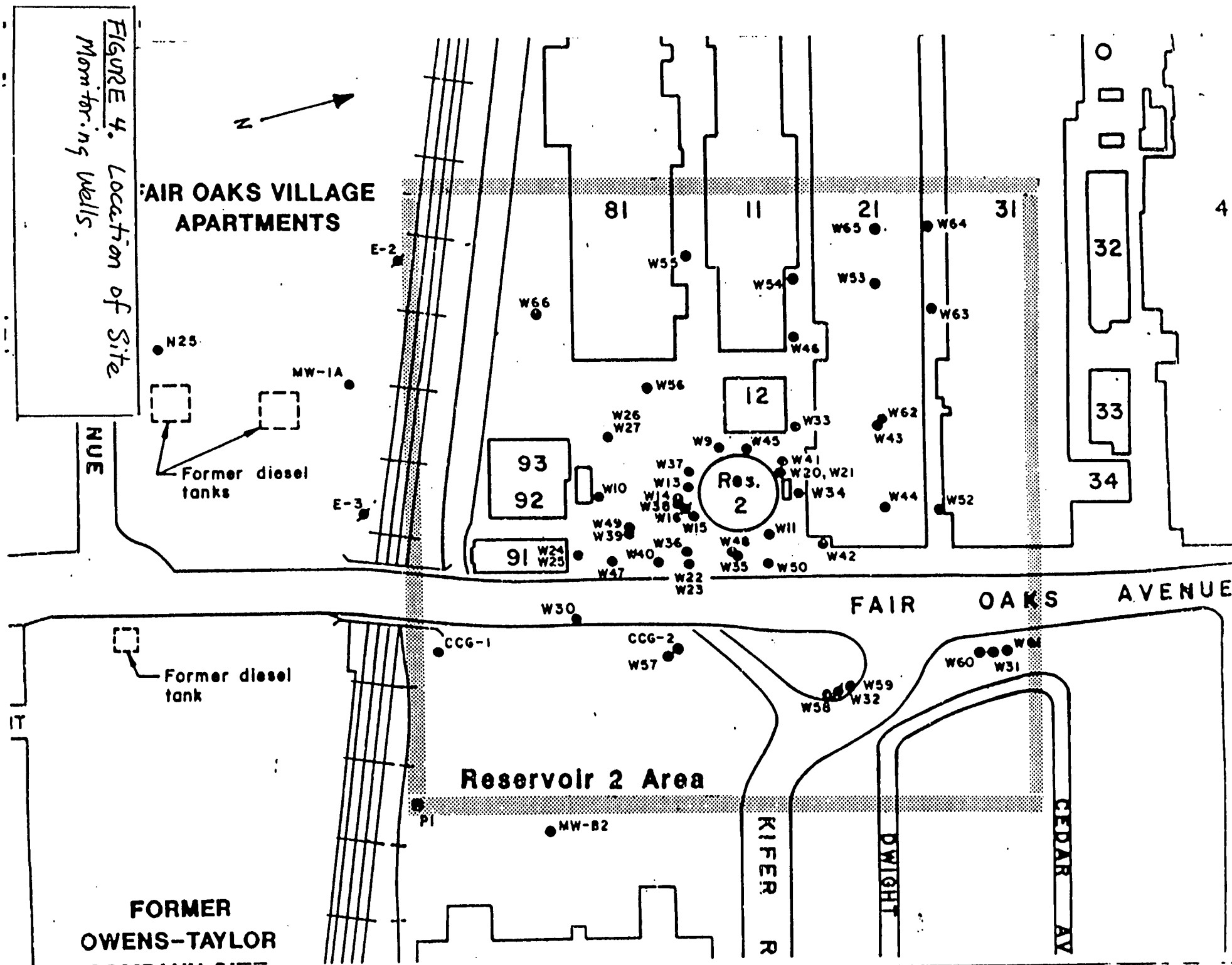


FIGURE 4. Location of Site Monitoring Wells.



