Rec'd 1/7/94

WORKPLAN FOR A DUAL-PHASE EXTRACTION PILOT TEST AT ARROW RENTALS 187 North L Street Livermore, California

Prepared for

Don-Sul, Inc.
187 North L Street
Livermore, CA 94550

January 7, 1994

Woodward-Clyde Consultants

500 12th Street, Suite 100
Oakland, California 94607-4014

Woodward-Clyde Consultants

Engineering & sciences applied to the earth & its environment

January 5, 1994
93C0276A

Ms. Eva Chu
Alameda County Health Care Services Agency
Department of Environmental Health
80 Swan Way, Room 200
Oakland, CA 94621

Subject: Workplan for a Dual Phase Extraction Pilot Test
Arrow Rentals Site, 187 North L Street, Livermore, CA

Dear Ms. Chu:

Attached for your review and approval is a workplan for a pilot test at the Arrow Rentals site located at 187 North L Street, Livermore, CA. This pilot test is proposed in order to gather data required to finalize the design for remediation of the site.

Woodward-Clyde Consultants is providing environmental engineering consulting services to Arrow Rentals and is submitting this workplan on their behalf. If you have any questions, please feel free to phone me at (510) 874-3138.

I am looking forward to working with you and other Alameda County staff on this project.

Sincerely,

Jo Beth Folger

Jo Beth Folger

Mike Basel will be technical person doing pilot test.

Attachment

cc: Rita Sullins, Arrow Rentals

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500 12th Street, Suite 100 • Oakland, CA 94607-4014 • (510) 893-3600 • Fax (510) 874-3268

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1.0
INTRODUCTION

1.1 BACKGROUND AND OBJECTIVES

The Arrow Rentals site, located at 187 North L Street in Livermore, California, was operated as a gasoline station from about 1951 to at least 1968. Don-Sul, Inc./Arrow Rentals purchased the property in 1972. Three of five existing underground storage tanks were removed in 1972. In 1984, a new 1000 gallon underground gasoline storage tank was installed. Two more tanks were removed in 1986. From 1988 through 1992, Woodward-Clyde Consultants (WCC) has performed studies of this site which have collected and analyzed information related to petroleum hydrocarbon contamination. Figure 1 shows the existing monitoring well locations as well as the locations of previous soil borings and Woodward-Clyde's interpretation of the extent of hydrocarbons in groundwater at the site.

The objective of the upcoming work is to remediate hydrocarobon impacted soil and groundwater to levels acceptable to the concerned regulatory agencies. Preliminary analysis indicates that a dual phase extraction (DPE) system (i.e. extraction of both groundwater and soil vapors) may be appropriate. In order to confirm this assumption and design an optimal system to perform that remediation, additional data regarding the characteristics of the soil must be obtained. This data can best be obtained by performing pilot tests as described in this workplan.

This workplan has been developed based on the limited data which is currently available. The results of two slug tests indicate that the hydraulic conductivity in the water-bearing zone at the site is approximately 10^{-4} cm/s. DPE has been found to be an applicable technology for groundwater and vapor extraction in soils having a hydraulic conductivity from 10^{-3} to 10^{-5} cm/s (Blake, et al, 1990). These approximations indicate that DPE may be applicable strategy for remediating the Arrow Rentals site. If the DPE pilot test indicates a higher hydraulic conductivity than expected, a remedial strategy incorporating conventional pump-and-treat techniques in conjunction with vapor extraction may be more applicable.

This workplan is intended to provide an outline for performance of the pilot test, given the assumptions provided by previous studies. During the performance of the pilot test, the schedule and planned activities may be modified slightly to accommodate the optimum collection of data. The results of the test will be used to design a long-term remedial strategy for the Arrow Rentals site.

1.2 DESCRIPTION OF PILOT TEST UNIT

The pilot test will be performed using a dual-phase extraction (DPE) system which simultaneously extracts vapor and groundwater by applying a vacuum to a small diameter pipe (suction "straw") inserted in the extraction well casing. After extraction from the well, soil vapor and groundwater are separated in a primary water knockout tank. The soil vapors flow through the vacuum pump before entering a secondary water knockout tank. Vapors then exit the DPE unit, and are routed through a granular activated carbon (GAC) air emissions treatment system.

