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Alameda County
Environmental Health

Thomas K. Bauhs
Project Manager
Retail and Terminal
Business Unit

Chevron Environmental Management Company
6001 Bollinger Canyon Road
San Ramon, CA 94583
Tel (925) 842-8898
Fax (925) 842-8370

September 14, 2007
(date)

Alameda County Health Care Services
1131 Harbor Bay Parkway, Suite 250
Alameda, CA 94502-6577

Re: Chevron Facility # 21-1173

Address: 500 Grand Avenue, Oakland, California

I have reviewed the attached report titled Workplan for Additional Soil Vapor Study and dated September 14, 2007.

I agree with the conclusions and recommendations presented in the referenced report. The information in this report is accurate to the best of my knowledge and all local Agency/Regional Board guidelines have been followed. This report was prepared by Conestoga Rovers & Associates, upon whose assistance and advice I have relied.

This letter is submitted pursuant to the requirements of California Water Code Section 13267(b)(1) and the regulating implementation entitled Appendix A pertaining thereto.

I declare under penalty of perjury that the foregoing is true and correct.

Sincerely,

Thomas K. Bauhs
Project Manager

Enclosure: Report

CONESTOGA-ROVERS
& ASSOCIATES

2000 Opportunity Dr, Suite 110, Roseville, California 95678
Telephone: 916·677·3407, ext. 100 Facsimile: 916·677·3687
www.CRAworld.com

September 14, 2007

Ms. Donna Drogos
Alameda County Health Care Services Agency
Department of Environmental Health
1131 Harbor Bay Parkway, Suite 250
Alameda, California 94502

Re: **Workplan for Additional Soil Vapor Study**
Former Texaco Service Station (Chevron 21-1173)
500 Grand Avenue
Oakland, California
ACHCSA Site No. RO-391

Dear Ms. Drogos:

Conestoga-Rovers & Associates (CRA) is submitting this *Workplan for Additional Soil Vapor Study* on behalf of Chevron Environmental Management Company (Chevron) for the site referenced above. This workplan is submitted as a follow-up to CRA's February 2007 investigation, and in response to the Alameda County Health Care Services Agency (ACHCSA) letter dated July 30, 2007 (Attachment A). CRA proposes advancing three soil borings to further evaluate the lateral extent of petroleum hydrocarbons in soil south of the site. CRA also proposes installing five soil vapor probes onsite to evaluate potential vapor intrusion risks. The site background and proposed scope of work are described below.

SITE DESCRIPTION

The property is located at 500 Grand Avenue, in Oakland, California, at the intersection of Grand Avenue and Euclid Avenue (Figures 1 and 2). Prior to decommissioning in 1991, the site was an active service station. The site is currently used as a parking lot. No structures currently exist. The property is surfaced with asphalt and the sidewalks are concrete. The property is in a mixed commercial and residential district in the City of Oakland, in Alameda County.

The property is relatively flat and level, cut into the natural slope of the land. Site elevation is approximately 20 feet above mean sea level (msl). Lake Merritt is located approximately 200 feet south of the property. The local topography consists of gently rolling hills and flatland.

PREVIOUS INVESTIGATIONS AND ACTIVITIES

Previous environmental investigations have been performed at the site since 1988. The following provides a synopsis of previous environmental characterization of the site.

1988 Sensitive Receptor Survey:

In May 1988, a sensitive receptor survey was performed (HLA 1989). According to the sensitive receptor survey, there are no public water supplies wells within 2,500 feet, there are no private water supply wells within 1,000 feet, and there is no school within 1,000 feet. Lake Merritt, an estuarine urban surface water body, is located 200 feet south of the property. Local drinking water is supplied via the Mokelumne Aqueduct, from the Sierra Nevada Mountains.

1988 Soil Gas Survey:

In September 1988, a soil gas survey was performed with 19 soil gas samples (HLA 1989). Elevated levels of total hydrocarbons and benzene, toluene, ethylbenzene, and xylenes (BTEX) were detected in the soil gas survey. Based on these results, HLA concluded that off-site migration had occurred beneath a portion of Grand Avenue.

1990-1991 Removal of Waste Oil UST and Clay Sewer Pipe:

One 500-gallon waste oil underground storage tank (UST) was excavated and removed from the site in September 1990, after observing separate-phase hydrocarbons in the tank pit backfill. The excavation was approximately 8 feet deep, 7.5 feet wide and 9.5 feet long. The waste oil tank had no apparent cracks or points of leakage when it was removed from the excavation. Total petroleum hydrocarbons as gasoline (TPHg), total petroleum hydrocarbons as diesel (TPHd), total oil & grease (TOG), and BTEX were detected in soil. Chlorinated hydrocarbons were not detected in soil from the tank excavation. During excavation of the waste-oil tank, two clay pipes were observed at approximately 1.5 fbg. One soil sample (B-13 at 2.5 fbg) collected near the western end of the clay pipe detected naphthalene (0.90 mg/kg), 2-methylnaphthalene (1.40 mg/kg), bis (2-ethylhexyl) phthalate (0.26 mg/kg), and trichloroethane (0.06 mg/kg). In January 1991, the clay pipe was excavated in the area of the waste-oil UST. The excavation was approximately 15 feet long, 2.5 feet wide and 4.5 feet deep. TPHg, TPHd, TOG, BTEX, and total petroleum hydrocarbons as motor oil (TPHmo) were detected in soil from the trench, but no chlorinated hydrocarbons were detected.

