RMT INC®

West Coast Office
Suite 370
3250 Ocean Park Blvd.
Santa Monica, CA 90405
(310) Phone: ~~213-452-5078~~
FAX: 213-450-5787
(310) 5781241

September 10, 1993

93 SEP 13 AM 11: 20

Ms. Susan Hugo
Alameda County
Health Care Services Agency
Department of Environmental Health
Hazardous Materials Division
80 Swan Way, Room 200
Oakland, CA 94621

RE: Workplan for Soil Vapor Extraction System Pilot Test
Aratex Services, Inc., 958 28th Street, Oakland, California

Dear Ms. Hugo:

Enclosed please find a workplan for a soil vapor extraction system pilot test at the referenced facility. As you may have noted in the Semi-Annual Groundwater Monitoring report (July 26, 1993) the product recovery system has not recovered any petroleum product since it was installed in March 1993. In response to these findings ARATEX engaged the services of RMT, Inc., to prepare a workplan for a soil vapor extraction (SVE) system pilot test to determine the feasibility of *in-situ* volatilization for the remediation of the petroleum hydrocarbon contaminated soil.

If you have questions or comments regarding our investigation or this report, please feel free to contact me at (310) 452-5078.

Sincerely,

James W Van Nortwick Jr /BMT

James W. Van Nortwick, Jr., Ph.D., P.E.
Project Manager

enc: Semi-Annual Groundwater Monitoring Report

cc: Robert J. Robbins, C.P.G.
Phillip Krejci
Roger Simpson
Bea Slater
File: 728/Tanks

12012.15 ARATEX\SERVISCOcmn SVE-WKPL.ltr

RMT INC

West Coast Office
Suite 370
3250 Ocean Park Blvd.
Santa Monica, CA 90405
Phone: 213-452-5078
FAX: 213-450-5787

WORKPLAN FOR SOIL VAPOR EXTRACTION SYSTEM PILOT TEST

958 28TH STREET
OAKLAND, CALIFORNIA

PREPARED FOR:

ARATEX SERVICES, INC.
SCHAUMBURG, ILLINOIS

PREPARED BY:

RMT, INC.
SANTA MONICA, CALIFORNIA

SEPTEMBER 1993

James W Van Nortwick Jr RMT
James W. Van Nortwick, Jr., Ph.D., P.E.
Project Manager

12012.15 ARATEX\SERVISCO SVE-WKPL.RPT

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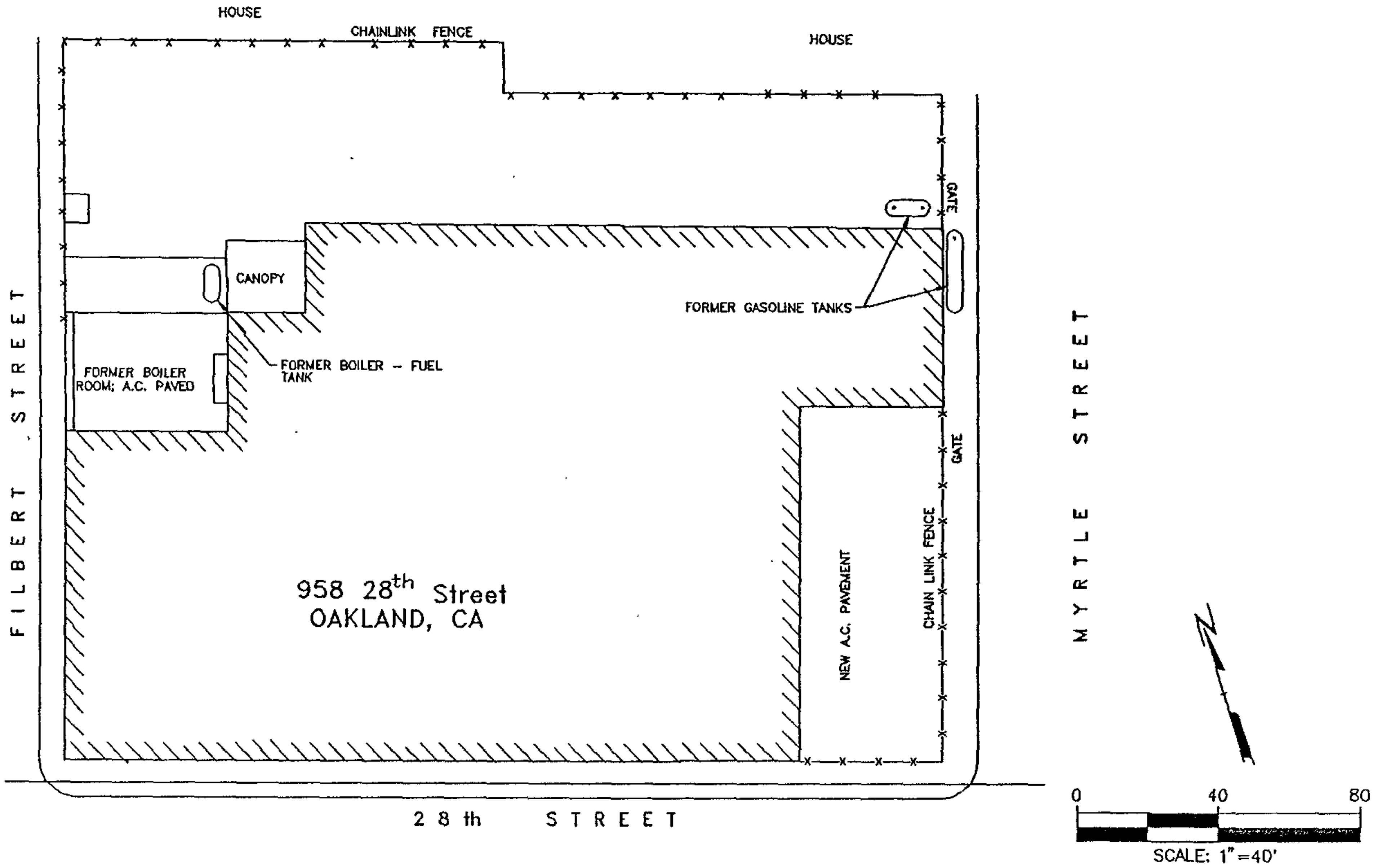
Section 1
INTRODUCTION

