DRAFT OF FEASIBILITY STUDY
FOR THE
JASCO CHEMICAL CORPORATION SITE
MOUNTAIN VIEW, CALIFORNIA

OHM Corporation

SFUND RECORDS CTR
88053685
SFUND RECORDS CTR
0816-00188

DRAFT OF FEASIBILITY STUDY FOR THE JASCO CHEMICAL CORPORATION SITE MOUNTAIN VIEW, CALIFORNIA

Prepared for:

Jasco Chemical Corp.
1710 Villa Street
Mountain View, CA 94042

Prepared by:

OHM Remediation Services Corp.
2950 Buskirk Ave., Suite 315
Walnut Creek, California 94596

March 22, 1991
Project #7403

TABLE OF CONTENTS

1.0 INTRODUCTION.....1-1

1.1 Purpose and Organization of Report.....1-1
1.2 Background Information.....1-2

1.2.1 Site Description.....1-2
1.2.2 Site History.....1-2
1.2.3 Nature and Extent of Contamination.....1-4
1.2.3.1 Soil.....1-4
1.2.3.2 Surface Water.....1-10
1.2.3.3 Groundwater.....1-10
1.2.4 Contaminant Fate and Transport.....1-15
1.2.4.1 Migration of Contaminants....1-15
1.2.4.2 Target Constituent Persistence.....1-17
1.2.5 Baseline Risk Assessment.....1-18

2.0 IDENTIFICATION AND SCREENING OF TECHNOLOGIES..2-1

2.1 Introduction.....2-1
2.2 Remedial Action Objectives.....2-2
2.3 General Response Actions.....2-8
2.4 Identification and Screening of Technology Types and Process Options.....2-9

2.4.1 Initial Screening and Elimination of Technologies.....2-9
2.4.2 Selection of Representative Process Options.....2-13
2.4.2.1 Applicable Remedial Process Options for Groundwater.....2-13
2.4.2.2 Non-Applicable Remedial Process Options for Groundwater.....2-18
2.4.2.3 Applicable Remedial Process Options for Soil.....2-21
2.4.2.4 Non-Applicable Remedial Process Options for Soil....2-26

3.0 DEVELOPMENT OF REMEDIAL ALTERNATIVES.....3-1

3.1 Groundwater Remedial Alternatives.....3-1

3.1.1 Alternative I: No Action.....3-5
3.1.2 Alternative IA: Continue Discharge to POTW Until Source Removal Completed.....3-7
3.1.3 Alternative II: Discharge to POTW.....3-10
3.1.4 Alternative III:UV Oxidation.....3-13

TABLE OF CONTENTS (continued)

3.1.5 Alternative IV: Liquid Phase Carbon Adsorption.....3-17
3.1.6 Alternative V: Air Stripping.....3-20
3.1.7 Alternative VI: Biological Treatment..3-25
3.1.8 Alternative VII:In-Situ Bioremediation.3-29

3.2 Soil Remedial Alternatives.....3-30

3.2.1 Alternative I: No Action.....3-32
3.2.2 Alternative IA: No New Action Until Closure.....3-33
3.2.3 Alternative II: Liner & Cap.....3-35
3.2.4 Alternative III:Off-site Treatment....3-38
3.2.5 Alternative IV: Enhanced Biological Treatment.....3-40
3.2.6 Alternative V: X-19 Biological Treatment.....3-43
3.2.7 Alternative VI: Excalibur Process.....3-47
3.2.8 Alternative VII:In-Situ Bioremediation.3-49

FIGURES

FIGURE	TITLE
1.1	Site Location Map
1.2	Site Plan
1.3	Existing and Former Structures
1.4	Location of Monitor Wells Installed During Previous Investigations
1.5	Location of Sample Points and Delineation of Drainage Swale Areas
1.6	Distribution of Target Constituents 3-30 Ft., Former Drainage Swale, DS-1
1.7	Distribution of Target Constituents 2-20 Ft., Former Drainage Swale, DS-2
1.8	Distribution of Target Constituents 2-30 Ft., Former Drainage Swale, DS-3
1.9	Distribution of Target Constituents Underground Storage Tank Area
1.10	Distribution of Target Constituents Former Underground Diesel Tank
1.11	Distribution of Target Constituents Drum Storage & Background Area
1.12	Director of Groundwater Flow in the A-aquifer

TABLES

TABLE	TITLE
1.1	Maximum Concentration of Target Constituents Detected in Drainage Swale Area #1
1.2	Maximum Concentration of Target Constituents Detected in Drainage Swale Area #2
1.3	Estimated Quantity of Target Constituents in Former Drainage Swale Area
1.4	Estimated Quantity of Target Constituents in Underground Storage Tank Area
1.5	Estimated Quantity of Target Constituents in Former Underground Diesel Tank Area
1.6	Analytical Results of Groundwater from V-4
2.1	Maximum Concentration Levels of Key Groundwater Contaminants
2.2	General Response Actions for Soil and Groundwater
2.3	Initial Screening of Technologies and Process Options for Groundwater
2.4	Initial Screening of Technologies and Process Options for Soil
2.5	Selection of Representative Groundwater Remedial Options
2.6	Selection of Representative Soil Remedial Options
3.1	Evaluation of Final Groundwater Alternatives
3.2	Evaluation of Final Soil Alternatives
3.3	Present Worth Costs of Remedial Alternatives
3.4	Analytical Requirements Under NPDES Permit

1. INTRODUCTION

1.1 PURPOSE AND ORGANIZATION OF REPORT

A Feasibility Study (FS) is being performed to develop remedial action alternatives for the Jasco Chemical Corporation (JASCO) site. The FS provides the basis for selecting the most appropriate alternative to treat soil and groundwater containing target constituents at the site. Results of the Remedial Investigation (RI) and the Endangerment Assessment (EA) conducted at JASCO have indicated there is a need for corrective action to mitigate the impacts of chemical compounds present at the site on the soil and groundwater. This FS has been prepared by O.H.M. Remediation Services Corp. (OHM) in accordance with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as revised by the Superfund Amendments and Reauthorization Act (SARA).

The purpose of the FS is to set remedial objectives for the primary target constituents and to examine remedial technologies which satisfy these objectives. The remedial objectives for this FS address the control and/or destruction of halogenated solvents and other organic constituents from the soil and groundwater. Available technologies are screened and those which are implementable are grouped into remedial action alternatives. The alternatives are examined in greater detail and assessed against the nine criteria set forth in the EPA Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA.

SECTION
1.0

1.2 BACKGROUND INFORMATION

1.2.1 Site Description

The study area includes (1) the real property located at 1710 Villa Street, Mountain View, California, hereafter "JASCO", (2) the property which lies west of JASCO at a distance of approximately 150 feet and north of JASCO at a distance of approximately 275 feet. Figure 1.1, Site Location, shows the location of the study area with respect to the City of Mountain View. Figure 1.2, Site Plan, shows the study area with respect to local roadways.

The area to the north and west of JASCO includes a portion owned by Southern Pacific Transportation Company (SP) and a portion of the Central Expressway, an east-west transportation corridor through the City of Mountain View as shown in Figure 1.2. The SP portion of the site consists of a 100-foot wide swath wherein two sets of railroad tracks extend in a general northwest-southeast direction connecting San Francisco with San Jose and points south. The Central Expressway, separated from the SP property by a six-foot high chain-link fence, is a four lane expressway with a 30-foot wide center median.

Figure 1.3, Existing and Former Structures, depicts the layout of the site and some of the general structures present. Structures include a chemical blending and packaging production area, a warehouse area for inventory, an underground storage tank area, and storage areas for new empty containers and drums.

1.2.2 Site History

JASCO took possession of the facility in 1976 and has operated the facility as a chemical blending and repackaging plant since this

time. Previous to JASCO's operation the facility was operated by West Coast Doors, Inc. a manufacturer of residential and industrial doors. The site is surrounded to the south, west and east by multi-unit residential property and to the north by railroad tracks and property owned by SP.

The site was originally zoned for industrial use. In December, 1985, the Mountain View City Council adopted the Villa-Mariposa Precise Plan. The plan specified changes in land use within the area bounded by the SP railroad tracks, Escuela Avenue, Villa Street, and Shoreline Boulevard; this area includes the JASCO site. The plan dictated the transition of this area from industrial uses to primarily residential and research and development uses. According to this plan, JASCO will have to cease industrial operations by December, 1995.

In January of 1983 a resident of the area issued a complaint to the San Francisco Bay Regional Water Quality Control Board (RWQCB) concerning an alleged release of chemicals from the facility. On August 3, 1986, after JASCO initiated a series of site investigations, the RWQCB issued Cleanup and Abatement Order (CAO) No. 87-094. During the period between the issuance of the CAO and the present, JASCO conducted additional soil quality investigations, constructed a 14 monitor well network (see Figure 1.4, Monitor Well Locations) providing soil and groundwater data from the upper two aquifers at the site, and implemented interim soil and groundwater remediation programs of the most affected areas. On June 24, 1988, EPA proposed the site for inclusion on the National Priorities List.

Interim remedial actions have been performed on-site. In April, 1987, groundwater extraction began from monitor well V-4 and has continued to operate. The extracted groundwater is discharged to the Mountain View sewer system under a permit from the city. The

permit allows JASCO to discharge as long as the groundwater does not exceed 1 part per million (ppm) total volatile organic compounds and does not exceed 0.75 ppm for any one constituent, as analyzed by EPA Method 601/602. The discharge is analyzed monthly to ensure compliance with the permit.

Five hundred seventy-two cubic yards of soil were excavated from the drainage swale area in October and November, 1988. The soil was disposed of at the Casmalia Resources Facility in Casmalia, California. Following excavation, a surface water runoff management system was installed to prevent further surface water infiltration. This drainage system is currently in place.

1.2.3 Nature and Extent of Target Constituents

The following is a description of the concentrations and distribution of target constituents within each potential source areas. Additional information is available in the Remedial Investigation (OHM Remedial Investigation, 1991).

1.2.3.1 Soil

Former Drainage Swale Area

The former drainage swale area has been divided into three areas (see Figure 1.5, Location of Sample Points and Delineation of Drainage Swale Areas). The areas are DS-1, DS-2, and DS-3. The extent of vadose zone soil containing detectable concentrations of target constituents is within Area DS-1 and DS-2. Area DS-3 has been excavated and the target constituents removed. Area DS-1 is bounded to the north by the ballast of the railroad tracks, to the south by the concrete pad, to the west by borehole SB-5, and to the east by borehole C-4. Target constituents were detected from the ground surface to the top of groundwater. Table 1.1, Maximum

Concentrations of Target Constituents in DS-1, lists the target constituents which were detected in soil samples collected from this area.

Area DS-2 is the remainder of the drainage swale to the west of the first area. The presence of target constituents in this area, with a few exceptions, is limited to a depth of three feet. Table 1.2, Maximum Concentrations of Target Constituents in DS-2, is a list of the target constituents detected in soil samples collected from within this area.

Most maximum concentrations were noted in samples collected at a depth of three feet from locations approximately 30 feet east of the interim soil excavation area.

Within the former drainage swale area, the distribution of halogenated volatile organic constituents and low to medium boiling point hydrocarbons is generally limited. They are distributed in the southern portion, less than ten feet north of the block wall.

The lateral distribution of acetone and alcohols extends across the entire length of the former drainage swale area from borehole SB-1 to SB-15 (approximately 200 feet). However, the highest concentrations are centered around boreholes SB-9 and SB-10. The lateral distribution of toluene, xylene and ethylbenzene extends across the length of the former drainage swale area from between boreholes S-1 and S-5 (approximately 200 feet). In the former drainage swale area benzene was detected only in the near-surface sample from boreholes S-1 and S-2. The presence of benzene at these locations may be unrelated to the activity at the site, as benzene is not used by JASCO in its production operations. Another potential source for the presence of this constituent in the near-surface soil is vehicle traffic from the Central

Expressway. Benzene, as well as toluene, xylene, and ethylbenzene, is a common additive to gasoline fuel.

The distribution of target constituents within areas DS-1, DS-2, and DS-3 is illustrated in the following: Figure 1.6, Distribution of Target Constituents in DS-1; Figure 1.7, Distribution of Target Constituents in DS-2; and Figure 1.8, Distribution of Target Constituents in DS-3. Table 1.3, Estimated Quantity of Target Constituents in Former Drainage Swale Area, lists the calculated average concentrations of target constituents within the former drainage swale area, not including DS-3. The average was calculated from each sample collected; this includes all samples from different depths from deep boreholes.

The total amount of target constituents estimated to be present in 400 and 750 cubic yards at average concentrations is also presented in Table 1.3. Four hundred and 750 cubic yards represent the minimum and maximum amount of soil in the former drainage swale area which may contain target constituents. The estimated quantity of chlorinated compounds in 750 cubic yards of soil is 2.9 pounds or 2 pints.

Underground Storage Tank Area

The presence of target constituents in soil in the vicinity of the underground storage tank area is limited to methylene chloride, 1,2-DCE, methanol, acetone, isopropanol and toluene. The presence of target constituents in soil in the vicinity of the underground storage tank area does not appear to follow any regular pattern, either laterally or at depth. Toluene and 1,2-DCE were detected at concentrations slightly greater than the minimum detection limit of 0.005 mg/kg in samples collected at depths between 20 feet and 30 feet to the east of the storage tank area. At the western boundary of the tank area methylene chloride was detected

between the depths of one foot and 20 feet in June of 1987. In November of 1986, acetone, methanol and isopropanol were detected at the northern portion of the tank area between the depths of five and 36 feet.

The distribution of target constituents within this area is presented in Figure 1.9, Distribution of Target Constituents in Underground Storage Tank Area. The average concentrations of target constituents present are listed in Table 1.4, Estimated Quantity of Target Constituents in Underground Storage Area.

The total amount of target constituents estimated to be present in 1,200 cubic yards at average concentrations is also presented in Table 1.4. One thousand two hundred cubic yards is estimated to be the amount of soil in the underground storage area which may contain target constituents. This soil estimate was calculated by finding the volume of soil beneath the storage tank area (depth to the underground storage tanks by width of area by length of area) and subtracting the volume occupied by the tanks. The estimated total weight of chlorinated compounds in this area 1.0 pounds or 0.75 pints.

Former Diesel Fuel Tank Area

Analyses of soil samples collected from the excavation at the time of tank removal indicated the presence of total petroleum hydrocarbons as diesel fuel at concentrations between 59 and 360 mg/kg. Benzene, toluene and xylene concentrations ranged from 0.39 to 9.6 mg/kg. Soil samples collected between the surface and the depth of groundwater at downgradient borehole B-7 did not contain detectable concentrations of the constituents, indicating a lack of downgradient migration of these constituents. Methylene chloride was detected in one sample collected at a depth of one foot from this borehole, which is above the level of the former

storage tank. The presence of methylene chloride is not likely to be associated with the former storage diesel tank operations.

The distribution of target constituents within this area is presented in Figure 1.10, Distribution of Target Constituents in Former Underground Diesel Tank Area. The average concentrations of target constituents present are listed in Table 1.5, Estimated Quantity of Target Constituents in Former Underground Diesel Tank Area.

The total amount of target constituents estimated to be present in 30 cubic yards at average concentrations is also presented in Table 1.5. Thirty cubic yards represent the amount of soil in the former drainage swale area which may contain target constituents. This soil estimate was calculated in the same way as the underground storage area. The constituents present at significant concentrations in this area were limited to benzene, diesel fuel, and xylene. The estimated quantities of these constituents are 0.1 lbs. (2 fluid ounces), 11.7 lbs. (1.75 gallons), and 0.5 lbs. (9 fluid ounces), respectively.

Drum Storage Area

The presence of target constituents in soil at the eastern edge of the drum storage area as indicated by samples collected in July, 1990 is limited to benzene, toluene, ethylbenzene and xylene at depths of less than ten feet. Methylene chloride and 1,1,1-TCA had been detected in samples collected from the depths of one foot and 20 feet in June, 1987; however, 1,1,1-TCA was also detected in samples collected from the depths of three and 20 feet at a background location upgradient of the drum storage area. The presence of 1,1,1-TCA in background samples at similar concentrations and depths as that of the drum storage area samples suggests that the drum storage area is not the source for these

constituents.

The distribution of target constituents within this area is presented in Figure 1.11, Distribution of Target Constituents in Drum Storage Area.

Background Locations

Soil samples collected from the surface and a depth of one foot at a location to the north of the SP railroad tracks contained detectable concentrations of toluene, xylene, ethylbenzene and methanol. This background data indicates the regional presence of these constituents. This regional contamination has likely contributed to the presence of toluene, xylene, ethylbenzene, and methanol in borehole samples collected within the former drainage swale area. Purgeable aromatic constituents (benzene, toluene, xylene and ethylbenzene) are common components of automobile fuel and the area is used heavily by automobiles and diesel powered trucks from the Central Expressway.

A near surface soil sample collected from a background location to the south of the drum storage area contained high boiling point hydrocarbons at a detectable concentration consistent with the presence of diesel fuel. Diesel powered delivery trucks use the area regularly. No target constituents were detected in soil samples collected from deeper depths at this location. This area was heavily used by diesel powered trucks.

TCA was also detected in the background location south of the drum storage area. This area has never been used in the production operations on-site. The source of TCA in this area may be from surface spillage from adjacent areas or from an upgradient source. It is not likely the drum storage area is the source, since the drum storage area is downgradient.

1.2.3.2 Surface Water

Surface water runoff from property neighboring JASCO is directed to storm sewer lines which discharge to Permenente Creek, located 600 feet west of the site. The storm sewer system, however, does not service JASCO directly. Surface runoff from the front yard area of JASCO flows to the north or northeast and collects near the production building. Surface runoff from the rear yard area collects in the drainage swale area. JASCO has installed a runoff management system at the site which directs all on-site runoff to several concrete sumps. Runoff is then pumped from the sumps to storage tanks on-site before being discharged to the sanitary sewer system through above-ground piping. Groundwater being extracted from well V-4 is being discharged, via above-ground pipes, to the city sewage system.

Permenente Creek is the nearest body of surface water. Permenente Creek is concrete lined. No other surface water bodies are located within one mile of JASCO. It is not likely runoff from the site has affected bodies of surface water in the area.

1.2.3.3 Groundwater

Three water bearing zones have been identified beneath JASCO during the investigations conducted on-site. These three zones have been identified as the A-, B(1), and B(2)-aquifers. Another aquifer, the C-aquifer, exists beneath the site. This aquifer, a source of drinking water, is at a depth of approximately 150 feet below grade (94 below mean sea level). The vadose zone lithology below the site consists of interbedded clay, silt, sandy clay, and sandy silt.

The A-aquifer, encountered at a depth of approximately 30 to 32

feet (28 feet above mean sea level), is of variable thickness. The A-aquifer is thickest in the vicinity of monitor well I-2 (14.7 feet) and thinnest in the vicinity of monitor well I-3. It is identified only by a soil color change and increase in sand content. The lithology of the A-aquifer is predominantly interbedded sand, gravel, and clay.

The direction of groundwater flow in the A-aquifer as recorded in October of 1987 was 30 degrees east of north (N30E, see Figure 1.12, Direction of Groundwater Flow in the A-aquifer) with a gradient of 0.004 ft/ft (0.004 vertical feet per each liner foot in the direction of groundwater flow). Groundwater flow within the A-aquifer has been affected by the extraction of groundwater from monitor well V-4. Pumping from monitor V-4 has caused the A-aquifer groundwater flow near the well to be deflected towards it. Downgradient of monitor well V-4, A-aquifer groundwater flow appears to be directed along a northeast trending line centered in the vicinity of monitor well V-7. The aquitard separating the A-aquifer and the B(1)-aquifer ranges in thickness from 6.5 feet at well I-1 to 17 feet at well I-2.

The thickness of the B(1)-aquifer ranges from 7.5 feet at well I-2 to 11.2 feet at well I-1. The lithology of this aquifer consists predominantly of silty and gravelly sand. The direction of groundwater flow within the aquifer as of August, 1987 was 15 degrees east of north at a gradient of 0.003 vertical feet per linear feet.

The aquitard between the B(1) and B(2)-aquifer was penetrated approximately five feet during installation of the B(1)-aquifer wells. The aquitard contains an abundance of coarse sediments. It is only one foot thick at well I-3.

The B(2)-aquifer was apparently penetrated at monitor well I-3.

It is 58 feet below grade (one foot below mean sea level). No wells are screened within this aquifer.

There is limited information about the lithology of the soils beneath the B-level aquifers since borings were not taken below the depth of the B-level aquifers. According to a study performed by Harding, Lawson, and Associates, the C-aquifer is generally separated from the overlying B-aquifer by a 20-40 foot thick clay layer or by a series of thinner clay layers. In the Mountain View area, the aquitard is laterally continuous and consists of stiff silty clay with lenses of sand. The top of the C-aquifer is located at a depth of 150 feet (94 feet below mean sea level).

Target Constituents within the A-Aquifer

Groundwater samples from the A-aquifer are collected quarterly and analyzed for target constituents. The following target constituents have been detected in groundwater collected from the A-aquifer monitor wells over the past four sampling events (January 1990 thru January 1991):

Halogenated Volatile Organics	Non-Halogenated Organics
1,1,1-TCA	Acetone
1,1-DCA	Ethanol
1,1-DCE	Methanol
Chloroethane	TPH as diesel
Methylene Chloride	

Phenolic Compounds

4-Nitrophenol

Pentachlorophenol

A summary of groundwater analysis since 1984 is presented in Appendix A, Summary of Groundwater Analytical Results. JASCO's

Publicly Owned Treatment Works (POTW) discharge permit require monthly analysis of monitor well V-4. The analytical results of the past year are listed in Table 1.6, Analytical Results of Samples from V-4, 1990.

The distribution of halogenated volatile organic constituents is generally limited to the area near and downgradient of the eastern portion of the former drainage swale area. Of the halogenated volatile organic constituents detected in monitor wells V-1, V-3, and V-4, only 1,1,1-TCA, 1,1-DCA and 1,1-DCE are currently present at detectable concentrations in downgradient monitor wells. The presence of chloroethane and vinyl chloride in A-aquifer groundwater is limited to monitor well V-4 at the eastern portion of the former drainage swale area. The presence of methylene chloride is limited to monitor wells V-1 and V-3 north of the underground storage tank area. The distribution of 1,1,1-TCA, 1,1-DCA, and 1,1-DCE, is limited to monitor wells V-1, V-3 and V-4 and several downgradient monitor wells.

The only additional target constituents currently present in A-aquifer groundwater are high boiling point hydrocarbons (present in monitor wells V-1, V-3, and V-4), and pentachlorophenol and 4-nitrophenol (present only in monitor well V-1). The occurrence of high boiling point hydrocarbons in wells V-1, V-3 and V-4 has been persistent but in decreasing concentrations over past sampling periods. Since they have not been identified in downgradient wells, this suggests that lateral migration is minimal. The phenolic compounds have been detected only during the most recent sampling event in July, 1990 and in one sampling event conducted in 1986. The concentrations of these constituents are only slightly above minimum detection limits and within the range of normal laboratory variation.

Target Constituents within the B(1)-Aquifer

The B(1)-aquifer monitor well network consists of three wells, I-1, I-2, and I-3 (see Figure 1.4). I-1 is constructed in the former drainage swale area. I-2 and I-3 are constructed downgradient of the site. Groundwater from these wells is collected and analyzed quarterly. Based on January, 1991 analysis of the groundwater, the target constituents within the B(1)-aquifer are limited to 1,1,1-TCA and 1,1-DCA in well I-2. The concentrations of 1,1,1-TCA and 1,1-DCA detected were 2.4 and 2.3 parts per billion (ppb), respectively. These concentrations are below the California Maximum Contaminants Level (MCLs) of 200 and 5 ppb, respectively. No target constituents have been detected in I-1 samples collected in 1990 or 1991. Phenol, which was detected in a I-3 sample collected in July, 1990, has not been detected since.

The B(1)-aquifer is not currently being used as a source of drinking water nor is it likely to be used in the future. A study of the potability of B(1)-aquifer groundwater was conducted at the Middlefield-Ellis-Whisman site (located 1.5 miles east of JASCO) in 1987. The groundwater was found to contain a number of major ions as well as fecal coliform bacteria at concentrations exceeding established drinking water standards.

Remediation of the B(1)-aquifer will not be addressed in the FS since: 1) the concentrations detected within the B(1)-aquifer are below the MCLs; 2) the presence of target constituents in the B(1)-aquifer is limited to 1,1,1-TCA and 1,1-DCA in one location; 3) the B(1)-aquifer is not currently used as a source of drinking water; 4) B(1)-aquifer groundwater, based upon analyses conducted at a site just east of JASCO, is not potable; and 5) vertical migration of B(1)-aquifer groundwater to underlying potable water sources is unlikely. Monitoring of the B(1)-aquifer will continue

for a period of time to assure the concentrations remain below the MCLs.

1.2.4 Target Constituents Fate and Transport

1.2.4.1 Migration of Target Constituents

Four potential pathways for the migration of target constituents from the site have been identified: vadose zone soil, groundwater, man-made potential conduits and surface and air dispersal.

Migration of target constituents through vadose zone soil at the site has occurred in several areas due to downward migration of precipitation and surface runoff through vadose zone soil containing target constituents by gravity. The presence of root casts and sandy interbeds provide a potential pathway for the vertical migration of target constituents to the A-aquifer. Lateral migration of target constituents in the vadose zone soil has occurred within the continuous coarse sand interbed about 15 feet below grade and along other discontinuous sandy interbeds. In the former drainage swale area and in on-site areas, downward percolation of precipitation and runoff is prevented by the runoff collection system which directs runoff to the local sanitary sewer system thereby minimizing target constituent migration through the vadose zone soil.

Downgradient migration of dissolved halogenated volatile organic constituents in a northerly direction has occurred within the A-aquifer. The stability of the concentrations of target constituents in downgradient monitor wells V-7, V-8 and V-9 suggest that the rate of migration is slow. Migration of target constituents from the drainage swale area appears to be limited to the more mobile chlorinated hydrocarbons such as 1,1,1-TCA, 1,1-DCA, 1,1-DCE and acetone. Less mobile target constituents such as

alcohols and petroleum hydrocarbon mixtures have not been detected in monitor wells downgradient from the former drainage swale and underground storage tank areas.

Vertical migration of target constituents between aquifers appears to have occurred as evidenced by the presence of target constituents in groundwater collected from monitor wells completed in the B(1)-aquifer (I-2 and I-3). The presence of these constituents may not be attributed to downward migration through the aquitard separating the A- and B(1)-aquifers. Target constituents may have been introduced into the B(1)-aquifer during construction of the B(1) wells. The greatest concentrations of target constituents from monitor well I-1 and I-2 were found immediately after the construction of the wells (August and September, 1987). Concentrations have decreased since then. No target constituents have been detected in groundwater samples from monitor well I-1 since August, 1987. Concentrations in monitor well I-2 initially decreased and have since stabilized.