1991 Decommissioning:

The service station was decommissioned in late 1991.

1991-1993 Removal of Three USTs, Excavation Activities, and Confirmation Samples:

In April 1992, three 10,000-gallon USTs were removed from the site, along with two dispenser islands and associated piping. During tank removal operations, approximately 25,000 gallons of hydrocarbon-bearing water was removed from the excavation and the site. In April and May 1992, over-excavation at the former fuel USTs extended to a depth of approximately 10 fbg. In the area of the former dispenser islands, the excavation extended to approximately 9 fbg. Approximately 1,550 cubic yards of soil were excavated from the area of the underground tanks, pump islands, and fuel lines. The material was subsequently disposed of off-site at an appropriate disposal facility. Confirmation soil samples were collected at the bottom and sides of the excavation. Samples collected along the southern edge of the excavation identified TPHg as high as 1,000 mg/kg. The excavation pit could not be extended south without undermining Grand Avenue. In January 1993 another phase of excavation occurred in the northern portion of the site with excavation of approximately 828 cubic yards of hydrocarbon contaminated soil. Dimensions of the January 1993 excavation were 6.5 feet deep, 25 feet across by 45 feet long. Approximately 6,300 gallons of water were removed from the excavation. Clean imported fill (crushed gravel and soil) was used to backfill the excavation pit.

1988-1993 Soil and Groundwater Investigations:

In June 1988, environmental activities included an investigation on whether petroleum hydrocarbons had impacted shallow soil and groundwater. This included soil borings, along with installation and sampling of monitoring wells. Concentrations of BTEX were detected in low concentrations in shallow soil samples (HLA July 1988). BTEX was also detected in groundwater. Additional site characterization was performed between 1989 and 1993 (see references). TPHg, TPHd, and BTEX were detected in both soil and groundwater. Groundwater monitoring continued through 2000.

1988-2000 Groundwater Monitoring:

From 1988 through 2000, monitoring wells were monitored and sampled. Analyses typically include TPHg (TPPH), total extractable petroleum hydrocarbons as diesel (TEPH/TPHd), BTEX, and methyl tert-butyl ether (MTBE). In 1999 and 2000, analyses also include total recoverable petroleum hydrocarbons as oil and grease (TRPH). The following Table 1 presents a summary of the highest concentrations of analytes in 2000 for on-site (MW-8K) and off-site monitoring wells (MW-8F, MW-8G, MW-8H, MW-8I, and MW-8J):

Table 1
Highest Concentrations in Groundwater (ug/L) in 2000

Well	TPPH (gasoline)	TEPH (diesel)	TRPH (oil & grease)	Benzene	Toluene	Ethyl Benzene	Xylenes	MTBE
On-Site	ND	53.2	9,100	ND	ND	ND	ND	ND
Off-Site	ND	433	35,200	ND	ND	ND	ND	ND

Note: ND = None Detected

1996 ORC Remedial Action:

In December 1996, additional remediation (beyond the three phases of excavation activities) consisted on installing oxygen-releasing compound (ORC) in selected monitoring wells to enhance biodegradation of the dissolved petroleum hydrocarbon plume. The ORC socks were removed before the second quarter 2000 groundwater monitoring event.

2001 Closure Request:

In a February 13, 2001, KHM requested that ACHA close the case in a letter report titled *Underground Storage Tank Case Closure Request.* KHM considered the case eligible for no further regulatory action based on the following conclusions:

- All petroleum hydrocarbon sources have been removed from the site. The USTs, dispenser islands, and associated piping were removed in 1990 to 1992.
- All petroleum hydrocarbon-impacted soil, with the exception of a narrow band beneath the Grand Avenue sidewalk, has been removed from the site. In 1992 and 1993, excavation activities removed approximately 2,378 cubic yards of petroleum hydrocarbon-impacted soil.
- During 1992 and 1993 remedial activities, approximately 31,300 gallons of petroleum hydrocarbon-impacted groundwater was pumped from the excavation for proper disposal.
- Soil and groundwater at the site have been adequately characterized.
- The only remaining petroleum hydrocarbons detected in groundwater are TEPH (diesel) and TRPH (oil & grease).
- Separate phase hydrocarbons (SPH) have never been observed in any groundwater monitoring wells.
- ORC has been used in site wells as a remedial action.
- Residual petroleum hydrocarbons pose a low risk to surface water quality in nearby Lake Merritt.
- Residual petroleum hydrocarbons pose a low risk to groundwater resources. Petroleum hydrocarbon-impacted groundwater is shallow and not used as a groundwater resource. There are no wells located between the site and Lake Merritt, the direction of groundwater flow.
- MTBE was not detected in any sampled monitoring wells.

PROPOSED SCOPE OF WORK

To further evaluate the extent of hydrocarbons in soil and groundwater, CRA proposes three Geoprobe® soil borings and five soil vapor probes. Proposed boring and probe locations are shown on Figure 2. CRA's standard operating procedures are presented as Attachment B. The specific scope of work is discussed below.

Underground Utility Location: CRA will notify underground service alert (USA) prior to field work to clear boring locations with utility companies. A private utility line locator will be contracted to additionally clear boring locations of utility lines.

Site Health and Safety Plan: CRA will prepare a site safety plan to inform site workers of known hazards and to provide health and safety guidance. The plan will be kept on site at all times and signed by all site workers.