1.1 Background

In 1988, Aratex Services, Inc., (ARATEX) engaged the services of IT Corporation to supervise the removal of three underground petroleum storage tanks from the property located at 958 28th Street, in Oakland, California. Evidence of a petroleum product release was identified in the vicinity of the gasoline storage tank during the tank removal activities. In response to a request from the Alameda County Health Care Services Agency (ACHCSA), a preliminary subsurface investigation was conducted in February 1989, and included the installation of three groundwater monitoring wells (MW-A1, MW-A2, and MW-A3). The results of this investigation identified the presence of total petroleum hydrocarbons as gasoline (TPH-G), total petroleum hydrocarbons as diesel (TPH-D), benzene, toluene, ethylbenzene, and xylenes (BTEX) in the soil and groundwater in the vicinity of the former gasoline storage tank. A site plan showing the layout of the facility is presented in Figure 1.

In June 1989, ARATEX engaged the services of RMT, Inc., (RMT) to conduct a subsurface investigation to further define the extent of petroleum contamination and develop a groundwater monitoring program. Field activities were conducted from March 1990, through November 1990, and included the advancement of several soil borings, the installation of three monitoring wells (MW-4, MW-5, and MW-6), and groundwater monitoring activities. Based on the results of the sampling activities, the lateral extent of soil and groundwater contamination was determined to be limited to the area immediately surrounding the former 7,000-gallon gasoline storage tank; however, evidence of free-product was identified in an unsaturated sandy gravel layer along the northern property boundary during the installation of monitoring well MW-4.

In October 1990, the ACHCSA requested that ARATEX investigate the potential source of free-product identified in monitoring well MW-4. Additional field activities were conducted from November 1990, through March 1993, and included the abandonment of monitoring well MW-4 and the installation of two additional groundwater monitoring wells (MW-4A and MW-7) and a product recovery well (R-1). Recovery well R-1 is located along the northern property boundary and intersects the unsaturated sandy gravel zone containing residual free-product. Recovery well R-1 is screened in the unsaturated zone at a depth of approximately 8 to 14 ft below ground surface (bgs), and constructed of 4-inch



ARATEX SERVISCO
SITE PLAN

DWN. BY:	RAS
DATE:	JUNE, 1993
PROJ.#	12012.13
FILE #	12012133

FIGURE 1

flush-threaded Schedule 40 PVC with a 0.020-inch factory-slotted screen interval. A site plan showing the locations of the monitoring wells and the recovery well is presented in Figure 2 and the recovery well construction diagram is included in Appendix A.

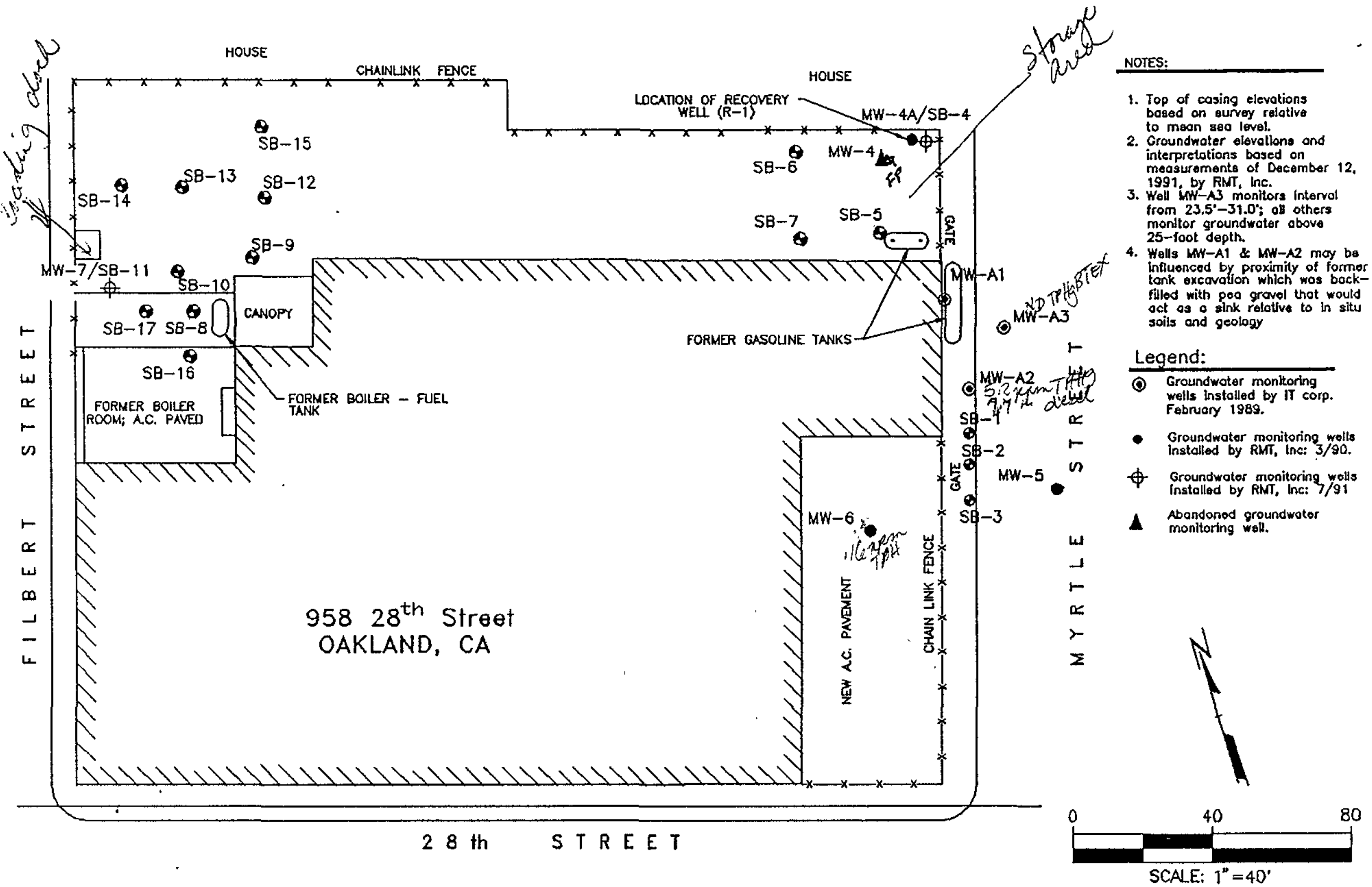
To date, no free-product has been recovered from recovery well R-1. In response to these findings, ARATEX engaged the services of RMT to conduct a soil vapor extraction (SVE) pilot-scale test to determine the feasibility of *in-situ* volatilization for the remediation of the contaminated soils in the suspected contaminant source area. (*In-situ* volatilization is the process by which VOC are removed from the unsaturated soil through utilization of forced or drawn air currents. *In-situ* volatilization is efficient in remediating soil impacted with volatile compounds such as the petroleum hydrocarbons present at this site. *In-situ* volatilization also has the additional benefit of enhancing biodegradation of organic compounds such as petroleum hydrocarbons.)