Migration through the aquitard separating the two aquifers is unlikely. A sample of the aquitard collected from the depth of 36 feet from monitor well I-2 was classified as clay (CL) with a vertical permeability of 3.1×10^{-7} cm/sec (6.1×10^{-7} ft/min). A sample collected from the depth of 28 feet at monitor well I-3 was also classified as clay (CL) with a vertical permeability of 2.8×10^{-6} cm/sec (5.5×10^{-6} ft/min). (Permeability values between 10^{-8} and 10^{-5} ft/min are considered to be low.) The lateral continuity of this aquitard both on-site and at downgradient locations was established during the installation of the B(1)-aquifer wells.

Lateral movement of target constituents within this aquifer would occur as a slow downgradient (northerly) migration. The presence of target constituents in B(1)-aquifer monitor wells over the past four monitoring phases is limited to 1,1,1-TCA and 1,1-DCA at

monitor well I-1. This suggests that there is no downgradient migration of target constituents from potential source areas.

The low permeability of the aquitard underlying the B(1)-aquifer makes vertical migration to underlying aquifers unlikely. Laboratory testing of samples collected from the aquitard indicated the permeability of the aquitard to be 2.9×10^{-7} cm/sec (5.7×10^{-7} ft/min) to 2.3×10^{-8} cm/sec (4.5×10^{-8} ft/min).

Lateral and vertical migration of target constituents may have occurred in the past along surface pathways, particularly in the area of the former drainage swale. However, such pathways have been eliminated or significantly decreased. Migration of target constituents along these pathways are unlikely.

The migration of target constituents through air pathways would be unlikely. Most target constituents are present at depths in excess of two feet, or are relatively immobile due to surface conditions or chemical characteristics.

1.2.4.2 Target Constituent Persistence

The target constituents present at the site can be divided into three categories: halogenated volatile organic constituents, non-halogenated organic constituents and phenolic compounds. The volatile organic constituents identified at the site are generally highly volatile and moderately to highly soluble. These constituents would not be expected to be persistent in near surface soils. At depth and in groundwater they would be more persistent due to their solubility in groundwater, the vadose zone moisture, and their resistance to biodegradation by naturally occurring soil organisms.

The phenolic compounds identified in soil and groundwater at the

site tend to be of low to medium solubility and low volatility. These constituents would tend to be very persistent in subsurface soil and groundwater. Their presence at the JASCO site is very limited and at very low concentrations.

The shorter chain petroleum hydrocarbons, which generally include thinners and gasoline, tend to be moderately to highly volatile with low solubility. They are readily biodegradable by naturally occurring soil organisms under aerobic conditions. For these reasons, such constituents would not be highly persistent at shallow soil depths. They would be more persistent in groundwater, as they have a tendency to remain as free product floating on the groundwater surface (no groundwater samples from JASCO has had floating free product).

The longer chain petroleum hydrocarbons (predominantly diesel fuels) are less volatile. They are not as readily biodegradable so tend to be very persistent in subsurface soil and groundwater.

1.2.5 Baseline Risk Assessment

An Endangerment Assessment for JASCO site was prepared by Jacobs Engineering Group Inc., an EPA consultant, in August of 1989 (see Appendix B, Jacobs Endangerment Assessment). This report did not take into account the removal of soil with high concentrations of target constituents.

The conclusions of the Jacobs (1989) EA are that:

- The site does not pose a significant health risk under current land-use conditions. The only complete exposure route was determined to be inhalation of volatile compounds and the potential cancer risk was determined to be less than 10^{-6}.

- Under future land-use conditions, the site could pose a significant risk via ingestion and inhalation of volatile compounds in groundwater used for domestic purposes. Jacobs (1989) estimated that a maximum plausible excess cancer risk of 4×10^{-3} for ingestion and 6×10^{-4} for vapor inhalation would be associated with use of groundwater in the A aquifer for domestic water supply.

- Use of groundwater for domestic purposes would also pose significant non-carcinogenic risks.

- Risks associated with exposure to contaminated soil by ingestion of surface soil or inhalation of fugitive dust were not significant.

OHM reviewed the Jacobs (1989) Endangerment Assessment and generally concurs with the conclusions of the report. The site does not currently pose a significant health risk but under certain conditions, future use could pose a significant risk. (For carcinogens, a significant risk is considered to be an increased risk of developing cancer as a result of lifetime exposure of greater than 1×10^{-6}.) Specifically, future domestic use of downgradient A-aquifer groundwater could pose a health risk. Based on this EA, only the potential future use of groundwater as a drinking water source was evaluated in detail in establishing cleanup criteria for chemicals at the Jasco site. This potential scenario is unlikely due to the restriction on the A-aquifer. The Santa Clara Valley Water District Ordinance (SCVWD) No. 85-1, Section 7, allows only monitor wells to be installed in the A-aquifer. SCVWD also requires potable water wells be constructed with a minimum 50-foot sanitary seal. This would preclude the use of the A- and B(1) aquifer groundwater as

drinking water.

The results of this Endangerment Assessment indicated that there are no significant carcinogenic or non-carcinogenic risks associated with exposure to on-site soils via incidental ingestion or fugitive dust inhalation.

SECTION
2.0

2. IDENTIFICATION AND SCREENING OF TECHNOLOGIES

2.1 INTRODUCTION

This initial screening step consists of identifying remedial technology types and selecting the most appropriate process option within each remedial technology type (i.e., enhanced bioremdiation process option to represent biological technology) for detailed evaluation. Appropriate process options must satisfy the remedial objectives and be technically implementable. The remedial objectives are based upon information from the Endangerment Assessment.

After the range of appropriate process options has been identified, one option, if possible, is selected for each technology type. This selection is based upon effectiveness, implementability, and cost. More than one option may be selected if they are sufficiently different in their performance that one would not adequately represent the other, or if two options appear to meet the criteria for selection. These options are developed into remedial alternatives.

A detailed analysis of the selected alternatives is performed to evaluate each alternative against the nine criteria specified by EPA. These nine criteria are:

1) Overall protection of human health and the environment;
2) Compliance with ARARs;
3) Long-term effectiveness and permanence;

4) Reduction of toxicity, mobility, and/or volume of target constituents;
5) Short-term effectiveness;
6) Implementability;
7) Cost;
8) State acceptance; and
9) Community acceptance.

This detailed analysis is performed to provide relevant information to aid decisionmakers in their selection of a site remedy.

2.2 REMEDIAL ACTION OBJECTIVES

The groundwater and soil at JASCO have been sampled and analyzed on many occasions. Detectable concentrations of target constituents are present in the groundwater and soil. As noted in the Endangerment Assessment prepared for the site (Appendix B) and in Appendix C, Remediation Levels for Soils at the Jasco Chemical Corporation Site, the Jasco site does not currently pose a significant health risk but future use could pose a significant risk under certain conditions. Specifically, although highly unlikely, the A-aquifer groundwater could be used as a drinking water source.

A groundwater sample collected in 1987 from well V-3 in the A-aquifer contained levels of total dissolved solids (TDS) that slightly exceeded 3,000 mg/l. This concentration is used as a criteria under California's Proposition 65 for determining if water is a "source of drinking water". Primary drinking water standards (Maximum Contaminant Levels or MCLs) were exceeded for turbidity and coliform bacteria were detected in the water. The water also exceeded Secondary Drinking Water Standards for TDS, chloride, color, iron, and manganese. Based on these results, the

water in the A-aquifer appears to be of poor quality and would not be usable as a drinking water source without substantial treatment.

Despite the poor quality of the A-aquifer water, the Jacobs EA evaluated the potential exposure associated with long-term domestic use of downgradient A-aquifer water. Jacobs (1989) modelled the migration of chemicals at the Jasco site using a one dimensional analytical model to evaluate the downward leaching of chemicals from vadose zone soils into the A-aquifer and a numerical model, SUTRA, to model the downgradient migration of chemicals within this aquifer. Based on the modelling effort in the Endangerment Assessment, a ratio between the concentration of a chemical in on-site soils and its expected future concentration in downgradient groundwater can be determined. The groundwater concentrations of target constituents have decreased since the Jacobs EA.

OHM used the soil concentration to groundwater concentration ratio or dilution factor, together with allowable groundwater concentrations (MCLs, listed in Table 2.1, or health risk-based values) to determine allowable concentrations of site chemicals in soils. These soil remediation goals are designed to adequately protect future on-site and nearby off-site residents from any potential health effects associated with the migration of chemicals in soils into groundwater that could be used as a domestic water source. These soil remediation levels are:

<u>Carcinogens</u>

Individual volatile organic compounds - 1 mg/kg
Vinyl Chloride - 0.5 mg/kg
Sum of all compounds - 5 mg/kg

Noncarcinogens

Individual volatile organic compounds - 50 mg/kg
Sum of all compounds - 100 mg/kg

These goals were developed based on a comparison with cleanup criteria used at other sites and a consideration of site-specific factors, including the potential for migration and the small amount of material present.

The models used by Jacobs (1989) do not consider retardation or degradation. Volatile organic compounds will not move at the same rate as water, but will be slowed somewhat by adsorption to soil particles. Some of the compounds are expected to become tightly bound to these particles or to become trapped in soil micropores. These compounds may not be readily desorbed back into the water column. Both biological and chemical degradation processes will act to break down some of the compounds. Studies at Moffett Field and elsewhere have indicated that some biodegradation of halogenated organic compounds is occurring. The occasional detection of vinyl chloride, a breakdown product of trichloroethylene and dichloroethylene, at the Jasco site may indicate that some degradation is occurring there.

Only a small area of the site contains chemicals, particularly following the excavation of the drainage swale area. Because the modelling effort assumed a larger area of the site contained target constituents, whereas a major portion of the soil containing target constituents has already been removed, the actual amount of dilution that would occur is likely to be greater than predicted by the Jacobs (1989) model. Furthermore, the modelling also assumed that the chemicals of concern were present in soils at a uniform concentration. Because the dilution factors used in this assessment were based on this assumption, chemicals

present in soils at levels slightly above the soil remediation goals would probably not pose a health concern as long as the average concentration of the chemical in a particular area was below the criteria.

In summary, several factors suggest that soil remediation goals developed based on the modelling conducted by Jacobs may be overly conservative of health protection:

- The models do not account for the likely retardation of organic chemicals as a result of adsorption by soil particles.
- The potential effect of either biological or chemical degradation are not considered in the model.
- The area of the former drainage swale containing the greatest quantity and highest concentrations of chemicals has been removed. Consequently, the majority of the potential source material has been removed.
- Because much of the target constituent containing soil considered in the Jacobs (1989) modelling has been removed, a greater amount of dilution may occur.
- The Jacobs (1989) modelling effort assumed a uniform chemical concentration in soils across the site. Dilution factors developed using this assumption are appropriate for determining an allowable average site concentrations.

Several additional factors indicate that exposure via the use of the A-aquifer as a domestic water source is highly unlikely:

- The A-aquifer contained elevated levels of TDS, turbidity, coliform bacteria, chloride, color, iron, and manganese. Based on these results, the water in the A-aquifer is of poor quality and would not be usable as a drinking water source without substantial treatment.
- The local regional water district restricts the use of A- and B-aquifer groundwater in order to prevent subsidence and to limit the potential for saltwater intrusion.

Considering these factors, the small amount of volatile organic compounds that would remain in soils may not reach groundwater and if they reach groundwater may not reach a potential exposure point.

Comparison of On-Site Concentrations with Soil Remediation Goals

For the area of the former drainage swale located west of the production facility (Area DS-2; Figure 1.7), a comparison of the soil remediation goals with chemical concentrations on site was made. These results indicate that most chemicals in these areas were present at levels below the soil remediation goals. Only two samples, collected in May 1988 at a depth of three feet, contained chemicals at levels above these values. In both SB-9 and SB-10, methylene chloride, a probable carcinogenic VOC, was detected (6.2 and 6 mg/kg, respectively). In SB-9 the noncarcinogenic compounds acetone and isopropanol were detected at 49 mg/kg and 164 mg/kg, respectively. Acetone was detected at 100 mg/kg in SB-10. Considering the very dry conditions in the region since 1988, the actual concentrations of these chemicals still remaining at the site are probably much lower as a result of volatilization. Even at the concentrations detected in 1988, the average concentrations of these chemicals in this area are well below the soil remediation criteria. In addition, isopropanol (rubbing alcohol) and acetone are much less toxic than 1,1,1-trichloroethane, the compound used as the basis for the soil remediation goals. Levels of these materials are somewhat above the soil remediation goals and are unlikely to pose a health risk.

Based on a review of the data and a consideration of the potential environmental behavior of these compounds, it seems unlikely that chemicals from the DS-2 area would pose a public health risk.

The northwest corner of the former drainage swale area (area DS-3, Figure 1.8) contains the greatest quantity and highest concentrations of chemicals. Remediation was performed in this area. Over 550 cubic yards of soil were removed and replaced with concrete to a depth of groundwater at approximately 25 feet. Consequently, this area (DS-3) has been removed as a potential source of chemicals to groundwater.

Analyses of samples collected from Area DS-1 (the former drainage swale area to the north and east of the interim soil excavation) indicated that some residual target constituents remain in this area (Figure 1.6). The material present at the highest concentrations were low-to-medium boiling point hydrocarbons. These compounds were detected in every sample from boring C-1. A maximum concentration of 6700 mg/kg was reported at five feet below the ground surface. Concentrations of 380 mg/kg and 38 mg/kg were reported at 25 feet and 30 feet below grade, respectively. Toluene and xylene were detected at 110 mg/kg and 37 mg/kg, respectively, from a depth of 5 feet. Concentrations were less than 10 mg/kg in the deeper samples. In boring C-2, low-to-medium boiling point hydrocarbons were reported at concentrations of 2800 mg/kg, 1300 mg/kg, and 2600 mg/kg, in samples collected from 15 feet, 20 feet, and 25 feet below grade, respectively. The low-to-medium boiling point hydrocarbons were not detected at other depths.

Concentrations of halogenated VOCs were generally low in area DS-1. Sampling locations SB-1 and SB-2 contained the probable carcinogenic VOCs 1,1-DCA and methylene chloride with concentrations between 0.5 and 2 mg/kg. Boring C-2 contained low levels of these compounds; the highest concentration of methylene chloride was 0.71 mg/kg from 20 feet below grade. Boring C-1 contained 1,1-DCA, 1,1-DCE, methylene chloride, and

tetrachloroethylene at concentrations above 1 mg/kg. 1,1-DCA (2.2 mg/kg), methylene chloride (3.2 mg/kg) and tetrachloroethylene (4 mg/kg) were all detected in boring C-1 at 25 feet below grade and 1,1-DCA was reported at 3 mg/kg at 30 feet below grade. The noncarcinogenic halogenated VOC, 1,1,1-TCA, was detected at 61 mg/kg at 5 feet but was present at less than 10 mg/kg at 15 and 20 feet and was not detected at greater depths in boring C-1.

The halogenated compounds present in Area DS-1 are at concentrations only slightly above the soil remediation goals. However, levels exceeding the soil remediation goals have been detected at, or just slightly above, groundwater. This proximity to the groundwater table will limit the dilution, degradation, and attenuation that might otherwise have occurred as the chemicals moved through the vadose zone. In addition, high levels of low-to-medium boiling point hydrocarbons present are at concentrations exceeding 1,000 mg/kg. These compounds may act to increase the desorption of other organic chemicals from soil particles.

2.3 GENERAL RESPONSE ACTIONS

To achieve the remedial action objectives required for JASCO, general response actions or conceptual remediation measures were developed in accordance with EPA guidelines for performance of feasibility studies under CERCLA. General response actions which may be pertinent for remediation of the groundwater and soil are presented in Table 2.2, General Response Actions for Groundwater and Soil.

2.4 IDENTIFICATION AND SCREENING OF TECHNOLOGY TYPES AND PROCESS OPTIONS

2.4.1 Initial Screening and Elimination of Technologies

Remedial technologies within each response action and process options associated with a given technology have been identified and evaluated. The remedial technologies and process options were initially evaluated for technical implementability. A process option may be considered not implementable if it cannot adequately treat the target constituents present or if it would be difficult to construct and maintain the process operation on-site. Those technologies or process options which cannot effectively be implemented have been eliminated from further consideration. The technologies and options which were evaluated are listed in Table 2.3 for groundwater and in Table 2.4 for soil.

The following groundwater remediation options were eliminated from further consideration:

- Horizontal Barriers
- Alternate water supply
- Coagulation/Flocculation
- Filtration
- Reverse Osmosis
- Dechlorination
- Neutralization
- Solvent Extraction
- Injection wells.

Horizontal barriers are used to prevent the vertical migration of target constituents. The flow of leachate passing through soil containing target constituents is impeded by the installation of a horizontal barrier. A horizontal barrier does not prevent lateral migration nor does it reduce the concentration of target constituents. A horizontal barrier would not be effective at JASCO since the target constituents have already migrated to

groundwater.

Alternative water sources are not applicable since the local population does not use the A-aquifer or B(1)-aquifer groundwater.

Coagulation/flocculation is a physical/chemical process in which fine particulate matter is conditioned for removal from a waste stream by addition of inorganic or organic chemicals. These induce and accelerate the aggregation of the particulates into larger, settleable particles. Again, there are no suspended constituents at JASCO, so this process is not applicable.

Filtration is a physical process which separates particles suspended in a fluid by forcing the fluid through a porous medium. As the fluid passes through the medium, the suspended particles are trapped on the surface of the filter medium and/or within the voids of the medium. This is not applicable for JASCO since there are no suspended constituents.

Reverse osmosis is a membrane separation process which uses mechanical force (high pressure from 250 to 1500 psi) as the primary driving force for transport of solute (usually water) through a membrane, concentrating the dissolved components. Water passes through the membrane, while the dissolved matter is left behind. This is essentially a molecular sieve, separating water from dissolved matter. The ratio between the clean water passing through the membrane and the rejected dissolved matter depends on the initial concentration of dissolved matter in the waste stream. The higher the concentration, the higher the rejected fraction. The level of the initial concentration will also determine the type of membrane to be used. Periodic washing of the membrane is required. Reverse osmosis cannot be effectively implemented at JASCO because it is designed for chemical compounds with molecular weights greater than 100 grams per mole and the majority of the

constituents present at JASCO do not meet this criteria.

Chemical dechlorination refers to a group of technologies which can be used to strip chlorine atoms from specific highly-chlorinated toxic compounds, such as PCBs and dioxins. Several commercial processes for treatment of transformer fluids are sodium-based, using proprietary solvents. Other processes, which use a potassium compound in combination with other alkali metals in polyethylene glycol, are in development. Dechlorination processes essentially strip the chlorine from the organics, to form an alkali metal salt and a substituted organic polymer. The majority of constituents at JASCO are not highly-chlorinated and could not be successfully treated by these processes.

Neutralization is a chemical process consisting of adding an acid or an alkali to a waste stream, in order to adjust its pH. Neutralization is not applicable since there is no pH problem.

Solvent extraction is a process in which selected constituents of a liquid solution are extracted by contacting it with another immiscible liquid, usually a solvent. The constituents to be removed must be more soluble in the extracting solvent than in the original solution. Solvent extraction would be difficult to implement because of the low concentration of constituents present in the groundwater; it may even aggravate the problem if the extracting solvent dissolves, even dilutely, in the groundwater. It is also difficult to find a solvent which will satisfactorily extract all the constituents from water, so a series of solvents would most likely be required, which would not be technically- or cost-effective.

Injection wells would be used to re-inject treated groundwater back into the aquifer. Unless all target constituents are removed from the groundwater, it would not be constructive to re-inject

the water. This would aggravate the problem which already exists at the site. This form of discharge would also be difficult and more expensive to implement since a Waste Discharge Permit would be required from the RWQCB and additional wells would need to be constructed. This permit is more difficult to obtain than a National Pollution Discharge Elimination System (NPDES) permit. Both are more expensive than discharge to the POTW.

The following soil remediation options were eliminated from further consideration:

- Dechlorination
- Neutralization
- Carbon Adsorption
- Resin Adsorption
- On-site Incineration.

Dechlorination and neutralization process options are not appropriate for the same reasons stated for the groundwater.

Carbon adsorption and resin adsorption cannot be applied directly to the soil. The target constituents must first be transferred to an aqueous or gaseous stream to use these processes. If either mass transfer processes can be successfully accomplished, these options may be reconsidered. The transfer process would first require either soil washing or vapor extraction.

On-site incineration is the destruction of target constituents by exposing them to extremely high temperatures (in excess of 1000 °C). It is an effective process but would be impractical to implement because of the proximity to local housing and the perceived health threat the local population and government believe exists. This method would not be cost effective for the small amount of soil present at this site; the cost of an on-site incinerator for a small site is prohibitive.

2.4.2 Selection of Representative Process Options

The remaining process options were evaluated for their effectiveness, implementability, and cost. One process, if possible, has been chosen to represent each technology. Table 2.5 and Table 2.6 present a summary of the evaluation for groundwater and soil, respectively.

2.4.2.1 Applicable Remedial Process Options for Groundwater

For groundwater, the applicable process options selected for each technology are as follows:

Remedial Technology	Process Option
No Action	None
Access Restrictions	Deed Restrictions
Monitoring	Groundwater Monitoring
Extraction	Groundwater Extraction
On-site Treatment:	
Biological Treatment	Anaerobic/Aerobic
Physical Treatment	Carbon Adsorption
Physical Treatment	Air Stripping
Chemical Treatment	Ultraviolet Peroxidation
In situ Treatment:	
Biological Treatment	Anaerobic/Aerobic
Off-site Discharge	Publicly Owned Treatment Works (POTW) Discharge
On-site Discharge	National Pollution Elimination Discharge System (NPDES) Permit

No Action

The No Action option must be retained per the National Contingency Plan. No action would consist of shutting down the groundwater extraction and discharge, discontinuing the quarterly monitoring of monitor wells, and allowing the plume of target constituents to degrade naturally. Further migration of the plume would most

likely occur. Local, state, and federal agencies do not consider this an acceptable option.

Deed Restrictions

Deed restrictions would limit the future use of groundwater at the site. Even without the deed restrictions, it is unlikely the groundwater in the A-aquifer will ever be used for potable water. The Santa Clara Valley Water District Ordinance (SCVWD) No. 85-1, Section 7, allows only monitor wells to be installed in the A-aquifer. SCVWD also requires potable water wells be constructed with a minimum 50-foot sanitary seal. This would preclude the use of the A- and B(1) aquifer groundwater as drinking water.

Groundwater Monitoring

Groundwater monitoring includes groundwater level measurement, the collection of groundwater samples and analysis of the samples for a range of target constituents. Quarterly groundwater monitoring is currently conducted to characterize and monitor the quality of groundwater at JASCO.

Groundwater Extraction

Groundwater extraction from the sub-surface reduces the amount of target constituents present within the aquifer, and limits the extent of migration by capturing groundwater. Groundwater extraction from the A-aquifer has been in operation since 1987. (Once extracted, the water is discharged, without additional treatment, to the City of Mountain View's sewage treatment plant.) Additional extraction wells would need to be installed to adequately capture groundwater flowing past the former drainage swale area and to treat the groundwater on a larger scale (see Appendix D, Groundwater Extraction System). Installation of these

wells assumes that the aquifer yield is adequate and extraction wells can be placed in feasible locations. Three wells in the A-aquifer, each pumping at 0.5 gallons per minute (the minimum anticipated pumping rate), would be adequate to capture groundwater in the direction of flow across the former drainage swale area. The basis for the extraction system is presented in Appendix D.

Ex site & In situ Biological Treatment

Biological treatment relies on natural, or specialized, bacteria to remove organic constituents from wastewater or soil. Provided the organic material is not toxic or refractory, and its concentration is not prohibitive to bacterial activity, bacteria can utilize the organic constituents as food. Certain biochemical reactions proceed in an aerobic environment (i.e., dissolved oxygen is present in the waste stream), others in an anaerobic (i.e., the waste stream is devoid of dissolved oxygen) environment. Regardless of the treatment environment, the process involves two pathways. In one pathway, bacteria synthesize organic matter for their metabolism and propagation of the species. In the second pathway, bacteria oxidize organic matter to the end product: carbon dioxide and water in the case of aerobic treatment, carbon dioxide and methane in anaerobic systems. In doing so, they produce the energy they need to sustain metabolism.

Currently there are no commercially-demonstrated biological processes in use which will totally degrade TCA, TCE, PCE, and vinyl chloride, although there is considerable progress being made in laboratory- and pilot-scale studies. Most of the other organic non-chlorinated constituents are known to be biodegradable. The bioremediation processes which exist degrade the above chlorinated components to DCA or DCE and then finally to vinyl chloride.

There are experimental processes which are being tested that may degrade these compounds further. These experimental processes utilize both aerobic and anaerobic treatment. JASCO may consider evaluating these processes at its site and, for this reason, both aerobic and anaerobic biotreatment have been retained for on-site technology consideration.

Ex situ and in situ bioremediation are both retained. Biological treatment can be performed either aerobically or anaerobically. Although soil conditions at JASCO (sand, clay, silt) may hinder in situ bioremediation, recent research performed at Stanford University suggests that in situ bioremediation may be possible at sites such as JASCO. Based on this recent research, the in situ option has been retained for further evaluation.

Carbon Adsorption

Adsorption processes rely upon surface phenomenon and molecular diffusion. The surface phenomenon remove dissolved organics from aqueous waste, or organics from air streams, through surface attachment to granular material of suitable characteristics. The organics are also removed from the waste stream as the molecules diffuse into the pore spaces of the carbon. Adsorption takes place when organic molecules in the liquid (or gaseous) phase become attached to the surface of the granular material, as a result of the attractive forces at the granular surface (absorbent) overcoming the kinetic energy of the liquid (or gaseous) constituents (adsorbate) molecules.

Activated carbon, a porous material having a large surface area per unit volume and a non-polar surface, can adsorb most organic compounds to some degree, although carbon usage can be excessive for certain constituents (e.g., vinyl chloride). Greater than 99 per cent removal efficiency can be achieved for many organics.

Exhausted carbon (i.e., carbon saturated with organics) is usually regenerated by thermal processes.

Air Stripping

Stripping is a mass transfer process in which volatile constituents are transferred from an aqueous solution into the gaseous phase (the stripping medium can be air or steam).

Air stripping is a proven technology for the removal of volatile organics from water; the non-volatiles remain in the stripped groundwater. It is accomplished normally in a counterflow packed tower, with the aqueous solution flowing downward and the air blown upwards. It is sometimes accomplished in an aerated tank where air is bubbled through the water.

Carbon adsorption, or another capture or destruction technology, must be provided in conjunction with stripping. This is due to the Bay Area Air Quality Management District's (BAAQMD) emission control standards.

Ultra Violet (UV) Oxidation

UV oxidation is a catalyzed oxidation process used to destroy organic compounds. Chemical oxidation of hydrocarbons produces carbon dioxide and water; oxidation of halogenated hydrocarbons produces inorganic halides. In the process, an oxidant, usually hydrogen peroxide or ozone, is added to the wastestream. After the addition of the oxidant, the wastestream flows across UV lamps. The energy from the UV light catalyzes the chemical oxidation of the organic compounds. Many organic compounds absorb energy from UV light and may undergo a change in their chemical structure or become more reactive with chemical oxidants. This increase in reactivity enhances the oxidation process. This is an

effective process for destroying many organic compounds, including chlorinated organics.