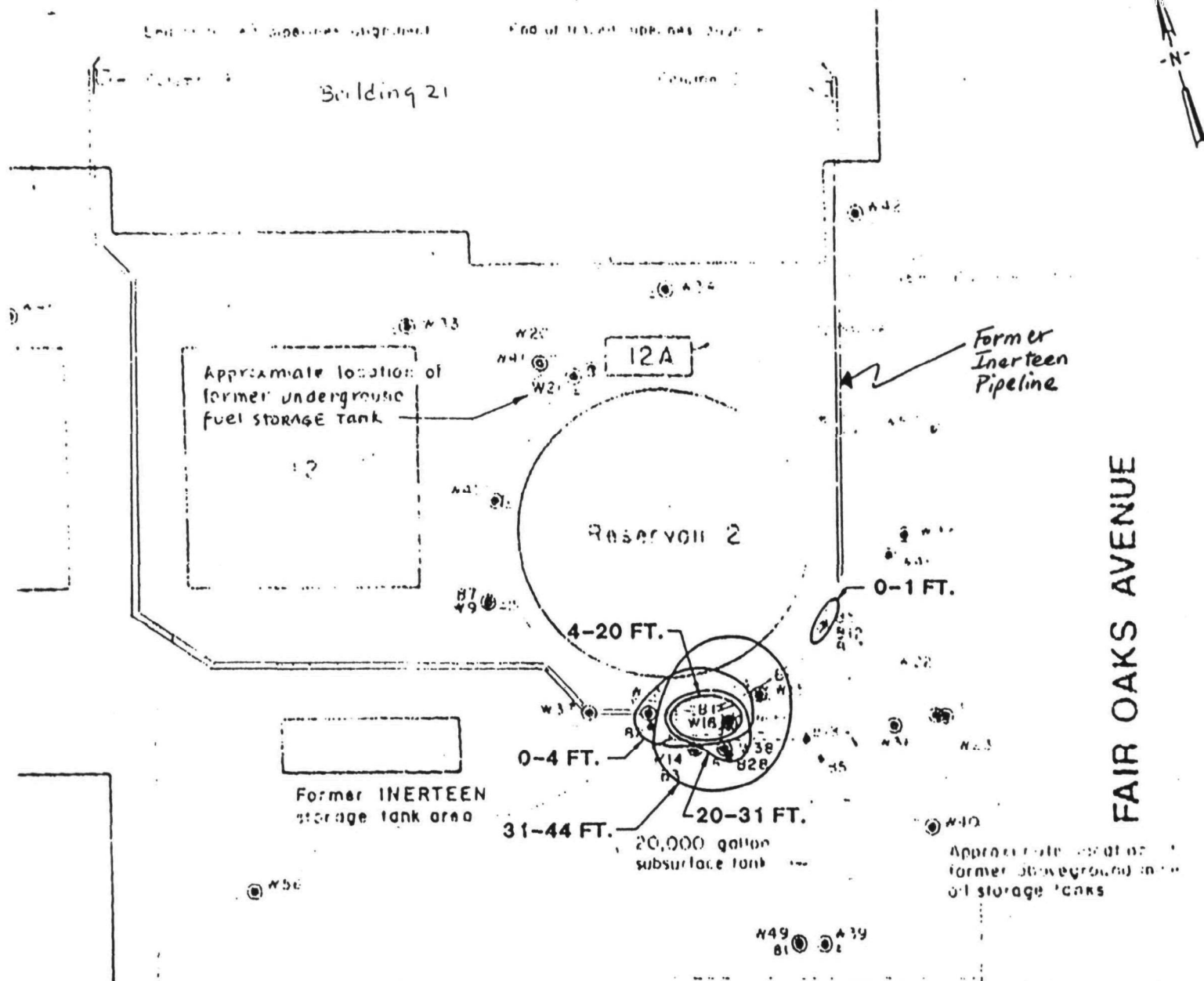
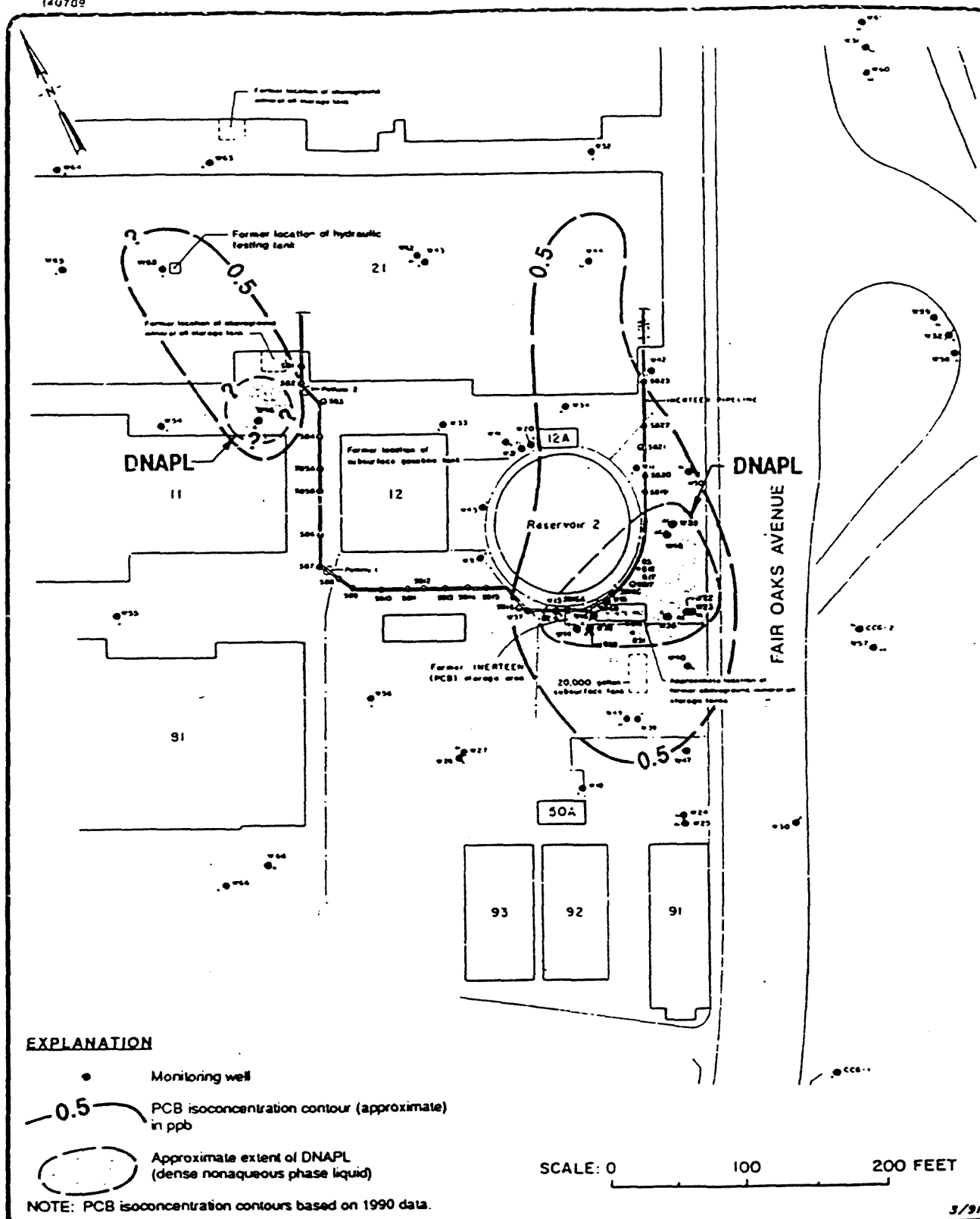


FIGURE 5.
DISTRIBUTION
OF PCB IN
SOIL (7500 ppm)