Permits: CRA will obtain boring permits from the ACHCSA and an encroachment permit from the City of Oakland prior to beginning field operations. A minimum of 72-hours notice will be given to the ACHCSA prior to field work.

Soil borings: CRA proposes advancing three Geoprobe® soil borings. After clearing to 8 fbg using a hand auger to further ensure no utilities are present, each boring will be advanced to approximately 20 feet below grade. Soil will be logged and sampled at 5 foot intervals beginning at 5 fbg. Upon completion, each boring will grouted to surface with neat Portland cement. CRA's Standard Field Procedures are presented as Attachment B.

Soil Screening: Soil samples will be screened using a photoionization detector (PID). PID readings, evidence of discoloration, stratigraphic location, the depth to groundwater, and the collection depth of previous samples containing hydrocarbons will be used to select soil samples for laboratory analysis.

Soil Vapor Probe Installation: CRA proposes to advance five hand-auger borings which will be completed as soil vapor probes at the approximate locations shown on Figure 2. The total depth of each boring will be approximately 6 fbg. Soil samples will be collected from each boring using a slide hammer and a drive-core barrel at approximately 2 and 5.5 fbg. The borings will be continuously logged by CRA field personnel. The final locations of the borings will be based on site and utility constraints as evaluated in the field.

The soil vapor probes will be constructed in general accordance with CRA's Standard Field Procedures (Attachment B). One-quarter inch diameter Nylaflow® nylon tubing will be fitted with a 6-inch long 0.010-inch slotted PVC filter screen. The tubing and screen will be placed into each open boring with the screen at approximately 5.5 fbg. Washed No. 2/16 silica sand will be placed from 5 to 6 fbg to create a filter pack around the PVC screen. A 3-inch layer of dry granular bentonite will be placed on top of the sand pack followed by hydrated bentonite powder to a few inches from the surface. The tubing exiting the bentonite will be capped, and the top of the point will be protected by a traffic-rated vault.

Soil Vapor Sampling: Soil vapor samples will be collected no sooner than 72 hours after installation of the probes to allow adequate time for accumulation of representative soil vapor. Soil vapor sample collection will not be scheduled until after a minimum of five consecutive significantly precipitation-free days (≥0.5 inches of rain).

Samples will be collected using a 1-liter SUMMA™ canister connected to the sampling tubing at each vapor point. Prior to collecting soil vapor samples, the initial vacuum of the canister will be measured and recorded on the chain-of-custody (this should be approximately 30-inches of mercury). The vacuum of the SUMMA™ canister will be used to draw the soil vapor through the flow controller until a negative pressure of approximately 5-inches of Hg is observed on the vacuum gauge. This is the residual vacuum and this measurement should be recorded on the chain-of-custody. With the flow controller set at approximately 30 ml/minute, sample collection should take approximately 30 minutes.

Prior to sample collection, stagnant air in the sampling apparatus will be sufficiently removed by purging approximately 3 probe volumes using a purge pump. The volume of the borehole will generally not be included in the volume calculation as it is assumed that the soil vapor concentrations in the probe and sand pack are equilibrated with the surrounding native soil.

A minimum of one field duplicate will be collected for each day of sampling. A field duplicate will be collected by using a splitter connected to the soil vapor probe. After vapor sampling, the SUMMA™ canisters will be properly labeled, packaged and sent to the Air Toxics laboratory under chain-of-custody for analysis. Samples will be analyzed on standard turn around time. CRA's *Standard Field Procedures for Soil and Soil Vapor Sampling* is presented as Attachment B.

Leak Detection: In order to detect any leakage of atmospheric gasses and/or ambient air during sampling, CRA will perform leak detection tests. Helium will be used as a source gas for leak detection. Field application of helium will be accomplished through using a containment structure (i.e. a clear, large volume Rubbermaid® or Tupperware® storage container) placed inverted over the entire sample probe and sampling apparatus. Additionally, CRA will analyze vapor samples for oxygen (O_2) and carbon dioxide (CO_2) to assess whether samples are compromised by surface vapor migration.

Chemical Analysis: Select soil samples will be analyzed for:

- TPHg by EPA Method 8015, and
- BTEX and MTBE by EPA Method 8260.

Vapor Chemical Analyses: The soil vapor samples will be kept at ambient temperature and submitted under chain-of-custody to Air Toxics for analysis. The samples will be analyzed on a 72 hour turn around time for:

- TPHd and TPHg by EPA Method TO-3, and
- BTEX and MTBE by EPA method TO-15.
- Helium, O_2, and CO_2 by Method ASTM 1946.

Soil and Water Disposal: Soil cuttings will be temporarily stockpiled and covered with plastic or placed in sealed DOT-approved drums on-site. Rinse water will be stored in drums pending proper disposal. Following review of laboratory analytical reports, wastes will be transported to a Chevron-approved disposal facility.

Reporting: Upon completion, CRA will document all field activities and analytical results in a report that, at a minimum, will contain:

- A brief summary of the site background and history,
- Descriptions of the drilling and sampling methods,
- Boring logs,
- Tabulated soil and groundwater sample analytic results,
- Tabulated vapor analytical results,
- A figure illustrating the location of the borings,
- Analytic reports and chain-of-custody forms,
- Soil/water disposal methods,
- An updated Site Conceptual Model (SCM), and
- CRA's conclusions and recommendations.

SCHEDULE

CRA will proceed with this work after receiving written approval of this work plan from the ACHCSA or following 60 days after submittal to the ACHCSA. CRA will submit an investigation report approximately six to eight weeks after completion of field activities.