Publicly Owned Treatment Works (POTW)

JASCO has been discharging extracted groundwater to the City of Mountain View's sewage treatment facility since 1987. This discharge is permitted by the City of Mountain View. The discharge is monitored monthly to ensure the concentrations do not exceed the levels set by the permit, which are less than 1 ppm total organics and less than 0.75 ppm for any one constituent as analyzed by EPA Method 601/602. The water is treated at the POTW.

On-site Discharge: National Pollution Discharge Elimination System Permit

On-site discharge of treated groundwater would require a NPDES permit. This permit would be obtained through the California Regional Water Quality Control Board. The permit would also require the monitoring of discharge to ensure that concentrations do not exceed allowable levels.

2.4.2.2 Non-Applicable Remedial Process Options for Groundwater

Several groundwater remedial process options were deemed to be non-applicable for the target constituents at JASCO. A description of these processes and their faults are discussed further.

Cap

A cap above soil containing target constituents would prevent surface water from leaching down through the soil resulting in vertical migration of target constituents. A cap could be considered as an interim action until remediation begins at the

site, but it would not resolve the longterm potential for environmental degradation.

Vertical Barriers

This technology involves the construction of an impermeable vertical barrier to stop the lateral migration of target constituents. The barrier may be a slurry wall or a grout curtain.

A slurry wall is constructed by digging a trench to the depth of a confining layer and pouring a bentonite slurry mixture into the trench as it is being dug. The slurry mixture is added to prevent the trench from collapsing on itself and to prevent the intrusion of groundwater. Eventually the slurry mixture is replaced with a concrete mix which hardens in place.

A grout curtain is constructed by injecting grout under pressure into pre-drilled boreholes. The grout flows through the soil and eventually hardens. The soil must be coarse so that the grout can penetrate through it.

These barriers have limited effectiveness, are difficult to implement and are very expensive. The barriers are susceptible to cracking or erosion by corrosive leachate. A barrier constructed at JASCO would have to extend to 57 feet below the ground surface (depth to confining layer). The cost of slurry wall is $3 to $5 per square feet (depth by length). Grout curtains are up to 10 times as expensive. Barriers to isolate JASCO could range from hundreds of thousands to millions of dollars. The equipment necessary to implement these barriers is quite large and the presence of the railroad tracks could inhibit the placement of isolation barriers. It would very difficult to mobilize and stage this equipment in the limited space at JASCO and it would not

solve the problem longterm.

Resin Adsorption

Resin adsorption operates in the same manner carbon adsorption does. The difference is the adsorbent media. Resin adsorption uses synthetic adsorbents (resins). These resins are (and can be) produced using high surface, porous polymers to suit specific applications. However, the commercial availability of specialty resins for adsorption of adsorbates of different chemical characteristics is quite limited. These resins are also more expensive than carbon. Since carbon is known to effectively adsorb most organics, it is currently the preferred method for treating water streams containing mixed organics.

Steam Stripping

Steam stripping can be applied for organics of low to high volatility and/or of high concentration (1 to 20 per cent). This process is accomplished in a counterflow tower. The process creates a small stream of condensed steam and organics which requires further treatment, usually by incineration. Steam stripping is more expensive than air stripping because it requires more energy than air stripping. This stripping method should not be necessary since the volatilities of the constituents at JASCO are high enough that air stripping will suffice in stripping them.

Supercritical Oxidation

This is a process in which an aqueous waste stream is subjected to temperatures and pressures above the critical point of water (375 °C and 22 MPa) to oxidize organics. Under these conditions, oxygen is miscible with supercritical water and inorganics are practically insoluble. This allows the organics to be oxidized

rapidly and the inorganics to be separated easily.

The process operates by feeding a pressurized waste solution into a reactor, along with air or oxygen. The combined fluid is elevated above the critical point, which causes rapid oxidation of the organics to CO_2, N_2, and CO. Halogens, phosphorous and sulfur are converted to weak acids. Inorganic salts are removed as a concentrated brine.

The cost to construct a facility for this process is extremely high. It is also not practical or implementable to build a longterm high temperature, high pressure process in a residential neighborhood.

2.4.2.3 Applicable Remedial Process Options for Soil

For soil, the applicable process options selected for each technology are as follows:

Remedial Technology	Process Option
No Action	None
Access Restrictions	Deed Restrictions
Monitoring	Vadose Monitoring
Extraction	Vapor Extraction
Cap	Asphalt Cap
Liner	Clay or Synthetic Liner
Excavation	Excavation of areas known to contain target constituents
On-site Treatment:	
Biological Treatment	Enhanced Aerobic Treatment and X-19
Biological Treatment	Anaerobic Treatment
Soil Washing	Excalibur Treatment
In situ Treatment:	
Biological Treatment	Aerobic/Anaerobic
Off-site Discharge	RCRA Facility

No Action

The No Action option must be retained per the National Contingency Plan. No action would consist of leaving all soils in place without the use of any means to prevent migration of target constituents.

Deed Restrictions

Deed restrictions would limit the use of the land. The land will most likely become residential property. If this happens strict restrictions (e.g., no exposed soil be allowed, surface must be covered by concrete or landscaping) may be implemented to limit exposure to soil containing target constituents, if it is left on-site. Also, homes will not be constructed over or near the S.P. property, where much of the target constituents are located.

Soil Monitoring

Soil samples will be collected and analyzed during excavation to characterize the extent of target constituents. When used in conjunction with a treatment process, sampling and analysis will also provide data regarding the progress of the treatment.

Vapor Extraction

Vapor extraction uses the same principle as air stripping. It is a mass transfer process in which volatile constituents are transferred from the soil to a gaseous phase. The stripping medium, air, is drawn through the soil to volatilize the constituents and transfer them to the gaseous stream. This process can be performed in situ or ex situ. If done in situ, vapor recovery wells are constructed and air is drawn through them. The decision to perform in situ or ex situ vapor extraction

is based in part on the type and volume of soil encountered. If the soil is air permeable, such as a coarse sand, in situ is possible. If, however, the soil is not very air permeable, such as a fine clay, and a nominal volume of soil is involved, ex situ treatment is more effective.

Vapor extraction has been retained, but is not expected to be effective in situ due to the type of soil at the site (clay with silt and sand). However, vapor extraction (in combination with bioremediation) could be very effective if the soil is mixed with a bulking agent and treated ex-situ, as is the case for the Enhanced Biological Treatment option.

Cap

A cap would prevent surface migration of target constituent by isolating soil containing target constituents from surface runoff. It would also prevent surface water from percolating down through these soil and further transporting target constituents into the groundwater.

Clay or Synthetic Liner

Soil placed within a clay or synthetic (such as a polymer plastic) liner is isolated from groundwater. This prevents both vertical and lateral migration of target constituents into the groundwater. The liner must be adequately engineered to ensure long-term integrity.

Excavation

Soil known to have significant concentrations of target constituents are excavated and either treated on-site or taken to a TSD facility. Soil analysis is used to confirm that the

appropriate soil is removed. The soil is treated or disposed of following excavation.

Ex situ & In situ Biological Treatment

As with the groundwater, both aerobic and anaerobic options are retained for ex situ and in situ biological approaches so that emerging processes can be evaluated.

Enhanced bioremediation is used for soil which contains a combination of volatile and non-volatile hydrocarbons that are biodegradable. This system is totally enclosed to assure that no air emissions occur during operation and to maintain a controlled environment for bioremediation. OHM uses an enclosed treatment system that includes a treatment vessel, air distribution system, and a vapor recovery system. The moist air passing through the soil in the vessel provides oxygen to the bacteria while simultaneously stripping the more volatile organics. The stripped air then passes through two carbon adsorption canisters that are in series. The air is monitored between and after the carbon canisters to determine when the carbon is exhausted and needs to be changed. Prior to treatment in the vessel, nutrients are added to the soil and it is pre-treated to assure adequate air distribution and biodegradation. Additional water and nutrients are added, as needed, during operation.

Another potential biological treatment method worth evaluating is a soil composting process using X-19, a proprietary soil additive that incorporates a specially developed microbial consortium. X-19 is applied to the soil in combination with a bulking agent; the additives are thoroughly mixed into the soil. The developer of this technology claims that it is effective in biodegrading chlorinated hydrocarbons, such as TCE and TCA, to non-detectable levels. The vendor suggests that the X-19 be mixed into the

target constituent containing soil along with the appropriate nutrients and water and that the entire soil pile be covered. Within several months, all of the organics supposedly will have been biodegraded and a rich soil amendment will result. Since this has not been effectively demonstrated (according to EPA protocol) for chlorinated hydrocarbons, a treatability (and possible a pilot study) would have to be performed to properly evaluate X-19's effectiveness and overall feasibility for treating this mixed organic containing soil.

In situ bioremediation has been retained based on recent research by Stanford University. Information concerning the research has not yet been reviewed by OHM. Information will be provided in an addendum to this document.

Excalibur Soil Washing/Catalytic Ozone Oxidation Process

The Excalibur process has been included because its inventors claim, and initial studies indicate, that it can very effectively remove mixed organic constituents from soil and destroy them using a specialized UV oxidation process. This patented process is being demonstrated through the SITE program. It is designed to treat soils that contain organic and inorganic constituents. The technology is a two-stage process; the first stage separates the target constituents from the soil; the second stage destroys the extracted constituents. The initial extraction step uses ultrapure water (prepared on-site by a patented process) and ultrasound to separate constituents from the soil. The second step uses ozone, ultraviolet (UV) light, and ultrasound simultaneously to oxidize the constituents. The treatment byproducts are decontaminated soil and salts. This technology is being demonstrated, under the EPA's SITE program, at a PCP-contaminated wood preserving facility. This technology has not been extensively demonstrated, although initial treatability

results have been very encouraging. Treatability studies would be required before this process could be seriously recommended for application at JASCO.

RCRA Permitted Facility

Soil is excavated and transported off-site to a RCRA permitted facility for treatment and disposal. Off-site disposal alone is not an option because the land-ban restrictions include some of the constituents present at JASCO. The soil would need to be pre-treated (e.g., incinerated) at a RCRA facility prior to disposal.

2.4.2.4 Non-Applicable Remedial Process Options for Soil

Several soil remedial process options were deemed to be non-applicable for the target constituents at JASCO. A description of these processes and their faults are discussed further.

Desorption

Heat is applied to soil to vaporize the target constituents. The vapor can either be discharged to the atmosphere or collected for further treatment. This process has been eliminated from further consideration because of the high energy requirements for a relatively small volume of soil and because it is not practical or publicly acceptable to operate a volatilizer in a residential community. Thermal treatment processes are comparatively more expensive than ex-situ vapor extraction or enhanced bioremediation, which would be equally effective.

Heated Stripping

Heated stripping is a stripping process in which the stripping

medium is heated; the medium can be steam or heated air. This process has been eliminated for the same reasons as desorption has, high energy and cost requirements in comparison to other options.

In situ Vitrification

In situ vitrification is a process in which the soil is heated to its melting point. The target constituents within the soil are either volatilized or thermally destroyed. Residual constituents are trapped within the matrix of the soil after it has cooled and hardened. The voids within the soil disappear and the soil experiences a loss of volume.

The technology heats the soil by means of electrodes placed around the area to be treated. A hood is placed over the area to capture off-gases. These off-gases are collected and treated.

Vitrification does not appear to be implementable at JASCO. This is an expensive technology designed for larger sites where no other option is feasible. It is most appropriate for inorganic waste and mixed waste; organics vaporize out of the soil. The area to be treated is located near the Southern Pacific Railroad tracks. The melt would extend to the tracks and any volume loss of the soil would damage the tracks' structural integrity. The vent hood, which is 50 feet by 50 feet, could not be extended over the active tracks.

The remaining options will now be organized into remedial alternatives.

SECTION
3.0

3.0 Development of Remedial Alternatives

Remedial alternatives have been developed by combining the remaining remedial process options. These alternatives have been evaluated against the nine criteria specified by the EPA. This evaluation is summarized in Table 3.1 for groundwater alternatives and Table 3.2 for soil alternatives. These nine criteria are:

1) Overall Protection of Human Health and Environment;
2) Compliance with ARARs;
3) Long-term Effectiveness and Permanence;
4) Reductions in Toxicity, Mobility, and Volume through Treatment;
5) Short-term Effectiveness;
6) Implementability;
7) Cost;
8) State Acceptance; and
9) Local Acceptance.

The cost for the alternatives were based on vendor quotes and published information. The costs are compared independent of the other criteria in Table 3.3, Present Worth Costs of Remedial Alternatives.

3.1 Groundwater Remedial Alternatives

The groundwater remedial alternatives have been developed and are given below. Each of these alternatives incorporates a series of remedial technologies which, in combination, address the above nine criteria.

Groundwater Remedial Alternative I: No Action

- No Action

Groundwater Remedial Alternative IA: No New Action Until Closure

- No New Action Until Closure of Facility
- Proceed with an Appropriate Alternative after Closure of Facility

Groundwater Remedial Alternative II: Discharge to POTW

- Deed Restrictions
- Extraction, equalization and mixing
- Off-site Discharge under POTW Permit
- Regular Groundwater Monitoring

Groundwater Remedial Alternative III: UV Oxidation

- Deed Restrictions
- Extraction
- UV Oxidation
- Polishing Treatment (optional)
- Regular Groundwater Monitoring
- Off-site Discharge under NPDES or POTW Permit

Groundwater Remedial Alternative IV: Carbon Adsorption

- Deed Restrictions
- Extraction
- Carbon Adsorption (liquid phase)
- Regular Groundwater Monitoring
- Off-site Discharge under NPDES or POTW Permit

Groundwater Remedial Alternative V: Air Stripping

- Deed Restrictions
- Extraction
- Air Stripping
- Carbon Adsorption (vapor phase)
- Carbon Adsorption (liquid phase)
- Regular Groundwater Monitoring
- Off-site Discharge under NPDES or POTW Permit

Groundwater Remedial Alternative VI: Biological Treatment

- Deed Restrictions
- Extraction
- Ex-situ Biological Treatment
- Carbon Adsorption (liquid phase)
- Off-site Discharge under NPDES or POTW Permit
- Regular Groundwater Monitoring

Groundwater Remedial Alternative VII: In-Situ Bioremediation

- To be provided in an addendum at a later date.

The extraction system for Alternatives II through VI will consist of a total of three wells in the A-aquifer. It is estimated that this system will be sufficient to control migration of target constituents off-site. Hydrogeological tests may be necessary to confirm this. The basis for the extraction system is presented in Appendix D.

The A-aquifer wells would pump at a maximum of 2 gallons per minute (gpm) each and a minimum of 0.5 gpm. The flowrate in the A-aquifer is not consistent. Currently, because of drought conditions, the maximum flowrate from V-4, an A-aquifer well, is less than 1 gallon per minute. The maximum flowrate from this system would be 6 gpm and the minimum would be 1.5 gpm. All treatment process equipment is based on the maximum flowrate of 6 gpm. The cost of each of these wells would be $10,000. The total cost of the extraction system would be $30,000. The cost of the extraction system is based on installing three new wells. However, monitor well V-4 could be used as part of the extraction system and only two new wells would need to be installed.

Due to the drought conditions, it may not be possible to effectively pump the A-aquifer until the water table rises. The effective pumping rate has consistently been decreasing. It started at 2.2 gpm and is currently down to 0.5 gpm. If minimal groundwater pumping cannot be achieved, it will likely be

necessary to defer groundwater extraction until the groundwater table rises. In addition, the treatment efficiency and cost of certain systems may be impacted by the reduced flowrates.

The method of discharge has not been selected, but discharge to a POTW would currently be more feasible to implement than discharge under a NPDES permit. To obtain a NPDES permit, an additional feasibility study might have to be performed for the California Regional Water Quality Control Board, the agency which issues NPDES permits. It would also be more economical to discharge to a POTW. The analytical requirements (see Table 3.4: Analytical Requirements under NPDES Permit) are extensive. The analyses listed are for both influent and effluent streams. The cost of these analyses is approximately $18,000 annually. The cost for discharging under the current POTW is $1.25 per 100 cubic feet of discharge, or $5,500 annually, based on a discharge rate of 6 gpm. The only analytical requirement for POTW discharge is a monthly EPA Method 601/602 performed on the effluent. The approximate annual analytical cost would be $1,500. The total annual cost for discharge to POTW would be $7,000.

Table 3.4
Analytical Requirements Under NPDES Permit

Analysis	Frequency	Cost per Sample
96-hour Bioassay	Biannual	$600
Metals (As, Ag, Cr, Cd, Cu, Hg, Ni, Pb, Se, Zn)	Monthly	$225
EPA Method 601/602	Monthly	$125
EPA 8015	Monthly	$200
EPA 625	Biannual	$500

Most of the alternatives provide for treatment of extracted groundwater that contains target constituents above acceptable standard. The treatments recommended have the ability to treat the **extracted groundwater** to below the groundwater ARARs. This does not mean the concentration of target constituents in the **groundwater which remains in the aquifer** will decrease correspondingly. A remediation life of 10 years has been suggested as the basis for this FS, however, there is no guarantee that this will achieve the ARARs in the aquifer. Recent theory, based on long term groundwater remediations, suggest that it may be impossible, and impractical, to meet such low cleanup criteria in groundwater aquifers.

3.1.1 Alternative I: No Action

The "no action" alternative is required for consideration by the EPA. It would require that the current extraction and discharge operations be discontinued and no other remedial action be taken.

<u>Overall Protection of Human Health and Environment</u>

Implementation of this alternative would not likely endanger public health in the short-term since the groundwater is not used for any purpose. It is unlikely it will be used as a drinking water source due to the poor water quality. However, this alternative might pose a danger to public health in the future, should the target constituents migrate to a drinking water aquifer, or if the groundwater is eventually used for drinking water.

<u>Compliance with ARARs</u>

This alternative could eventually comply with the ARARs through naturally occurring processes such as biodegradation, diffusion,

and abiotic degradation. The time required to accomplish this is not known but would likely be a number of decades.

Long-term Effectiveness and Permanence

The natural degradation of the target constituents which would occur over the decades would be permanent. However, until degradation of the target constituents is complete, the population which would be at risk could increase if the target constituents diffused widely.

Reductions in Toxicity, Mobility, and Volume

The "no action" alternative would not reduce the toxicity or mobility of the target constituents in the short term. The volume of material containing target constituents would increase because of diffusion of the constituents.

Short-term Effectiveness

"No action" would not be effective in the short-term. The natural degradation of the constituents is a very long-term process.

Implementability

This alternative would be easily implemented. Very little would have to be done to discontinue the current extraction and discharge process.

Cost

There would be no cost to implement this alternative.

State and Community Acceptance

It is very unlikely that the State or community would accept this alternative.

3.1.2 Alternative IA (Interim Measure): Continue Discharge to POTW Until Source Removal Completed and for an Additional Year Afterwards

This is an interim remedial alternative. Results of the Remedial Investigation suggest that groundwater concentration of target constituents is originating from the remaining soil containing target constituents in the Drainage Swale Area. The concentration of target constituents in the groundwater has been consistently dropping. The intent of this option is to: 1) continue to discharge to the POTW for at least one year after the soil in the Drainage Swale Area is removed; 2) continue to monitor the groundwater quality; and 3) establish whether the target constituents in the groundwater will decrease dramatically. If the concentrations do not decrease after one year, the EPA-selected groundwater remedial alternative would then be implemented. If the concentrations had decreased significantly, but had not yet met ARARs, groundwater pumping and discharge to the POTW would be continued until remedial objectives were met.

Since California is in a drought and the groundwater table has significantly dropped, the local aquifer is not directly contacting the entire zone of soil which may contain target constituents. The potential for migration of target constituents has been substantially reduced during the drought period and does not present an imminent danger to the public. Also, the A-aquifer is not being used for a drinking water supply and is unlikely to be used as a drinking water supply in the near future.

Overall Protection of Human Health and Environment

Implementation of this alternative would not likely endanger public health in the short-term since the groundwater is not used for any purpose, nor is it likely to be used as a drinking water source in the future due to the poor quality of the water. In the long-term, an appropriate remedial alternative would be implemented, if warranted, to ensure the protection of public health and the environment.

Compliance with ARARs

The POTW which treats JASCO's wastewater is located in Palo Alto and discharges to the San Francisco Bay. The POTW's effluent concentrations of the target constituents found in JASCO's groundwater are below detectable levels. The groundwater treated by the POTW would comply with the ARARs. Any future remedial alternative would treat groundwater to comply with the ARARs. It is expected that once the drainage swale soil is removed, the groundwater quality will improve with time to comply with the ARARs.

Long-term Effectiveness and Permanence

The long-term effectiveness and permanence of this alternative would be determined after the drainage swale soil was removed. If this action was not effective, then another more effective and permanent remedial alternative would be implemented.

Reductions in Toxicity, Mobility, and Volume

Discharge to the POTW would reduce the toxicity, mobility, and volume of target constituents by removing the groundwater and preventing further migration of groundwater. The groundwater

would be extracted and discharged to a POTW. Any future remedial alternative selected would further reduce the toxicity, mobility, and volume of target constituents.

Short-term Effectiveness

The implementation of this process poses no threat to the environment or the health of the community or JASCO employees. There is no exposure to the public. The groundwater would be extracted and discharged directly to the POTW. The time required to achieve the remedial objectives depends upon after the final remedial alternative selected (see other treatment alternative descriptions).

Implementability

This first part of this alternative (i.e., extract and discharge to POTW) would be easily implemented. It would be a continuation of the current operation. The implementability of the final part of this alternative would depend upon the final alternative selected by the EPA. (See the Implementability Section for each of the other alternatives selected.)

Cost

The discharge cost of this treatment is $1.25 per 100 cubic feet of groundwater. The current extraction system can operate at a maximum of 2 gpm. The annual cost for discharge would be $2,000 to treat 2 gpm, continuously. No capital costs are associated with maintaining this current operation.

Additional operating costs would be for monthly analysis of the groundwater by EPA Method 601/602. This would be an annual cost of $1,500. Total annual cost would be $3,500.

The present worth of this alternative cannot be determined because the life of the project has not been determined. The life of the project and any future costs would need to be determined once the final alternative is selected.

State and Community Acceptance

If the POTW discharge limits can be consistently met, the State and community may accept this alternative since the intent is to clean up the actual source and to provide additional treatment later, if needed. This alternative poses no health threat to the public and should be accepted by the community.

3.1.3 Alternative II: Discharge to POTW

Groundwater would continue to be extracted and discharged to the City of Mountain View's sewage treatment plant. There would be no treatment prior to discharge. A permit from Mountain View is necessary to perform this alternative and has already been obtained.

This alternative is currently being implemented under permit. The existing permit allows JASCO to discharge groundwater containing less than 1 ppm total organic compounds and less than 0.75 ppm of any one compound as detected by EPA Method 601 and 602. If there are any plumes of target constituents, this current treatment scheme would have to be increased to capture them.

Overall Protection of Human Health and Environment

As long as JASCO complies with the permit limit on organic compounds, the POTW will be able to adequately treat the water to a safe level. The target constituents would be removed

permanently over the long-term. Migration of constituents would be controlled to prevent degradation of potential drinking water sources. The toxicity, mobility, and volume of the target constituents would be reduced. The operation of the system would not pose a threat to human health or the environment.

Compliance with ARARs

The POTW which treats JASCO's wastewater is located in Palo Alto and discharges to the San Francisco Bay. The POTW's effluent concentrations of the target constituents found in JASCO's groundwater are below detectable levels. The groundwater treated by the POTW would comply with the ARARs.

Long-term Effectiveness and Permanence

There should be no residual risk once the remedial objectives have been met. The target constituents would be treated off-site by the POTW and no residual target constituents would be produced on-site. Groundwater monitoring should be continued for a pre-determined period of time to ensure no constituents remain in the aquifer.

Reduction in Toxicity, Mobility, and Volume

The toxicity, mobility, and volume of target constituents would be reduced by removing the groundwater and preventing further migration of constituents. The groundwater would be extracted and discharged to a POTW. The POTW would treat the groundwater to meet their effluent requirements.

Short-term Effectiveness

The implementation of this process poses no threat to the

environment or the health of the community or JASCO employees. There is no exposure to the public. The groundwater would be extracted and discharged directly to the POTW. It is estimated that remedial objectives would be met within 10 years.

Implementability

This alternative is implementable. It is currently in use on a small scale. One well is extracting 2 gallons per minute or less of groundwater (pumping from 0.91 to 0.95 gpm for month of February, 1991) which is discharged to a POTW. An extraction system, consisting of several wells, would have to be installed to control potential target constituent plumes emanating from the site. This a reliable process. The current process has operated without problems since 1987.

Cost

The capital cost would be $30,000 for the extraction system. The discharge cost of this treatment is $1.25 per 100 cubic feet of groundwater. Assuming an extraction system operating at 6 gpm for 365 days a year, the annual cost for discharge would be $5,500. In addition, monthly analysis of the groundwater is required using EPA Method 601/602. This would be an annual cost of $1,500. Total annual cost would be $7,000.

The present worth of this alternative would be $72,000 based on a 10 year remediation life and 10% discount rate.

State and Community Acceptance

If the discharge limits can be consistently met and the source of target constituents is removed, the State and community may accept this alternative. This alternative poses no health threat to the

public and should be accepted by the community.

3.1.4 Alternative III: UV Oxidation

This remedial alternative consists of extracting the groundwater and treating it using UV oxidation. UV oxidation treatability studies have been performed on groundwater with similar target constituents from another Superfund site in San Jose, California. During these studies UV oxidation successfully destroyed chlorinated solvents and no additional treatment process was necessary for polishing.

The advantage of using UV oxidation is the destruction of the target constituents rather than transferring them form one media to another. However, this process is fairly sophisticated. Because of this, it is more costly, requires more time to set up, and more attention to maintain. A holding tank would be required because of the low flowrate. The treatment would operate on a batch basis. When enough groundwater has been collected, the system would be operated until the holding tank had been emptied.

However, the presence of petroleum hydrocarbons in JASCO's groundwater could decrease this alternative's effectiveness. Additionally, there is the potential to produce toxic byproducts that are not totally oxidized. OHM recommends, and the vendors of the process require, an operational treatability study. A treatability study would evaluate UV oxidation's performance on JASCO's site groundwater. This would help to determine if the ARARs could be met.

<u>Overall Protection of Human Health and Environment</u>

This alternative provides for the overall protection of human health and environment by destroying the target constituents in

the groundwater. The constituents would be permanently destroyed over the longterm. Migration of the constituents would be controlled to prevent degradation of drinking water sources. The toxicity, mobility, and volume of the target constituents would be reduced. The implementation and operation of the system would not pose a threat to human health or the environment.

Compliance with ARARs

UV oxidation has been shown to destroy many of the target constituents present in the extracted groundwater to comply with ARARs, although it does not degrade 1,1,1-TCA as effectively as saturated chlorinated hydrocarbons. Compliance with ARARs can only be determined by performing a treatability test.