WESTINGHOUSE ELECTRIC CORPORATION
MARINE DIVISION
REMEDIAL INVESTIGATION/FEASIBILITY STUDY
SUNNYVALE, CALIFORNIA

SOILS WITH PCB GREATER THAN 500 MK/KG

POOR COPY
ORIGINAL



WESTINGHOUSE ELECTRIC CORPORATION
MARINE DIVISION
REMEDIAL INVESTIGATION FEASIBILITY STUDY
SUNNYVALE, CALIFORNIA

A-AQUIFER PCB CONCENTRATIONS

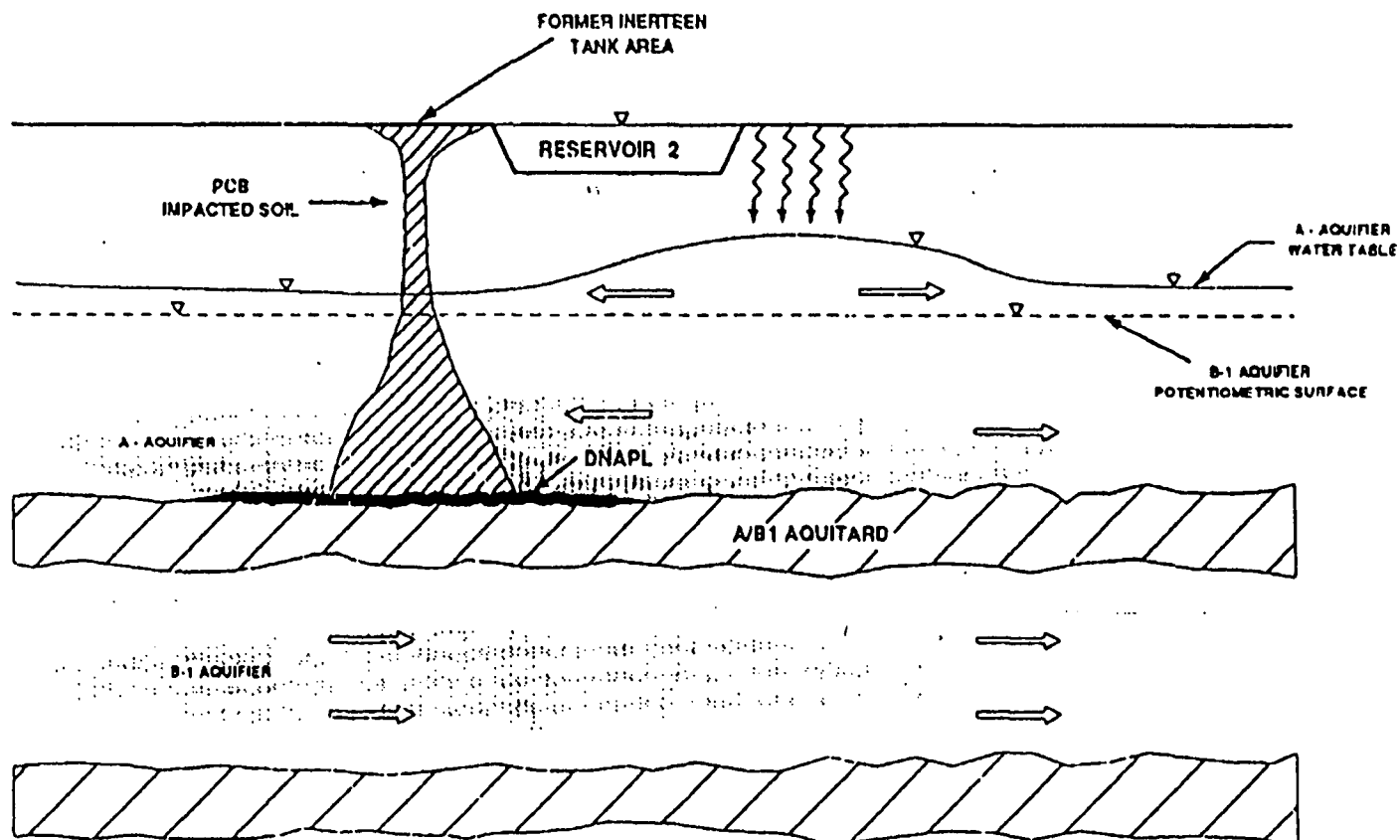
FIGURE 6.

(April 1990)
Approximate
Extent of
DNAPL in A
Aquifer.

POOR QUALITY
ORIGINAL

SOUTH

NORTH

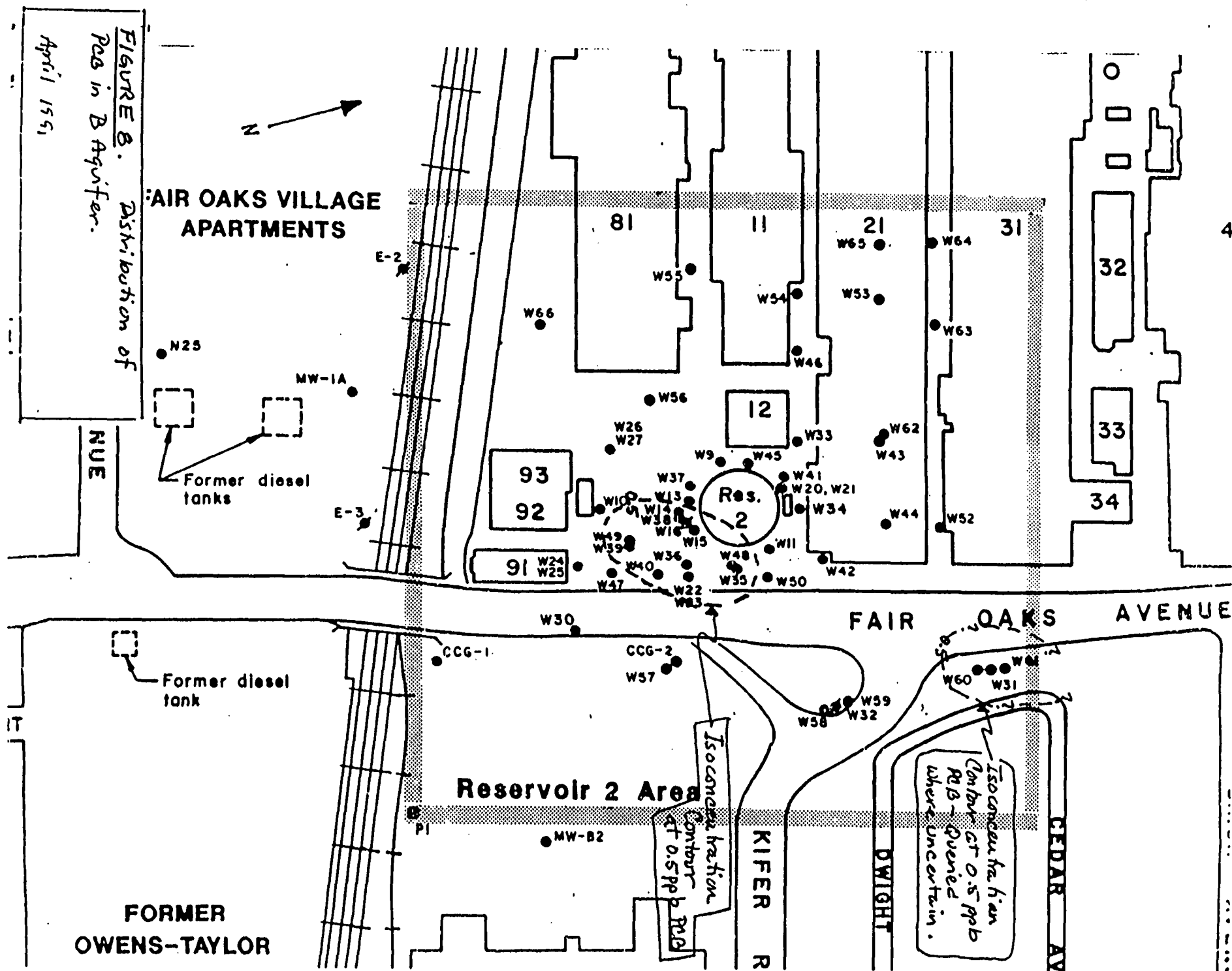


**FIGURE 7. CONCEPTUAL CROSS-SECTION
THROUGH RESERVOIR 2 AREA
WESTINGHOUSE SUNNYVALE, CA**

EXPLANATION	
	Groundwater
	Flow direction
	PCBs and fuels in groundwater
	Dense Non-Aqueous Phase Liquid (DNAPL)