The liquid that is separated from the vapor stream accumulates in the primary knockout tank until an electronic float cycles on the fluid transfer pump. Liquid is pumped out of the primary tank, through a flow totalizer, and discharged to a temporary holding tank. Average groundwater extraction rates are calculated from the measurements of the flow totalizer and the elapsed time between cycles of the fluid transfer pump. For the pilot test, the liquid transfer pump will be programmed to empty the water knockout tank in 6 gallon cycles. Water which accumulates in the secondary knockout tank is pumped by a recirculating pump through an air-cooled heat exchanger for use as the liquid ring, vacuum pump sealant. The system has a number of safety switches and automatic controls which are located on a control panel on the unit.

The components for the mobile, DPE pilot test unit are mounted on a trailer licensed for highway transport by the California Department of Motor Vehicles. The pilot test unit is capable of developing a vacuum of up to 28 inches of mercury (in. Hg). The vacuum is provided by an Atlantic Fluidics liquid ring vacuum pump with a rated capacity of 130 inlet cubic feet per minute (cfm). The vacuum pump is driven by a 10-horsepower motor operating at a speed of 1,740 revolutions per minute, which requires an external, three-phase,

AC power supply of 230 or 460 volts. Electric power will be provided by a 25-kW diesel-powered generator.

2.0
SCOPE OF WORK

The dual-phase extraction (DPE) pilot study will consist of four tasks, as follows:

- Task 1 - Preliminary Preparation
- Task 2 - DPE Pilot Test
- Task 3 - Data Analysis
- Task 4 - Report

These tasks include procurement of appropriate permits, performance of a DPE pilot test at the site, collection and analysis of applicable data, and a report which discusses the results and provides recommendations for a long-term remedial strategy. Details of each task are discussed in the following subsections.

2.1 TASK 1 - PRELIMINARY PREPARATION

Preliminary activities will include an evaluation of the potential for free product recovery, background monitoring of groundwater levels at the site, and procurement of appropriate permits for the subsequent DPE pilot test. All work will be coordinated with Arrow Rentals to minimize disruption of the existing business operation. It is expected that some equipment at the site may be moved temporarily, but the pilot test will not require any significant changes to business operation.

Prior to the pilot test, a passive oil skimmer will be installed in well W-1, which has contained a thickness of free product of four inches to two feet. The level of free product on November 10, 1993 was above the top of the screened interval of the well. The oil skimmer is designed to float at the oil/water interface and has an inlet with a hydrophobic screen which only permits product to enter the skimmer. Free product entering the float would be collected in a hollow cylinder, which would be emptied periodically by pulling the skimmer assembly to the surface or by using a pump. If the oil/water interface remains above the top of the screened interval of the well, the oil skimmer will not be used because

continuous recovery of free product from the well would not be possible. In this case, the skimmer would be installed in the well during the pilot test and checked on an hourly basis.

Background water levels will be monitored in two wells for 24 hours prior to the pilot test using pressure transducers and an automatic datalogger. Transducers will be installed in wells in which the water level is within the screened interval of the well casing. Assuming the site conditions as shown in Table 1 remain unchanged, background monitoring will be conducted using well W-B and well W-3.

Permits which will be obtained for the DPE pilot test include a water disposal permit from the Livermore POTW. Preliminary discussions with the POTW have indicated that the permit will require approximately one month to process. Verbal approval will also be obtained from the air quality management district, which does not require a permit for a pilot test.

2.2 TASK 2 - DPE PILOT TEST

After completing the preliminary preparation, the dual-phase extraction pilot test will be conducted during a two day period. Groundwater and soil vapor will be simultaneously extracted from different extraction wells by applying a vacuum to a PVC pipe, or straw, inserted down the well casings This system has been used by WCC to recover groundwater at depths as low as 60 feet below grade in soils of low hydraulic conductivity. The pilot test will be conducted using the standard DPE operating procedures developed by WCC.

The pilot test will consist of mobilization of equipment at the site, monitoring of operating parameters, monitoring of induced vacuum and groundwater levels in wells, and field and laboratory analysis of vapor and groundwater samples. Mobilization at the site will include placement of the equipment and supplies that are listed in Table 2. Groundwater and vapor will be extracted using a mobile DPE unit, which is discussed in further detail in a subsequent section. Other major equipment include a 25-kW diesel generator, holding tank for storing extracted water, and vapor-phase granular activated carbon (GAC) drums for air emissions treatment. This equipment will be placed within 50 feet of well W-A.