1.2 Purpose and Scope

The purpose of this workplan is to present the scope of services proposed to be undertaken to carryout the mid-scale test.

The scope of services for the pilot-scale test included the following activities:

- Installation of a pilot-scale soil vapor extraction unit.
- Collection and chemical analysis of extracted soil-vapor samples.
- Determination of well-head vacuums and flowrates at the extraction well and observation wells throughout the test.
- Interpretation of pilot-scale test results and SVE system design.



NOTES:

1. Top of casing elevations based on survey relative to mean sea level.
2. Groundwater elevations and interpretations based on measurements of December 12, 1991, by RMT, Inc.
3. Well MW-A3 monitors interval from 23.5'-31.0'; all others monitor groundwater above 25-foot depth.
4. Wells MW-A1 & MW-A2 may be influenced by proximity of former tank excavation which was back-filled with pea gravel that would act as a sink relative to in situ soils and geology

Legend:

- ◎ Groundwater monitoring wells installed by IT corp. February 1989.
- ● Groundwater monitoring wells installed by RMT, Inc: 3/90.
- ⌖ Groundwater monitoring wells installed by RMT, Inc: 7/91
- ▲ Abandoned groundwater monitoring well.

ARATEX SERVISCO
MONITORING WELL LOCATIONS

RMT INC.

DWN. BY:	RAS
DATE:	JUNE, 1993
PROJ.#	12012.13
FILE #	12012134

FIGURE 2

Section 2
SVE PILOT-SCALE TEST

2.1 Design Considerations

The results of the remedial investigations conducted at the ARATEX facility indicate that petroleum hydrocarbons are present in the unsaturated soil. The findings and conclusions of these investigations pertinent to the design of a SVE pilot-scale test to evaluate the feasibility of *in-situ* volatilization for soil remediation are summarized below:

- The stratigraphy of the site has been defined to a depth of approximately 26 ft bgs. The uppermost 7 to 10 ft bgs consists of fine-grained cohesive sandy clay and clay. The soil underlying this unit and extending to a depth of approximately 12 to 15 ft bgs consist of sand, sandy gravel, and gravel. A fine-grained cohesive sandy clay unit underlies the sandy gravel unit and extends to a depth of at least 26 ft bgs.
- The depth to groundwater is approximately 14 ft bgs.
- The results of chemical analyses performed on soil samples collected from the unsaturated sandy gravel unit located immediately above the groundwater table identified the presence of petroleum hydrocarbons.
- The presence of free-product was identified in soil borings located along the northern property boundary in the vicinity of the recovery well R-1.
- Recovery well R-1 is screened in the unsaturated sandy gravel unit at a depth of approximately 8 to 14 ft below ground surface (bgs).
- The presence of dissolved petroleum hydrocarbons (benzene, toluene, ethylbenzene, and xylenes) have been identified in groundwater samples collected from monitoring wells located in the vicinity of the underground gasoline storage tank.
- The presence of contamination in the unsaturated zone is a potential source of the groundwater contamination.

2.2 Radius of Influence Determination

The radius of influence of the extraction well is a critical parameter in the design of an SVE system. The radius of influence is typically defined as the distance at which the subsurface vacuum reaches zero. Assuming that the subsurface pressure distribution in the region of an SVE recovery well can be modeled using cylindrical coordinates (with $\partial p/\partial z = 0$ and the recovery well placed at the coordinate axis origin), the following equation (Bear, 1979) can be derived to relate the radial subsurface pressure distribution to the recovery well flowrate and the soil parameters:

$$P' = \frac{Q}{4\pi m(\frac{k}{\mu})} \int_{\phi}^{\infty} \frac{e^{-x}}{x} dx \qquad \text{where: } \phi = \frac{r^2 \epsilon \mu}{4kP_{atm}t} \qquad (1)$$

P' = Gauge Vacuum Pressure
ϵ = Soil Porosity
μ = Viscosity (air)
r = Distance from Extraction Well
Q = Extraction Well Flowrate
k = Soil Intrinsic Permeability
m = Length of Extraction Well Screened Interval
t = Time

For values of ϕ less than 0.1, equation (1) predicts that a plot of P' versus $ln(r)$ at constant time (t) should yield a straight line. By determining the slope and intercept of this plot for a set of representative pilot-scale testing data, a relationship between the recovery well flowrate (Q) and the radius of influence can be developed. This relationship can be used to assess and optimize well placement alternatives and soil-vapor extraction flowrates.