NOT TO SCALE

FIGURE 8. Distribution of
Pb in B Aquifer.
April 1951



2023

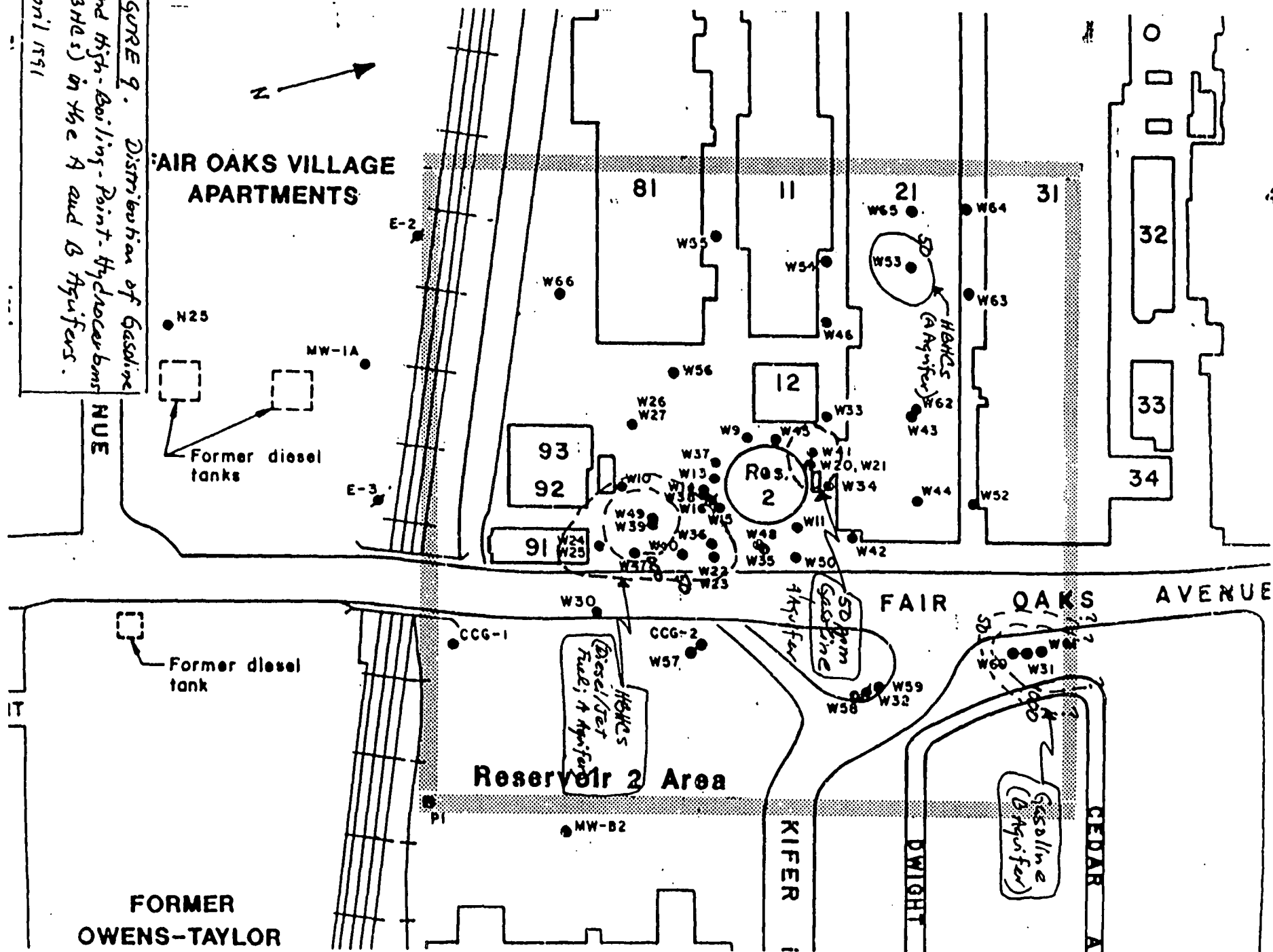


Figure 10. Distribution of VOCs in A Aquifer, April 1991 (No detections in B Aquifer)

