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April 22, 1992

Lester Feldman
Regional Water Quality Control Board
1800 Harrison, Suite 700
Oakland, CA 94621

Re: Livermore Arcade Shopping Center PCE Site - Soil Vapor Extraction Pilot Test Work Plan

Dear Mr. Feldman:

Preliminary results of the remedial investigation for the Livermore Arcade Shopping Center PCE Site indicate that pilot testing of a soil vapor extraction ("SVE") system is necessary before completion of the feasibility study regarding the site. Enclosed for your information is a copy of the work plan that will guide this pilot testing program.

Since the remedial investigation has been substantially completed, we also anticipate releasing the draft remedial investigation ("RI") report in the near future. The RI report will be circulated in advance of the feasibility study report in order to keep you informed of the current status of our investigations, and to provide a basis for further discussions among the parties.

Thank you for your attention to this matter. Following release of the RI report, we would like to arrange a meeting to discuss the implications of the RI.

Sincerely,

Alan Waltner

Attachment: H+GCL SVE pilot test work plan

cc (with attachment):

Larry Seto
Alameda County Health Department
Dept. of Environmental Health
80 Swan Way, Suite 200
Oakland, CA 94621

Livermore Arcade Shopping Center
Work Plan for
Remedial System Pilot Test

April 16, 1992

Prepared for:

Grubb and Ellis Realty Income Trust
and
California Regional Water Quality Control Board

Prepared by:

H⁺GCL

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1.0 Introduction

It has been determined that an isolated zone of sub-surface soil and ground water has been contaminated with tetrachloroethylene (PCE) at the Livermore Arcade Shopping Center (Arcade) in Livermore, California, and that remediation of this site is required. The "Livermore Arcade Shopping Center (Arcade) Soil and Ground-Water Investigation, Work Plan for Remedial Investigation/Feasibility Study January, 1992, (Work Plan) indicated that a draft combined Remedial Investigation/Feasibility Study (RI/FS) Report would be circulated following completion of the RI/FS. The Work Plan also stated, however, that pilot tests might be necessary to complete the feasibility study. Following the remedial investigation, which has now been substantially completed, it has been determined that additional pilot scale testing will in fact be necessary to evaluate the performance of a soil-vapor extraction (SVE) system at this site. As anticipated, the remedial investigation has confirmed that the ground-water table at the site has dropped dramatically since the contamination was discovered, and it appears that the water has dropped below the zone of contamination. This indicates that treatment of the contaminated soil, now located above the ground water, should be effective in removing the source of contamination and eliminate further ground-water contamination. Soil-vapor extraction (SVE) should be very effective in this situation, and is proposed for on-site pilot testing prior to final recommendations. The data collected from the pilot test will be used for the feasibility study.

A complication has arisen at the site, however. The recent rains in California have caused the water table to begin rising. If the ground water should again rise into the zone of contaminated soil, then soil-vapor extraction alone may not be sufficient to accomplish complete remediation. Therefore, the option will be open to add air sparging (AS) to the vapor extraction system to provide a complete soil and ground-water treatment system to meet the changing needs. If rising ground water appears to become a problem, then an air sparging pilot test will also be conducted.

2.0 Remedial Technology Description

The Work Plan identified three preliminary remedial action alternatives, including no action, ground-water treatment, and SVE. It has been tentatively determined that the no-action alternative will not meet the contaminant based applicable or relevant and appropriate requirement (ARAR) specified by the Regional Water Quality Control Board of 5 parts per billion (ppb) in the ground water. The no action alternative also does not appear able to reduce to acceptable levels the human health risks identified in the baseline health risk assessment.

As to the remaining two preliminary remedial action alternatives, an initial screening indicates that SVE is likely to be significantly less costly than ground water extraction and treatment, with equal or greater effectiveness and ability to meet ARARs. Current cost estimates (including operation and maintenance) for a SVE system at this site are in the range of $100,000 to $150,000. It should be noted that until completion of the feasibility study and remedial design phases, these general estimates are subject to substantial change. For comparison purposes, however, a ground water extraction and treatment system of comparable scope is estimated to cost in the range of $200,000 to $250,000 (lifecycle costs including operating and maintenance).