Immediately prior to initiating the pilot test, the groundwater level in all wells near the pilot test site will be measured using an electric water level sounder. The thickness of free product

(where present) will be measured using a hydrocarbon interface probe. Free product has previously only been detected in well W-1. The locations of wells which will be sounded are shown on Figure 1, and include wells W-1, W-2, W-3, W-A, W-B, and W-C.

The pilot test will include a 24-hour test of dual-phase extraction from well W-A, followed by a shorter, 4-hour test using well W-3. Vapor and groundwater will be extracted from the wells using a 1-inch-diameter PVC straw. The straw in well W-A will be inserted to a depth of 6 feet below the static groundwater level, and the straw in well W-3 will be inserted to a depth of 4 feet below the static groundwater level. At these depths, soil vapor will be drawn into each test well through four feet of screened casing. Fluids will be conveyed from the extraction well to the DPE unit using flexible, 2-inch-diameter PVC suction hose.

At the Arrow Rentals site, the groundwater level is approximately 40 feet below the ground surface. The DPE system, which applies a vacuum of up to 32 feet of water, can not extract groundwater from below 32 feet as a solid column. The DPE system extracts groundwater from such depths as entrained droplets in the vapor stream. WCC experience at similar sites has indicated that a maximum groundwater extraction rate of 2 gpm is achievable for an optimum vapor velocity of 5,000 feet per minute. Since the groundwater level in well W-A is currently above the top of the screened casing, air will be initially supplied by a compressor and bubbled into the extraction well to aid recovery of the groundwater. After this initial priming, the groundwater level will drop to the screened interval and soil vapor will enter the casing.

WCC will provide constant supervision of the operating system throughout the pilot test to maintain continuous operation and collect data. Data which will be collected is listed in Table 3 and will include the operating parameters of the DPE unit, groundwater and vapor extraction rates, groundwater level and vacuum response in adjacent wells, and sample collection for chemical analyses. Sample data sheets for data which will be recorded manually are attached as Appendix A. Field data will be collected on an hourly basis during initial startup, and at two-hour intervals during the latter stages of the test.

Adjacent wells will be monitored for induced vacuum using pressure-fitted PVC end caps equipped with brass labcocks connected to magnehelic vacuum gages. The endcaps will be removed at four hour intervals and groundwater levels will be measured for each well using

electric water level sounders. Groundwater level data for wells W-1 and W-B will be collected automatically using pressure transducers and a datalogger.

Extracted vapor will be sampled and analyzed periodically during the pilot test by three methods: a hand-held flame ionization detector (FID), Gastec tubes, and laboratory analyses of samples in tedlar bags. The FID will be used to monitor the total organic concentration in the vapor stream entering and leaving the GAC drums. These concentrations will allow the effectiveness of the GAC to be monitored throughout the pilot test. It is expected that two 150-pound drums of GAC will provide adequate air treatment for the two-day pilot test. The Gastec tubes will be used to indicate the concentrations of total petroleum hydrocarbons, oxygen and carbon dioxide in the vapor.

Samples of the vapor will also be collected periodically using Tedlar bags and delivered via courier to a laboratory for analysis. Two samples will be collected one hour after the air compressor is shut off: one from the inlet to the first GAC drum and one from the outlet of the second GAC drum. Both of these samples will be analyzed for hydrocarbon constituents by EPA Method TO-14, and the sample from the inlet will also be analyzed for atmospheric gases such as oxygen and carbon dioxide by a Modified ASTM D-3416. A sample will also be collected from the inlet prior to shutdown of the test and analyzed by EPA Method TO-14. It is assumed that the vapor concentrations will not vary significantly during the pilot test, and two samples of the extracted vapor before GAC treatment will be sufficient to indicate the concentrations throughout the pilot test.

Samples of extracted groundwater will be collected during the pilot test at the approximate same time that vapor samples are collected. These samples will be analyzed for total petroleum hydrocarbons using Modified EPA Method 8015. A composite sample will also be collected from the holding tank after completion of the pilot test and analyzed using Modified EPA Method 8015. The results of the composite analysis will be used to determine appropriate disposal of the stored groundwater. It is assumed that this water will be discharged directly to the Livermore POTW.