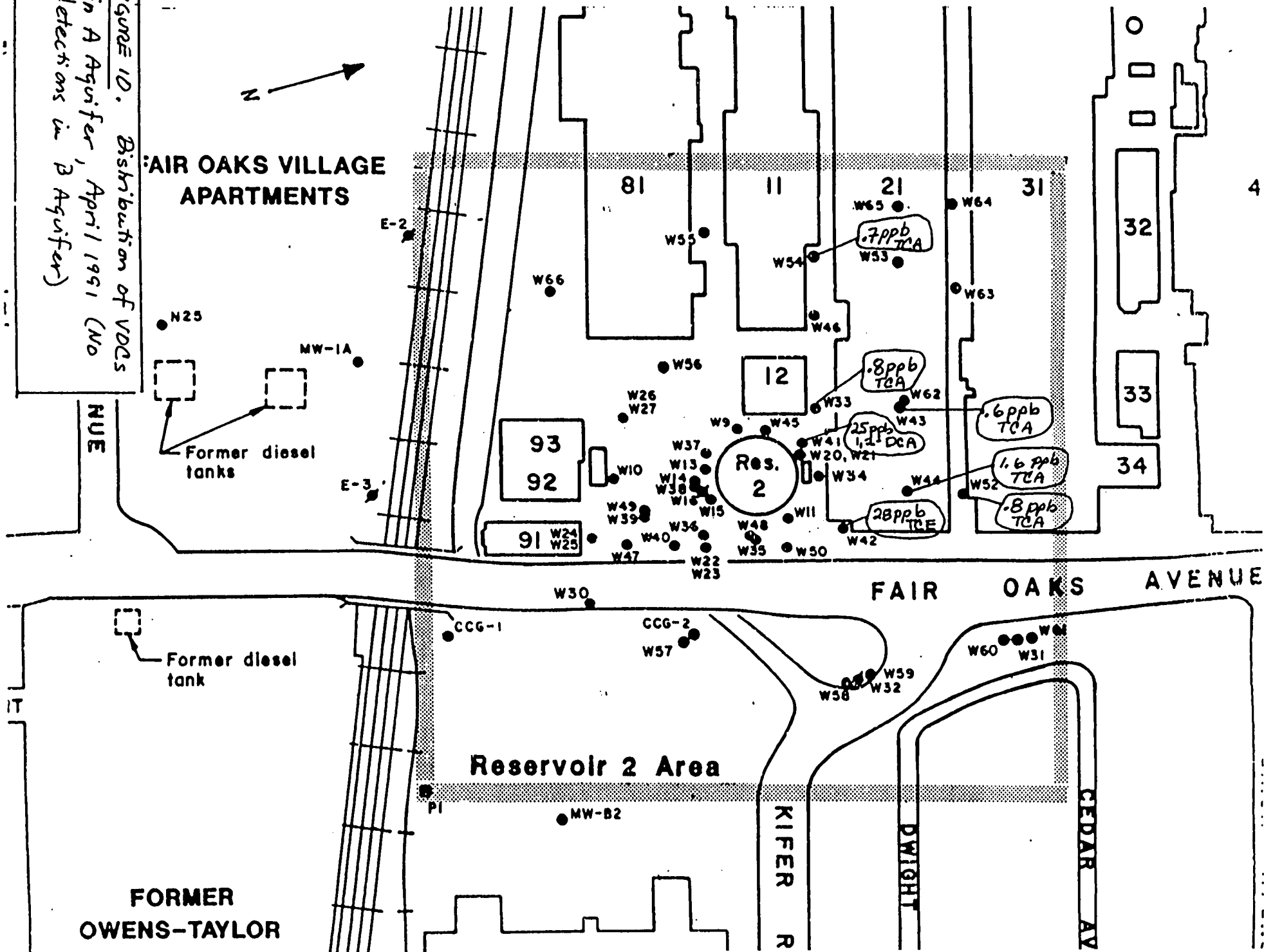


FIGURE 11. Sketch of
General Conceptual Groundwater
Remediation System

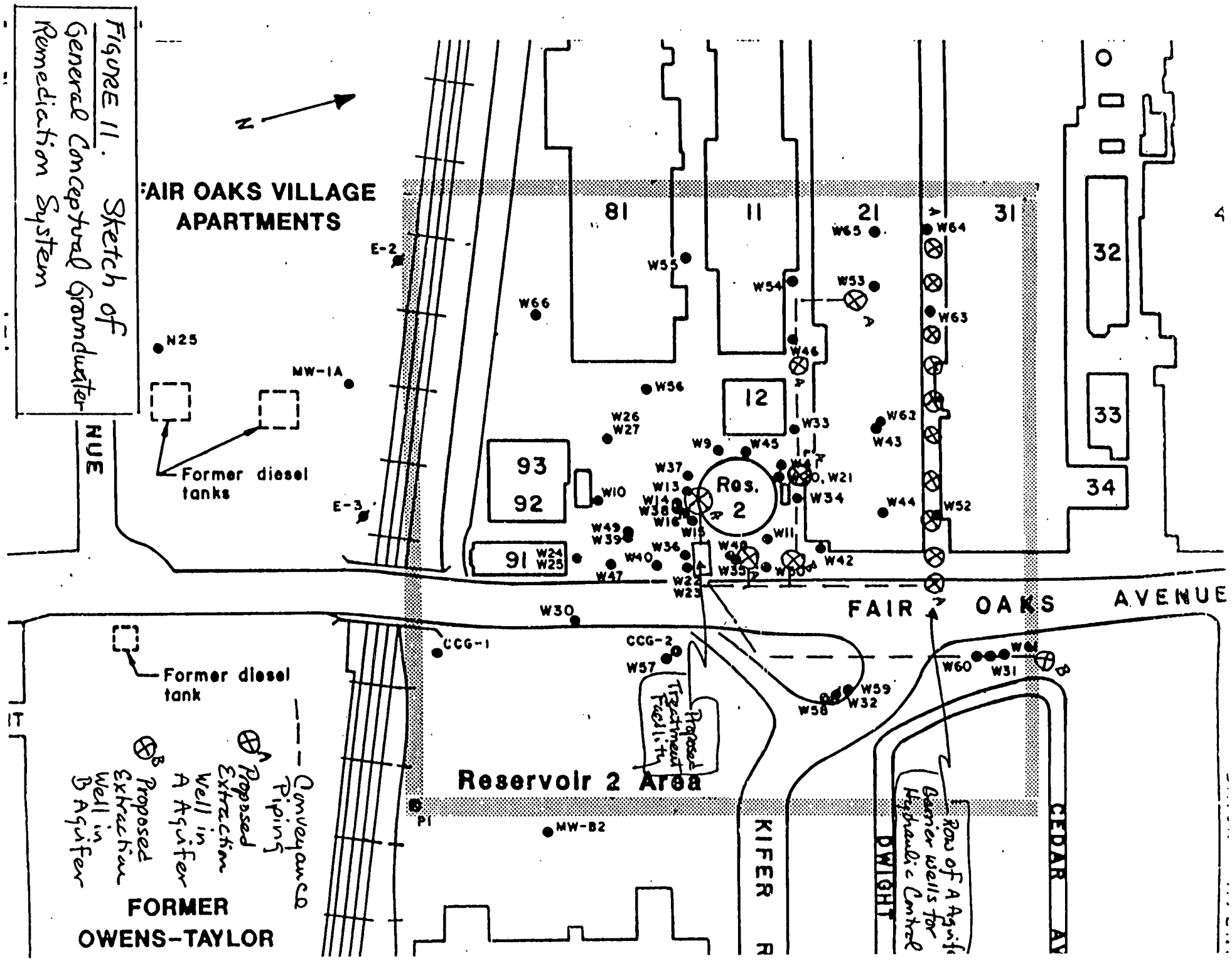


Table 1.
Scenario 1
Worker Exposure: Ingestion of Chemicals in Soil

Equation:

$$\text{Absorbed dose (mg/kg-day)} = \frac{\text{CS} \times \text{ABS} \times \text{INGR} \times \text{CF} \times \text{FI} \times \text{EF} \times \text{ED}}{\text{BW} \times \text{AT}}$$

where: CS = chemical concentration in soil (mg/kg)
 ABS = absorption fraction (unitless)
 INGR = ingestion rate (mg soil/day)
 CF = conversion factor (10⁻⁶ kg/mg)
 FI = fraction ingested from contaminated source (unitless)
 EF = exposure frequency (days/years)
 ED = exposure duration (years)
 BW = body weight (kg)
 AT = averaging time (period over which exposure is averaged - days)

Variable	Case	Receptor	Value (Rationale/Source)
CS	RME	Workers (all)	95% confidence interval of mean concentrations in soil (EPA, 1989a)
	Typical	Workers (all)	Arithmetic mean concentrations in soil (EPA, 1989a)
ABS	RME/Typical	Workers (all)	0.3 PCBs (EPA, 1990a), 1.0 others (default assumption; EPA, 1989a)
INGR	RME/Typical	Workers (all)	100 mg/day (age groups greater than 6 years old; EPA, 1989d)
FI	RME/Typical	Workers (all)	1.0 (assumed)
EF	RME	Subsurface worker	0.6 day/year (3 days every 5 years)
		Surface worker	50 days/year
	Typical	Subsurface worker	0.2 day/year (1 day every 5 years)
		Surface worker	6 days/year
ED	RME	Workers (all)	30 years (EPA, 1989c)
	Typical	Workers (all)	9 years (average length of employment at facility)
BW	RME/Typical	Workers (all)	70 kg (average; EPA, 1989c)
AT	RME/Typical	Workers (all)	Pathway-specific period of exposure for noncarcinogenic effects (i.e., ED x 365 days/year), and 70-year lifetime for carcinogenic effects (i.e., 70 years x 365 days/year)