SVE also allows cleanups to be performed with a modular or phased approach, utilizing one or more trailer mounted extraction units. Due to site-specific uncertainties in the performance of SVE systems, it is proposed to evaluate the results of a single SVE module before selecting the final remedy and scaling the system to the final level.

SVE systems work above the water table. This soil treatment method removes volatile organic compounds (VOCs) from soil by drawing vapor, primarily air, through the soil enhancing the natural rate of volatilization. Air is drawn through the soil by applying a vacuum at a well with a vacuum blower. The pressure difference created by the vacuum draws air from the ground surface or from adjacent wells open to the atmosphere through the contaminated area. A concentration difference is created between the relatively clean air flow and the contamination. This contamination difference allows the contaminants in the soil to be transferred by volatilization into the air and ultimately extracted through the vent well, which is under a vacuum. Three main factors control the performance of a soil-vapor extraction system: (1) chemical composition of the contamination, (2) vapor flow rate through the unsaturated zone and (3) flow path of carrier vapors relative to the location of the contaminants. In order to design a functional SVE system, the above factors must be determined.

The typical SVE system uses vertical extraction wells, located within the contaminated soil, that are connected to a high capacity vacuum blower. The withdrawn soil-vapor is usually treated by activated carbon before being released to the atmosphere. Vapor extraction wells must be screened, at least partially, in the vadose zone. Existing monitor wells and ground water extraction wells can be used as vapor extraction wells if they are screened above the water table as well as below. Suitably located existing wells can be converted for vapor extraction by merely connecting a vacuum blower to the well casing with PVC pipe.

The SVE system to be used in the pilot testing program will consist of a trailer mounted EG&G Rotron model DR 707 regenerative blower vacuum pump driven by a 5 horsepower explosion proof electric motor. This blower produces a vacuum of 6 in. Hg at a flow rate of 100 scfm. Preliminary estimates of the porosity in the vadose zone indicate that this system will extract soil vapors at a rate of approximately 40 cfm with a corresponding vacuum of 6.6 in. Hg.

Extracted vapors will be passed through a Westates model VSC-200 carbon adsorption unit before discharge to the ambient air. These units have a maximum flow rate of 100 cfm and a shipping weight of 235 lbs. Two of these will be connected in series so that when the first unit becomes saturated, the second unit will take over and become the first unit. The saturated unit will be removed and a new unit replaced in the second position. As indicated in the draft remedial investigation report, soil-vapor concentrations up to 772 ppm were found in MW 7, where the highest concentrations were identified. The carbon adsorption unit is expected to reduce exhaust concentrations of PCE to less than 10 ppm, assuming intake flows of up to 100 cfm and an average intake PCE concentration of 100 ppm. This reduction will satisfy the 90% reduction requirement for the action-specific ARAR discussed below in section 6.0.

The equipment costs of the pilot testing system are anticipated to be approximately $30,000 and the monthly operation and maintenance costs for the system are anticipated to be $6,300. Additional drilling, sampling and analysis costs required to conduct the pilot testing program are anticipated to total $8,000.

The pilot testing system is sized and designed so as to likely serve as a component of the final remedial action undertaken at the site.

If ground-water treatment is also required because of the rising ground water table, then air sparging may be recommended in addition to SVE. The addition of air sparging would add approximately $5,000 to the total equipment cost.

Air sparging targets volatile organic vapors (VOCs) below the water table. The approach effectively creates a crude air stripper in the subsurface, with soil acting as the packing. Air is injected into the aquifer and allowed to flow through the water column over the soil packing. Air bubbles that contact dissolved and adsorbed phase contaminants in the aquifer cause the VOCs to volatilize. The organics are then carried by the air bubbles to the vadose zone where they are captured by a vapor extraction system or allowed to escape through the ground surface. Biological activity takes place within this soil packing and is enhanced by the availability of oxygen from the injected air.