CLOSING

CRA appreciates the opportunity to work with you on this project. Please contact Brian Carey at (916) 677-3407 (ext. 106) if you have any questions or comments.

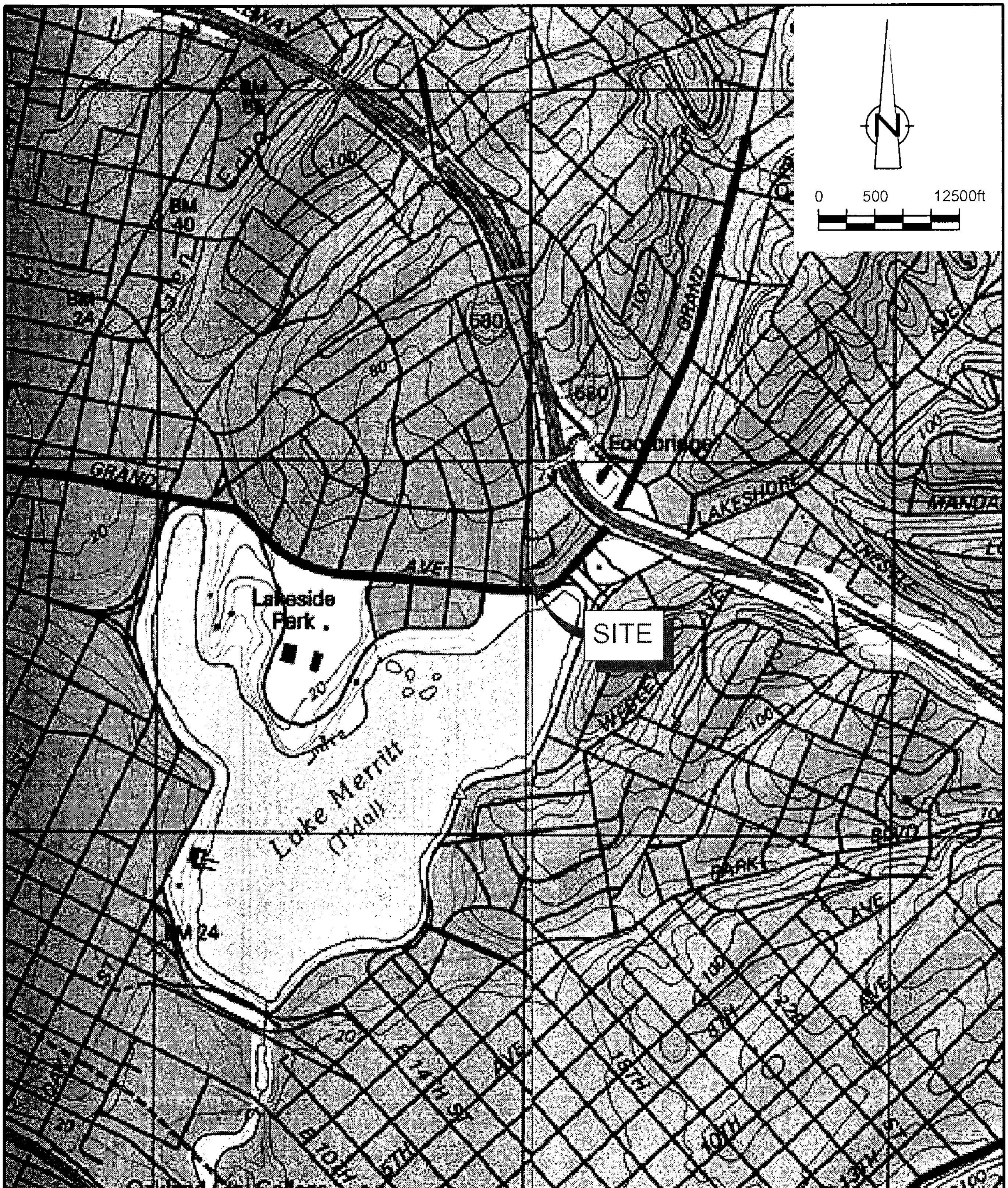
Sincerely,
CRA Environmental Technology, Inc.

for Chris Benedict
Staff Scientist

PROFESSIONAL GEOLOGIST
BRIAN P. CAREY
No. 7820
Exp 1/08
STATE OF CALIFORNIA

Brian Carey, P.G.
Project Geologist

Figures:	1 – Vicinity Map
	2 – Site Plan
Attachments:	A – Regulatory Correspondence
	B – Standard Field Procedures
cc:	Mr. Tom Bauhs, Chevron Environmental Management Company, P.O. Box 6012, K2204, San Ramon, CA 94583



SOURCE: TOPO! MAPS.

figure 1

VICINITY MAP
FORMER TEXACO SERVICE STATION 21-1173
500 GRAND AVENUE
Oakland, California