Table 2.
Scenario 1
Worker Exposure: Dermal Contact with Chemicals in Soil

Equation:

$$\text{Absorbed dose (mg/kg-day)} = \frac{\text{CS} \times \text{ABS} \times \text{CF} \times \text{SA} \times \text{AF} \times \text{EF} \times \text{ED}}{\text{BW} \times \text{AT}}$$

where: CS = chemical concentration in soil (mg/kg)
 ABS = absorption fraction (unitless)
 CF = conversion factor (10^{-6} kg/mg)
 SA = skin surface area available for contact (cm^2/event)
 AF = soil-to-skin adherence factor (mg/cm^2)
 EF = exposure frequency (days/years)
 ED = exposure duration (years)
 BW = body weight (kg)
 AT = averaging time (period over which exposure is averaged - days)

Variable	Case	Receptor	Value (Rationale/Source)
CS	RME	Workers (all)	95% confidence interval of mean concentrations in soil (EPA, 1989a)
	Typical	Workers (all)	Arithmetic mean concentrations in soil (EPA, 1989a)
ABS	RME/Typical	Workers (all)	0.1 PCBs (EPA, 1990a); DCB, TCB (0.25; see text Section 8.5)
SA	RME/Typical	Workers (all)	3,200 cm^2 (hands and arms; surface area; EPA, 1989c)
AF	RME	Workers (all)	1.5 mg/cm^2 (EPA, 1984)
	Typical	Workers (all)	0.5 mg/cm^2 (EPA, 1984)
EF	RME	Subsurface worker	0.6 day/year (3 days every 5 years)
		Surface worker	50 days/year
	Typical	Subsurface worker	0.2 day/year (1 day every 5 years)
		Surface worker	6 days/year
ED	RME	Workers (all)	30 years (EPA, 1989c)
	Typical	Workers (all)	9 years (average length of employment at facility)
BW	RME/Typical	Workers (all)	70 kg (average; EPA, 1989c)
AT	RME/Typical	Workers (all)	Pathway-specific period of exposure for noncarcinogenic effects (i.e., ED x 365 days/year), and 70-year lifetime for carcinogenic effects (i.e., 70 years x 365 days/year)

Table 3
Scenario 2
Residential Exposure: Ingestion of Chemicals in Soil

Equation:

$$\text{Absorbed dose (mg/kg-day)} = \frac{\text{CS} \times \text{ABS} \times \text{INGR} \times \text{CF} \times \text{FI} \times \text{EF} \times \text{ED}}{\text{BW} \times \text{AT}}$$

where: CS = chemical concentration in soil (mg/kg)
 ABS = absorption fraction (unitless)
 INGR = ingestion rate (mg soil/day)
 CF = conversion factor (10^{-6} kg/mg)
 FI = fraction ingested from contaminated source (unitless)
 EF = exposure frequency (days/year)
 ED = exposure duration (years)
 BW = body weight (kg)
 AT = averaging time (period over which exposure is averaged - days)

Variable	Case	Receptor	Value (Rationale/Source)
CS	RME	All	95% confidence interval of mean concentrations in soil (EPA, 1989a)
	Typical	All	Arithmetic mean concentration (EPA, 1989a)
ABS	RME/Typical	All	0.3 PCBs (EPA, 1990a), 1.0 other chemicals
INGR	RME/Typical	Adults	100 mg/day (age groups greater than 6 years old; EPA, 1989d)
	RME/Typical	Children	200 mg/day (children 1 through 6 years old; EPA, 1989d)
FI	RME/Typical	All	1.0 (assumed)
EF	RME/Typical	All	365 days/year (assumed)
ED	RME	Adults	30 years (90th percentile time at one residence; EPA, 1989c)
	Typical	Adults	9 years (median time at one residence; EPA, 1989c)
	RME/Typical	Children	6 years (EPA, 1991b)
BW	RME	All	Median body weight for each respective age group (70 kg adult male, 16 kg child; EPA, 1989c, 1991a)
AT	RME	All	Pathway-specific period of exposure for noncarcinogenic effects (i.e., ED x 365 days/year), and 70-year lifetime for carcinogenic effects (i.e., 70 years x 365 days/year)

Table 4
Scenario 2
Residential Exposure: Dermal Contact with Chemicals in Soil

Equation:

$$\text{Absorbed dose (mg/kg-day)} = \frac{\text{CS} \times \text{ABS} \times \text{CF} \times \text{SA} \times \text{AF} \times \text{EF} \times \text{ED}}{\text{BW} \times \text{AT}}$$

where: CS = chemical concentration in soil (mg/kg)
 ABS = absorption fraction (unitless)
 CF = conversion factor (10^{-6} kg/mg)
 SA = skin surface area available for contact (cm^2/event)
 AF = soil-to-skin adherence factor (mg/cm^2)
 EF = exposure frequency (days/years)
 ED = exposure duration (years)
 BW = body weight (kg)
 AT = averaging time (period over which exposure is averaged - days)

Variable	Case	Receptor	Value (Rationale/Source)
CS	RME	All	95% confidence interval of mean concentrations in soil (EPA, 1989a)
	Typical	All	Arithmetic mean concentrations in soil (EPA, 1989a)
ABS	RME/Typical	All	0.1 for PCBs (EPA, 1990a); 0.25 for DCB and TCB (see text Section 8.5)
SA	RME/Typical	Adults	4,600 cm^2 (hands, forearms, and one-half legs; surface area; EPA, 1989c)
	RME/Typical	Child	1,800 cm^2 (hands and one-half arms and legs; surface areas; EPA, 1989b)
AF	RME	All	1.5 mg/cm^2 (EPA, 1984)
	Typical	All	0.5 mg/cm^2 (EPA, 1984)
EF	RME/Typical	All	365 days/year (assumed)
ED	RME	Adults	30 years (national upper bound time [90th percentile] at one residence; EPA, 1989c)
	Typical	Adults	9 years (median national time at one residence; EPA, 1989c)
	RME/Typical	Children	6 years (EPA, 1991b)
BW	RME/Typical	All	Median body weights for each respective age group (70 kg adult male, 16 kg child; EPA, 1989c and 1991a)
AT	RME/Typical	All	Pathway-specific period of exposure for noncarcinogenic effects (i.e., ED x 365 days/year), and 70-year lifetime for carcinogenic effects (i.e., 70 years x 365 days/year)

Table 5
Scenario 2
Residential Exposure: Ingestion of Chemicals in Drinking Water
(and Beverages Made Using Drinking Water)