Air sparging wells must be screened only below the surface of the aquifer in order to allow pressurization of the well and enhance the transfer of air into the aquifer. Air is forced into the aquifer by means of a high pressure air blower. Existing ground-water monitor wells and recovery wells may be used for air sparging if they are screened only below the ground-water table and are appropriately located. Small diameter pipes or well points driven into the ground can also serve as air injection points.

Air sparging induces movement of ground water within the aquifer and increases the concentration of vapors in the soil. Therefore, AS is usually operated in conjunction with an SVE system, as an AS/SVE system, in order to control the movement of vapors in the soil. The combined techniques of soil vapor extraction and air sparging can provide very effective remediation in a short time and at a reasonable cost.

This remedial system pilot test work plan outlines a testing procedure that will determine if an SVE system will be a feasible and economical treatment method for the Arcade site, if it will be sufficient to provide complete treatment, or if AS must be added. The pilot test will also provide design criteria for a full scale treatment system.

3.0 Data Requirements

Additional data are required to determine if SVE is the appropriate method for soil treatment at the Arcade site. The horizontal and vertical extent of contamination, the type of contamination, and the soil's permeability to air must be determined. The type of contamination in the soil has already been determined. The other unknowns will be obtained through additional soil gas measurements, soil borings, and through an on-site pilot test of an SVE system. With the data from these tests, the number of wells required, the well positions, and the estimated time required for treatment can be determined. This will be followed with an on-site pilot test of an AS system, if this is determined to be necessary.

PCE is known to be the major contaminant at the Arcade Site. A soil boring sample from MW 17 indicated that traces of cis-1,2-dichloroethene are also present in the soil. The soil-vapor survey that was performed on the monitor wells indicated that toluene, o,p and m xylene and trichloroethene could be present in the soil as well.

Since SVE and AS are volatilization treatment processes, the vapor pressures of the contaminants in the soil is of most concern. If the vapor pressure of the compound is 1 mm Hg or above the compound can generally be removed by SVE or AS. Table 1 shows the vapor pressures of the contaminants that are present in the subsurface at the Arcade Site.

Table 1

Compound	Vapor Pressure @ Temperature (mm Hg)
Benzene	76 (20 C)
Toluene	22 (20 C)
Ethylbenzene	7 (20 C)
o-Xylene	5 (20 C)
m-Xylene	6 (20 C)
p-Xylene	6.5 (20 C)
1,2-DCE	200 (25 C)
TCE	60 (20 C)
PCE	14 (20 C)

The vapor pressures of the compounds in table 1 show that all the compounds of concern can be removed by SVE or AS.

The horizontal and vertical extent of soil contamination at the Arcade site has not been fully determined. Water samples obtained from the monitor wells before the groundwater receded, show that the water contamination extended downgradient to MW 14 with 1 ppb of PCE found in the well during sampling on 7-25-91. A good assumption is that the soil contamination does not exceed the boundaries of the groundwater contamination before the groundwater receded. Two soil borings were drilled, one near the source of contamination (MW 17) and another downgradient (MW 18). The soil boring samples from MW 17 show the depth of contamination ranging from 42 feet to 65 feet below ground surface in that area. The soil boring samples from MW 18 show the contamination ranging from 46 feet to 55.5 feet.

Soil-vapor samples were obtained from the monitor wells to better ascertain the horizontal extent of contamination. These samples show that the contamination extends downgradient to, and possibly past, MW 13; and to the sides, possibly past MW 10 (West) and MW 9 (East). In order to properly determine the applicability of an SVE or AS system, a determination of the extent of contamination is required. To make this determination additional soil borings may be required. Soil-vapor and groundwater sample results will be used to properly place these additional soil borings, and additional soil-vapor samples may be required for this purpose.