Long-term Effectiveness and Permanence

If treatability studies demonstrate that ARAR's can be met and after the response objectives have been met, there should be no remaining risk to human health or environment. The process should not produce toxic residual compounds and the destruction of the target constituents is a permanent process.

Reduction in Toxicity, Mobility, and Volume

Past treatability studies have demonstrated that UV oxidation is capable of destroying the types of target constituents present at JASCO. This treatment would reduce the toxicity, mobility, and volume of target constituents. The UV oxidation process would provide toxicity and volume reduction by permanently destroying the constituents. The mobility of the constituents would be reduced by the extraction system. It would be designed to capture the migration plume.

Short-term Effectiveness

The implementation of this process would pose no health threat to the community or JASCO workers. It also poses no threat to the environment. No target constituents would be released to the atmosphere. Groundwater would be contained within the system until it was treated. Once treated, the groundwater would be disposed of off-site by discharging to a POTW. This alternative would result in a reduction in the concentration of target constituents over the short term. Eventually the rate of decrease in concentration would slow down and level off at some concentration. It is estimated the remedial objectives may be met in approximately 10 years.

Implementability

This alternative is moderately difficult to implement. The UV oxidation equipment is fabricated off-site and delivered to the site. The difficulty arises from fine-tuning the system to perform optimally. Vendors of UV oxidation claim their systems are reliable and they provide technical support to maintain the operation. Experience indicates that there can be considerable operational and quality problems, especially if the wastewater stream concentrations are inconsistent.

The low flowrate will require this treatment be operated on a batch basis. This will require a holding tank and an operator to turn the system on and off.

Cost

The capital costs are as follows:

UV Oxidation Equipment -	$120,000
Holding Tank -	$ 5,000
Treatability Study -	$ 5,000
Start-up Cost -	$ 5,000
Groundwater Extraction System -	$ 30,000
TOTAL CAPITAL COST -	$165,000

A treatability study is required by the vendor of this technology. The start-up cost associated with this system is for a field engineer to set-up the system. The cost of a field engineer is $2,000 for the first week and $500 for each additional day, travel cost and expenses have not been included in this cost.

The annual operating costs associated with operating the UV system are as follows:

Process Chemicals & Utilities -	$ 5,000
Labor -	$22,000
Discharge to POTW -	$ 7,000
TOTAL ANNUAL OPERATING COST -	$34,000

The process chemicals and utilities are based on a vendor quote of $1.40 per 1000 gallons of water treated.

No additional land or site development would be necessary. Since JASCO will cease operations in the future, labor costs have been included to operate the system on a batch basis. Any technical servicing would be performed by the vendor at additional cost.

Assuming a 10-year remediation life and a 10 percent discount rate, the present worth of the project would be $370,000.

State and Community Acceptance

The State and community would most likely be willing to accept this alternative. It has been accepted by the California Regional Water Quality Control Board for a site in San Jose, California. The operation of the system would not disturb the local residents nor be dangerous to them.

3.1.5 Alternative IV - Liquid Phase Carbon Adsorption

In this alternative, the groundwater is extracted and then treated by passing it through a liquid phase carbon adsorption bed. The target constituents are adsorbed by the carbon, which would then be taken off-site for regeneration. The carbon vendor will perform the regeneration by incineration. The regeneration process will destroy the target constituents.

The advantage of this system is that it is easily implementable and requires little attention to maintain. "Off the shelf" units can be placed in line to implement. Maintenance consists of monitoring the effluent to determine when the carbon units need to be replaced. This process does not, however, destroy the target constituents until the carbon is regenerated; it merely transfers them from the groundwater to the carbon. When the carbon becomes saturated, the carbon vendor replace the old carbon with new carbon. The old carbon will be regenerated by the vendor.

Overall Protection of Human Health and Environment

This alternative provides for the overall protection of human health and environment. The target constituents would be permanently removed over the long term. Migration of the target constituents in the aquifer would be controlled to prevent degradation of drinking water sources. The toxicity, mobility,

and volume of the target constituents would be reduced. The operation of the system would not pose a threat to human health or the environment.

Compliance with ARARs

Carbon would remove the target constituents from the extracted groundwater to comply with the ARARs.

Long-term Effectiveness and Permanence

Once the remedial objectives had been met, there would be no residual risk. The process would produce no residual compounds. Removal of the target constituents by carbon is permanent. Monitoring should be continued for a period of time to ensure no target constituents remains in the aquifer.

Reduction of Toxicity, Mobility, and Volume

Carbon would absorb the target constituents present in the groundwater. It is expected that this treatment would remove the target constituents to a non-detectable level. This process is permanent and does not produce residual compounds. The toxicity of the target constituents would not be reduced by this method. Once the carbon was regenerated by incineration, the toxicity would be reduced. The mobility is reduced by the extraction system. The extraction system would be designed to capture the groundwater. The volume of target constituents present in the aquifer would be reduced as the groundwater was treated.

Short-term Effectiveness

The implementation of this process poses no risk to the environment or the health of the community or JASCO workers. No

target constituents would be released to the atmosphere. Groundwater would be contained within the system. The treated groundwater would be disposed of by discharging to a POTW. Spent carbon would be taken off-site for regeneration. This alternative would produce a reduction in the concentration of target constituents in the short term. Eventually the rate of decrease in concentration would slow and level off. It is estimated that remedial objectives might be met in approximately 10 years.

Implementability

This alternative is implementable. The carbon units are "off the shelf" units which are piped into the extraction system. Because carbon adsorption is a relatively simple process, it should be fairly reliable. Effluent would have to be monitored for breakthrough of target constituents. Once there is breakthrough, the unit would be taken out of service and another unit placed on-line. The old carbon unit is regenerated by the carbon vendor. The effectiveness of this alternative is not affected by the low flowrate.

Cost

The capital costs are as follows:

Two Carbon Units -	$115,000
Groundwater Extraction System -	$ 30,000
TOTAL CAPITAL COST -	$145,000

The annual operating costs associated with operating the carbon

system are as follows:

Carbon Regeneration -	$30,000
Labor -	$ 2,000
Discharge to POTW -	$ 7,000
TOTAL ANNUAL OPERATING COST -	$39,000

The carbon regeneration costs are based on carbon usage of 49 pounds of carbon per day. Carbon regeneration cost are $1.60 per pound.

No additional land or site development would be necessary. Since JASCO will cease operations in the future, labor costs have been included to maintain the system.

Assuming a 10-year remediation life and a 10 percent discount rate, the present worth of the project would be $380,000.

State and Community Acceptance

The State and community would most likely be willing to accept this alternative. The operation of the units would not disturb the local residents nor be dangerous to them.

3.1.6 Alternative V: Air Stripping

This alternative consists of extracting the groundwater and treating it by air stripping. The air effluent from the air stripper would be treated by passing it through a vapor phase carbon bed or a catalytic oxidizer. If passed through a carbon bed, the volatilized organics would be adsorbed onto the carbon. If passed through a catalytic oxidizer, the volatilized organics would be converted to carbon dioxide and water (for organic compounds) or hydrogen chloride, carbon dioxide, and water (for

chlorinated hydrocarbons). Treated groundwater would be discharged to the POTW.

Both the vapor phase carbon bed and catalytic oxidizer are evaluated for economic reasons. Both would remove the target constituents from the air stream and would provide acceptable treatment.

Traditionally, this method of treatment is the least expensive if all target constituents can be readily adsorbed on vapor phase carbon. The cost advantage decreases significantly when there are target constituents in the groundwater that cannot be adequately treated in the vapor phase. This process does not immediately destroy the target constituents. It transfers them from the groundwater to the air. The target constituents would eventually be destroyed either during carbon regeneration or after passing through the catalytic oxidizer.

Overall Protection of Human Health and Environment

This alternative provides for the overall protection of human health and environment. The target constituents would be permanently removed or destroyed over the long-term. It is not known if the ARARs would be achieved in the aquifer, but migration of the target constituents would be controlled to prevent degradation of drinking water sources. The toxicity, mobility, and volume of the target constituents would be reduced. The operation of the system would pose no threat to human health or the environment. Air emissions would be passed through a carbon bed or catalytic oxidizer to remove or destroy target constituents prior to release to the atmosphere.

Compliance with ARARs

All target constituents in the extracted groundwater could be removed by air stripping followed by carbon adsorption (although it would be very expensive to use vapor phase carbon to adsorb vinyl chloride) or catalytic oxidation to comply with the ARARs.

Long-term Effectiveness and Permanence

Once the remedial objectives have been met, there should be no residual risk. The process should produce no residual compounds. Air emissions would be treated with carbon or catalytic oxidation before being released to the atmosphere. The removal of the target constituents by carbon would be permanent. During carbon regeneration the target constituents would be thermally destroyed. Monitoring should be continued for a period of time to ensure no target constituents remains in the aquifer. Catalytic oxidation would result in on-site destruction of the constituents.

Reduction of Toxicity, Mobility, and Volume

The target constituents present in the groundwater would be removed by air stripping and carbon adsorption or catalytic oxidation. It is expected that this treatment would remove the target constituents to a non-detectable level in the treated groundwater. This process is permanent and does not produce residual compounds. The toxicity of each target constituent would be reduced by this method, either during carbon regeneration by incineration or after being passed through the catalytic oxidizer. The mobility would be reduced by the extraction system. The extraction system would be designed to capture the groundwater. The volume of target constituents present in the aquifer would be reduced as the groundwater was treated.

Short-term Effectiveness

The implementation of this process poses no health threat to the community or JASCO workers and poses no risk to the environment. No target constituents would be released to the atmosphere. Air emissions would be passed through a carbon bed or catalytic oxidizer to assure the air effluent posed no threat to the public. Groundwater would be contained within the system. The treated groundwater would be disposed of off-site by discharging to a POTW. This alternative would produce a reduction in the concentration of target constituents in the short term. Eventually the rate of decrease in concentration would slow and level off at some concentration. It is estimated the remedial objectives might be met in approximately 10 years.

Implementability

This alternative is implementable, although the groundwater flowrates are very low for standard air strippers. The air stripping tower and catalytic oxidizer would be fabricated off-site and delivered to the site. Carbon units are "off-the-shelf" units which are piped into the air exhaust system. The operating units should be fairly reliable. Air effluent from the carbon units would have to be monitored between the two units for breakthrough of target constituents. Once there was breakthrough, the unit would be taken out of service and another unit would be placed on-line. The old carbon unit would be regenerated by the carbon vendor.

The low flowrate will require this treatment be operated on a batch basis. This will require a holding tank and an operator to turn the system on and off.

Cost

The cost of this alternative was found to be higher than expected because of the need to treat air emissions. The concentration of target constituents in air emissions would be low because of the low flowrate of treated water. This low air concentration does not produce a very strong driving force for the target constituents to adsorb onto the carbon. This causes a high usage rate of carbon and increases the operating cost.

The capital costs are as follows:

Air Stripping Tower -	$ 50,000
Holding Tank -	$ 5,000
Two vapor phase carbon units -	$ 30,000
Extraction System -	$ 30,000
TOTAL CAPITAL COST -	$115,000

or

Air Stripping Tower -	$ 50,000
Holding Tank -	$ 5,000
Catalytic Oxidizer -	$150,000
Extraction System -	$ 30,000
TOTAL CAPITAL COST -	$235,000

The annual operating costs associated with operating the air stripper system are as follows:

Utilities -	$ 2,000
Carbon Regeneration -	$34,000
Labor -	$22,000
Discharge to POTW -	$ 7,000
TOTAL ANNUAL OPERATING COST -	$65,000

The utility cost would be for the air blower. Vapor phase carbon

usage has also been estimated at 46 pounds per day. Regeneration cost for vapor phase would be $2.00 per pound. Since JASCO will cease operations in the future, labor costs have been included to operate and maintain the system. The operating cost for the catalytic oxidizer would be:

Utilities -	$ 5,000
Catalyst Regeneration -	$ 2,000
Labor -	$22,000
Discharge to POTW -	$ 7,000
TOTAL ANNUAL OPERATING COST -	$36,000

The utilities would be for the air blower and the operation of the catalytic oxidizer.

Assuming a 10-year remediation life and a 10 percent discount rate, the present worth of the project would be $505,000 if vapor phase carbon was used. If the catalytic oxidizer was used, the present worth would be $452,000. The catalytic oxidizer would be less expensive over the life of the remediation.

State and Community Acceptance

The State would most likely be willing to accept this alternative. The community may not accept this alternative. Though the operation of the air stripper poses no risk, the public may not feel comfortable having an air stripper operating in the neighborhood.

3.1.7 Alternative VI: Biological Treatment

This alternative consists of extracting the groundwater and biologically treating it to destroy the majority of non-chlorinated compounds. Carbon would follow the initial

biological treatment to remove target constituents (such as TCE and DCE) which may not have biodegraded. Treatability studies would have to be performed to determine to what extent the target constituents present could be biodegraded and, consequently, how much carbon would be required. Treatability studies would be required to optimize biological treatment and carbon adsorption to meet the ARARs. OHM suggests that this option be left to the discretion of JASCO, due to the need for EPA-protocol treatability tests, process optimization tests, and highly variable costs (dependent on carbon usage).

The advantage of this alternative, if effective, would be the immediate destruction of many of the higher concentration constituents. The microorganisms would biologically degrade many of the target constituents. However, the biological treatment of some of the chlorinated compounds present is unproven. Liquid phase carbon would most likely provide the means for removing most of the chlorinated compounds. This alternative would comply with the ARARs.

Overall Protection of Human Health and Environment

This alternative provides for the overall protection of human health and environment. Compounds which are not biologically degraded will be adsorbed onto the carbon. The target constituents would be permanently removed over the long-term, either by bioremediation or carbon adsorption. Migration of the target constituents would be controlled to prevent degradation of drinking water sources. The toxicity, mobility, and volume of the target constituents would be reduced. The operation of the system would be totally enclosed, so would pose no threat to human health or the environment.

Compliance with ARARs

The target constituents in the extracted groundwater would either be biodegraded or removed by carbon adsorption to comply with the ARARs.

Long-term Effectiveness and Permanence

Once the remedial objectives have been met, there should be no residual risk. If the bioremediation process produced toxic intermediate products, they would most likely be adsorbed on the carbon beds. A treatability study would help to better define any intermediate products. Biodegradation of chlorinated hydrocarbons, if complete, would produce carbon dioxide, water, salt, and/or hydrogen chloride. The removal of the target constituents by carbon is permanent. Monitoring should be continued for a pre-determined period of time to ensure no target constituents remains in the aquifer.

Reduction of Toxicity, Mobility, and Volume

The biodegradation process would reduce the toxicity, and volume of organic hydrocarbons. The extent of biodegradation of the chlorinated organics would need to be determined in a treatability study. However, if these chlorinated compounds are determined to be non-biodegradable, carbon would absorb them. The mobility is reduced by the extraction system. The extraction system would be designed to capture the groundwater. The volume of target constituents present in the aquifer would be reduced as the groundwater was treated, either by biological processes or by carbon adsorption.

Short-term Effectiveness

The implementation of this process poses no risk to the environment or to the health of the community or JASCO workers. No target constituents would be released to the atmosphere. Groundwater would be contained within the system. The treated groundwater would be disposed of off-site by discharging to a POTW. This alternative would produce a reduction in the concentration of target constituents in the short term. Eventually the rate of decrease in concentration would slow and level off. It is estimated the remedial objectives might be met in approximately 10 years.

Implementability

This alternative is implementable. Biological treatment would require a reactor vessel to contain the microorganisms necessary for the process. These reactor vessels could be fabricated off-site. The carbon units are "off-the-shelf" units which are piped into the extraction system. The reliability of the system would depend on the complexity of the biological treatment. With biotreatment systems, there is always a potential for upsets due to temperature, pH, concentration, or other system shocks.

Effluent from the carbon beds would have to be monitored for breakthrough of target constituents. Once there is breakthrough, the unit would be taken out of service and another unit placed on-line. The old carbon unit would be regenerated by the carbon vendor.

Cost

The capital costs are as follows:

Biological Reactor -	$100,000
Two liquid phase carbon units -	included in bioreactor cost
Groundwater Extraction System -	$ 30,000
TOTAL CAPITAL COST -	$130,000

The annual operating costs associated with operating the biological treatment system are as follows:

Process Chemicals & Utilities -	$ 3,000
Labor -	$ 2,000
Carbon Regeneration -	$0 to $30,000
Discharge to POTW -	$ 7,000
TOTAL ANNUAL OPERATING COST -	$12,000 to $42,000

The process chemicals and utilities are estimated. The range of carbon regeneration is based on total biodegradation and no biodegradation. Since JASCO will cease operations in the future, labor costs have been included to maintain the system.

Assuming a 10-year remediation life and a 10 percent discount rate, the present worth of the project would range from $203,000 to $383,000.

State and Community Acceptance

The State and community would most likely be willing to accept this alternative. The operation of the units would not disturb the local residents nor be dangerous to them.

3.1.8 Alternative VII: In-Situ Bioremediation

To be added at a later date.

3.2 Soil Remedial Alternatives

Soil remediation alternatives are listed below. Approximately 750 cubic yards of soil will have to be treated or disposed. Additional soil may require treatment when the underground tanks are removed.

Soil Remedial Alternative I: No Action

- No Action

Soil Remedial Alternative IA: No New Action Until Closure

- No New Action Until Closure of Facility
- Proceed with an Appropriate Alternative after Closure of Facility

Soil Remedial Alternative II: Liner & Cap

- Deed Restrictions
- Excavation and Replacement
- Liner
- Cap
- Regular Leachate Monitoring

Soil Remedial Alternative III: Off-site Treatment

- Deed Restrictions
- Excavation
- Off-site RCRA Treatment and/or Disposal

Soil Remedial Alternative IV: Enhanced Biological Treatment

- Deed Restrictions
- Soil Excavation
- Enhanced Biological Treatment
- On-site Replacement

Soil Remedial Alternative V: X-19 Treatment

- Deed Restrictions
- Soil Excavation
- X-19 Treatment
- On-site Replacement

Soil Remedial Alternative VI: Excalibur Process

- Deed Restrictions
- Soil Excavation
- Soil Washing (Excalibur Process)
- On-site Replacement

Soil Remedial Alternative VI: In Situ Bioremediation

- To be provided in an addendum at a later date

The alternative which lists on-site replacement of the soil assumes that the soil can be treated to comply with ARARs.

The excavation of 750 cubic yards of soil would cost $200,000. This is unusually expensive because of the nearby railroad tracks. Excavation of this amount of soil would normally cost from $3,000 to $8,000 per 100 cubic yards. The removal of the soil without shoring of the excavation might cause the active rail line to slump. Excavation of soil in the drainage swale would be performed with a drill rig because of this problem. Large augers would be used to "drill out" the soil. After the borehole was completed, it would be backfilled to prevent slumping of the nearby soil. It is estimated that 750 cubic yards of soil would be excavated from the drainage swale area and treated. Cost of the alternatives are based on this volume of soil.

The preferred treatment approach would be an in-situ process, such as vapor extraction or bioremediation, because of the high cost of excavation. Unfortunately, the soil characteristics of the JASCO site (clay with sand) are inappropriate for in-situ processes. Clays have very low permeabilities and sands have very high permeabilities. If vapor extraction were used, air would be drawn through the sand preferentially and have little effect on the target constituents held within the clays. Necessary nutrients and oxygen needed for bioactivity would also preferentially flow through the sand, thus limiting the biodegradation of target

constituents within the clay.

3.2.1 Alternative I: No Action

As with Groundwater, the No Action option must be retained. No treatment would be implemented and the soil would simply be left in place.

Overall Protection of Human Health and Environment

Under the current land-use, implementation of this alternative would not directly endanger public health. This alternative does not provide protection for the environment. Target constituents could migrate from soil to groundwater and might further degrade the groundwater quality.

Compliance with ARARs

This alternative could eventually comply with the ARARs through naturally occurring processes such as biodegradation, diffusion, and abiotic degradation. The time required to accomplish this is not known but would likely be a number of decades.

Long-term Effectiveness and Permanence

The natural degradation of the target constituents which would occur over the decades would be permanent. However, as this natural degradation occurs, the population at risk could increase if the target constituents migrate to the groundwater.

Reductions in Toxicity, Mobility, and Volume

This alternative would not reduce the toxicity or mobility of the target constituents in the short term. The volume of target

constituent containing material would increase because of diffusion and leaching of the constituents.

Short-term Effectiveness

"No Action" would not be effective in the short-term. The natural degradation of the target constituents is a very long-term process.

Implementability

This alternative would require no effort to implement.

Cost

There would be no cost required to implement this alternative.

State and Community Acceptance

It is not likely that the State or community would accept this alternative.

3.2.2 Alternative IA: No New Action Until Closure

This alternative would allow for a unified and comprehensive action to remove soil containing target constituents. Soil containing target constituents could be removed at one time and more easily after the JASCO's operations have ceased. (JASCO is required to move out of the existing facility by December 13, 1995, at which time they will close the entire facility.) The buildings would be demolished and soil containing target constituents would be identified and removed. Once removed, the EPA-selected remedial alternative would be implemented to treat the soil.

Overall Protection of Human Health and Environment

Under the current land-use, implementation of this alternative would not directly endanger public health. The implementation of another remedial alternative after plant closure would provide for the protection of human health and the environment.

Compliance with ARARs

This alternative would comply with ARARs within several years. The EPA-selected remedial alternative would be implemented in the future such that the ARARs would be met.

Long-term Effectiveness and Permanence

The remedial option implemented would result in long-term effectiveness and permanence.

Reductions in Toxicity, Mobility, and Volume

This alternative would not reduce the toxicity or mobility of the target constituents in the short-term. In the long-term, the EPA-selected remedial alternative will be implemented to reduce the toxicity, mobility, and volume target constituents.

Short-term Effectiveness

There would be no short-term effect until the final alternative is implemented. The time necessary to accomplish the remedial objectives could not be determine until the final alternative is selected.

Implementability

This alternative would require no effort to implement initially. The implementability of the final alternative would be determined when it was selected.

Cost

There would be no cost required to implement this alternative initially. Future costs would be determined when the final remedial alternative is selected.

State and Community Acceptance

The intent of this alternative is to remove and treat the soil, just at a later date. It is not known if the State or community would accept this alternative.

3.2.3 Alternative II: Liner & Cap

Soil containing target constituents would be excavated, placed in a lined pit, and covered with a cap. This would prevent target constituents from migrating to the groundwater and would isolate it from human contact. A deed restriction would be placed on the property to limit excavation in the contained area.

Because there is no treatment and the soil is left on-site, this alternative is unlikely to be accepted by the State and community.

Overall Protection of Human Health and Environment

This alternative provides for the overall protection of human health and environment by controlling the migration of target constituents. The alternative would be designed to provide

permanent containment of the target constituents. The toxicity and volume of the target constituents would not be reduced. The mobility of the constituents would be reduced. The implementation of this process could produce some airborne particulates (during excavation) which would need to be controlled.

Compliance with ARARs

The excavated areas would comply with the ARARs. The placement of untreated wastes subject to landban regulations would not comply with the ARARs since the concentration of target constituents would not be reduced. These areas would be covered with a cap so there would be no exposure to the public.

Long-term Effectiveness and Permanence

The alternative would provide a degree of long-term effectiveness. The permanence of this alternative is dependent upon the permanence of the liner and cap, which could be disturbed. The liner would be designed and constructed to contain the target constituents for a long-term basis. A leachate collection system would be constructed beneath the liner to monitor for any leakage. Deed restrictions would need to be implemented and enforced to guarantee the cap's integrity.

Reductions in Toxicity, Mobility, and Volume

The toxicity and volume of target constituents would not be reduced using this alternative, but the mobility of the target constituents would be reduced by containing them within the liner and cap.

Short-term Effectiveness

There is a risk that excavation of soil could produce airborne particulates. Dust suppression would be practiced during excavation to prevent particulates from becoming airborne. No other risk to human health or environment would exist during implementation of this alternative. This alternative could be completed in less than six months.

Implementability

This alternative is implementable. It would, however, limit future construction activities in the contained area. All known areas containing target constituents would be identified and excavated. The excavated soil would be placed in a lined pit. A cap would be placed above the pit, totally containing the soil.

Cost

The capital cost for a liner and cap would be:

Excavation -	$200,000
Liner & Cap -	$ 50,000
TOTAL -	$250,000

Regular monitoring would be needed to detect any leaks.

Monitoring & Analytical Cost -	$ 4,000
TOTAL -	$ 4,000

This alternative could be implemented in less than six months. The present worth cost of the alternative, assuming a five-year monitoring program and a 10% discount rate, would be $265,000. The need for continued soil monitoring would be evaluated at the

end of the five years.

State and Community Acceptance

It is not known if the State or community would accept this alternative. The property will eventually be used for residential property. It may not be acceptable to the State or community to have target constituents left on residential property, whether it is contained or not.

3.2.4 Alternative III: Off-site Treatment

Soil containing target constituents would be excavated and transported off-site for treatment and disposal at a RCRA permitted facility.

Treating and disposing of the soil off-site has the advantage of removing soil containing target constituent from the site. However, JASCO would still be responsible for the soil. This is an expensive alternative. The soil would most likely have to be transported out of state for incineration since there are no incinerators in California.

Overall Protection of Human Health and Environment

This alternative provides for the overall protection of human health and environment. The soil would be properly treated and disposed of by a RCRA permitted facility. The treatment would most likely be incineration which would permanently destroy the target constituents. The toxicity, mobility, and volume of target constituents would be reduced. Precautions would be taken to reduce the amount of the airborne constituents during excavation of soil to prevent exposure to workers and nearby residents. There is always a risk associated with transporting hazardous

material off-site since there is the potential for a spill, accident, or future liability at the TSD facility.

Compliance with ARARs

This alternative would comply with the ARARs. Target constituents would be removed from the site and be totally destroyed by off-site treatment.

Long-term Effectiveness and Permanence

There would be no residual risk at the site. On-site, there would be no byproducts of this treatment alternative. At the treatment facility, the incineration would reduce the target constituents to non-toxic compounds. This alternative offers permanent removal of the target constituents.

Reductions in Toxicity, Mobility, and Volume

Since the target constituents would be removed from the site and destroyed, the toxicity, mobility, and volume would be reduced with this alternative.

Short-term Effectiveness

There is a risk that excavation of soil could produce airborne particulates. Dust suppression would be practiced during excavation to prevent particulates from becoming airborne. No other risk to human health or environment would exist during implementation of this alternative at the site. This alternative could be completed in less than six months.

Implementability

This alternative would not be difficult to implement. A TSD facility would have to be located that would accept the soil and the soil would need to be properly manifested for transportation.

Cost

Off-site treatment of the soil would most likely be necessary prior to disposal. The off-site treatment would be incineration.

Excavation -	$200,000
Transportation -	$63,000
Treatment & Disposal -	$950,000
TOTAL -	$1,213,000

Transportation costs are based on $50 per hour per truck. It would take 42 truckloads 30 hours (portal to portal) to transport all the soil. The cost for treatment and disposal is $0.45 per pound of soil. The cost for disposal could decrease to $400 per ton if no incineration is required.