Equation:

$$\text{Intake (mg/kg-day)} = \frac{\text{CW} \times \text{FI} \times \text{ABS} \times \text{IR} \times \text{EF} \times \text{ED}}{\text{BW} \times \text{AT}}$$

where: CW = chemical concentration in soil (mg/l)
 FI = fraction ingested from source (unitless, assumed to be 1)
 ABS = fraction absorbed (unitless, assumed to be 1)
 IR = ingestion rate (l/day)
 EF = exposure frequency (days/years)
 ED = exposure duration (years)
 BW = body weight (kg)
 AT = averaging time (period over which exposure is averaged - days)

Variable	Case	Receptor	Value (Rationale/Source)
CW	RME	All	Maximum concentrations in ground water (EPA, 1989a)
	Typical	All	Arithmetic mean concentration in ground water (EPA, 1989a)
FI			
ABS	RME/Typical	All	1 (by convention; EPA, 1989b)
IR	RME/Typical	Adult	2 l/day (EPA, 1991a)
	RME/Typical	Child	1 l/day (EPA, 1991a)
EF	RME/Typical	All	365 days/year (EPA, 1989b)
ED	RME	Adults	30 years (90th percentile time spent at one residence; EPA, 1989a)
	Typical	Adults	9 years (median time spent at one residence; EPA, 1989a)
	RME/Typical	Children	6 years (EPA, 1991b)
BW	RME/Typical	Adult	70 kg (EPA, 1989a, 1990b)
	RME/Typical	Child	16 kg (typical value corresponding to body weight of 4-year-old; EPA, 1991a)
AT	RME/Typical	All	Pathway-specific period of exposure for noncarcinogenic effects (i.e., ED x 365 days/year), and 70-year lifetime for carcinogenic effects (i.e., 70 years x 365 days/year)

Table 6.
Summary of Estimated Carcinogenic and Noncarcinogenic Risks
at the Westinghouse Site

	Typical Exposure Scenario		RME Scenario	
	Cancer Risk	Hazard Index	Cancer Risk	Hazard Index
<u>Ground-Water Exposure</u>				
Aquifer A				
<u>Adult Male Resident</u>				
Ingestion	5.25E-03	5.95E+00	5.15E-02	1.80E+01
Inhalation/dermal	1.35E-05	2.59E+00	9.82E-05	7.90E+00
TOTAL	5.26E-03	8.54E+00	5.16E-02	2.59E+01
<u>1- to 6-year-old Child Resident</u>				
Ingestion	7.64E-03	1.29E+01	2.31E-02	3.94E+01
Inhalation/dermal	1.45E-05	5.66E+00	4.28E-05	1.73E+01
TOTAL	7.65E-03	1.86E+01	2.31E-02	5.67E+01
Aquifer B1				
<u>Adult Male Residents</u>				
Ingestion	1.87E-05	3.24E-02	9.80E-05	8.08E-02
Inhalation/dermal	1.05E-07	9.44E-02	9.34E-07	2.41E-01
TOTAL	1.88E-05	1.27E-01	9.89E-05	3.22E-01
<u>1- to 6-year-old Child Resident</u>				
Ingestion	2.72E-05	7.11E-02	4.29E-05	1.77E-01
Inhalation/dermal	1.53E-07	2.07E-01	4.09E-07	5.28E-01
TOTAL	2.73E-05	2.78E-01	4.33E-05	7.05E-01
<u>Soil Exposure</u>				
<u>Adult Male Resident</u>				
Ingestion	7.62E-02	1.12E-02	1.19E-01	2.44E-02
Dermal	1.67E-01	1.94E-01	9.46E-01	4.21E-01
TOTAL	2.43E-01	2.05E-01	1.00E+00	4.45E-01
<u>1- to 6-year-old Child Resident</u>				
Ingestion	1.29E-01	9.85E-02	2.00E-01	2.14E-01
Dermal	4.64E-01	3.32E-01	6.32E-01	7.21E-01
TOTAL	5.93E-01	4.31E-01	8.32E-01	9.35E-01
<u>Surface Worker</u>				
Ingestion	6.01E-04	2.90E-04	2.55E-02	1.08E-01
Dermal	3.20E-03	1.16E-03	3.38E-01	1.08E-01
TOTAL	3.80E-03	1.45E-03	3.64E-01	1.17E-01
<u>Subsurface Worker</u>				
Ingestion	1.82E-07	8.70E-07	4.37E-06	7.63E-06
Dermal	9.78E-07	3.49E-06	6.99E-05	9.16E-05
TOTAL	1.16E-06	4.36E-06	7.43E-05	9.92E-05

TABLE 7
Remedial Alternatives

	Alternative A No Action	Alternative B No Excavation Capping Groundwater Containment	Alternative C Excavation to 8 ft Offsite disposal or treatment Capping/Groundwater Containment		Alternative D Excavation to 32 ft. Offsite disposal or treatment Capping/Groundwater Containment	
Protects Health and Environment	<ul style="list-style-type: none"> - No reduction in risk - Potential water supplies threatened 	<ul style="list-style-type: none"> - Protects workers at surface but not in subsurface - Groundwater containment protects downgradient aquifers 	<ul style="list-style-type: none"> - Protects workers at surface and in subsurface - Groundwater containment protects downgradient aquifers 		<ul style="list-style-type: none"> - Protects workers at surface and in subsurface - Groundwater containment protects downgradient aquifers 	
Complies with Federal, State, Local Requirements	<ul style="list-style-type: none"> - Does not comply 	<ul style="list-style-type: none"> - Complies with all requirements except drinking water Standards for PCB 	<ul style="list-style-type: none"> - Complies with all requirements except drinking water Standards for PCB 		<ul style="list-style-type: none"> - Complies with all requirements except drinking water Standards for PCB 	
Reduces Toxicity, Mobility and Volume (TMV) Through Treatment	<ul style="list-style-type: none"> - No reduction in TMV 	<ul style="list-style-type: none"> - Reduces TMV by Treating extracted groundwater - No TMV for soils 	C1 Disposal	C2 Treatment	D1 Disposal	D2 Treatment
			<ul style="list-style-type: none"> - No TMV through treatment with disposal of soil 	<ul style="list-style-type: none"> - Treatment of soils reduces TMV 	<ul style="list-style-type: none"> - No TMV through treatment with disposal of soil 	<ul style="list-style-type: none"> - Treatment of soils reduces TMV
			<ul style="list-style-type: none"> - Reduces TMV by Treating extracted groundwater 		<ul style="list-style-type: none"> - Reduces TMV by Treating extracted groundwater 	
Effectiveness	<ul style="list-style-type: none"> - Not effective 	<ul style="list-style-type: none"> - Institutional controls and long term management of soils and groundwater in source area 	<ul style="list-style-type: none"> - More effective/less management required when 8 ft. of soil removed - Still relies on institutional controls and long term pumping 		<ul style="list-style-type: none"> - Soils in source area removed completely but still relies on long term pump and treat control of groundwater 	
Implementability	<ul style="list-style-type: none"> - Easily implemented 	<ul style="list-style-type: none"> - Easily implemented 	<ul style="list-style-type: none"> - Some difficulty for soils treatment (C2) option with storage, transport, treatment 		<ul style="list-style-type: none"> - Some difficulty for soils treatment (C2) option with storage, transport, treatment 	
COSTS			C1	C2	D1	D2
Capital	\$ 62,000	\$1,325,000	\$1,725,000	\$3,114,000	\$2,691,000	\$7,733,000
Annual O & M	\$ 158,000	\$225,000	\$225,000	\$225,000	\$225,000	\$225,000
Present Worth	\$3,744,000	\$6,474,000	\$6,874,000	\$8,263,000	\$7,840,000	\$12,882,000