The soil's permeability to air determines the air flow rate and the horizontal extent of influence that can be obtained by applying a vacuum to a well. A sandy soil will provide a high permeability to air and a large influence area as opposed to a clayey soil, which will have a low permeability to air and a small influence area. The air permeability has a direct impact on the number and spacing of the vacuum wells. Air permeability is best determined in the field by applying a vacuum to a well and measuring the lateral extent of the effect over time with vacuum gauges attached to probes that are placed in the same vertical horizon as the screened area of the vacuum well. The results from this test will enable the calculation of the soil's permeability to air, the area of influence, and the optimum air flow rate. With this data and the data provided from the determination of the extent of contamination, the number and the spacing of the wells can be determined.

4.0 Subsurface Investigation

The Investigative work required to obtain the needed data will consist of drilling up to three additional soil borings at the Arcade Site. Each hole will be completed for use as both a monitor well and an SVE well.

The following subsurface investigation tasks will be performed:

1) Drill additional soil borings at recommended locations.

   Advance the boring through the extended unsaturated zone and through the saturated zone to the bottom of the aquifer.

   Utilize a core sampler to document the depth of lithologic contacts and to identify the depth of the clay aquitard. Take precautions to prevent penetrating the clay aquitards.

   Collect soil samples every five feet for laboratory analyses in the interval between the surface and the clay aquitard to establish a PCE distribution profile in the saturated and unsaturated zone.

   Deliver soil samples to an EPA and California certified environmental laboratory under strict chain-of-custody protocols.

   Analyze the soil for halogenated volatile organic compounds by EPA Method 8010 and aromatic volatile compounds by EPA Method 8020.

   Analyze one soil sample from each boring location for Title 26 Metals.

   Analyze one soil sample from each boring location for semi-volatiles (including PCBs and pesticides) by EPA Method 8270. If other contaminants not previously identified are discovered, the SAP may be expanded.

2) Stop each boring upon entry into the clay aquitard; complete the hole as a screened well, with the screen extending high enough to be used for a SVE vacuum well.

   Survey the new wells to determine the relative ground-water elevations.

   If groundwater is present, develop each well by the surge/bail method or by the bail/pump method.

If ground water is present, sample ground water from each well.

Deliver ground-water samples to a California certified environmental laboratory under strict chain-of-custody protocols.

Analyze the ground water for halogenated volatile organics by EPA Method 601 and aromatic volatile organics by EPA Method 602.

Analyze one ground-water sample from each of the new wells for Title 26 Metals.

Analyze one ground-water sample from each of the new wells for semi-volatiles (including PCBs and pesticides) by EPA Method 625. If other contaminants not previously identified are discovered, the SAP may be expanded.

All work performed at the Arcade site under this work plan will be conducted according to the H⁺GCL Standard Operating Procedures (refer to Work Plan for Remedial Investigation/ Feasibility Study). A Quality Assurance/Quality Control document has been developed for the Arcade site work and is presented in the Work Plan for Remedial Investigation/ Feasibility Study. A Sampling and Analysis Plan (SAP) has been developed for the Arcade site work and is also presented in the Work Plan for Remedial Investigation/Feasibility Study. A Health and Safety Plan is also presented in the Work Plan for Remedial Investigation/Feasibility Study. All field personnel involved with the subsurface investigation tasks will be familiar with the contents of the H⁺GCL Health and Safety Plan (HSP) specifically designed for the Arcade site. One copy of the HSP will be kept on-site at all times for the duration of the field investigation. All on-site personnel will read, sign, and agree to adhere to the plan.