2.3 TASK 3 - DATA ANALYSIS

After completion of the pilot test, the data will be summarized and analyzed to allow the performance of DPE at the site to be evaluated. Summary tables will include a chronological presentation of test parameters such as applied vacuum, measured responses such as induced vacuum and groundwater drawdown, and results of chemical analyses of vapor and groundwater samples. Figures will be prepared which graphically demonstrate the vapor and groundwater extraction rates, vacuum responses, and groundwater responses. Based on the analysis of the data, WCC will provide recommendations regarding an appropriate long-term remedial strategy at the Arrow Rentals site.

2.4 TASK 4 - REPORT PREPARATION

A report will be provided which summarizes the performance of the pilot test, discusses the results, states conclusions, and provides recommendations for a long-term remedial strategy. The report may also provide recommendations regarding further work which should be completed before a remediation design can be completed.

TABLE 1

WELL CONSTRUCTION AND GROUNDWATER DEPTHS

Well No.	Total Depth of Well (Feet BGS)	Screened Interval Depth Below Ground (Feet)	Depth to Groundwater* (Feet BGS)	Well Diameter
W-A	63	42-57.5	40.23	4″
W-B	55	40-55	41.33	4″
W-C	55	45-55	39.2	2″
W-D	57.5	42-57.5	NA	4″
W-E	61	40.5-60.5	NA	2″
W-1	56.5	45.5-55.5	40.34	2″
W-2	49	39-49	40.28	2″
W-3	48	38-48	39.76	2″

*Depth to groundwater as measured on November 10, 1993. W-D and W-E were not measured.

BGS = Below ground surface.

TABLE 3

DATA TO BE COLLECTED DURING PILOT TEST

Time when test unit is started and stopped
Time of each measurement
Applied vacuum at vacuum pump inlet
Temperature at vacuum pump inlet and outlet
Vapor flow rate
Identification of test wells
Induced vacuum at monitoring wells
Groundwater level in adjacent wells
Cumulative extracted groundwater volume
FID readings of extracted vapor and effluent discharged to atmosphere
Gastec tube analysis results

TABLE 2

EQUIPMENT AND SUPPLIES REQUIRED FOR PILOT TEST

Mobile DPE system
25-kW diesel generator to power test unit
4,000-gallon holding tank for storing water produced during test
Two 55-gallon drums of vapor-phase granular activated carbon for air emissions control
OVA-FID for monitoring volatiles in extracted soil gas
Sensidyne™ pump and Gastec™ tubes for monitoring CO_2, O_2, and petroleum hydrocarbons, in extracted soil gas
Hydrocarbon interface probe for monitoring groundwater and hydrocarbon liquid level in monitoring wells
Groundwater sample bottles for chemical analysis of extracted water
Tedlar™ bags for collection and laboratory analysis of extracted soil gas
Water level indicators
Vacuum gauges for monitoring vacuum at wells and soil gas probes
Thermometer for checking temperature of extracted gas/water mixture
Flow meter for measuring soil gas extraction rate
Flow totalizer for measuring cumulative groundwater extraction volume
Pipe, valves and fittings for connecting test unit to wells
Log books for recording test data and conditions
Tools and supplies for installing and dismantling connections
Hard hats, field boots, rain clothes, gloves
Health and safety personal protective equipment

SAMPLE DATA SHEET FOR DPE PILOT TEST

Well Vacuum Data

Location:
Extraction Wells:
Pilot Unit: WCC Dual Phase Extraction Pilot Trailer

Date	Time	Vacuum at Wellhead (In Hg)		Vacuum in Straw (In Hg)		Vacuum in casing of monitoring wells (In H2O)						Comments
		Well #	Well #	Well #	Well #	Well #	Well #	Well #	Well #	Well #	Well #	

SAMPLE DATA SHEET FOR DPE PILOT TEST

Pilot Unit Data

Location:
Extraction Wells:
Pilot Unit: WCC Dual Phase Extraction Pilot Trailer

Date	Time	Pump Vacuum (In Hg)	P discharge (psi)	T inlet (deg F)	T outlet (deg F)	Air Velocity (fpm)	Air Flow (cfm)	FQI (gal)	Total Flow (gal)	Comments

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SAMPLE DATA SHEET FOR DPE PILOT TEST