TABLE 8
Groundwater Cleanup Criteria
ppb¹

Chemical Name	Standard
Benzene	1 ²
1,2-Dichlorobenzene	600 ³
1,3-Dichlorobenzene	130 ⁴
1,4-Dichlorobenzene	5 ²
1,1-Dichloroethane	5 ²
1,2-Dichloroethane	0.5 ²
1,1-Dichloroethene	6 ²
cis-1,2-Dichloroethene	6 ²
Ethylbenzene	680 ²
Monochlorobenzene	30 ²
Polychlorinated biphenyls	0.5 ⁶
Toluene	1000 ³
1,2,4-Trichlorobenzene	5 ⁵
1,1,1-Trichloroethane	200 ³
Trichloroethene	5 ³
Xylene(s)	1750 ²

1. ppb = parts per billion
2. State Maximum Contaminant Level (MCL)
3. Federal Maximum Contaminant Level (MCL)
4. State Department of Health Services Action Level
5. Proposed Federal Maximum Conataminant Level, expected to be promulgated March 1992
6. Promulgated Federal MCL, effective July 1992

Table 9

COMPOUND	Maximum Contaminant Levels (MCLs)		Highest Detected Concentration at site (a) (µg/l)	Calculated Ingestion Rate (b) (mg/kg-day)	Chronic Reference Dose (c) (Rfd) (mg/kg-day)	Cancer Potency Factor (c) (slope factor) (mg/kg-day) ⁻¹	Chemical Specific Cancer Risk (d)	Hazard Quotient for Non-carcinogens (e)
	EPA (µg/l)	State (µg/l)						
<u>VOLATILE ORGANICS</u>								
Benzene	5	1		1.22E-05	NA	2.9E-02	3.6E-07	
Chlorobenzene	100	30	9.6	2.74E-04	2.0E-02	NA		1.4E-02
1,2-Dichlorobenzene	600		174	4.97E-03	9.0E-02	NA		5.5E-02
1,3-Dichlorobenzene		130 (f)	120	3.43E-03	NA	NA		
1,4-Dichlorobenzene	75	5		6.12E-05	NA	2.4E-02		
1,1-Dichloroethane		5	1.2	1.47E-05	1.0E-01			1.5E-04
1,2-Dichloroethane	5	0.5		6.12E-06	NA	9.1E-02	5.6E-07	
1,1-Dichloroethene	7	6	5	6.12E-05	9.0E-03	6.0E-01	3.7E-05	6.8E-03
cis-1,2-Dichloroethene	70	6	2	5.71E-05	1.0E-02	NA		5.7E-03
Ethylbenzene	700	680	330	9.43E-03	1.0E-01	NA		9.4E-02
Polychlorinated biphenyl	0.5			6.12E-06	NA	7.7E+00	4.7E-05	
Toluene	1,000		100	1.22E-03	2.0E-02	NA		6.1E-02
1,2,4-Trichlorobenzene	9			1.10E-04	1.3E-03	NA		8.4E-02
1,1,1-Trichloroethane	200	200	22	6.29E-04	9.0E-02	NA		7.0E-03
Trichloroethene	5	5		6.12E-05	NA	1.1E-02	6.7E-07	
Xylene(s)	10,000	1,750	987	2.82E-02	2.0E+00	NA		1.4E-02
						Total Risk (g)	8.5E-05	
						Hazard Index (h)		3.4E-01

(a) Only listed for those site COCs at concentrations less than federal or state water quality criteria.
(b) Assumes that concentration of compound in drinking water matches, state or federal MCL, DHS Action Level, or highest detected concentration (see section 8, table 8.5-5 for equation).
(c) From Health Effects Assessment Summary Tables (HEAST), Four Quarter FY - 1990
(d) Chemical-specific cancer risk calculated by multiplying ingestion by slope factor
(e) Chemical hazard index calculated by dividing ingestion by reference dose
(f) DHS Action Level
(g) Total risk calculated by summing chemical-specific cancer risk
(h) Hazard Index calculated by summing chemical-specific hazard quotients
Blank space: No existing value.

Table 10
Sensitivity Analysis Summary

Cost	Low	Difference	% Less Than Median	Median	Difference	% Greater Than Median	High
Capital Cost							
A	\$47,000	\$15,000	24%	\$62,000	\$16,000	26%	\$78,000
B	\$1,210,000	\$115,000	9%	\$1,325,000	\$161,000	12%	\$1,486,000
C1	\$1,610,000	\$115,000	7%	\$1,725,000	\$161,000	9%	\$1,886,000
C2	\$2,999,000	\$115,000	4%	\$3,114,000	\$161,000	5%	\$3,275,000
D1	\$2,576,000	\$115,000	4%	\$2,691,000	\$161,000	6%	\$2,852,000
D2	\$7,618,000	\$115,000	1%	\$7,733,000	\$161,000	2%	\$7,894,000
O&M Cost, Year 1							
A	\$370,000	\$20,000	5%	\$390,000	\$19,000	5%	\$409,000
B,C,D	\$435,000	\$23,000	5%	\$458,000	\$24,000	5%	\$482,000
O&M Cost, Year 2							
A	\$150,000	\$8,000	5%	\$158,000	\$8,000	5%	\$166,000
B,C,D	\$214,000	\$11,000	5%	\$225,000	\$13,000	6%	\$238,000
Present Worth							
A	\$3,543,000	\$201,000	5%	\$3,744,000	\$202,000	5%	\$3,946,000
B	\$6,106,000	\$368,000	6%	\$6,474,000	\$456,000	7%	\$6,930,000
C1	\$6,506,000	\$368,000	5%	\$6,874,000	\$456,000	7%	\$7,330,000
C2	\$7,895,000	\$368,000	4%	\$8,263,000	\$456,000	6%	\$8,719,000
D1	\$7,472,000	\$368,000	5%	\$7,840,000	\$456,000	6%	\$8,296,000
D2	\$12,514,000	\$368,000	3%	\$12,882,000	\$456,000	4%	\$13,338,000

Low=20% less, Median=base case, High=20% more

Ground-water extraction system variables: number and location of wells, soil disposal, pumps

Ground-water treatment system variables: design flow rate, O&M for alternate flow rates

Ground-water monitoring system variables: number of wells, O&M