State and Community Acceptance

This alternative would most likely be accepted by the State and community. The alternative could be safely implemented and target constituents would be removed leaving no health risk to the local population.

3.2.5 Alternative IV: Enhanced Biological Treatment

Soil containing target constituents would be excavated, prepared, and placed in a totally enclosed reactor vessel (which might

consist of soil contained between sealed liners) for enhanced biological treatment. Preparation of the soil would consist of mixing the soil and adding a bulking agent and nutrients for the microorganisms. Mixing the soil and adding in a bulking agent aids the process by making the soil more permeable to air and water. Indigenous microorganisms could be used, or specialized microbial consortia could also be added. The activity of the microorganisms would be increased by the addition of nutrients.

The reactor vessel would have an air distribution system along the bottom. Air would be drawn through this distribution system to provide oxygen to the microorganisms and to simultaneously extract volatile organics. This air stream is passed through carbon to adsorb volatile organics which are extracted from the soil. This process is suited for the mixture of target constituents at JASCO. The chlorinated hydrocarbons, which are not easily biodegraded, are volatile and would be extracted by the air and adsorbed on carbon. The heavier hydrocarbons, which are not volatile, would be biodegraded.

This alternative would provide a cost-effective option to biologically destroy the non-volatile target constituents (and some of the volatiles as well) and to adsorb volatile compounds onto carbon beds. This alternative is expected to be effective.

Overall Protection of Human Health and Environment

It is expected that operation of this process would not pose a threat to human health or environment. Chlorinated compounds would be adsorbed on carbon and the other target constituents, as well as some of the chlorinated compounds, would be biodegraded.

Compliance with ARARs

This alternative would most likely meet ARARs. A treatability study would assist in determining whether this alternative would comply with the ARARs. Organic hydrocarbons have been shown to be biodegradable. Chlorinated hydrocarbons are less biodegradable, but are very volatile. These volatile compounds would be adsorbed in the carbon beds.

Long-term Effectiveness and Permanence

This alternative would provide long-term effectiveness and permanence since the target constituents would either be removed from the soil, or biodegraded.

Reduction of Toxicity, Mobility, and Volume

Enhanced biological treatment would provide a reduction in toxicity, mobility, and volume of target constituents.

Short-term Effectiveness

Proper implementation of this alternative would pose no threat to the community, JASCO workers, or the environment. Dust suppression would be practiced during excavation to prevent particulates from becoming airborne. No other risk to human health or environment would exist during implementation of this alternative. This alternative could be completed in less than 2 years.

Implementability

This alternative is implementable. OHM and other companies have implemented this type of process. Once all the preparation has

been completed, it requires little attention. Carbon canisters would need to be monitored for breakthrough of target constituents.

Cost

The cost for this alternative would be:

Excavation -	$200,000
Treatment -	$113,000 to $169,000
TOTAL -	$313,000 to $369,000

The total cost range of this alternative reflects a cost of $150 to $225 per cubic yard of soil and is based on past experience.

State and Community Acceptance

The State and community would most likely accept this alternative. The implementation and operation of the process would not pose a threat to human health or environment. The microorganisms used would most likely be those which are native to the soil, so would pose no threat to human health or environment. It would also provide permanent destruction, or removal by carbon adsorption of the target constituents.

3.2.6 Alternative V: X-19 Biological Treatment

Soil containing target constituents would be excavated and treated using the X-19 amendment process. The X-19 process has been proven to effectively biodegrade petroleum hydrocarbons and other organics that are readily biodegradable. The developer has presented information that suggests that the microbial consortium in X-19 is capable of degrading more recalcitrant chlorinated organics as well. However, to date the process has not been

tested using an EPA approved protocol or other enclosed bioreactor study with a detailed mass balance. There are indications that this process could indeed be effective, but it would be necessary to conduct an EPA-protocol treatability study to demonstrate that the chlorinated compounds were indeed being biodegraded.

This process would be applied by mixing the X-19 additive into the soil in a controlled manner (with water) to avoid volatilization of the target constituents, while also mixing in any nutrients required. The soil would then be placed either on a liner, securely covered with an additional liner/cover, or all of the soil would be placed in a secure treatment vessel. The vendor states that within several months, the microorganisms will have completed their work of degrading the organics to non-detectable levels. If this process is effective, it will require minimal handling and attendance and the soil could be reused on site as a soil amendment after treatment was complete.

Overall Protection of Human Health and Environment

This process would be protective of human health and the environment as long as it was contained (to eliminate any emissions) and it was effective in degrading all target constituents. The only potential for exposure would be during the initial excavation and the final soil removal (if the target constituents were not destroyed). During excavation moisture would be added to the soil to minimize the emissions. It would simultaneously provide the moisture required for bioremediation to occur. The organisms used are naturally occurring and non-genetically engineered organisms.

Compliance with ARARs

Compliance with ARARs cannot be demonstrated without performing a

treatability test. With bioremediation the cost of treatment increases substantially as one decreases the cleanup criteria. Although the vendor has claimed that non-detectable levels can be achieved, experience indicates that treatment of extremely low levels of target constituents requires a primary substrate to sustain the microbial culture. The microbes will then continue to consume the target constituents as a secondary food source.

Long-term Effectiveness and Permanence

Those target constituents that could be biodegraded would be permanently biodegraded. It is unknown whether the chlorinated compounds would be completely biodegraded. There is a possibility that biodegradation would continue to take place beyond the initial treatment period. Most of the biodegradation would be completed in the soil pile within a relatively short period (less than one year) while controlled treatment was being conducted.

Reductions in Toxicity, Mobility, and Volume

This process should reduce the above characteristics for the non-chlorinated target constituents present. However, it is unknown to what extent it would reduce these characteristics for the chlorinated organic target constituents. Only a detailed treatability study can provide this information for the soil matrix and specific target constituents present.

Short-term Effectiveness

If this process is effective, whatever degradation occurs should be completed within one year, so it would provide short-term effectiveness for those target constituents it is capable of degrading.

Implementability

This process would be fairly easy to implement at the Jasco site in Mountain View. Whether the liner approach or contained bioreactor approach was used, treatment could be conducted at the site. There appears to be adequate space available for on-site treatment since the volume of soil to be treated is relatively small (less than 750 CY). If the soil volume exceeded the quantity that could be practically treated at one time, the soil could be treated in stages, although the client prefers to treat the soil in the shortest time period possible, considering the future land use.

Cost

The cost for this alternative would be:

Excavation -	$200,000
Soil handling -	$90,000 to 169,000
X-19 Consortium -	$13,000
EPA Treatability Study -	$30,000 to $50,000
TOTAL -	$333,000 to $432,000

The per ton cost of X-19 is $50. Assuming a 3:1 mixture of soil to X-19, 250 tons of material would be used.

State and Community Acceptance

Bioremediation processes tend to be accepted by regulatory agencies and communities if the microorganisms used are not genetically engineered or otherwise dangerous to human health. Considerable resistance would not be expected provided: 1) the process was contained; 2) it could be proven that the microorganisms did not present any health danger and; 3) the

hazardous compounds were controlled during excavation, mixing and placement.

3.2.7 Alternative VI: Excalibur Process

This alternative has been included because preliminary results have indicated that ultrapure water is very effective in dissolving all types of target constituents in soils, from sand through clay. It has been implied that ultrapure water is a "universal solvent". The inventors claim that ultrapure water, in combination with UV ozonation and ultrasound, is much more effective than traditional UV oxidation processes in destroying a mixture of organic compounds. There is not extensive data available on this process, since it is a fairly new and innovative process. It may be beneficial to perform a treatability study to further evaluate this process, dependent upon the results of this feasibility study. OHM recommends that this be left to the discretion of JASCO, since this is a very innovative technology and would require treatability testing without any assurances that the process would be viable.

Overall Protection of Human Health and Environment

If this process is shown to be effective, it would protect the environment by removing and destroying the target constituents present, rather than only transferring them to another media. There would be a minor risk associated with the operation of a small ozone-generating system in a residential neighborhood, so the system's safety controls would have to be thoroughly reviewed and approved.

Compliance with ARARs

The vendors of the Excalibur process claim it would be capable of

treating the soil to comply with the ARARs. They recommend a treatability study to confirm the effectiveness.

Long-term Effectiveness and Permanence

If effective, this system would permanently destroy organic constituents during the on-site treatment operation. The pertinent question relates to the level of decontamination that could be achieved and whether this process would destroy all of the target constituents of concern that are present. This can only be determined by conducting a treatability and/or pilot study.

Reductions in Toxicity, Mobility, and Volume

This option would reduce all of the above properties by destroying the organic constituents. The extent to which this process could reduce these properties for the target constituents present in the JASCO soil is unknown.

Short-term Effectiveness

If this process is demonstrated to be effective (in treatability or pilot tests), it would be effective within the short term since once a fullscale system is built the treatment process could be completed in a relatively short period of time. It is assumed that treatment would be completed within one year or less.

Implementability

A mobile treatment skid is available to treat up to five cubic feet of solids per hour. This is a pilot scale system that could not cost-effectively treat the total volume of soil containing target constituents at the Jasco site. Excalibur has not yet

built a fullscale treatment system. If they were to develop and build such a treatment system, implementation at the site should be straight forward, as this would be a short term operation. However, at this time there is no assurance that a fullscale system will be built.

Cost

The cost of this alternative would be:

Excavation -	$200,000
Treatability Test -	$ 50,000
Treatment -	$ 60,000 to 150,000
TOTAL -	$310,000 to $400,000

The treatment cost is based on an estimated of $200 per cubic yard of material to be treated.

State and Community Acceptance

It is likely that the State and community would accept this process because it is very similar to other UV oxidation processes being used at Superfund sites and past precedent has been set to for such a system at a nearby site.

3.2.8 Alternative VII: In-situ Bioremediation

To be added in an addendum.

TABLES

Table 1.1

Maximum Concentration of Target Constituents Detected in Drainage Swale Area #1

CONSTITUENT	MAXIMUM CONCENTRATION (mg/kg)	DATE	DEPTH(ft)
1,1-Dichloroethane (DCA)	3.0	7/90	30'
1,1-Dichloroethene (DCE)	1.7	7/90	5'
1,2-Dichloroethene (DCE)	0.015	7/90	25'
1,1,1-Trichloroethane (TCA)	61.0	7/90	5'
Acetone	8.8	5/88	3'
Benzene	0.12	6/90	1'
Bromoform	0.17	7/90	25'
Ethanol	0.7	5/88	3'
Ethylbenzene	0.37	6/90	1'
Isopropanol	76.0	7/90	3'
Methanol	60.0	7/90	3'
Methylene Chloride	4.2	7/90	20'
Toluene	110.0	7/90	5'
Tetrachloroethene (PCE)	4.0	7/90	25'
Trichloroethene(TCE)	0.015	7/90	3'
Total Petroleum Hydrocarbons:			
as Kerosene	10.0	5/88	3'
as Paint Thinner	5.2	5/88	3'
High Boiling Point(bp)	290.0	6/90	1'
Low - Medium bp	6700.0	7/90	5'
Xylene	37.0	7/90	5'

Table 1.2

Maximum Concentration of Target Constituents Detected in Drainage Swale Area #2

CONSTITUENT	MAXIMUM CONCENTRATION (mg/kg)	DATE	DEPTH(ft)
1,1-DCA	0.61	5/88	3'
1,1,1-TCA	0.44	5/88	3'
2-Propanone	5.4	6/87	16'
Acetone	100.0	5/88	3'
Benzene	0.0079	6/90	1'
Ethanol	3.4	5/88	3'
Ethylbenzene	1.2	5/88	3'
Isopropanol	164.0	5/88	3'
Methanol	9.0	5/88	3'
Methylene Chloride	6.2	5/88	3'
Methyl Ethyl Ketone	1.9	5/88	3'
PCE	0.24	5/88	3'
Toluene	8.2	5/88	3'
Total Petroleum Hydrocarbons:			
as Diesel	14.0	6/87	6'
as Paint Thinner	170.0	5/88	3'
High bp	48.0	6/90	1'
Low-Med bp	1.4	6/90	0.5'
Xylene	11.0	7/90	3'

Table 1.3
Estimated Quantity of Target Constituents
in Former Drainage Swale Area

	AVERAGE CONCENTRATION (mg/kg)	ESTIMATED QUANTITY IN : 400 cu. yd. (lbs.)	400 cu. yd. (gal.)	750 cu. yd. (lbs.)	750 cu. yd. (gal.)
1,1,1-TCA	0.6056	0.6783	0.0613	1.2707	0.1149
1,1-DCA	0.1296	0.1452	0.0148	0.2720	0.0278
1,1-DCE	0.0136	0.0152	0.0015	0.0285	0.0028
1,2-DCA	0.0000	0.0000	0.0000	0.0000	0.0000
1,2-DCE	0.0000	0.0000	0.0000	0.0000	0.0000
Acetone	7.3132	8.1913	1.2392	15.3446	2.3214
Benzene	0.0005	0.0006	0.0001	0.0010	0.0001
Bromodichloromethane	0.0000	0.0000	0.0000	0.0000	0.0000
Bromoform	0.0014	0.0016	0.0001	0.0030	0.0001
Carbon Tetrachloride	0.0000	0.0000	0.0000	0.0000	0.0000
Chloroform	0.0000	0.0000	0.0000	0.0000	0.0000
Diesel	1.2596	1.4109	0.2113	2.6430	0.3959
Ethanol	0.1679	0.1880	0.0276	0.3522	0.0517
Ethlybenzene	0.1175	0.1316	0.0182	0.2465	0.0341
High BP HC	3.3220	3.7209	0.5573	6.9703	1.0440
Isopropanol	7.4164	8.3069	1.2658	15.5612	2.3713
Kerosene	0.3571	0.4000	0.0592	0.7494	0.1108
Lacquer Thinner	0.0654	0.0732	0.0110	0.1371	0.0205
Low-Med BP HC	58.6786	65.7243	9.8438	123.1198	18.4402
Methanol	1.1418	1.2789	0.1934	2.3957	0.3623
Methyl Ethyl Ketone	0.4321	0.4840	0.0703	0.9067	0.1316
Methylene Chloride	0.6132	0.6868	0.0616	1.2867	0.1155
Paint Thinner	6.8107	7.6285	1.1426	14.2903	2.1403
Tetrachloroethane	0.0000	0.0000	0.0000	0.0000	0.0000
Tetrachloroethene	0.0371	0.0416	0.0031	0.0779	0.0057
Toluene	1.4391	1.6119	0.2230	3.0195	0.4178
Trichloroethene	0.0003	0.0003	0.0000	0.0005	0.0000
Xylene	1.1655	1.3054	0.1819	2.4455	0.3407

*The volume of soil in the former Drainage Swale is estimated to range from 400 to 750 cubic yards total. Assuming 1.4 tons/cubic yard, total weight would be: 1,120,000 lbs. (510,000 kg) in 400 cubic yds.
2,100,000 lbs. (950,000 kg) in 750 cubic yds.

Volumes of constituents based on published densities, Hawley's Condensed Chemical Dictionary.

Table 1.4
Estimated Quantity of Target Constituents in Underground Storage Tank Area

	AVERAGE CONCENTRATION (mg/kg)	ESTIMATED WEIGHT (lbs)	ESTIMATED VOLUME (gal.)
1,2-DCE	0.0003	0.0009	0.0001
1,1,1-TCA	0.0040	0.0135	0.0012
Acetone	0.2460	0.8295	0.1255
Isopropanol	0.4060	1.3691	0.2086
Methanol	0.8800	2.9675	0.4487
Methylene Chloride	0.2988	1.0076	0.0904
Toluene	0.0006	0.0020	0.0003

1200 cubic yards to be excavated. 1.4 tons per cubic yards.
Total weight of excavated material = 3,360,000 lbs. (1,530,000 kg.)

Table 1.5
Estimated Quantity of Target Constituents in Former Underground Diesel Tank Area

	AVERAGE CONCENTRATION (mg/kg)	ESTIMATED WEIGHT (lbs)	ESTIMATED VOLUME (gal.)
Benzene	1.1300	0.0946	0.0129
Methylene Chloride	0.0133	0.0011	0.0001
TPH as Diesel	139.6667	11.6974	1.7520
Toluene	0.4400	0.0369	0.0000
Xylene	5.8000	0.4858	0.0677

30 cubic yards to be excavated. 1.4 tons per cubic yards.
Total weight of excavated material = 84,000 lbs (38,000 kg.)

Volumes of constituents based on published densities, Hawley's Condensed Chemical Dictionary.

TABLE 2.1
MAXIMUM CONCENTRATION LEVELS FOR TARGET CONSTITUENTS
IN GROUNDWATER AT JASCO CHEMICAL CORPORATION SITE

Chemical	MCL (ug/L) EPA	California
1,1-Dichloroethane	NA	5
1,2-Dichloroethane	5	0.5
1,1-Dichloroethene	7	6
Methylene Chloride	NA	NA
Tetrachloroethene	NA	5
1,1,1-Trichloroethane	200	200
Trichloroethene	5	5
Vinyl Chloride	2	0.5

Table 2.2
General Response Actions for Soil and Groundwater

GENERAL SCREENING ACTIONS	MEDIA	DESCRIPTIONS	COMMENTS	STATUS
No Action	Ground Water	No action; groundwater extraction and discharge would be stopped	Mandatory consideration per EPA guidance document	Retained
	Soil	No action	Mandatory consideration per EPA guidance document	Retained
Institutional Actions	Ground Water	Restrictions applied pertaining to site usage; use of alternate water supplies	Potentially applicable to protect potential receptors	Retained
	Soil	Land use restrictions	Potentially applicable to protect potential receptors	Retained
Collection	Ground Water	Extraction of ground water prior to treatment and/or disposal	Potentially applicable; currently in use at the site without additional treatment	Retained
	Soil	Extraction of soil vapors prior to treatment and/or disposal	Potentially applicable	Retained
Containment	Ground Water	The impediment of ground water flow to control the migration of contaminants	Potentially applicable in retarding down-gradient flow	Retained
	Soil	The encapsulation of contaminated media to control the migration of contaminants	Potentially applicable to minimizing migration of contaminants	Retained
Diversion	Ground Water	The deflection of ground water flow away from areas of contamination	Not effective for remediation of shallow A-zone groundwater or for preventing down-gradient flow	Not applicable
Excavation	Ground Water	Partial excavation and recovery of identified contamination established by the regulatory agencies	Alone, may not achieve remediation goals for groundwater	Not applicable
Excavation	Soil	Partial excavation and recovery of identified source area	Potentially effective by removing heavily contaminated soil	Retained

Table 2.2
General Response Actions for Soil and Groundwater

GENERAL SCREENING ACTIONS	MEDIA	DESCRIPTIONS	COMMENTS	STATUS
On-Site Treatment	Ground Water	Biological, physical, and/or chemical treatment applied to contaminated groundwater	Potentially effective in reducing concentrations of organics present in the groundwater	Retained
	Soil	Biological, physical, thermal, and/or chemical treatment applied to contaminated soil	Potentially effective in reducing concentrations of organics present in the soil	Retained
In-situ Treatment	Ground Water	Biological treatment applied to contaminated groundwater while still in place	Potentially effective in reducing organics concentrations	Retained
	Soil	Biological, physical, thermal treatment and/or vitrification applied to contaminated soil while still in place	Potentially effective in reducing organics concentrations	Retained
Off-Site Discharge	Ground Water	Extracted ground water discharged to local POTW	Potentially effective in reducing concentrations of organics	Retained
	Soil	Excavated soil treated and/or disposed of at RCRA facility; disposal at RCRA facility is discouraged by SARA (1986)	Potentially effective in reducing concentrations of organics	Retained
On-Site Discharge	Ground Water	Extracted ground water treated and discharged on-site via NPDES permit or injection wells	Potentially effective in reducing concentrations of organics; discharge via NPDES permit needed	Retained
Relocation	Ground Water and Soil	Reimbursement of buildings and land costs impacted by organics contaminated ground water and soil to public receptors; includes relocation costs	No complete exposure pathways present at the site	Not applicable

TABLE 2.4
Initial Screening of Technologies and Process Options for Soil

General Response Actions	Remedial Technology	Process Option	Description	Screening Comments
No Action	None	Not applicable	No action	Required for consideration
Institutional Actions	Access restrictions	Deed restrictions	Deeds for property would include restrictions on soil usage	Potentially applicable
	Monitoring	Vadose monitoring	Monitoring of vadose zone soil gases	Potentially applicable
Collection	Extraction	Vapor extraction	Series of wells to extract contaminated soil vapor	Potentially applicable
Containment	Cap	Asphalt cap	Capping soil with asphaltic concrete	Potentially applicable
	Liner	Clay liner	Treating soil to an appropriate level and then replacing in a lined area to reduce leachate potential	Potentially applicable
Excavation	Excavation and Underground Tank Removal	Physically removing source area	Defined areas of contaminated soil and other potential sources, such as tanks, excavated	Potentially applicable
On-site Treatment	Biological Treatment	Aerobic	Aerobic biological degradation of organic compounds using microorganisms in a bioreactor	Potentially applicable
		Enhanced Aerobic Biological Treatment	Aerobic biological treatment with aeration provided by vapor extraction	Potentially applicable
		Anaerobic	Anaerobic biological degradation of organic compounds using microorganisms in a bioreactor	Potentially applicable
	Physical Treatment	Soil Washing	Extraction of contaminants by washing soil with an appropriate solvent	Potentially applicable
	Physical Treatment	Carbon Adsorption	Adsorption of contaminants onto activated carbon	Not applicable; method is used for water treatment
	Physical Treatment	Resin Adsorption	Adsorption of contaminants onto synthetic adsorbents	Not applicable; method is used for water treatment
	Physical Treatment	Desorption	Contaminants separated by heating soil	Potentially applicable
	Physical Treatment	Heated stripping	Transfer of VOCs from soil into a hot gas stream	Potentially applicable

TABLE 1.6
Analytical Results of Groundwater from V-4
1990

Groundwater concentrations given in ug/L.

Constituent	Jan-90	Feb-90	Feb-90	Mar-90	Mar-90	Apr-90	May-90	Jun-90	Jul-90	Aug-90	Sep-90	Oct-90	Nov-90	Dec-90
Chloroethane	ND	ND	15	12	ND	ND	ND	ND	ND	ND	ND	ND	ND	36
Chloromethane	ND	ND	ND	ND	ND	ND	4.3	ND	ND	ND	ND	ND	ND	ND
1,1 Dichloroethane	870	470	850	520	410	300	260	280	250	260	210	230	210	380
1,2-Dichloroethane	ND	ND	9.4	ND	ND	ND	2.6	ND	ND	ND	ND	ND	ND	2.6
1,1 Dichloroethene	85	48	60	40	48	33	22	35	36	35	23	22	13	33
Methylene Chloride	320	29	430	92	110	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1,1-Trichloroethane	530	190	750	320	320	98	58	68	47	38	30	25	19	57
1,1,2-Trichloroethene	ND	ND	9	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Vinyl Chloride	ND	ND	ND	10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

TABLE 2.3
Initial Screening of Technologies and Process Options for Groundwater

General Response Actions	Remedial Technology	Process Options	Description	Screening Comments
No Action	None	Not applicable	No action	Required for consideration
Institutional Actions	Access restrictions	Deed restrictions	Deeds for property would include restrictions on wells	Potentially applicable
	Alternate water supply	City water supply	Connect affected residents to municipal water system	Not applicable, residents now served by municipal water system
	Monitoring	Ground water monitoring	On-going monitoring of wells	Potentially applicable
Collection	Extraction	Ground water recovery	Series of wells to extract contaminated ground water	Potentially applicable, one well already in place
Containment	Cap	Clay and soil cap	Compacted clay covered with soil over areas of contamination	Potentially applicable
	Vertical barrier	Slurry wall	Trench around contaminated area is filled with a soil (or cement) bentonite slurry	Potentially applicable
	Vertical barrier	Grout curtain	Pressure injection of grout in a ground through boreholes	Potentially applicable
	Horizontal barrier	Grout injection	Pressure injection of grout at depth	Not applicable, will not stop lateral migration of contaminants
On-site Treatment	Biological Treatment	Aerobic	Biological degradation of organic contaminants using microorganisms in an aerobic environment in a bioreactor	Potentially applicable
	Biological Treatment	Anaerobic	Biological degradation of organic contaminants using microorganisms in an anaerobic environment in a bioreactor	Potentially applicable
	Physical Treatment	Carbon Adsorption	Adsorption of contaminants onto activated carbon	Potentially applicable
	Physical Treatment	Resin Adsorption	Adsorption of contaminants onto synthetic adsorbents	Potentially applicable
	Physical Treatment	Coagulation/ Flocculation	Fine suspended particulates are formed into larger settleable particles	Not applicable, no suspended contaminants
	Physical Treatment	Steam Stripping	Organics are removed by contact with steam and recovery of vapors	Potentially applicable

TABLE 2.3
Initial Screening of Technologies and Process Options for Groundwater

General Response Actions	Remedial Technology	Process Options	Description	Screening Comments
	Physical Treatment	Filtration	Suspended contaminants are trapped as influent is forced through a filter media	Not applicable, no suspended contaminants
	Physical Treatment	Reverse Osmosis	Separation of contaminants via application of pressure gradient across a semi-permeable membrane	Not applicable for low molecular weight VOCs present at Jasco
	Physical Treatment	Air Stripping	Transfer of VOCs from aqueous stream into a gas stream	Potentially applicable
	Chemical Treatment	Dechlorination	Reaction to remove chlorine atom(s) from chlorinated VOCs to form alkali metal salt and a substituted organic polymer	Not applicable for chlorinated compounds on-site
	Chemical Treatment	Neutralization	Chemical adjustment of pH	Not applicable for VOCs
	Chemical Treatment	Solvent extraction	Contaminants are extracted by contacting it with another immiscible liquid, usually a solvent	Not appropriate for dilute mixture of contaminants
	Chemical Treatment	UV Peroxidation	Chemical bonds are broken to from CO_2 and H_2O using ultra-violet light and a strong oxidizer such as ozone or H_2O_2	Potentially applicable
	Chemical Treatment	Supercritical water oxidation	The properties of supercritical water bring about rapid oxidation of organics and precipitation of inorganics	Potentially applicable
In-situ Treatment	Biological Treatment	Aerobic	Injection of nutrients and/or microorganisms to enhance biological degradation	Potentially applicable
	Biological Treatment	Anaerobic	Biological degradation of contaminants in an anaerobic environment	Potentially applicable
Discharge	Off-site discharge	POTW	Extracted ground water is discharged to local POTW for treatment	Potentially applicable
	On-site discharge	NPDES	Groundwater is treated and discharged to storm sewer	Potentially applicable
	On-site discharge	Injection wells	Re-inject treated water into water bearing zone	Not applicable