612049-200(PRES001)GN-WA002 AUG 10/2007

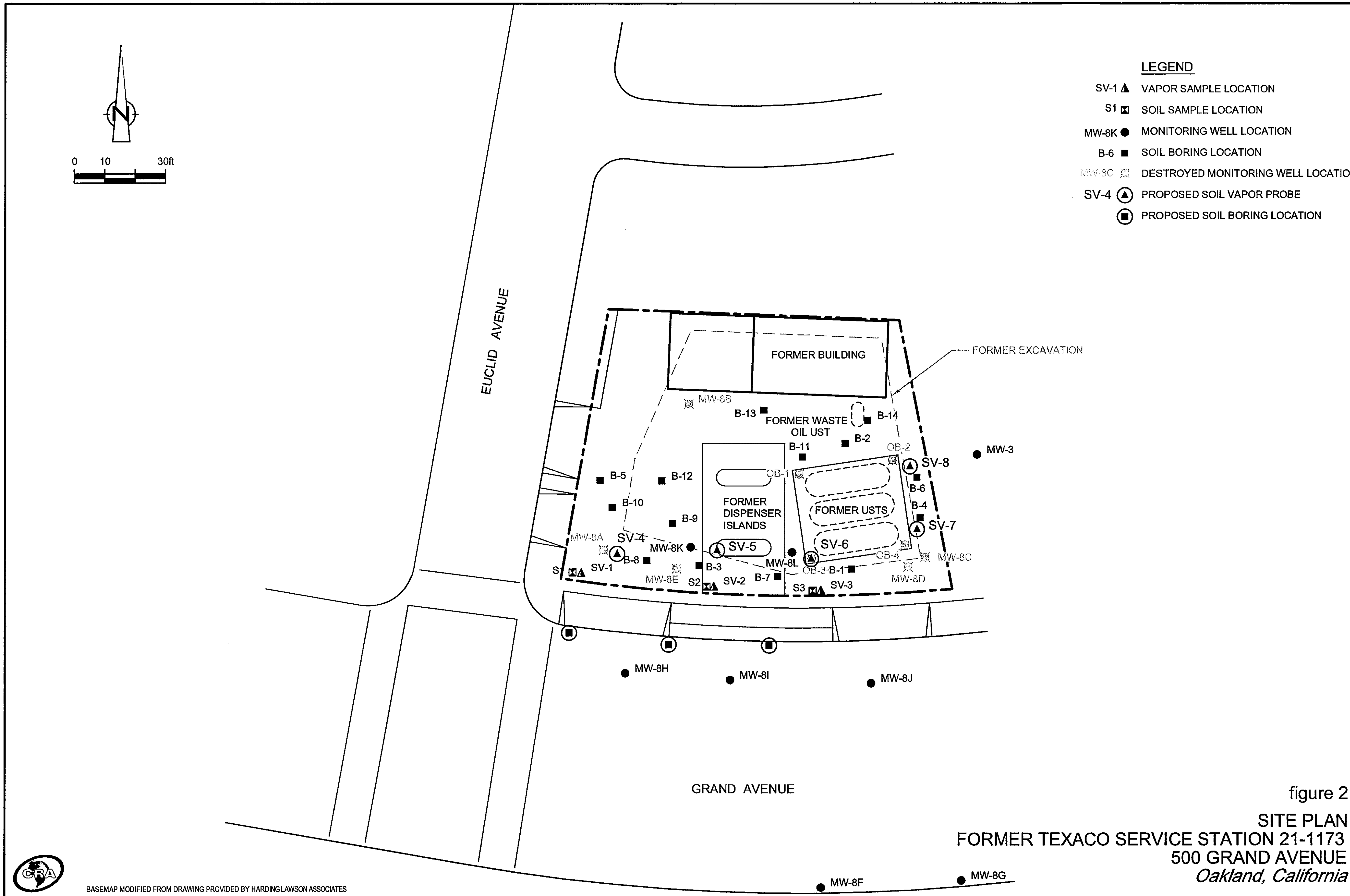


figure 2

SITE PLAN
FORMER TEXACO SERVICE STATION 21-1173
500 GRAND AVENUE
Oakland, California

BASEMAP MODIFIED FROM DRAWING PROVIDED BY HARDING LAWSON ASSOCIATES

612049-200(PRES001)GN-WA001 AUG 24/2007

CONESTOGA-ROVERS
& ASSOCIATES

ATTACHMENT A

Regulatory Correspondence

ALAMEDA COUNTY
HEALTH CARE SERVICES
AGENCY
DAVID J. KEARS, Agency Director

RECEIVED
AUG 03 2007
By Bc

ENVIRONMENTAL HEALTH SERVICES
ENVIRONMENTAL PROTECTION
1131 Harbor Bay Parkway, Suite 250
Alameda, CA 94502-6577
(510) 567-6700
FAX (510) 337-9335

July 30, 2007

Mr. Tom Bauhs
Chevron Environmental Management Co.
6001 Bollinger Canyon Rd., Room K2204
San Ramon, CA 94583

Dear Mr. Bauhs:

Subject: Fuel Leak Case RO0000391 & Global ID T0600101355, Chevron #21-1173/Exxon #7-0237, 500 Grand Ave., Oakland, CA 94610

Alameda County Environmental Health (ACEH) staff has been requested to provide comment to the February 28, 2007 Subsurface Investigation Report for the subject site. Upon review of this report, it appears that Cambria (CRA) proposed in their discussion to submit a Supplemental Soil Vapor Workplan to repeat sample collection in previously proposed areas. It appears that this is the result of not being able to collect prior samples, not running the requested quality control samples and obtaining different results in the duplicate sample for SV-2. It appears that your Supplemental Soil Vapor Workplan has not been submitted. We, therefore request that you address the following technical comments when submitting the technical report requested below.