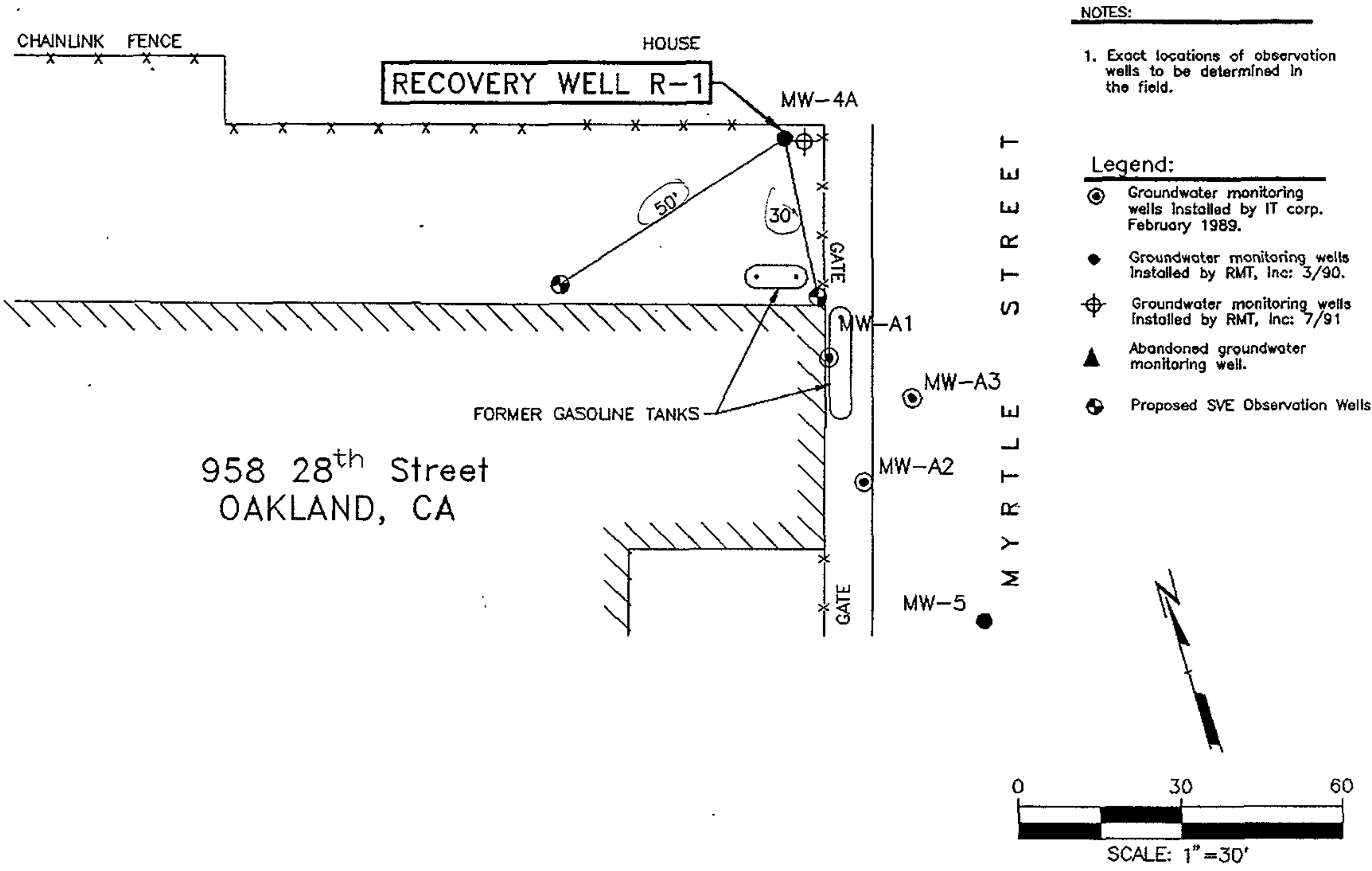
2.3 *In-situ* Permeability Testing

The pilot-scale test will be conducted using a portable SVE unit consisting of a blower, off-gas treatment, and necessary instrumentation. Because the SVE unit will be rented for the pilot test, specific information on the blower and off-gas treatment is not available at this time. However, it is anticipated that the test will be performed using a trailer mounted internal combustion engine (IC) equipped with an auxiliary blower and catalytic converter for off-gas treatment. (A typical IC unit is presented in Appendix B).

In-situ permeability testing will be conducted using recovery well R-1 and two newly installed observation wells. During the test, a vacuum will be induced on each extraction well for approximately 2 hrs and the well-head vacuums will be measured throughout that period. While any single well is being tested, the remaining observation wells and selected groundwater monitoring wells will be instrumented with vacuum gauges to evaluate the extent of influence through the subsoil. In addition, samples of the extracted soil-vapor will be collected from the extraction well at 30-min intervals throughout the pilot-scale test. Each sample will be collected using a sampling pump and a 250-ml glass sampling tube and analyzed using a Photovac 10S50 Gas Chromatograph.

The SVE pilot-scale test will include the following:

- Installation of a temporary blower capable of withdrawing 150 standard cubic feet per minute (scfm) under free air conditions on recovery well R-1.
- Installation of two observation wells at varying radial distances surrounding the existing recovery well R-1. The observation wells will be installed to a depth of approximately 15 ft bgs and constructed of 2-inch Schedule 40 PVC and will be used to help determine the radius of influence of the recovery well and subsurface air flow characteristics. It is anticipated that several of the observation wells will be used as extraction wells in the full-scale remediation system. (The proposed location of the SVE observation wells is presented in Figure 3.)
- Collection of soil-vapor samples at half-hour intervals from the SVE extraction well. The air samples will be analyzed for the presence of volatile organic compounds, including benzene, toluene, ethylbenzene, and xylenes (BTEX) using a portable gas chromatograph (GC). The results from the chemical analyses performed on the extracted soil-vapor samples will be used to estimate VOC emission rates and optimize soil-vapor extraction flowrates. In addition, the results of the chemical analyses will be included in the air permit application.
- Recording of well-head vacuum at the extraction well and *in-situ* soil pressures at the SVE observation wells throughout the test period to determine the soil permeability, radius of influence, and optimal soil-vapor extraction flowrate.



ARATEX SERVISCO
PROPOSED SVE OBSERVATION WELL LOCATIONS

RMT INC.