Minor modifications to the Community Relations Plan are necessary to address this pilot testing program. First, since the remedial investigation is substantially complete, and additional pilot testing work is necessary before completion of the feasibility study, the draft Remedial Investigation Report will be issued before the Feasibility Study Report. This Remedial System Pilot Test Work Plan is intended as a supplement to the January 1992 Work Plan for the site. Next, other than the potentially responsible parties identified in the demand letter issued January 30, 1992, and a telephone inquiry from a representative of the Coast Guard National Response Center, no other party or member of the public has responded to the demand letter or to the published notice described in the Community Relations Plan. As a result, the draft RI Report and the Pilot Test Work Plan will be circulated only to appropriate agencies, the responding parties, and the current site operator. In addition, since potential contamination was discovered adjacent to Paul's Dry

Cleaning in the Millers Outpost center, and the Beacon Gasoline Station adjacent to the site, copies of the draft RI Report and the Pilot Test Work Plan will be transmitted to the owners and/or operators of those facilities as well. The second published notice will not occur until the draft Feasibility Study Report becomes available, as originally contemplated in the Community Relations Plan.

5.0 Pilot Test of Remediation System

In order to determine the appropriate treatment method for the Arcade site and to obtain design parameters, the soil's permeability to air and the area of influence of the vacuum created in the soil must to be determined. To perform this test, a vacuum blower, with vapor phase carbon and a vacuum gauge, will be attached to MW 17. The pilot test will be conducted as follows:

1) Install 2-inch diameter well points down to a TD elevation of 55 feet below ground surface at the following distances 10, 20, 40, 50 feet (MW 7 will be used for the 30 foot location).

   On the well points, install pressure gauges with a range of 0 to 10 psi.

   Attach vacuum blower system to MW 17.

2) Turn on vacuum blower and obtain measurements from the pressure gauges at the following time intervals 1, 10, 50, 100, 200, 300, 400, 500, 600, and 1000 minutes.

   From a sampling port on the blower system take gas samples to be analyzed by a portable gas chromatograph at the following time intervals 5, 30, 60, 150, and 550 minutes.

   Shut off the vacuum blower after 1000 minutes.

Additional vacuum gauges will also be attached to existing wells in the area of MW 17 to better identify the areal extent of the vacuum created in the subsurface. If it is determined that AS will be required because of the rising water table or other factor, then a similar pilot test will be conducted with only an AS system in operation. A pressure blower will be connected to an AS well (to be selected from an existing well or newly installed, if necessary) and air pressure measurements will be taken from the same locations described above for the SVE pilot test. The same time intervals will be used. Next, measurements will be made with both the SVE and AS systems operating together.

Following the initial vapor extraction test described above, the unit will be moved sequentially to monitoring wells MW 2, MW 5, and MW 6. The initial testing protocol will then be repeated in sequence at each well, although additional vacuum sample points will not be installed.

Based upon the results of these initial tests, the system will be returned to the well that resulted in the greatest quantity of PCE (measured by the product of the average concentration and volume) during the initial testing. The system will then be operated for a period of approximately 7 days, with gas samples taken at daily intervals. The actual period of operation will be based upon the rate of continuing production of PCE from the well. As appropriate, the pilot testing system may then be relocated to one of the other wells and a similar testing protocol will be observed.

The purpose of this testing protocol is to provide a flexible, iterative program that will allow experimentation with the operation of the system in response to site specific conditions. One goal of the program is to determine the most cost-effective configuration and operational protocols for the final remedial action, focusing specifically on cost-effective tradeoffs between capital expenditures for more and/or larger systems as balanced against operation and maintenance costs. Another goal will be to determine the ability of the system to meet all applicable cleanup goals for the site, specifically the goal of preventing the recontamination of usable ground water at levels exceeding 5 ppb, the ground water ARAR identified by the Regional Water Quality Control Board.

Sampling information will be recorded in a field log book and will follow H⁺GCL standard operating procedures. Vapor samples will be analyzed on-site by use of a Photovac portable gas chromatograph (GC). The GC will be calibrated on-site prior to each sampling event and the quality control results entered in the log book. Sample results will be entered in the log book as well as a data base that will be used for report preparation.