Field Chemistry Data

Location:
Extraction Wells:
Pilot Unit: WCC Dual Phase Extraction Pilot Trailer

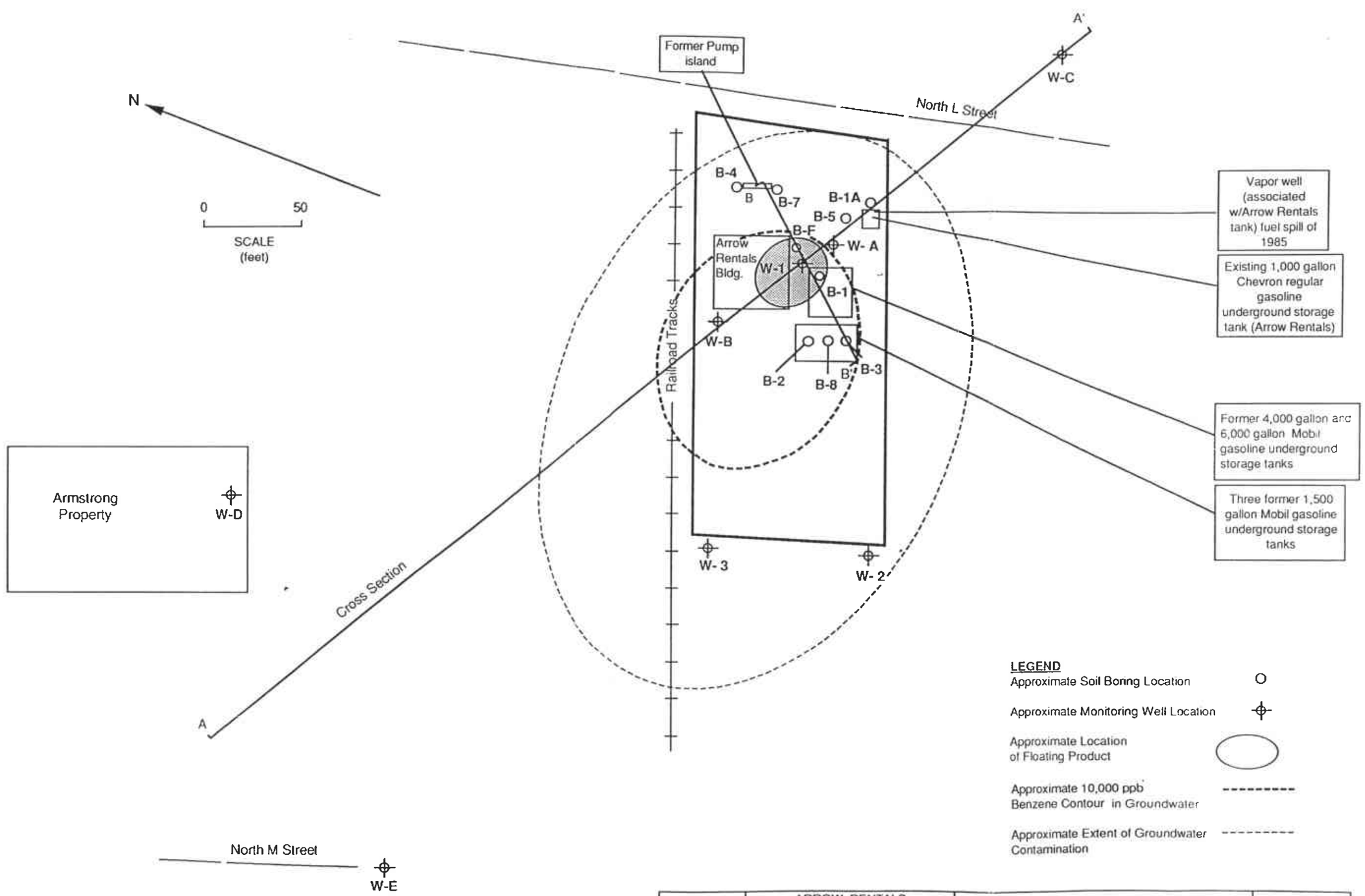
Date	Time	Vapor monitoring with OVA (ppm)			Gastec Colorimetric Tubes (ppm)					Comments
		GAC Inlet	Btwn GAC	GAC Outlet	Pet. Distill	Gasoline		CO2 (%)	O2 (%)	

SAMPLE DATA SHEET FOR DPE PILOT TEST

Groundwater Level Data

Location:
Extraction Wells:
Pilot Unit: WCC Dual Phase Extraction Pilot Trailer

Date	Time	Groundwater Levels in monitoring wells (ft below top off casing)								Comments



	ARROW RENTALS 187 North L Street Livermore, California	EXISTING SITE CONDITIONS	
Woodward-Clyde Consultants			FIGURE 1