DWN. BY:	RAS
DATE:	JULY, 1993
PROJ.#	12012.15
FILE #	12012151

FIGURE 3

Section 3

DATA EVALUATION AND FULL-SCALE SVE SYSTEM DESIGN

The data from the SVE pilot-scale test will be evaluated and used in the design of the full-scale SVE system. The data collected, including system vacuum, airflow rate, air temperature, and off-gas concentrations will be input into a spreadsheet and used to compute VOC emission rates. An example of a spreadsheet is contained in Appendix C. This information will be used to size the full-scale blower and off-gas treatment.

The vacuum readings collected from adjacent wells during the pilot test will be used to calculate the radius of influence of each vapor extraction well. If necessary, additional vapor extraction wells may be installed. *The full-scale SVE system will consist of the following components:*

- Below-grade piping to connect the vapor extraction wells
- A common blower and motor
- Off-gas treatment
- Site improvements to accommodate the blower, motor, and controls
- Instrumentation to measure airflow rate and sampling points to collect off-gas sample
- Discharge piping and stack

Section 4

REGULATORY REQUIREMENTS

Based upon information supplied by the Bay Area Air Quality Management District (BAAQMD), off-gas treatment is required during pilot testing of an SVE system. As indicated in Section 2, off-gas treatment will be provided during the pilot-scale testing using a catalytic conversion unit. RMT anticipates that the necessary pilot testing can be completed in two days on-site.

Following the design of the full-scale SVE remediation system, and prior to construction, an Authority to Construct permit will be obtained from the BAAQMD. In addition, prior to start-up of the full-scale system, an operating permit will also be obtained from BAAQMD.

APPENDIX A

RECOVERY WELL CONSTRUCTION DIAGRAMS

Modifiers used in soil descriptions signify the following:

trace	<10 %,
little	10 to 20 %,
some	20 to 30 %,
and	30 to 50 %,
SS	California split-spoon sampler,

Colors are according to the Munsell color chart.

LOG OF TEST BORING

F-203 (R 01-87)

PROJECT NAME ARATEX - SERVISCO
LOCATION OAKLAND, CA
CONTRACTOR WEST HAZMAT DRILLING
DRILLING METHOD HOLLOW STEM AUGER

BORING NO. R-1
SHEET NO. 1 OF 2
PROJECT NO. 12012.13
INSTALLATION
SURFACE ELEV.
BOREHOLE DIA. 10 IN.

SAMPLING NOTES				
INTERVAL		RECOVERY		MOISTURE
NO.	TYPE	N	%	
1	SS	23	100	W
2	SS	20	100	SM
3	SS	50	100	SM
4	SS	50	100	SM
5	SS	50	100	M
6	SS	30	100	M
7	SS	50	100	M

DEPTH 1 2 3 4 5 6 7 8 9 10

VISUAL CLASSIFICATION AND GENERAL OBSERVATIONS

ASPHALT 4 - 6 IN.

SILTY CLAY (CL)
Some silt, very stiff, mod. plasticity, dusky brown, roots.

CLAY (CL-CH)
Trace silt, very stiff, mod. plastic, pale yellowish brown to dark yellowish brown.

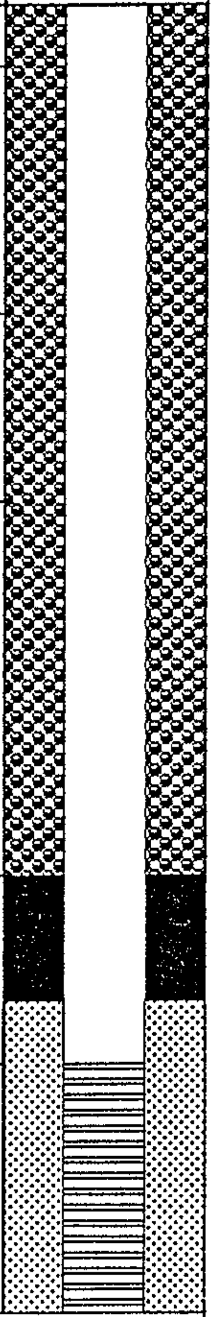
SANDY SILTY CLAY (CL)
Some sand and silt, trace gravel, hard, mod. yellowish brown.

increasing silt and sand.

SILTY SAND (SM)
Some silt, little clay and gravel, gradational upper contact, very dense, mod. yellowish brown, stained lt. olive gray lower 6 in., mottling and oxidation lower 6 in.

GRAVELLY SAND (SW)
Fine - coarse sand, fine gravel, trace silt, well graded, dense, angular, stained olive gray, strong petroleum odor.

GENERAL WELL CONSTRUCT.



GENERAL NOTES

DATE STARTED 22 MAR 93
DATE COMPLETED 22 MAR 93
RIG CME-53
CREW CHIEF
LOGGED T. DAVIS CHECKED

WATER LEVEL OBSERVATIONS

WHILE DRILLING ∇ 12.5
AT COMPLETION ▼
AFTER DRILLING
CAVE-IN: DATE/TIME DEPTH
WATER: DATE/TIME DEPTH

LOG OF TEST BORING

F-203 (R 01-87)

PROJECT NAME ARATEX - SERVISCO
LOCATION OAKLAND, CA
CONTRACTOR WEST HAZMAT DRILLING
DRILLING METHOD HOLLOW STEM AUGER

BORING NO. R-1
SHEET NO. 2 OF 2
PROJECT NO. 12012.13
INSTALLATION
SURFACE ELEV.
BOREHOLE DIA. 10 IN.

SAMPLING NOTES					
INTERVAL		RECOVERY		MOISTURE	
NO.	TYPE	N	%		DEPTH
8	SS	48	100	M	
9	SS	12	66	M	
10	SS	13	66	M	
11	SS	38	100		
12	SS	38	100		
13	SS	18	100		

VISUAL CLASSIFICATION AND GENERAL OBSERVATIONS

CLAYEY SANDY GRAVEL (GP)
Fine - coarse, angular sand and gravel, little clay (decreasing w/ depth), very dense, lt. to mod. brown with variegated gravel, sl. mottled, tr. petroleum odor.