TECHNICAL COMMENTS

1. Quality Control Sampling- We request that appropriate quality control sampling be performed when collecting the soil vapor samples. This should follow the DTSC Guidance document, December 15, 2004, revised February 7, 2005. A tracer gas and a background air sample should be included.
2. Duplication of Samples- Cambria noted that because the leak testing analysis was left out and their inability to collect a soil vapor sample from SV-3, a supplemental work plan would be submitted to repeat sample collection at previously proposed areas plus additional sampling along northern Grand Avenue. Please collect soil samples from S-1 and S-2 at depths of 5' bgs to best duplicate prior sample data. Based upon the results of the previous investigation, we request that additional soil vapor samples be collected on-site. We suggest samples north of S-2 and along the eastern property boundary.

TECHNICAL REPORT REQUEST

Please submit the following technical report to our office according to the following schedule:

- August 30, 2007- Supplemental Soil Vapor Work Plan

ELECTRONIC SUBMITTAL OF REPORTS

Effective **January 31, 2006**, the Alameda County Environmental Cleanup Oversight Programs (LOP and SLIC) require submission of all reports in electronic form to the county's ftp site. Paper copies of reports will no longer be accepted. The electronic copy replaces the paper copy and will be used for all public information requests, regulatory review, and compliance/enforcement activities. Please do not submit reports as attachments to electronic mail. Submission of reports to the Alameda County ftp site is an addition to existing requirements for electronic submittal of information to the State Water Resources Control Board (SWRCB) Geotracker website. Submission of reports to the Geotracker website does not fulfill the requirement to submit documents to the Alameda County ftp site. In September 2004, the SWRCB adopted regulations that require electronic submittal of information for groundwater cleanup programs. For several years, responsible parties for cleanup of leaks from underground storage tanks (USTs) have been required to submit groundwater analytical data, surveyed locations of monitor wells, and other data to the Geotracker database over the Internet. Beginning July 1, 2005, electronic submittal of a complete copy of all necessary reports was required in Geotracker (in PDF format). Please visit the SWRCB website, (http://www.swrcb.ca.gov/ust/cleanup/electronic_reporting) for more information.

In order to facilitate electronic correspondence, we request that you provide up to date electronic mail addresses for all responsible and interested parties. Please provide current electronic mail addresses and notify us of future changes to electronic mail addresses by sending an electronic mail message to me at barney.chan@acgov.org.

PERJURY STATEMENT

All work plans, technical reports, or technical documents submitted to ACEH must be accompanied by a cover letter from the responsible party that states, at a minimum, the following: "I declare, under penalty of perjury, that the information and/or recommendations contained in the attached document or report is true and correct to the best of my knowledge." This letter must be signed by an officer or legally authorized representative of your company. Please include a cover letter satisfying these requirements with all future reports and technical documents submitted for this fuel leak case.

PROFESSIONAL CERTIFICATION & CONCLUSIONS/RECOMMENDATIONS

The California Business and Professions Code (Sections 6735, 6835, and 7835.1) requires that work plans and technical or implementation reports containing geologic or engineering evaluations and/or judgments be performed under the direction of an appropriately registered or certified professional. For your submittal to be considered a valid technical report, you are to present site specific data, data interpretations, and recommendations prepared by an appropriately licensed professional and include the professional registration stamp, signature, and statement of professional certification. Please ensure all that all technical reports submitted for this fuel leak case meet this requirement.

AGENCY OVERSIGHT

If it appears as though significant delays are occurring or reports are not submitted as requested, we will consider referring your case to the Regional Board or other appropriate agency, including the County District Attorney, for possible enforcement actions. California Health and Safety Code, Section 25299.76 authorizes enforcement including administrative action or monetary penalties of up to $10,000 per day for each day of violation.

If you have any questions, please call me at (510) 567-6765.

Sincerely,

Barney M Chan

Barney M. Chan
Hazardous Materials Specialist

cc: files, D. Drogos
Mr. David Herzog, Cambria Environmental, 2000 Opportunity Drive, Suite 110, Roseville, CA 95678
Mr. Brad Howard, Howard Tours Inc., 516 Grand Ave., Oakland, CA 94610-3515

7_30_07 500 GrandAve

CONESTOGA-ROVERS
& ASSOCIATES

ATTACHMENT B

Standard Field Procedures

STANDARD FIELD PROCEDURES FOR SOIL BORING AND MONITORING WELL INSTALLATION

This document presents standard field methods for drilling and sampling soil borings and installing, developing and sampling groundwater monitoring wells. These procedures are designed to comply with Federal, State and local regulatory guidelines. Specific field procedures are summarized below.

SOIL BORINGS

Objectives

Soil samples are collected to characterize subsurface lithology, assess whether the soils exhibit obvious hydrocarbon or other compound vapor or staining, and to collect samples for analysis at a State-certified laboratory. All borings are logged using the Unified Soil Classification System by a trained geologist working under the supervision of a California Professional Geologist (PG).

Soil Boring and Sampling

Soil borings are typically drilled using hollow-stem augers or direct-push technologies such as the Geoprobe®. Soil samples are collected at least every five ft to characterize the subsurface sediments and for possible chemical analysis. Additional soil samples are collected near the water table and at lithologic changes. Samples are collected using lined split-barrel or equivalent samplers driven into undisturbed sediments at the bottom of the borehole.

Drilling and sampling equipment is steam-cleaned prior to drilling and between borings to prevent cross-contamination. Sampling equipment is washed between samples with trisodium phosphate or an equivalent EPA-approved detergent.