6.0 Residuals Management and Action-Specific ARARs

There are primary action-specific ARARs for the air discharge from the pilot testing program which will affect this response action. In California, the authority to regulate stationary sources of emissions has been delegated to local air quality management districts. The site is located in the Bay Area Air Quality Management District (BAAQMD). Therefore, BAAQMD regulations constitute generally applicable, promulgated state requirements under state environmental law under CERCLA.

Vapor extraction systems are regulated directly under BAAQMD Regulation 8, Rule 47, which provides in pertinent part as follows:

> 8-47-101 Description: The purpose of this Rule is to limit emissions of organic compounds from contaminated ground water and soil. The provisions of this rule shall apply to new and modified air stripping and soil-vapor extraction equipment used for the treatment of ground water or soil contaminated with organic compounds.
>
> 8-47-109 Exemption, Small Operations: The provisions of Section 8-47-101 shall not apply to operations that satisfy both of the following requirements:
>
> 109.1 Operations that emit no more than one of the following compounds: benzene, vinyl chloride, trichloroethylene, perchloroethylene or methylene chloride, and
>
> 109.2 Benzene emissions do not exceed 0.05 pounds per day, vinyl chloride emissions do not exceed 0.2 pounds per day or trichloroethylene, perchloroethylene or methylene chloride emissions do not exceed 0.5 pounds per day.
>
> 9-47-113 Exemption, Air Stripping and Soil-Vapor Extraction Operations Less Than One Pound Per Day: The provisions of Section 8-47-301 shall not apply to operations with total emissions of less than 1 pound per day of benzene, vinyl chloride, perchloroethylene, methylene chloride and/or trichloroethylene provided the requirements of Section 8-47-402 are satisfied. Once an exemption pursuant to this section is granted, if the emissions of an operation exceed 1 pound per day then that operation is subject to Section 8-47-301. The operator of the source may submit a petition to the APCO in writing requesting review under this exemption if uncontrolled emissions have been shown, due to sustained remediation activities, to have dropped to a constant emission rate of less than 1 pound per day.

8-47-301 Emission Control Requirement, Specific Compounds: Any air stripping and soil-vapor extraction operations which emit benzene, vinyl chloride, perchloroethylene, methylene chloride and/or trichloroethylene shall be vented to a control device which reduces emissions to the atmosphere by at least 90% by weight.

8-47-302 Organic Compounds: Any air stripping and soil-vapor extraction operations with a total organic compound emission greater than 15 pounds per day shall be vented to a control device which reduces the total organic compound emissions to the atmosphere by at least 90% by weight.

8-47-400 Administrative Requirements

8-47-401 Reporting, Superfund Amendments and Reauthorization Act (SARA) Sites: Any person responsible for air stripping or soil-vapor extraction operations which have not applied for a District Permit shall provide written notification to the APCO of intention to operate. This notice shall include:

401.1 Address of the remediation site.

401.2 Schedule of starting date 30 days prior to start-up.

401.3 Written certification that the proposed operation will be in compliance with the requirements of this Rule.

401.4 Any person seeking to satisfy the conditions of Section 8-47-113 shall submit the risk analysis for APCO approval as required in Section 8-47-402.

8-47-402 Less than 1 Pound Per Day Petition: Any person seeking to satisfy the condition of Section 8-47-113 shall:

402.1 Submit a petition to the APCO in writing requesting review and written approval of a risk analysis for the benzene, vinyl chloride, perchloroethylene, methylene chloride and/or trichloroethylene organic compound emissions that are less than 1 pound epr day.

(Additional monitoring and record keeping requirements are included).

It is anticipated that with the carbon adsorption system in place, a reduction of well over 90% of the PCE emissions by weight will occur. The resulting emissions will also be well below the 0.5 pound per day level, which triggers a risk assessment requirement in the absence of 90% controls.

All of the procedural requirements of the BAAQMD will be complied with. After the initial two-week pilot test is completed, information from the test will be submitted to the BAAQMD along with a 30-day prior notification of intent to operate the system, if required.