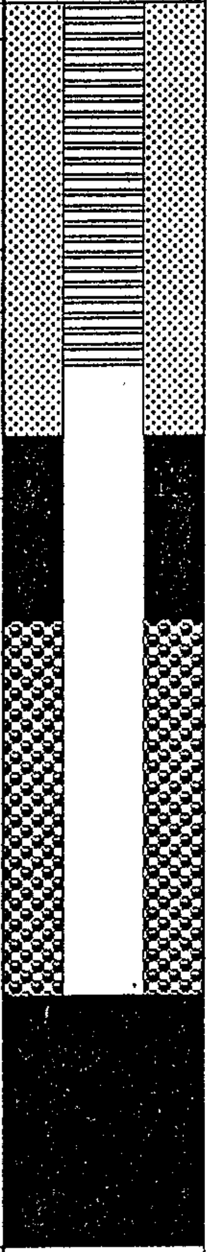
SANDY CLAY (CL)
clay with little fine Sand, hard, lt. brown.

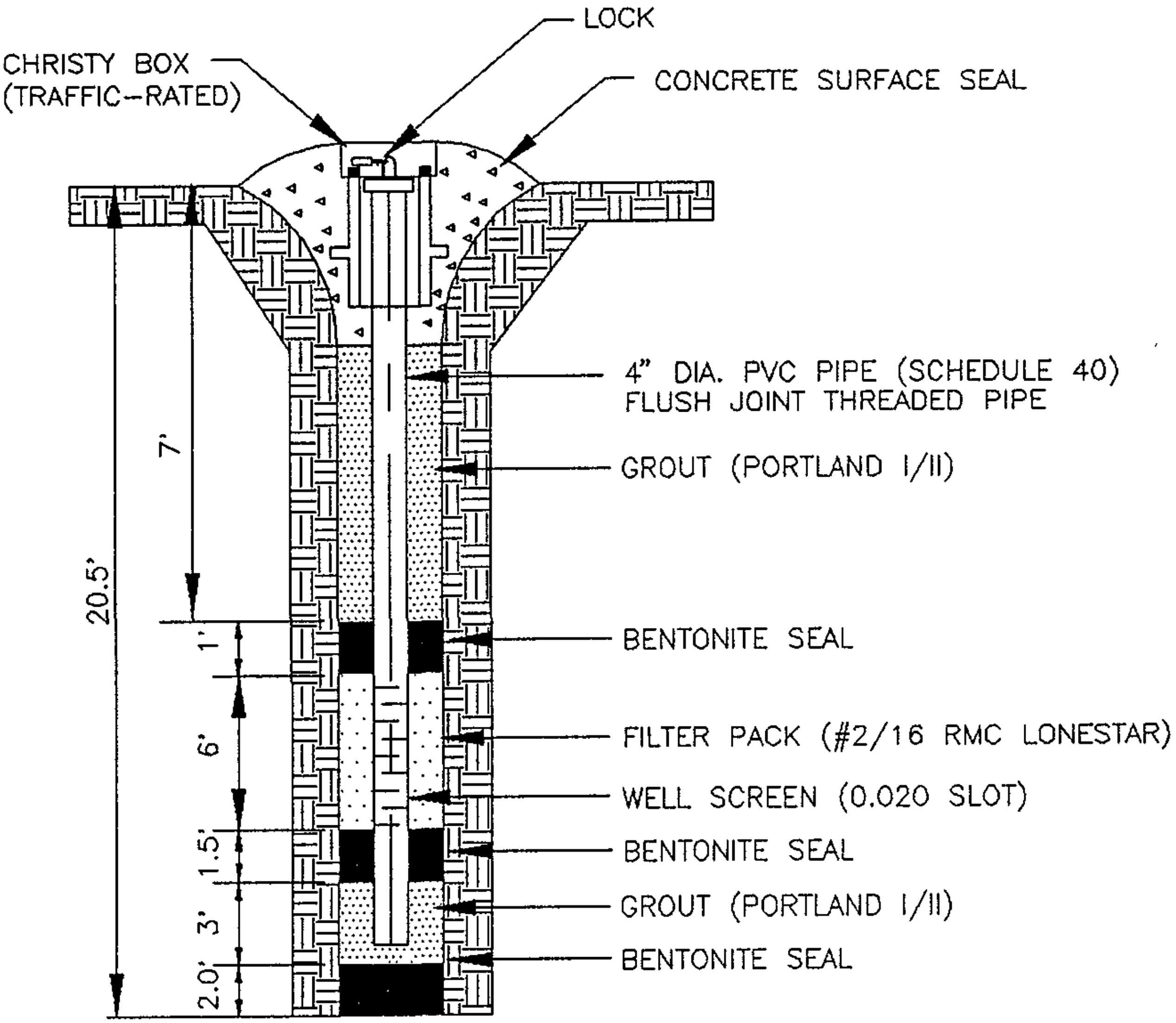
GRAVELLY SAND (SW)
Sand, fine - coarse, some gravel, fine - coarse, angular, well graded, tr. clay, medium dense, lt. olive gray.

SILTY SANDY CLAY (CL)
Little silt and very fine sand, tr. gravel, medium dense to dense, low plasticity, alternating lt. brown and pale olive.

Total depth = 20.5 ft.

GENERAL WELL CONSTRUCT.





WELL R–1
WELL CONSTRUCTION DIAGRAM

NOT TO SCALE

RMT INC.