TABLE 2.4
Initial Screening of Technologies and Process Options for Soil

General Response Actions	Remedial Technology	Process Option	Description	Screening Comments
On-site Treatment	Chemical Treatment	Dechlorination	Reaction to remove chlorine atom(s) from chlorinated VOCs to form alkali metal salt and a substituted organic polymer	Not applicable for contaminants at Jasco, process designed for PCBs and dioxins.
	Chemcial Treatment	Neutralization	Chemical adjustment of pH	Not applicable for VOCs
	Thermal Treatment	Incineration	Contaminated soil are exposed to extreme heat to destroy the contaminants	Not applicable; an incinerator would not acceptable to the local citizens or government
In-situ Treatment	Biological Treatment	Aerobic	Injection of nutrients and/or microorganisms into media to enhance biological degradation in place	Potentially applicable
	Solidification	Vitrification	Soil is melted at extremely high temperatures to form glass; contaminants are destroyed and/or immobilized within the glass matrix	Potentially applicable
Discharge	Off-site discharge	RCRA Facility	Contaminated soil transported to RCRA facility for treatment and disposal	Potentially applicable

Table 2.5
Selection of Representative Groundwater Remedial Options

General Response Actions	Remedial Technology	Process Options	Effectiveness	Implementability	Cost	Retained for Remedial Alternatives
No Action	None	Not applicable	Will not achieve remedial action objectives	Implementable, not acceptable to public or local government	None	Yes
Institutional Actions	Access restrictions	Deed restrictions	Effectiveness depends on future enforcement of restrictions	Implementable, legal requirements	Low capital	Yes
	Monitoring	Ground water monitoring	Effective in determining migration of contaminants	Implementable, already in place	Low to moderate capital, high O&M	Yes
Collection	Extraction	Ground water extraction	Effectively prevents migration	Implementable, already in place with no other treatment	Low to moderate capital, moderate O&M	Yes
Containment	Cap	Clay and Soil Cap	Not effective for remediation; can be used to prevent further contamination prior to remedial action	Implementable	Low to moderate capital, low to moderate O&M	No
	Vertical Barrier	Slurry Wall	Limited effectiveness, long-term effectiveness not proven	Difficult to implement, must be tied to aquitard	Extremely high capital, low O&M	No
	Vertical Barrier	Grout Curtain	Limited effectiveness, long-term effectiveness not proven	Difficult to implement, must be tied to aquitard	Extremely high capital, low O&M	No
On-site Treatment	Biological Treatment	Aerobic	Effectiveness to be determined for chlorinated compounds	Implementability to be determined	Low to moderate capital, moderate O&M	Yes
	Biological Treatment	Anaerobic	Effective for select chlorinated compounds. Used in line with aerobic treatment	Implementability to be determined	Low to moderate capital, low to moderate O&M	Yes
	Physical Treatment	Carbon Adsorption	Effective in reducing concentration of contaminants	Implementable	Moderate capital, moderate O&M	Yes

Table 2.5
Selection of Representative Groundwater Remedial Options

General Response Actions	Remedial Technology	Process Options	Effectiveness	Implementability	Cost	Retained for Remedial Alternatives
	Physical Treatment	Resin Adsorption	Effective in reducing concentration of contaminants	Implementable	Moderate capital, moderate O&M	No
	Physical Treatment	Steam Stripping	Effective in reducing concentration of contaminants	Implementable	Moderate capital, high O&M	No
	Physical Treatment	Air Stripping	Effective in reducing concentrations of contaminants. Air may need to be treated.	Implementable	Moderate capital, moderate O&M	Yes
	Chemical Treatment	UV Peroxidation	Effective in destroying contaminants	Implementable	Low to moderate capital, low to moderate O&M	Yes
	Chemical/Physical Treatment	Supercritical water oxidation	Effective in destroying organic compounds	Implementable	High capital, high O&M	No
In situ Treatment	Biological	Aerobic	To be determined	To be determined	To be determined	Yes
	Biological	Anaerobic	To be determined	To be determined	To be determined	Yes
Discharge	Off-site discharge	POTW	Effective in removing contaminated ground water from the aquifer. Treatment is left to city sewage treatment facility.	Implementable, already in place. Concentrations of contaminants must be monitored and remain below permitted level.	Low to moderate capital, low O&M	Yes
	On-site discharge	NPDES	Effective in removing contaminated ground water from the aquifer.	Implementable, permit required.	Moderate to high for laboratory analysis	No

Table 2.6
Selection of Representative Soil Remedial Options

General Response Actions	Remedial Technology	Process Option	Effectiveness	Implementability	Cost	Retained for Remedial Alternatives
No Action	None	Not applicable	Does not achieve remedial action objectives	Not acceptable to public or government	None	Yes
Institutional Actions	Access restrictions	Deed restrictions	Effectiveness depends on continued future implementation. Does not reduce contamination	Legal requirements and authority	Negligible cost	Yes
	Monitoring	Vadose monitoring	Useful for documenting conditions. Does not reduce contamination.	Alone, not acceptable to public or government	Low capital, low O&M	Yes
Collection	Extraction	Vapor extraction	Effective for VOC's; not effective for non- and semi-volatile	Implementable	Low to moderate capital, moderate O&M	Yes
Containment	Cap	Asphalt cap	Effective, but susceptible to cracking	Implementable	Low to moderate capital, high O&M	Yes
	Liner	Clay liner	Effective, but susceptible to cracking	Implementable	Low to moderate capital, moderate O&M	Yes
Excavation	Excavation	Excavate known areas of contamination	Effective in removing contamination sources	Implementable	Moderate to high capital, no O&M	Yes
On-site Treatment	Biological Treatment	Aerobic	Effectiveness to be determined for chlorinated VOCs	Implementable	Low to moderate capital, low O&M	No
		Enhanced aerobic biological treatment	Effectiveness to be determined for chlorinated VOCs	Implementable	Low to moderate capital, low O&M	Yes

Table 2.6
Selection of Representative Soil Remedial Options

General Response Actions	Remedial Technology	Process Option	Effectiveness	Implementability	Cost	Retained for Remedial Alternatives
On-site Treatment	Biological Treatment	Anaerobic	Effectiveness to be determined for chlorinated VOCs	Implementable	Low to moderate capital, low O&M	Yes
	Physical Treatment	Excalibur Soil Washing Process	Effectiveness needs to be evaluated in treatability study	Implementable	To be determined	Yes
	Physical Treatment	Desorption	Effective for VOC's; less effective for non- and semi-volatiles	Implementable	High capital, high O&M	No
	Physical Treatment	Heated Stripping	Effective in reducing concentration of contaminants	Implementable	Moderate to high capital; moderate to high O&M	No
In-situ Treatment	Biological Treatment	Aerobic	To be determined	To be determined	To be determined	Yes
	Biological Treatment	Anaerobic	To be determined	To be determined	To be determined	Yes
	Solidification	Vitrification	Effective in thermally destroying or immobilizing contaminants	Not implementable; possibility in damaging nearby railroad tracks	High capital	No
Discharge	Off-site discharge	RCRA Facility	Effective for disposal of hazardous waste	Implementable, Jasco still liable for future liability	High capital	Yes

Table 3.1
Evaluation of Final Groundwater Alternatives

Criteria	Alternative I No Action	Alternative II Discharge to POTW	Alternative III UV Oxidation
OVERALL PROTECTIVENESS			
Human Health Protection			
- Groundwater Ingestion	No existing users of groundwater, no reduction for future users.	No existing users of groundwater, will reduce risk for future users.	See Alternative II.
Environmental Protection	Allows continued contamination of groundwater.	Continued contamination is curbed by capturing plumes of contamination; will provide treatment for current contamination.	See Alternative II.
COMPLIANCE WITH ARARs			
- Chemical Specific ARARs	Does not comply with ARARs.	Treated water will comply with ARARs; groundwater within aquifer may not comply with ARARs.	See Alternative II.
LONG-TERM EFFECTIVENESS AND PERMANENCE			
Magnitude of Residual Risk			
- Groundwater Ingestion	Future risk may increase as contaminants migrate further.	Future risk will be reduced as contaminated groundwater is treated.	See Alternative II.
Adequacy and Reliability of Controls	No controls over remaining contamination. No reliability.	Extraction wells will be designed to control migration of contaminated groundwater. Reliable, this system has been in use since 1987.	See Alternative II. Process is relatively simple, but equipment problems will have to be serviced by vendor.
Need for 5-year Review	Review should be required to ensure adequate protection of human health and environment.	See Alternative I. Also recommended to justify continued treatment.	See Alternative II.
REDUCTION OF TOXICITY, MOBILITY, AND/OR VOLUME			
Treatment Process Used	None.	POTW will provide treatment.	Ultra-violet oxidation.
Amount Destroyed or Treated	None.	Contaminants in extracted groundwater will be treated.	All contaminants will be destroyed in process.

Table 3.1
Evaluation of Final Groundwater Alternatives

Criteria	Alternative IV Carbon Adsorption	Alternative V Air Stripping	Alternative VI Biological Treatment with Carbon Adsorption
OVERALL PROTECTIVENESS			
Human Health Protection			
- Groundwater Ingestion	See Alternative II.	See Alternative II.	See Alternative II.
Environmental Protection	See Alternative II.	See Alternative II.	See Alternative II.
COMPLIANCE WITH ARARs			
- Chemical Specific ARARs	See Alternative II.	See Alternative II.	See Alternative II.
LONG-TERM EFFECTIVENESS AND PERMANENCE			
Magnitude of Residual Risk			
- Groundwater Ingestion	See Alternative II.	See Alternative II.	See Alternative II.
Adequacy and Reliability of Controls	See Alternative II. Reliable process. Effluent needs to be monitored for breakthrough.	See Alternative II. Reliable process. Air and water effluent will need to be monitored for breakthrough.	See Alternative II. Reliable process may need treatability study to optimize process.
Need for 5-year Review	See Alternative II.	See Alternative II.	See Alternative II.
REDUCTION OF TOXICITY, MOBILITY, AND/OR VOLUME			
Treatment Process Used	Liquid-Phase Carbon Adsorption	Air stripping and vapor phase treatment with carbon or catalytic oxidation.	Biological treatment and liquid phase carbon adsorption.
Amount Destroyed or Treated	All contaminants transferred to carbon, destroyed during regeneration.	All contaminants transferred to carbon, destroyed during regeneration or destroyed by catalytic oxidation.	Known to degrade organic compounds. Chlorinated compounds will be adsorbed on carbon and destroyed during regeneration.

Table 3.1
Evaluation of Final Groundwater Alternatives

Criteria	Alternative VII In situ Biological Treatment
OVERALL PROTECTIVENESS	
Human Health Protection	To be evaluated
- Groundwater Ingestion	
Environmental Protection	
COMPLIANCE WITH ARARs	
- Chemical Specific ARARs	
LONG-TERM EFFECTIVENESS AND PERMANENCE	
Magnitude of Residual Risk	
- Groundwater Ingestion	
Adequacy and Reliability of Controls	
Need for 5-year Review	
REDUCTION OF TOXICITY, MOBILITY, AND/OR VOLUME	
Treatment Process Used	
Amount Destroyed or Treated	

Table 3.1
Evaluation of Final Groundwater Alternatives

Criteria	Alternative I No Action	Alternative II Discharge to POTW	Alternative III UV Oxidation
Reduction of Toxicity, Mobility, or Volume	None.	Toxicity, mobility, and volume reduced.	See Alternative II.
Irreversible Treatment	None.	Depends on POTW.	Irreversibly destroyed by UV oxidation.
Type & Quantity of Residuals Remaining after Treatment	No treatment, so most contamination remains.	Unknown, long-term treatment may not eliminate all contamination in aquifer, no residuals in treated groundwater.	See Alternative II.
Statutory Preference for Treatment	Does not satisfy.	May not satisfy.	Satisfies.
SHORT-TERM EFFECTIVENESS			
Community Protection	Possible migration to drinking water aquifer may endanger community.	Installation and operation would not endanger community.	See Alternative II.
Worker Protection	No significant risk to workers.	Protection from contaminated cuttings from well drilling.	See Alternative II.
Environmental Impacts	Continued impact from existing conditions.	Aquifer drawdown may occur, no other impacts.	See Alternative II.
Time Until Action is Complete	Not applicable.	Estimated to be 10 years.	Estimated to be 10 years.
IMPLEMENTABILITY			
Ability to Construct and Operate	No construction or operation.	Easy to construct, currently in operation.	Easy to construct. May be most difficult alternative to operate especially since flow is so low that can not operate continuously.
Ease of Doing More Action if Needed	If more action determined to be necessary, may need to go through FS/ROD process.	Additional treatment process units can be added without difficulty.	See Alternative II.
Ability to Monitor Effectiveness	No monitoring.	Monitor well network in place.	Treated effluent can be readily monitored.
Ability to Obtain Approvals and Coordinate with Other Agencies	Unlikely approval would be obtained.	POTW already in place.	See Alternative II. Discharge concentrations must comply with current permit.

Table 3.1
Evaluation of Final Groundwater Alternatives

Criteria	Alternative IV Carbon Adsorption	Alternative V Air Stripping	Alternative VI Biological Treatment with Carbon Adsorption
Reduction of Toxicity, Mobility, or Volume	See Alternative II.	See Alternative II.	See Alternative II.
Irreversible Treatment	Irreversibly destroyed during carbon regeneration.	See Alternative IV.	Altered if biodegraded. Irreversibly destroyed during carbon regeneration (if adsorbed on carbon).
Type & Quantity of Residuals Remaining after Treatment	See Alternative II.	See Alternative II.	See Alternative II.
Statutory Preference for Treatment	Satisfies.	Satisfies.	Satisfies.
SHORT-TERM EFFECTIVENESS			
Community Protection	See Alternative II.	See Alternative II.	See Alternative II.
Worker Protection	See Alternative II.	See Alternative II.	See Alternative II.
Environmental Impacts	See Alternative II.	See Alternative II.	See Alternative II.
Time Until Action Is Complete	Estimated to be 10 years.	Estimated to be 10 years.	Estimated to be 10 years.
IMPLEMENTABILITY			
Ability to Construct and Operate	Easy to construct and operate.	Most difficult to construct. Operation more difficult than carbon.	Easy to construct. Operation subject to environmental upsets, i.e. temperature, pH, etc.
Ease of Doing More Action If Needed	See Alternative II.	See Alternative II.	See Alternative II.
Ability to Monitor Effectiveness	See Alternative III.	See Alternative III.	See Alternative III.
Ability to Obtain Approvals and Coordinate with Other Agencies	See Alternative III.	See Alternative III.	See Alternative III.

Table 3.1
Evaluation of Final Groundwater Alternatives

Criteria	Alternative VII In situ Biological Treatment
Reduction of Toxicity, Mobility, or Volume	
Irreversible Treatment	
Type & Quantity of Residuals Remaining after Treatment	
Statutory Preference for Treatment	
SHORT-TERM EFFECTIVENESS	
Community Protection	
Worker Protection	
Environmental Impacts	
Time Until Action Is Complete	
IMPLEMENTABILITY	
Ability to Construct and Operate	
Ease of Doing More Action If Needed	
Ability to Monitor Effectiveness	
Ability to Obtain Approvals and Coordinate with Other Agencies	

Table 3.1
Evaluation of Final Groundwater Alternatives

Criteria	Alternative I No Action	Alternative II Discharge to POTW	Alternative III UV Oxidation
Availability of Services and Capacities	No services or capacities required.	POTW permit allows discharge of maximum volume.	Service will be provided by vendor. Monitoring services to be procurred.
Availability of Equipment, Specialist, and Materials	None required.	See Alternative I.	UV equipment and process chemicals available. Specialist needed to optimize operation.
Availability of Technologies	None required.	See Alternative I.	UV technology available
COST			
Capital Cost	0	$30,000	$166,000
Annual Operating Cost	0	$7,000	$30,000
Present Worth Cost (assume 10% discount rate)	0	$72,000	$350,000

Table 3.1
Evaluation of Final Groundwater Alternatives

Criteria	Alternative IV Carbon Adsorption	Alternative V Air Stripping	Alternative VI Biological Treatment with Carbon Adsorption
Availability of Services and Capacities	See Alternative III.	Service will need to be procured as well as monitoring.	See Alternative III.
Availability of Equipment, Specialist, and Materials	Carbon and associated equipment readily available.	Air stripper, carbon and catalytic oxidizer needed, readily available. Specialist needed to erect.	Reactor vessel and carbon beds needed, readily available.
Availability of Technologies	Carbon technology available.	Air stripping and carbon technology available.	Biodegradation and carbon technology available.
COST			
Capital Cost	$145,000	$235,000 or $115,000	$96,000
Annual Operating Cost	$39,000	$33,000 or $57,000	$12,000 to $51,000
Present Worth Cost (assume 10% discount rate)	$380,000	$460,000 or $430,000	$170,000 to $410,000

Table 3.1
Evaluation of Final Groundwater Alternatives

Criteria	Alternative VII In situ Biological Treatment
Availability of Services and Capacities	
Availability of Equipment, Specialist, and Materials	
Availability of Technologies	
COST	
Capital Cost	
Annual Operating Cost	
Present Worth Cost	

Table 3.2
Evaluation of Final Soil Alternatives

Criteria	Alternative I No Action	Alternative II Liner & Cap	Alternative III Off-site Treatment
OVERALL PROTECTIVENESS			
Human Health Protection			
- Direct Contact/ Soil Ingestion	No reduction in risk.	Cap reduces risk by restricting contact with contaminated soil.	Reduces risk since soil would be excavated and taken off-site.
Environmental Protection	Contaminants would continue to migrate to groundwater.	Liner would prevent further migration of contaminants to groundwater.	Soil removal would prevent further migration of contamination to groundwater.
COMPLIANCE WITH ARARs			
- Chemical Specific ARARs	Would not comply with ARARs.	Would not comply with ARARs.	Would comply with ARARs.
LONG-TERM EFFECTIVENESS AND PERMANENCE			
Magnitude of Residual Risk			
- Direct Contact/ Soil Ingestion	Source and associated risk still remain.	Risk eliminated as long as cap and liner maintained. Inherent hazard of waste remains since it is not removed or destroyed.	Risk eliminated, source is removed.
Adequacy and Reliability of Controls	No controls over remaining contamination. No reliability.	Cap & liner would control migration of contaminants. Leachate collection and detection system would monitor for migration. Reliable.	Treatment and disposal off-site will control contaminants adequately. Reliable treatment method.
Need for 5-year Review	Should be performed to ensure adequate protection of human health and environment	Necessary to assure leachate collection and detection system working properly.	Not necessary, treatment will not take 5 years.
REDUCTION OF TOXICITY, MOBILITY, AND/OR VOLUME			
Treatment Process Used	None.	None.	Off-site incineration.
Amount Destroyed or Treated	None.	None.	All contaminants present destroyed.

Table 3.2
Evaluation of Final Soil Alternatives

Criteria	Alternative IV Enhanced Bio-Treatment	Alternative V X-19 Treatment	Alternative VI Excalibur Process
OVERALL PROTECTIVENESS			
Human Health Protection			
- Direct Contact/ Soil Ingestion	Reduces risk by excavating and treating soil.	Treatability study to determine effectiveness of X-19.	Treatability study to determine effectiveness of Excalibur Process.
Environmental Protection	See Alternative III.	See Alternative III.	See Alternative III.
COMPLIANCE WITH ARARs			
- Chemical Specific ARARs	Expected to comply with ARARs.	To be determined.	To be determined.
LONG-TERM EFFECTIVENESS AND PERMANENCE			
Magnitude of Residual Risk			
- Direct Contact/ Soil Ingestion	See Alternative III.	See Alternative III.	See Alternative III.
Adequacy and Reliability of Controls	Contaminants would be controlled adequately. Contaminated soil contained, air effluent treated before emitted to atmosphere. Reliable treatment.	See Alternative IV. There may be no air emissions from this alternative. Reliable treatment.	See Alternative IV. There would be no air emissions from this process. Reliability is unknown since the process has only recently been developed.
Need for 5-year Review	See Alternative III.	See Alternative III.	See Alternative III.
REDUCTION OF TOXICITY, MOBILITY, AND/OR VOLUME			
Treatment Process Used	Biological degradation and vapor extraction.	Biological degradation.	Soil washing and UV oxidation of wash solution.
Amount Destroyed or Treated	Organic compounds biodegraded, chlorinated compounds transferred to carbon.	Vendor claims X-19 will degrade all compounds present. Treatability study recommended.	Vendor claims process will destroy all compounds present. Treatability study recommended.

Table 3.2
Evaluation of Final Soil Alternatives

Criteria	Alternative VII In Situ Biological
OVERALL PROTECTIVENESS	
Human Health Protection	
- Direct Contact/ Soil Ingestion	To be evaluated
Environmental Protection	
COMPLIANCE WITH ARARs	
- Chemical Specific ARARs	
LONG-TERM EFFECTIVENESS AND PERMANENCE	
Magnitude of Residual Risk	
- Direct Contact/ Soil Ingestion	
Adequacy and Reliability of Controls	
Need for 5-year Review	
REDUCTION OF TOXICITY, MOBILITY, AND/OR VOLUME	
Treatment Process Used	
Amount Destroyed or Treated	

Table 3.2
Evaluation of Final Soil Alternatives

Criteria	Alternative I No Action	Alternative II Liner & Cap	Alternative III Off-site Treatment
Reduction of Toxicity, Mobility, or Volume	None.	Toxicity & volume not reduced, mobility reduced.	Reduced toxicity, mobility and volume .
Irreversible Treatment	None.	None.	Incineration would be irreversible.
Type & Quantity of Residuals Remaining after Treatment	No treatment, so most contamination remains.	Residuals would remain, but in a contained area.	None.
Statutory Preference for Treatment	Does not satisfy.	Does not satisfy.	Does not satisfy.
SHORT-TERM EFFECTIVENESS			
Community Protection	Migration of contaminants to groundwater may increase risk to public.	Excavation might cause dust which will need to be suppressed.	See Alternative II.
Worker Protection	No significant risk to workers.	Protection required against dermal contact and inhalation of contaminated dust during excavation. No risk during operation.	See Alternative II.
Environmental Impacts	Continued impact from existing conditions.	No impact.	No impact.
Time Until Action is Complete	Not applicable.	6 months.	6 months.
IMPLEMENTABILITY			
Ability to Construct and Operate	No construction or operation.	Simple to construct and operate.	Simple to implement.
Ease of Doing More Action If Needed	May need to go through FS/ROD process to perform additional work.	Once soil is capped, it would be difficult to perform addtional work.	Once incinerated, additional work would be difficult to perform.
Ability to Monitor Effectiveness	No monitoring performed.	Liner will be equipped with leachate collection/ detection system which could be easily monitored.	Treatment facility will determine effectiveness.
Ability to Obtain Approvals and Coordinate with Other Agencies	Unlikely other agencies would accept this option.	No approval necessary.	See Alternative II.
Availability of Services and Capacities	No services or capacities required.	See Alternative I.	Need transportation and a treatment facility.

Table 3.2
Evaluation of Final Soil Alternatives

Criteria	Alternative IV Enhanced Bio-Treatment	Alternative V X-19 Treatment	Alternative VI Excalibur Process
Reduction of Toxicity, Mobility, or Volume	See Alternative III.	To be determined.	To be determined.
Irreversible Treatment	Biodegradation would be irreversible. Contaminants	Biodegradation would be irreversible.	Vendor claims process would be irreversible.
Type & Quantity of Residuals Remaining after Treatment	Very low levels of organic contaminants may remain.	To be detemined.	To be determined.
Statutory Preference for Treatment	Satisfies.	Satisfies.	Satisfies.
SHORT-TERM EFFECTIVENESS			
Community Protection	See Alternative II.	See Alternative II.	See Alternative II.
Worker Protection	See Alternative II.	See Alternative II.	See Alternative II.
Environmental Impacts	No impact.	No impact.	No impact.
Time Until Action Is Complete	1 to 2 years.	1 to 2 years.	1 to 2 years.
IMPLEMENTABILITY			
Ability to Construct and Operate	Construction and operation fairly straight forward.	Simple to construct and operate.	To be determined.
Ease of Doing More Action If Needed	Additional work would not be difficult to implement.	See Alternative IV.	See Alternative IV.
Ability to Monitor Effectiveness	Monitoring can readily be performed.	See Alternative IV.	See Alternative IV.
Ability to Obtain Approvals and Coordinate with Other Agencies	An air emissions permit from BAAQMD required.	See Alternative II.	See Alternative II.
Availability of Services and Capacities	Readily available.	Available.	Limited availability.