Sample Analysis

Sampling tubes chosen for analysis are trimmed of excess soil and capped with Teflon tape and plastic end caps. Soil samples are labeled and stored at or below 4° C on either crushed or dry ice, depending upon local regulations. Samples are transported under chain-of-custody to a State-certified analytic laboratory.

Field Screening

One of the remaining tubes is partially emptied leaving about one-third of the soil in the tube. The tube is capped with plastic end caps and set aside to allow hydrocarbons to volatilize from the soil. After ten to fifteen minutes, a portable volatile vapor analyzer measures volatile hydrocarbon vapor concentrations in the tube headspace, extracting the vapor through a slit in the cap. Volatile vapor analyzer measurements are used along with the field observations, odors, stratigraphy and groundwater depth to select soil samples for analysis.

Water Sampling

Water samples, if they are collected from the boring, are either collected using a driven Hydropunch® type sampler or are collected from the open borehole using bailers. The groundwater samples are decanted into the appropriate containers supplied by the analytic laboratory. Samples are labeled, placed in protective foam sleeves, stored on crushed ice at or below 4°C, and transported under chain-of-custody to the laboratory. Laboratory-supplied trip blanks accompany the samples and are analyzed to check for cross-contamination. An equipment blank may be analyzed if non-dedicated sampling equipment is used.

Grouting

If the borings are not completed as wells, the borings are filled to the ground surface with cement grout poured or pumped through a tremie pipe.

MONITORING WELL INSTALLATION, DEVELOPMENT AND SAMPLING

Well Construction and Surveying

Groundwater monitoring wells are installed to monitor groundwater quality and determine the groundwater elevation, flow direction and gradient. Well depths and screen lengths are based on groundwater depth, occurrence of hydrocarbons or other compounds in the borehole, stratigraphy and State and local regulatory guidelines. Well screens typically extend 10 to 15 feet below and 5 feet above the static water level at the time of drilling. However, the well screen will generally not extend into or through a clay layer that is at least three feet thick.

Well casing and screen are flush-threaded, Schedule 40 PVC. Screen slot size varies according to the sediments screened, but slots are generally 0.010 or 0.020 inches wide. A rinsed and graded sand occupies the annular space between the boring and the well screen to about one to two feet above the well screen. A two feet thick hydrated bentonite seal separates the sand from the overlying sanitary surface seal composed of Portland type I, II cement.

Well-heads are secured by locking well-caps inside traffic-rated vaults finished flush with the ground surface. A stovepipe may be installed between the well-head and the vault cap for additional security.

The well top-of-casing elevation is surveyed with respect to mean sea level and the well is surveyed for horizontal location with respect to an onsite or nearby offsite landmark.

Well Development

Wells are generally developed using a combination of groundwater surging and extraction. Surging agitates the groundwater and dislodges fine sediments from the sand pack. After about ten minutes of surging, groundwater is extracted from the well using bailing, pumping and/or reverse air-lifting through an eductor pipe to remove the sediments from the well. Surging and extraction continue until at least ten well-casing volumes of groundwater are extracted and the sediment volume in the groundwater is negligible. This process usually occurs prior to installing the sanitary surface seal to ensure sand pack stabilization. If development occurs after surface seal installation, then development occurs 24 to 72 hours after seal installation to ensure that the Portland cement has set up correctly.

All equipment is steam-cleaned prior to use and air used for air-lifting is filtered to prevent oil entrained in the compressed air from entering the well. Wells that are developed using air-lift evacuation are not sampled until at least 24 hours after they are developed.

Groundwater Sampling

Depending on local regulatory guidelines, three to four well-casing volumes of groundwater are purged prior to sampling. Purging continues until groundwater pH, conductivity, and temperature have stabilized. Groundwater samples are collected using bailers or pumps and are decanted into the appropriate containers supplied by the analytic laboratory. Samples are labeled, placed in protective foam sleeves, stored on crushed ice at or below 4°C, and transported under chain-of-custody to the laboratory. Laboratory-supplied trip blanks accompany the samples and are analyzed to check for cross-contamination. An equipment blank may be analyzed if non-dedicated sampling equipment is used.

Waste Handling and Disposal

Soil cuttings from drilling activities are usually stockpiled onsite and covered by plastic sheeting. At least three individual soil samples are collected from the stockpiles and composited at the analytic laboratory. The composite sample is analyzed for the same constituents analyzed in the borehole samples in addition to any analytes required by the receiving disposal facility. Soil cuttings are transported by licensed waste haulers and disposed in secure, licensed facilities based on the composite analytic results.

Groundwater removed during development and sampling is typically stored onsite in sealed 55-gallon drums. Each drum is labeled with the drum number, date of generation, suspected contents, generator identification and consultant contact. Upon receipt of analytic results, the water is either pumped out using a vacuum truck for transport to a licensed waste treatment/disposal facility or the individual drums are picked up and transported to the waste facility where the drum contents are removed and appropriately disposed.

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STANDARD FIELD PROCEDURES FOR SOIL VAPOR PROBE INSTALLATION AND SAMPLING

DIRECT PUSH AND VAPOR POINT METHODS

This document describes Conestoga-Rovers & Associates' standard field methods for soil vapor sampling. These procedures are designed to comply with Federal, State and local regulatory guidelines. Specific field procedures are summarized below.

Objectives

Soil vapor samples are collected and analyzed to assess whether vapor-phase subsurface contaminants pose a threat to human health or the environment.