DWN. BY:	RAS
DATE:	APRIL, 1993
PROJ.#	12012.13
FILE #	12012133

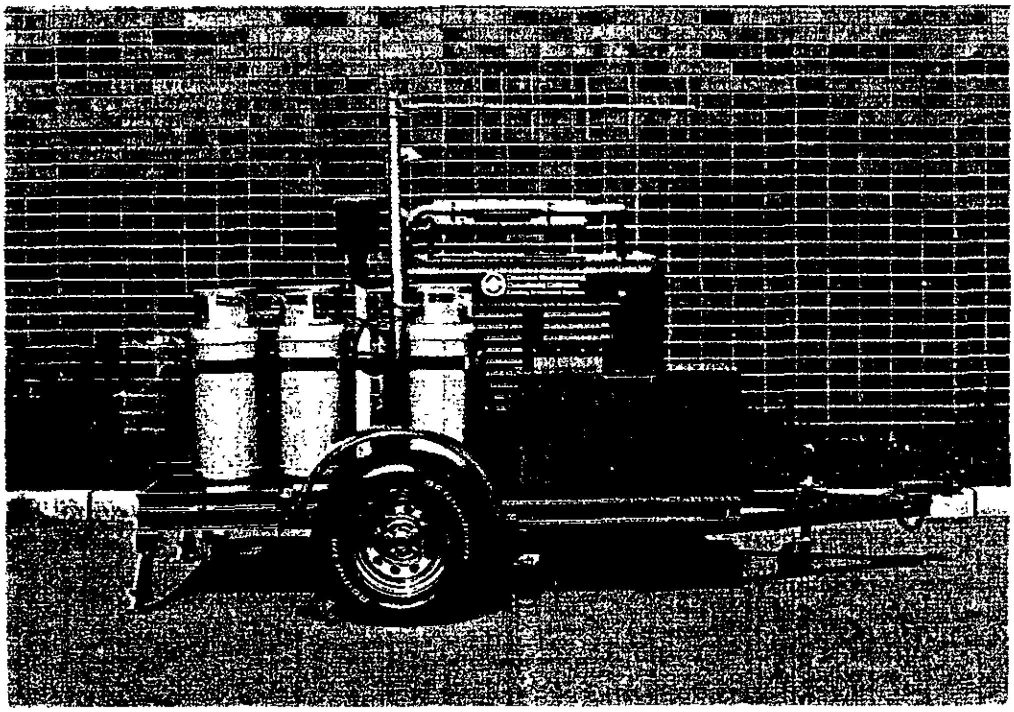
APPENDIX B

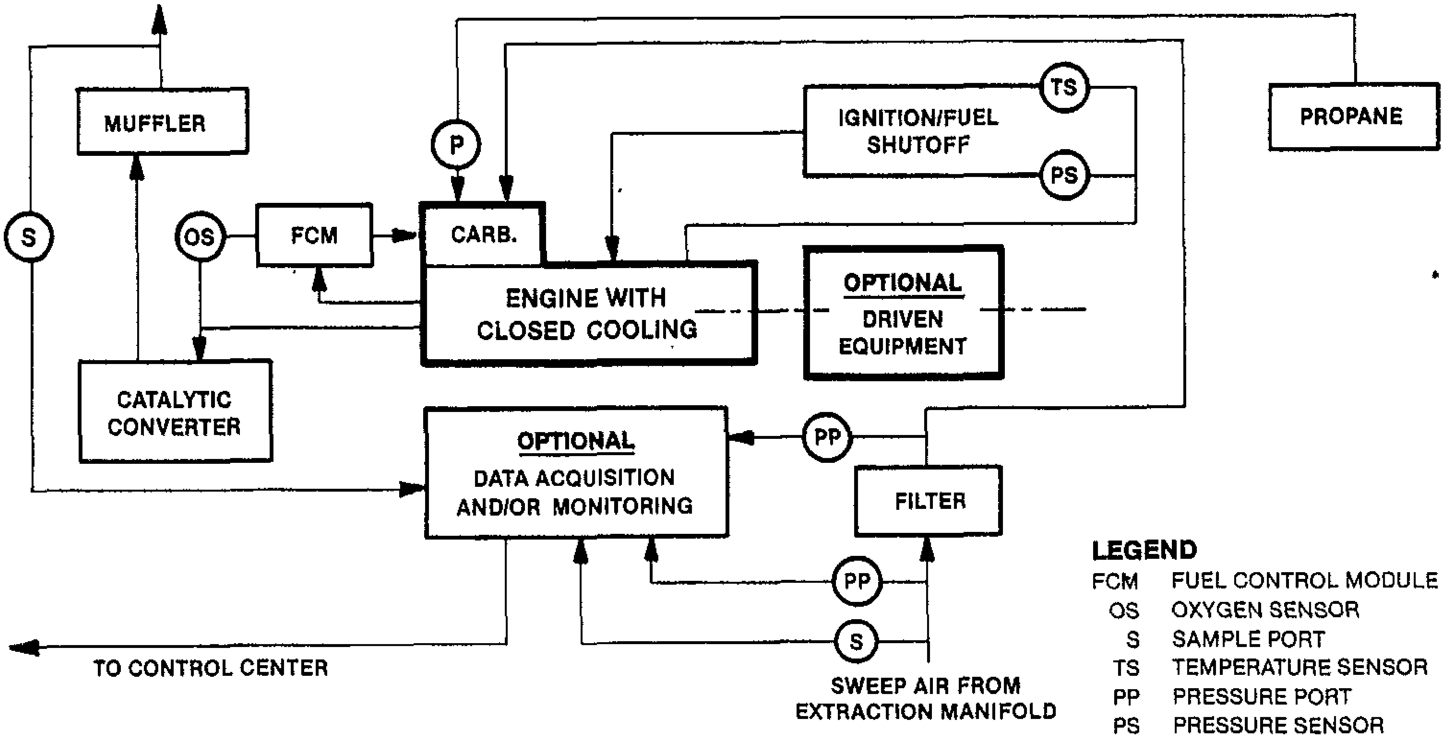
SVE BLOWER/CATALYTIC CONVERSION UNIT

LARGE SCALE EXTRACTION TREATMENT SYSTEM

CONVERSE ENVIRONMENTAL WEST

3393 East Foothill Boulevard, Pasadena, California 91107
818-796-8200 Fax 818-351-1060



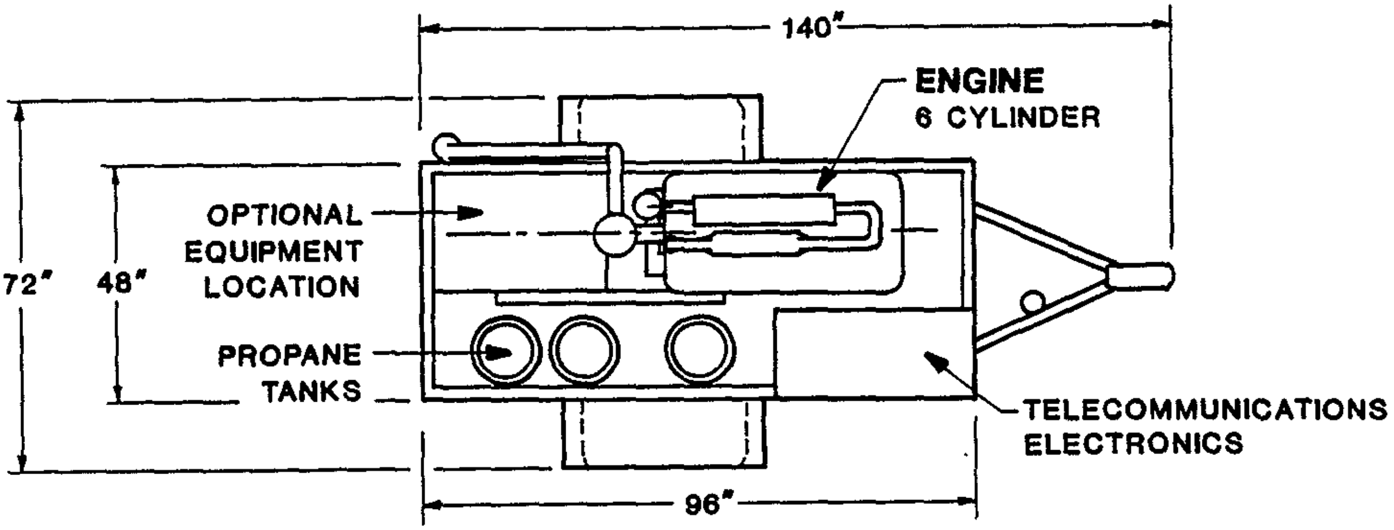


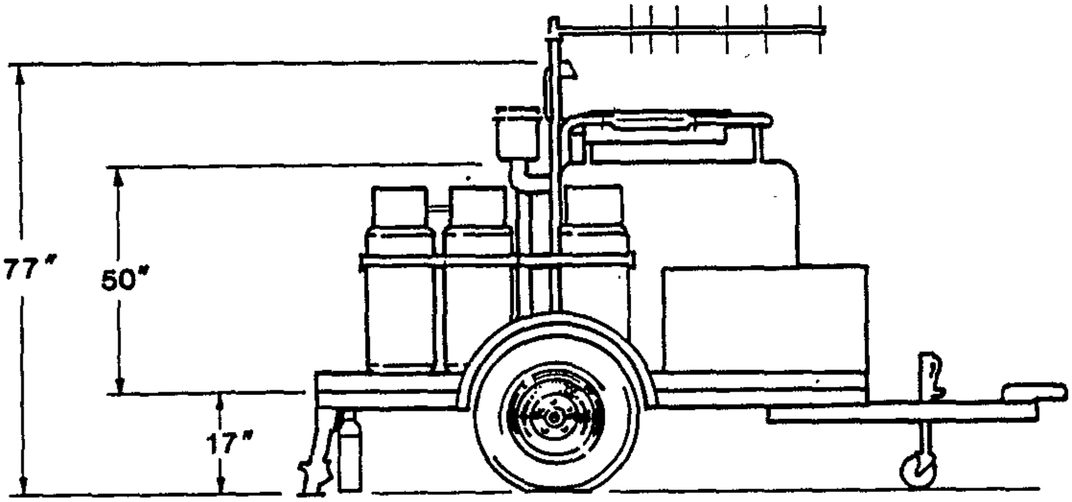
LEGEND

FCM	FUEL CONTROL MODULE
OS	OXYGEN SENSOR
S	SAMPLE PORT
TS	TEMPERATURE SENSOR
PP	PRESSURE PORT
PS	PRESSURE SENSOR
P	PRESSURE REGULATOR

VAPOR EXTRACTION FLOW DIAGRAM

SPECIFICATIONS





STANDARD FEATURES

1. Contaminated Vapor Filter — 10 micron, 97% Efficient
2. Engine — 6 Cylinder Industrial Power Unit, Liquid Cooled, 300 CID, Propane Fuel
3. Carburetion — 2 Stage Vaporizer-Regulator, 450 CFM Carburetor
4. Fuel Control Computer — Controls Air Fuel Ratio via Oxygen Sensor & Engine Parameters
5. Catalytic Converter — 3-way, Meets EPA Standards
6. Muffler — Heavy Duty
7. Propane Tanks — Three 43 Pound (10 Gal.) Portable, UL Listed
8. Trailer — Two 15 in. Wheels, Leveling Jack, Two Jack stands, 3500 lb. Axle