Table 3.2
Evaluation of Final Soil Alternatives

Criteria	Alternative VII In Situ Biological
Reduction of Toxicity, Mobility, or Volume	
Irreversible Treatment	
Type & Quantity of Residuals Remaining after Treatment	
Statutory Preference for Treatment	
SHORT-TERM EFFECTIVENESS	
Community Protection	
Worker Protection	
Environmental Impacts	
Time Until Action is Complete	
IMPLEMENTABILITY	
Ability to Construct and Operate	
Ease of Doing More Action If Needed	
Ability to Monitor Effectiveness	
Ability to Obtain Approvals and Coordinate with Other Agencies	
Availability of Services and Capacities	

Table 3.2
Evaluation of Final Soil Alternatives

Criteria	Alternative I No Action	Alternative II Liner & Cap	Alternative III Off-site Treatment
Availability of Equipment, Specialist, and Materials	None required.	Excavation equipment and materials available.	Excavation equipment available.
Availability of Technologies	*None required.*	*Technology available.*	*Limited number of* Incinerators.
Cost			
Capital Cost	$0	$250,000	$950,000
Annual Operating Cost	$0	$4,000	$263,000
Present Worth Cost (assume 10% discount rate)	$0	$290,000	$1,213,000

Table 3.2
Evaluation of Final Soil Alternatives

Criteria	Alternative IV Enhanced Bio-Treatment	Alternative V X-19 Treatment	Alternative VI Excalibur Process
Availability of Equipment, Specialist, and Materials	Excavation equipment available.	Excavation equipment and X-19 additive available.	Process equipment will need to be fabricated.
Availability of Technologies	Technology available.	Only one vendor of technology.	Only one vendor of technology.
Cost			
Capital Cost	$113,000 to $169,000	$133,000 to $232,000	$60,000 to $150,000
Annual Operating Cost	$200,000	$200,000	$200,000
Present Worth Cost (assume 10% discount rate)	$313,000 to $369,000	$333,000 to $432,000	$260,000 to $350,000

Table 3.2
Evaluation of Final Soil Alternatives

Criteria	Alternative VII In Situ Biological
Availability of Equipment, Specialist, and Materials	
Availability of Technologies	
Cost	
Capital Cost	
Annual Operating Cost	
Present Worth Cost (assume 10% discount rate)	

Table 3.3
Present Worth Costs of Remedial Alternatives

GROUNDWATER REMEDIAL ALTERNATIVES
PRESENT WORTH COST

Criteria	Alternative I No Action	Alternative II Discharge to POTW	Alternative VI Biological Treatment w/ Carbon Adsorption	Alternative III UV Oxidation	Alternative IV Carbon Adsorption	Alternative V Air Stripping
Capital Cost	0	$30,000	$130,000	$165,000	$145,000	$235,000 or $115,000
Annual Operating Cost	0	$7,000	$12,000 to $42,000	$34,000	$39,000	$36,000 or $65,000
Present Worth Cost (10% discount rate)	0	$72,000	$203,000 to $383,000	$370,000	$380,000	$452,000 or $505,000

SOIL REMEDIAL ALTERNATIVES
PRESENT WORTH COST

Criteria	Alternative I No Action	Alternative II Liner & Cap	Alternative VI Excalibur Process	Alternative IV Enhanced Bio-treatment	Alternative V X-19 Treatment	Alternative III Off-site Treatment
Capital Cost	$0	$250,000	$60,000 to $150,000	$113,000 to $169,000	$133,000 to $232,000	$950,000
Annual Operating Cost	$0	$4,000	$200,000	$200,000	$200,000	$263,000
Present Worth Cost (10% discount rate)	$0	$274,000	$260,000 to $350,000	$313,000 to $369,000	$333,000 to $432,000	$1,213,000

FIGURES

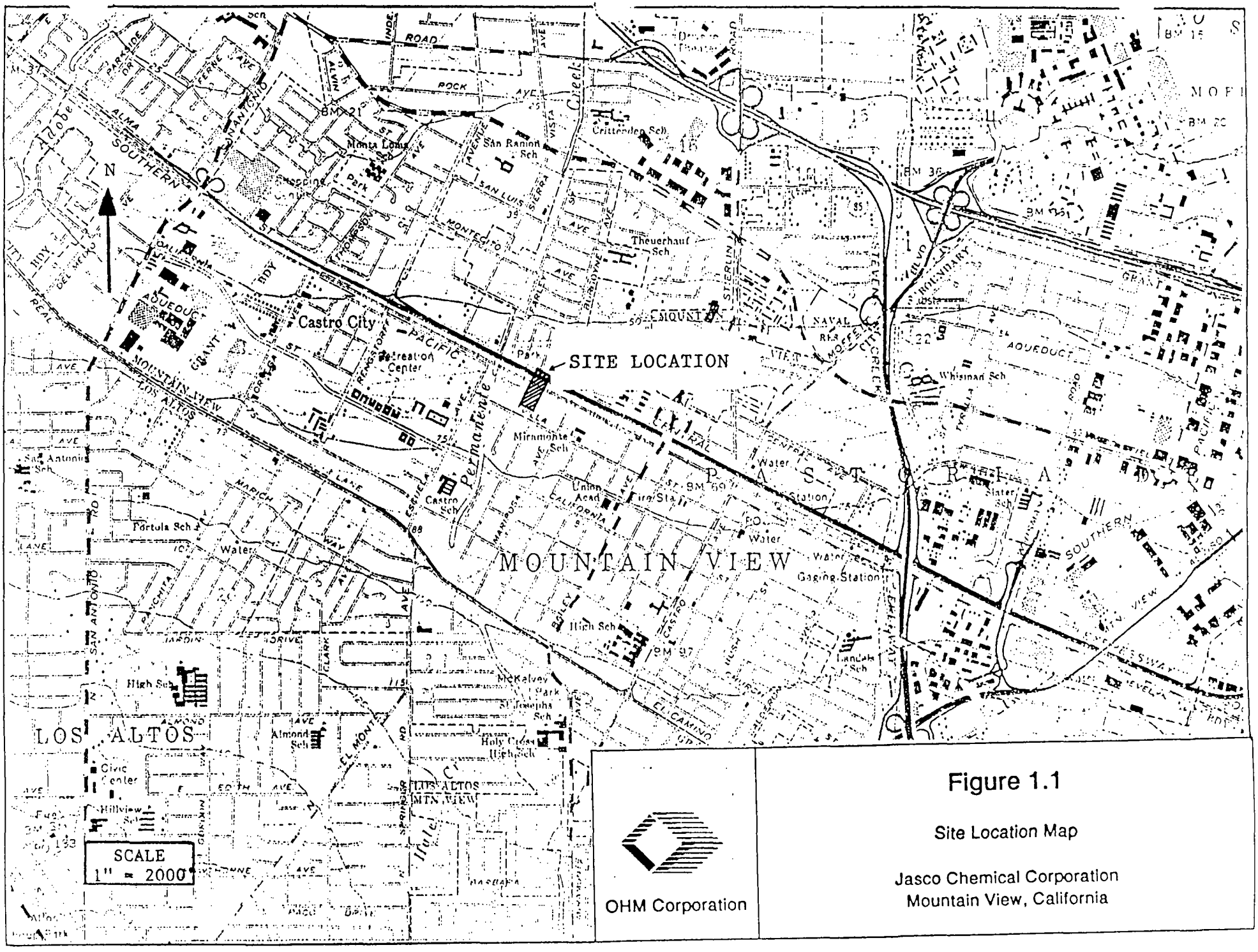


Figure 1.1

Site Location Map

Jasco Chemical Corporation
Mountain View, California

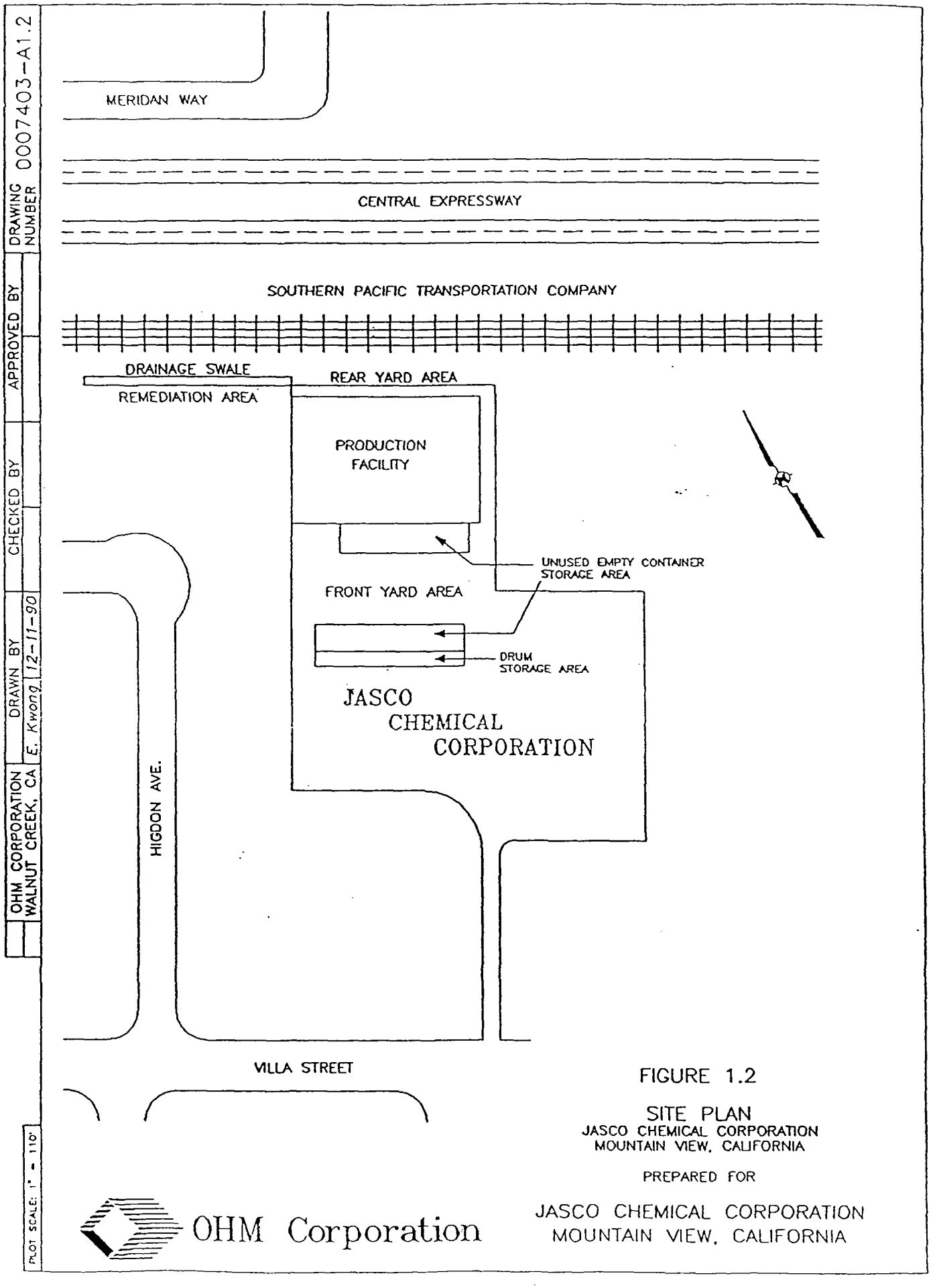


FIGURE 1.2

SITE PLAN
JASCO CHEMICAL CORPORATION
MOUNTAIN VIEW, CALIFORNIA

PREPARED FOR

JASCO CHEMICAL CORPORATION
MOUNTAIN VIEW, CALIFORNIA

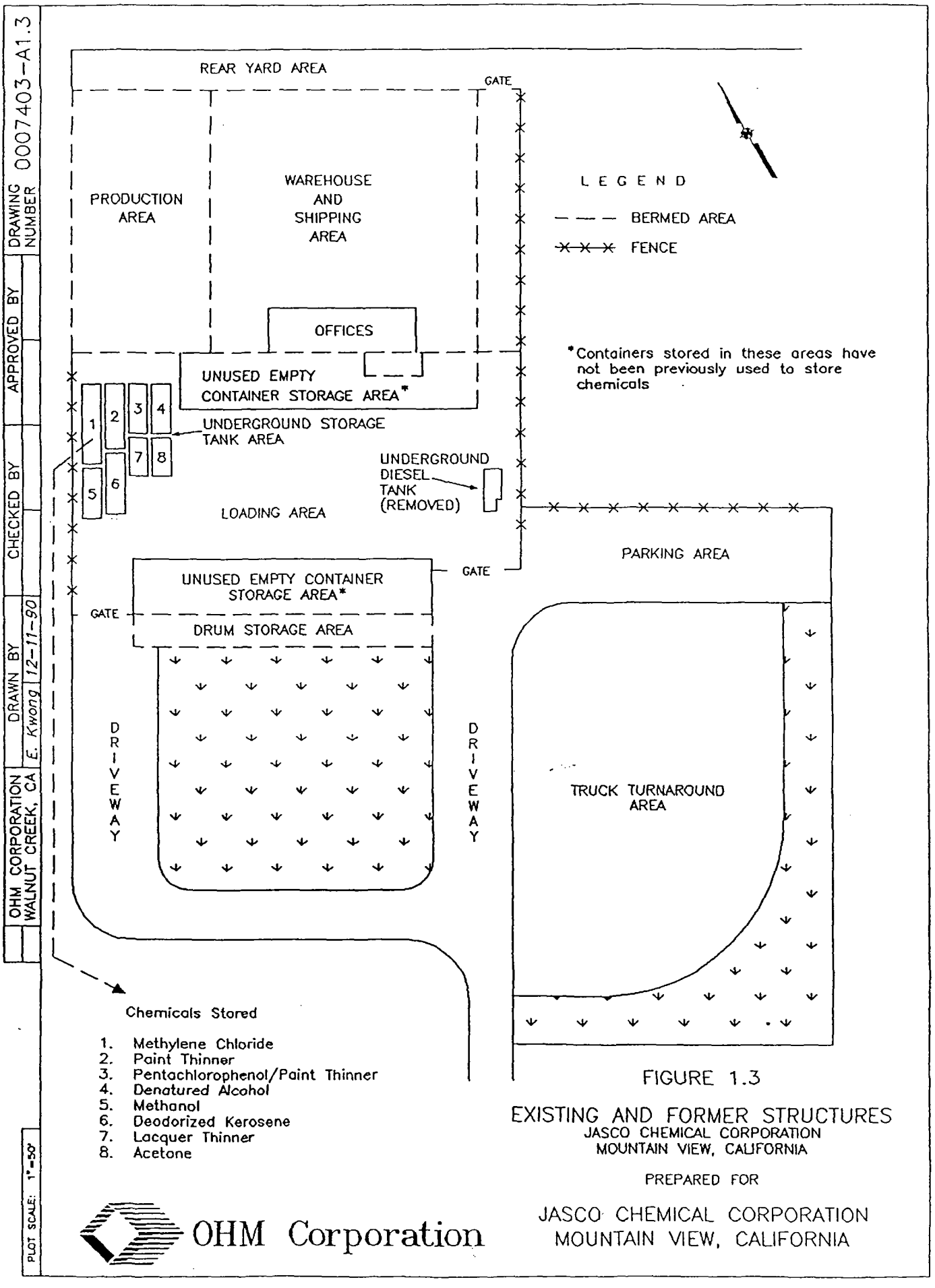


FIGURE 1.3

EXISTING AND FORMER STRUCTURES
JASCO CHEMICAL CORPORATION
MOUNTAIN VIEW, CALIFORNIA

PREPARED FOR

JASCO CHEMICAL CORPORATION
MOUNTAIN VIEW, CALIFORNIA

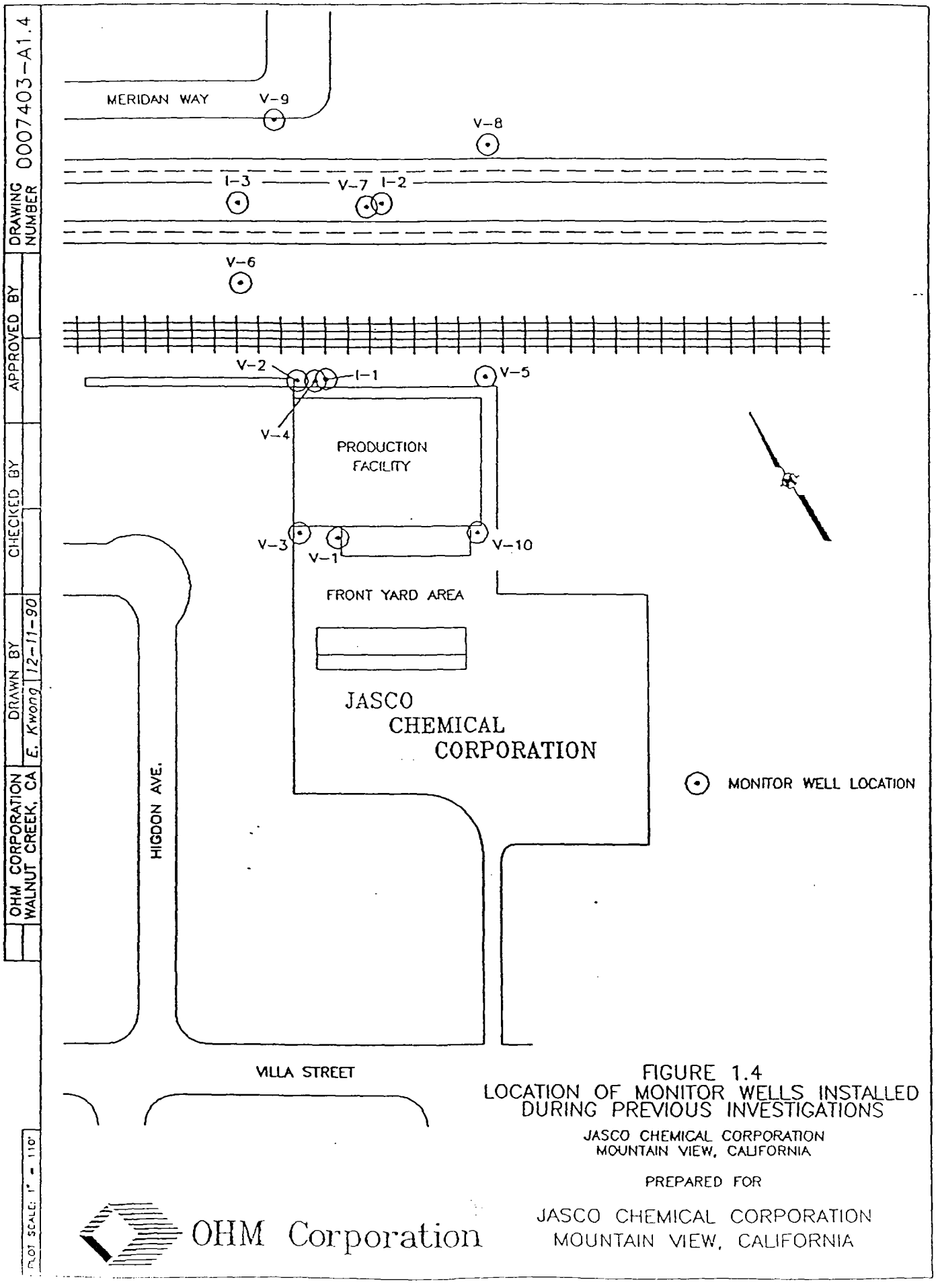


FIGURE 1.4
LOCATION OF MONITOR WELLS INSTALLED DURING PREVIOUS INVESTIGATIONS

JASCO CHEMICAL CORPORATION
MOUNTAIN VIEW, CALIFORNIA

PREPARED FOR

JASCO CHEMICAL CORPORATION
MOUNTAIN VIEW, CALIFORNIA

PLOT SCALE = 1"=30'	OHM CORPORATION WALNUT CREEK, CA	DRAWN BY E. Kwong 12-18-90	CHECKED BY	APPROVED BY	DRAWING NUMBER 0007402-A4.1

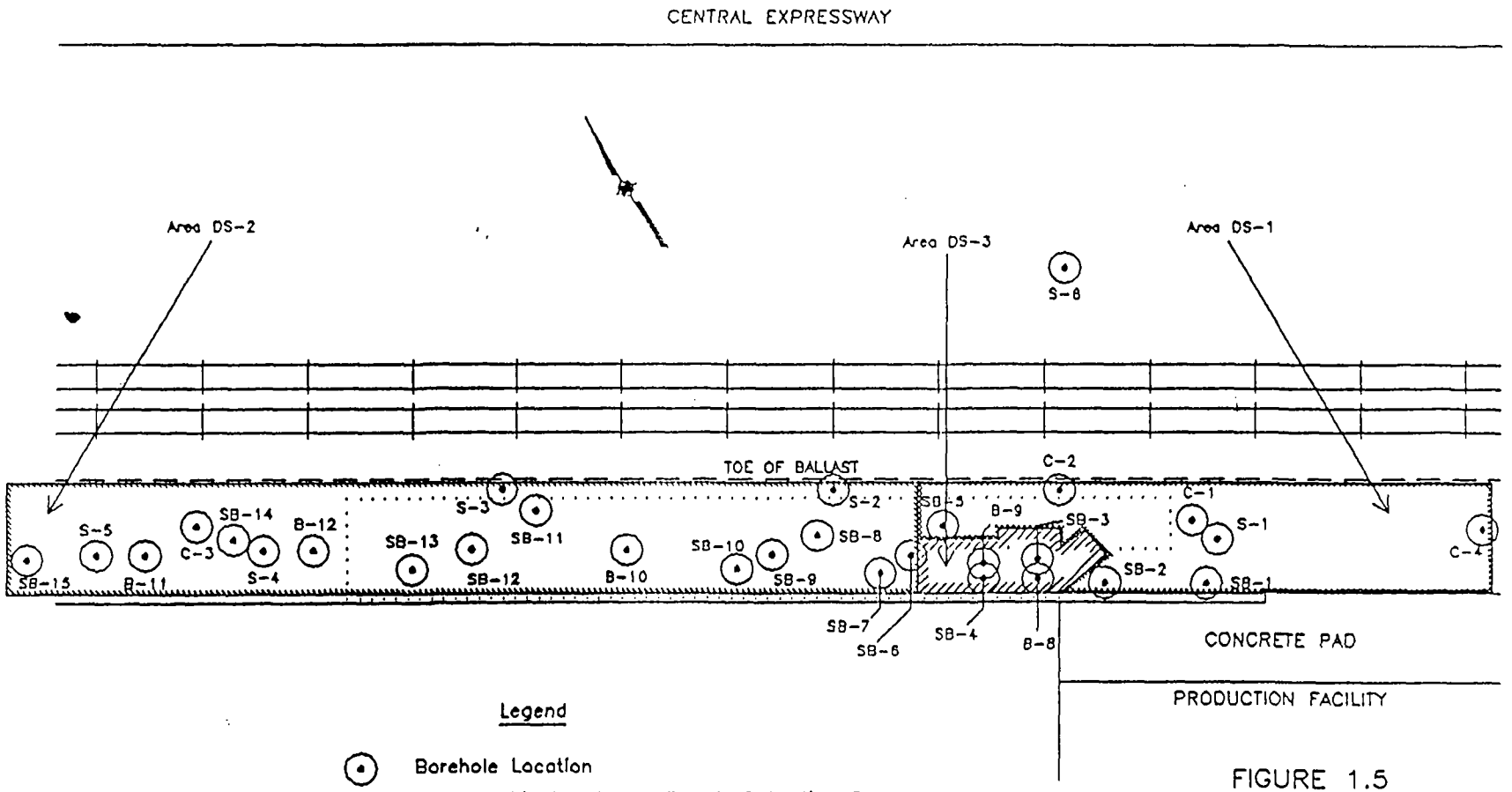


FIGURE 1.5
LOCATION OF SAMPLE POINTS AND DELINEATION OF DRAINAGE SWALE AREAS

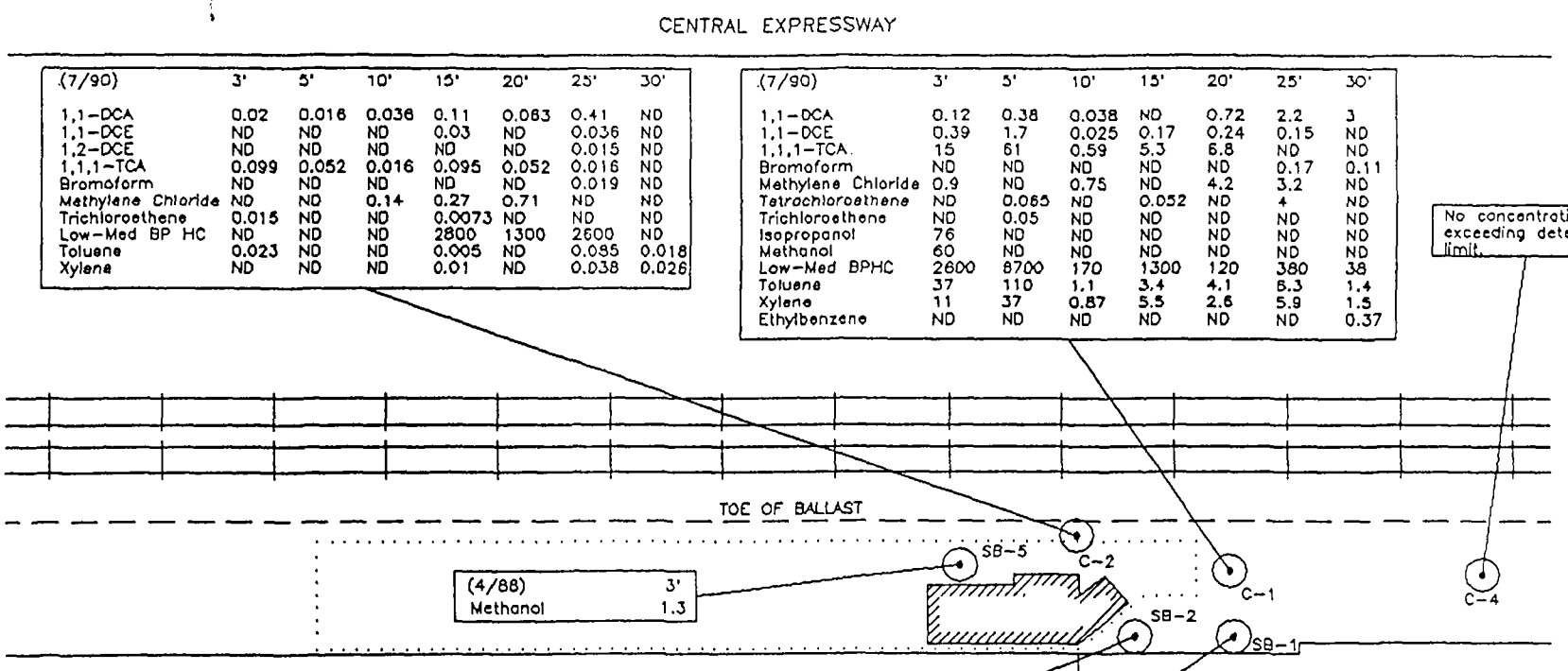
JASCO CHEMICAL CORPORATION
MOUNTAIN VIEW, CA

PREPARED FOR

JASCO CHEMICAL CORPORATION
MOUNTAIN VIEW, CA

OHM Corporation

PLOT SCALE = 1"=30'	OHM CORPORATION WALNUT CREEK, CA	DRAWN BY	CHECKED BY	APPROVED BY	DRAWING NUMBER 0007403-A4.4
		E. Kwong 12-18-90			



(7/90)	3'	5'	10'	15'	20'	25'	30'
1,1-DCA	0.02	0.016	0.036	0.11	0.063	0.41	ND
1,1-DCE	ND	ND	ND	0.03	ND	0.036	ND
1,2-DCE	ND	ND	ND	ND	ND	0.015	ND
1,1,1-TCA	0.099	0.052	0.016	0.095	0.052	0.016	ND
Bromoform	ND	ND	ND	ND	ND	0.019	ND
Methylene Chloride	ND	ND	0.14	0.27	0.71	ND	ND
Trichloroethene	0.015	ND	ND	0.0073	ND	ND	ND
Low-Med BP HC	ND	ND	ND	2800	1300	2600	ND
Toluene	0.023	ND	ND	0.005	ND	0.085	0.018
Xylene	ND	ND	ND	0.01	ND	0.038	0.026

(7/90)	3'	5'	10'	15'	20'	25'	30'
1,1-DCA	0.12	0.38	0.038	ND	0.72	2.2	3
1,1-DCE	0.39	1.7	0.025	0.17	0.24	0.15	ND
1,1,1-TCA	15	61	0.59	5.3	6.8	ND	ND
Bromoform	ND	ND	ND	ND	ND	0.17	0.11
Methylene Chloride	0.9	ND	0.75	ND	4.2	3.2	ND
Tetrachloroethene	ND	0.065	ND	0.052	ND	4	ND
Trichloroethene	ND	0.05	ND	ND	ND	ND	ND
Isopropanol	76	ND	ND	ND	ND	ND	ND
Methanol	60	ND	ND	ND	ND	ND	ND
Low-Med BPHC	2600	8700	170	1300	120	380	38
Toluene	37	110	1.1	3.4	4.1	6.3	1.4
Xylene	11	37	0.87	5.5	2.6	5.9	1.5
Ethylbenzene	ND	ND	ND	ND	ND	ND	0.37

No concentrations exceeding detection limit.

(4/88)	3'
Methanol	1.3

Legend

- Borehole Location
- Impermeable Membrane Runoff Collection System
- Area of Interim Soil Excavation

All concentrations of Target Constituents given in mg/kg

Sample dates given in upper left hand corner of each data box.