9. Engine Safety Gauges — Low Oil Pressure or High Coolant Temperature Will Shut Off Ignition and Fuel
10. Read Out Gauges — Engine Oil Pressure, Engine Coolant Temperature, Engine RPM Hours.

OPTIONAL FEATURES

1. Data Acquisition — Engine Monitoring and/or Sample Monitoring
2. Telecommunication — Transmits Data to Remote Monitoring Location. 48 Channels Maximum
3. Driven Equipment — Engine can Drive a Pump, Generator, etc. up to 100 BHP

SPECIFICATIONS

1. Weight — 1800 lb. w/Trailer, 1400 lb. w/skid
2. Dimensions (inch) — w/Trailer 140L, 77H, 72W; w/Skid 96L, 60H, 48W
3. Engine — Continuous Power 100 HP @ 3600 RPM, Continuous Torque 180ft-lb.
4. Throughput Capacity — up to 100 CFM

APPENDIX C

SVE PILOT-SCALE TEST DATA SPREADSHEET

Summary of Chemical Analyses of Soil-Vapor Samples

SVE Test Well	Field Data			Off-Gas Analysis		Calculated Data				Cumulative Recovery		
	System Pressure (inches of w.c.)	Differential Pressure (inches of w.c.)	Wellhead Temperature (°F)	TPH (lbs/cf)	Benzene (lbs/cf)	Cumulative Operation (hrs)	Air Flow (cfm)	TPH Flux (lb/hr)	Benzene Flux (lb/hr)	TPH (lb)	Benzene (lb)	Total VOC (lb)