(4/88)	3'
1,1-DCA	1.4
1,1,1-TCA	2.6
Acetone	6.3
Methylene Chloride	1.7
Toluene	0.3
Acetone	8.8
Methanol	5.0
TPH (Kerosene)	10
TPH (Paint Thinner	5.2

(4/88)	3'
1,1-DCA	0.54
1,1,1-TCA	1.1
Methylene Chloride	1.3
Acetone	1.1
Ethanol	0.7
Methanol	3.3

FIGURE 1.6
DISTRIBUTION OF TARGET CONSTITUENTS
3-30', FORMER DRAINAGE SWALE, DS-1

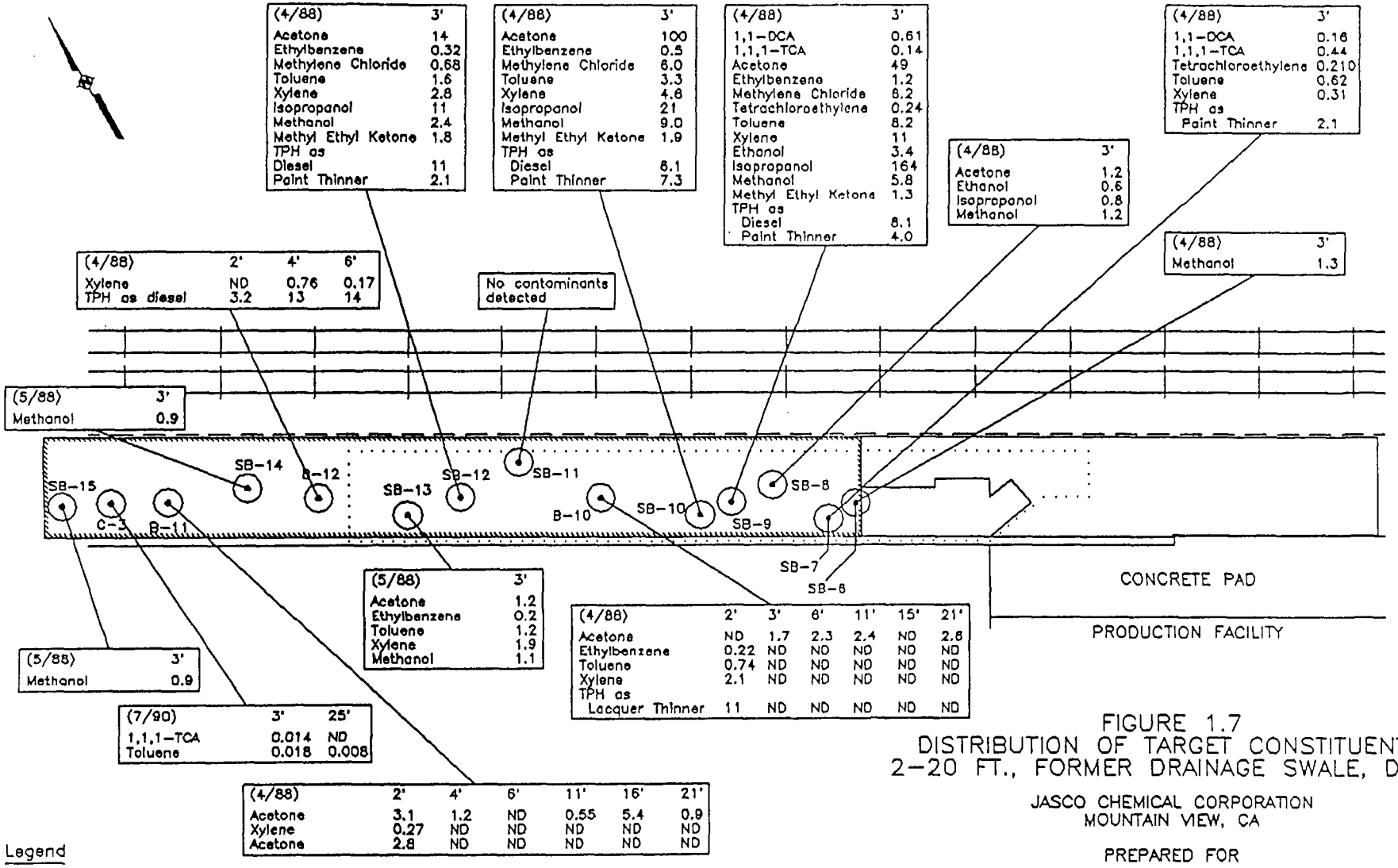
JASCO CHEMICAL CORPORATION
MOUNTAIN VIEW, CA

PREPARED FOR

JASCO CHEMICAL CORPORATION
MOUNTAIN VIEW, CA

OHM Corporation

PLOT SCALE = 1"=30'	OHM CORPORATION WALNUT CREEK, CA	DRAWN BY	CHECKED BY	APPROVED BY	DRAWING NUMBER 0007403-A4.5
		E. Kwong 12-18-90			



Legend

- Borehole Location
- Impermeable Membrane Runoff Collection System

All concentrations of Target Constituents given in mg/kg

Sample date given in upper left hand corner of each data box.

FIGURE 1.7
DISTRIBUTION OF TARGET CONSTITUENTS
2-20 FT., FORMER DRAINAGE SWALE, DS-2

JASCO CHEMICAL CORPORATION
MOUNTAIN VIEW, CA

PREPARED FOR
JASCO CHEMICAL CORPORATION
MOUNTAIN VIEW, CA

OHM Corporation

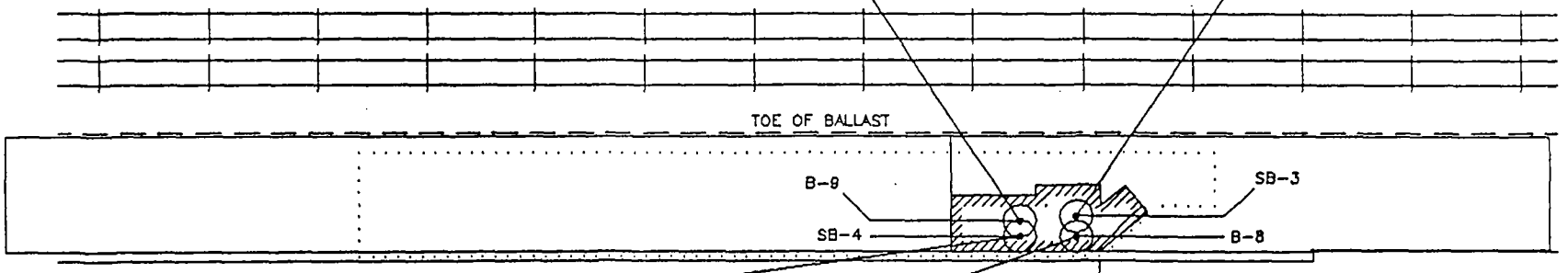
PLOT SCALE = 1"=30'	OHM CORPORATION WALNUT CREEK, CA	DRAWN BY E. Kwong 12-18-90	CHECKED BY	APPROVED BY	DRAWING NUMBER 0007403-A4.6

Legend

- Borehole Location
- Impermeable Membrane Runoff Collection System
- All concentrations of Target Constituents in mg/kg
- Sample date given in upper left hand corner of each data box.

(4/88)	2'	4'	6'	11'	16'	21'
1,1-DCA	ND	2.2	0.88	0.23	ND	ND
1,1-DCE	0.16	ND	ND	ND	ND	ND
1,1,1-TCA	0.34	30	28	0.29	ND	ND
2-Propanone	24	25	6.2	5.1	ND	ND
Bromodichloromethane	0.16	ND	ND	ND	ND	ND
Ethylbenzene	ND	3	4.2	ND	ND	ND
Methylene Chloride	9.3	42	21	7.4	16	15
Tetrachloroethane	ND	0.87	1.3	ND	ND	ND
TCE	ND	1.4	1.5	ND	ND	ND
Toluene	2.3	38	41	0.27	ND	ND
Xylene	0.45	18	27	ND	ND	ND
Acetone	16	25	1.8	27	12	4
Isopropanol	ND	1.5	ND	ND	ND	ND
TPH as						
Lacquer Thinner	16	ND	ND	ND	ND	ND
Paint Thinner	96	5000	2000	29	ND	ND

(5/88)	3'
1,1,1-TCA	47
Acetone	91
Methylene Chloride	210
Toluene	38
Xylene	27
Ethanol	20
Isopropanol	18
Methanol	32
TPH as	
Kerosene	150
Paint Thinner	320



(5/88)	3'
1,1-DCA	1.2
1,1,1-TCA	7.3
Acetone	28
Ethylbenzene	2.2
Methylene Chloride	64
Tetrachloroethylene	1.0
TCE	0.56
Toluene	17
Xylene	210
Isopropanol	60
Methanol	14
TPH as	
Kerosene	140
Paint Thinner	320

(4/88)	3'	5'	10'	15'	20'
1,1-DCA	27	34	0.98	0.2	0.76
1,1-DCE	13	ND	ND	ND	ND
1,1,1-TCA	ND	1.5	22	2.3	0.21
1,2-DCA	3.9	ND	ND	ND	ND
Carbon Tetrachloride	650	ND	ND	ND	ND
Chloroform	2.3	ND	ND	ND	ND
Ethylbenzene	170	NA	NA	NA	NA
Methylene Chloride	3400	2.4	71	8.9	18
Tetrachloroethane	16	0.0067	0.31	ND	ND
TCE	490	ND	0.85	0.088	ND
Toluene	1700	NA	NA	NA	NA
Acetone	270	NA	15	NA	13
Isopropanol	3.5	NA	1	NA	2.5
TPH as					
Paint Thinner	11000	NA	2600	NA	20

FIGURE 1.8
DISTRIBUTION OF TARGET CONSTITUENTS
2-30', FORMER DRAINAGE SWALE, DS-3

JASCO CHEMICAL CORPORATION
MOUNTAIN VIEW, CA

PREPARED FOR

JASCO CHEMICAL CORPORATION
MOUNTAIN VIEW, CA

OHM Corporation

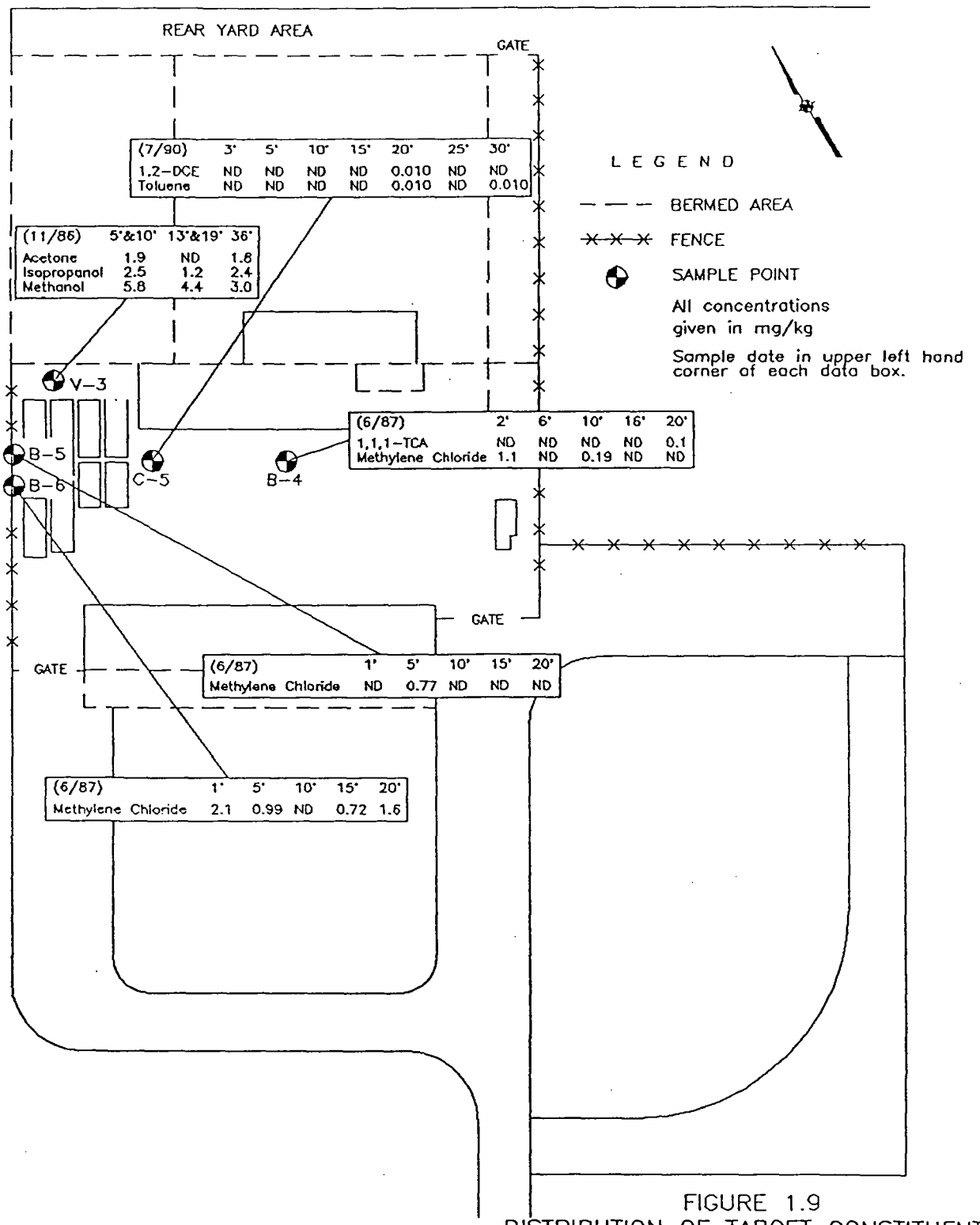


FIGURE 1.9
DISTRIBUTION OF TARGET CONSTITUENTS
UNDERGROUND STORAGE TANK AREA
JASCO CHEMICAL CORPORATION
MOUNTAIN VIEW, CALIFORNIA

PREPARED FOR

JASCO CHEMICAL CORPORATION
MOUNTAIN VIEW, CALIFORNIA

OHM Corporation

DRAWING NUMBER 0007403-A4.7
APPROVED BY
CHECKED BY
DRAWN BY E. Kwong 12-11-90
OHM CORPORATION WALNUT CREEK, CA
PLOT SCALE: 1"=50'

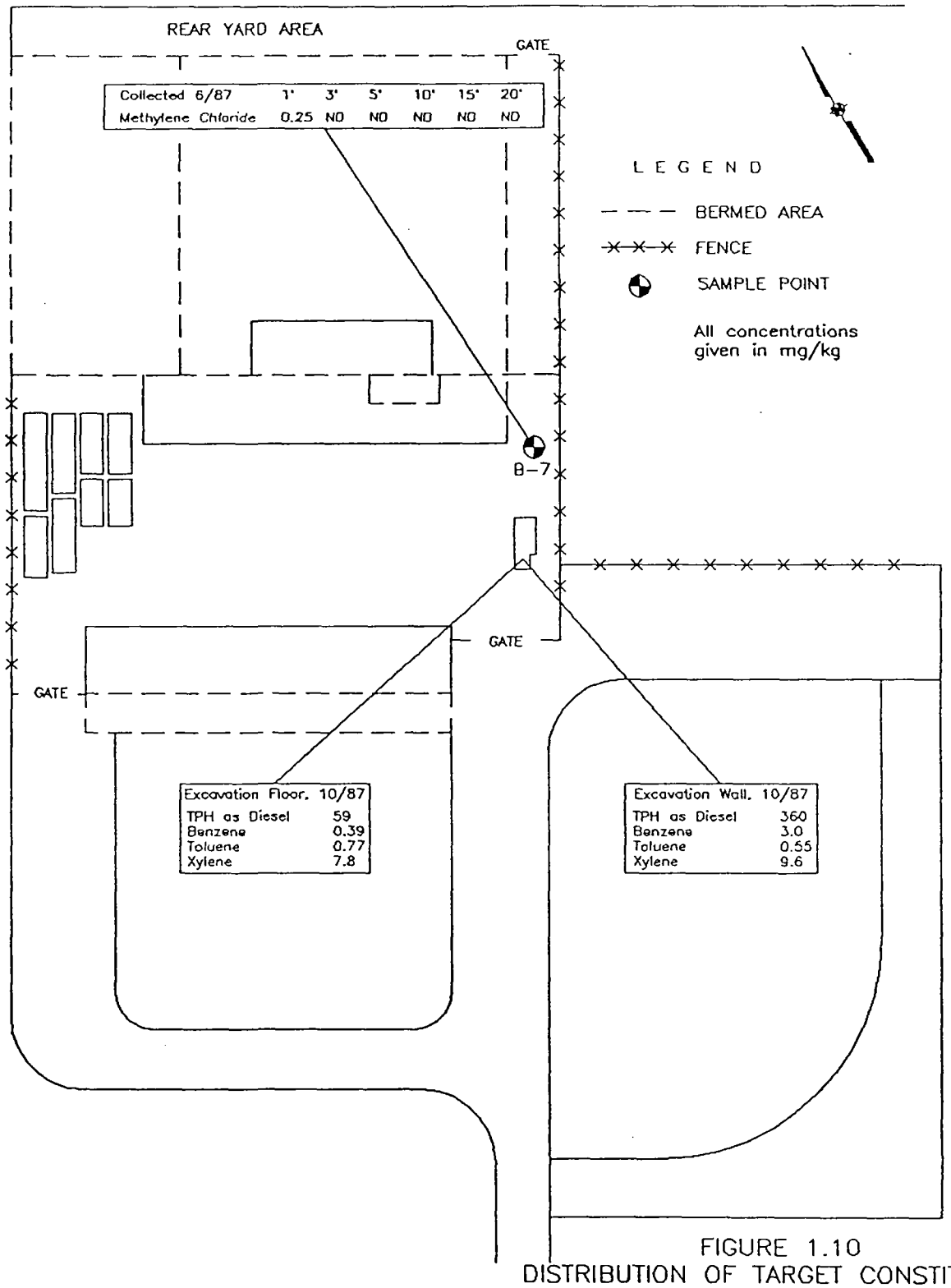


FIGURE 1.10
DISTRIBUTION OF TARGET CONSTITUENTS
FORMER UNDERGROUND DIESEL TANK
JASCO CHEMICAL CORPORATION
MOUNTAIN VIEW, CALIFORNIA

PREPARED FOR

JASCO CHEMICAL CORPORATION
MOUNTAIN VIEW, CALIFORNIA

OHM Corporation

DRAWING NUMBER	0007403-A4.8
APPROVED BY	
CHECKED BY	
DRAWN BY	E. Kwong 12-11-90
OHM CORPORATION WALNUT CREEK, CA	
PLOT SCALE:	1"=50'

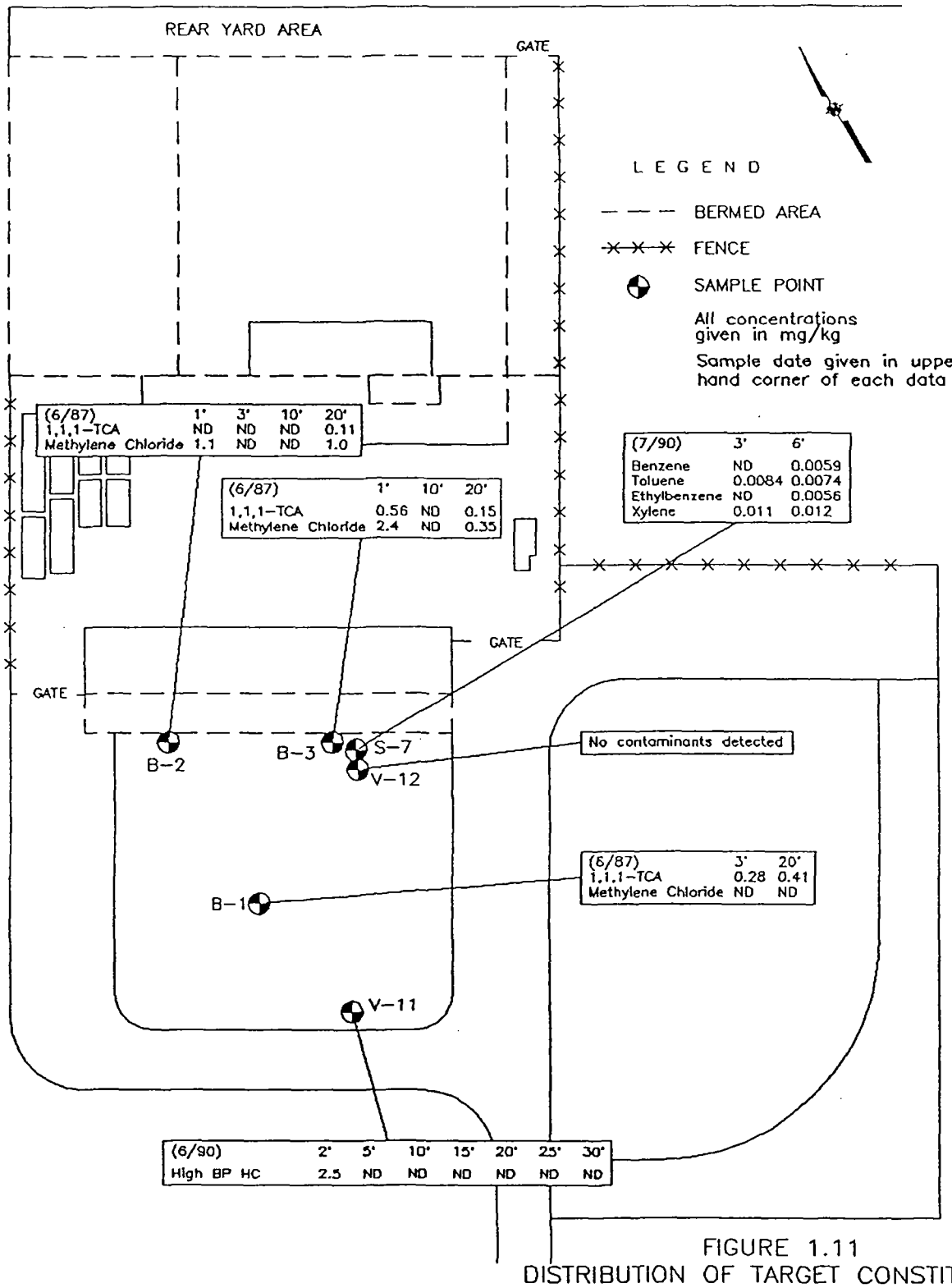


FIGURE 1.11
DISTRIBUTION OF TARGET CONSTITUENTS
DRUM STORAGE & BACKGROUND AREA
JASCO CHEMICAL CORPORATION
MOUNTAIN VIEW, CALIFORNIA

PREPARED FOR

JASCO CHEMICAL CORPORATION
MOUNTAIN VIEW, CALIFORNIA

OHM Corporation

DRAWING NUMBER 0007403-A4.9
APPROVED BY
CHECKED BY
DRAWN BY E. Kwong 12-11-90
OHM CORPORATION WALNUT CREEK, CA
PLOT SCALE: 1"=50'

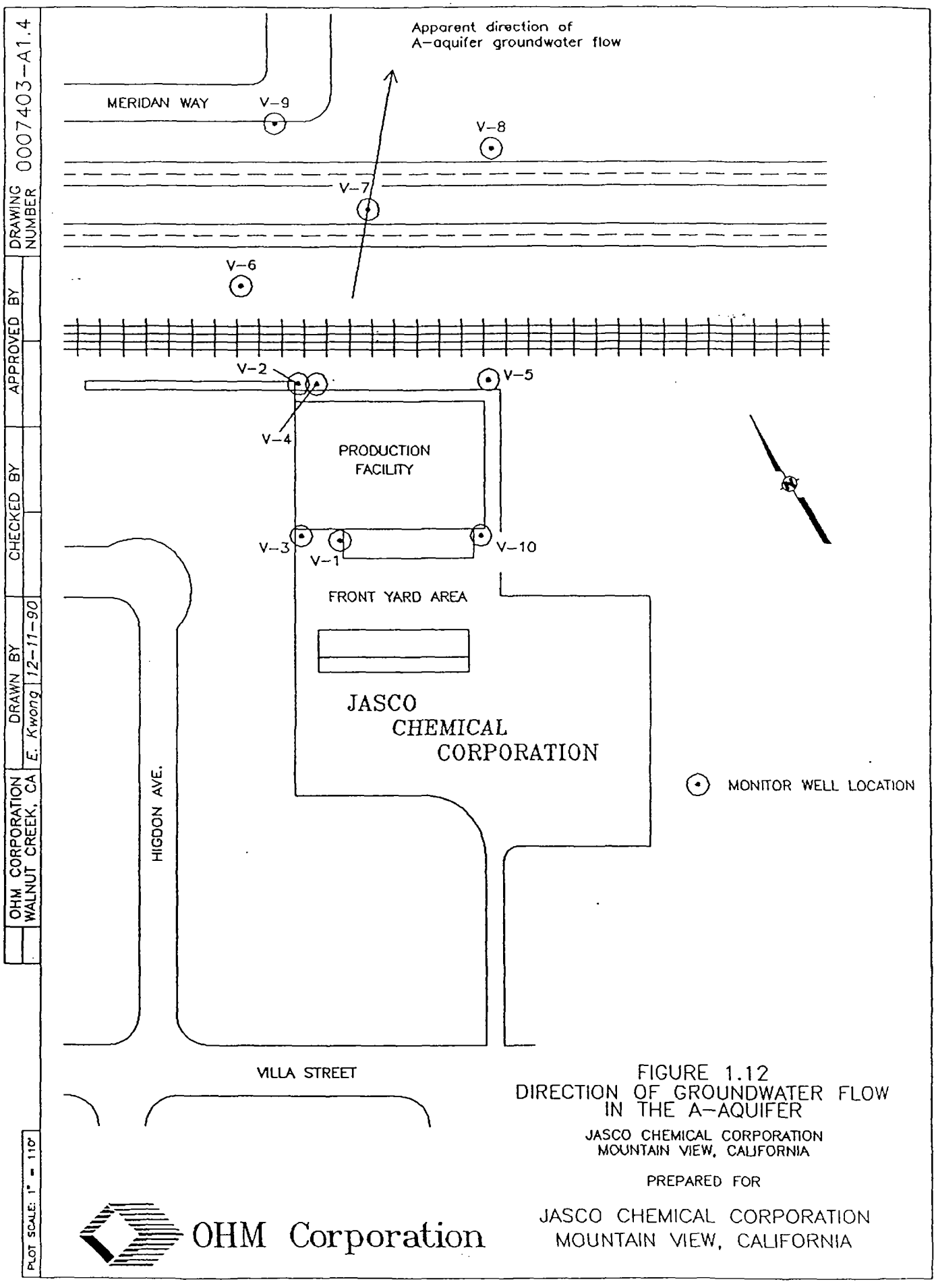


FIGURE 1.12
DIRECTION OF GROUNDWATER FLOW
IN THE A-AQUIFER

JASCO CHEMICAL CORPORATION
MOUNTAIN VIEW, CALIFORNIA

PREPARED FOR

JASCO CHEMICAL CORPORATION
MOUNTAIN VIEW, CALIFORNIA