Direct Push Method for Soil Vapor Sampling

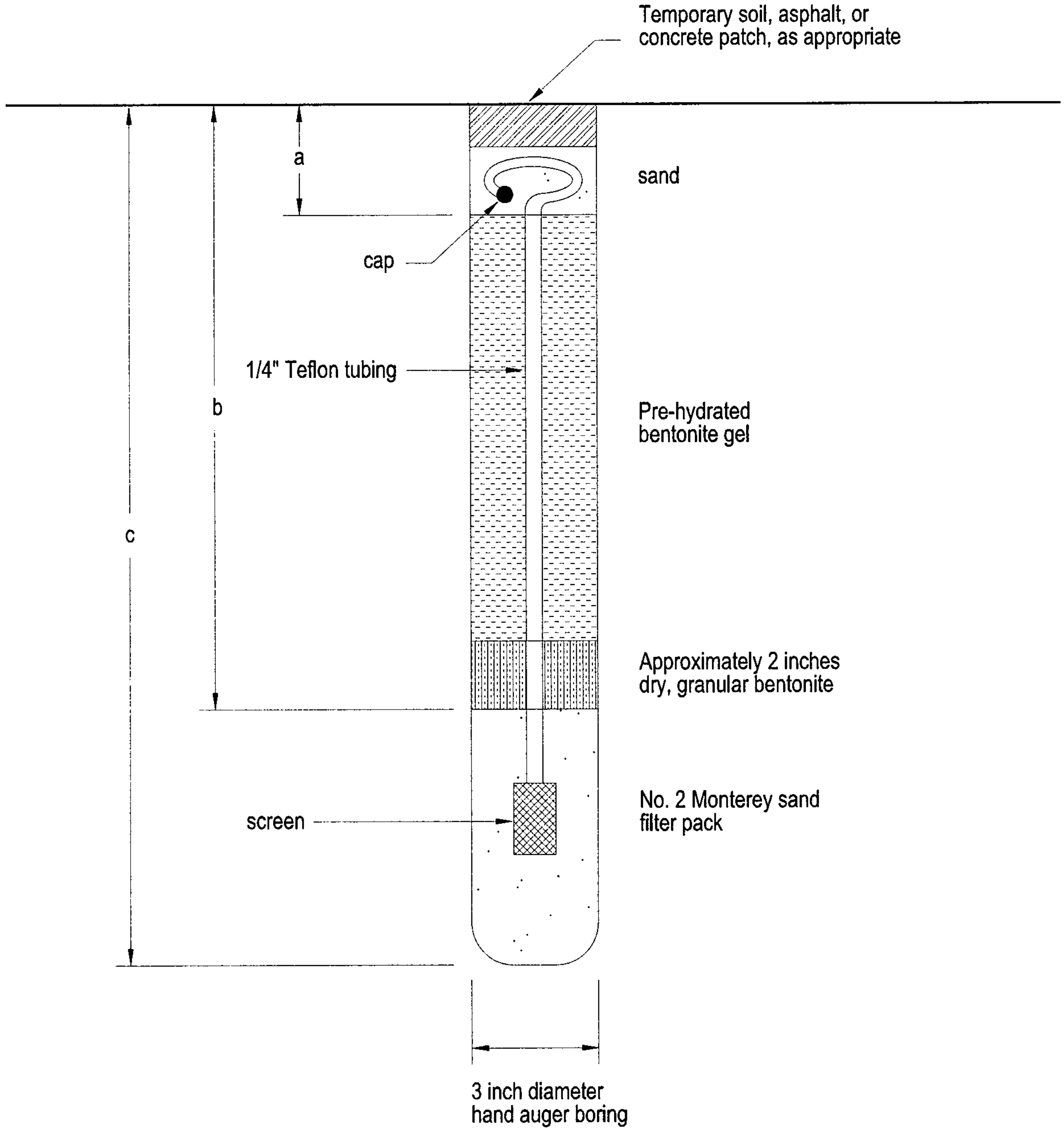
The direct push method for soil vapor sampling uses a hollow vapor probe, which is pushed into the ground, rather than augured, and the stratigraphy forms a vapor seal between the surface and subsurface environments ensuring that the surface and subsurface gases do not mix. Once the desired soil vapor sampling depth has been reached, the field technician installs disposable polyethylene tubing with a threaded adapter that screw into the bottom of the rods. The screw adapter ensures that the vapor sample comes directly from the bottom of the drill rods and does not mix with other vapor from inside the rod or from the ground surface. In addition, hydrated bentonite is placed around the sampling rod and the annulus of the boring to prevent ambient air from entering the boring. The operator then pulls up on the rods and exposes the desired stratigraphy by leaving an expendable drive point at the maximum depth. The required volume of soil vapor is then purged through the polyethylene tubing using a standard vacuum pump. The soil vapor can be sampled for direct injection into a field gas chromatograph, pumped into inert tedlar bags using a "bell jar" sampling device, or allowed to enter a Summa vacuum canister. Once collected, the vapor sample is transported under chain-of-custody to a state-certified laboratory. The ground surface immediately adjacent to the boring is used as a datum to measure sample depth. The horizontal location of each boring is measured in the field relative to a permanent on-site reference using a measuring wheel or tape measure. Drilling and sampling equipment is washed between samples with trisodium phosphate or an equivalent EPA-approved detergent. Once the sampling is completed, the borings are filled to the ground surface with neat cement.

Shallow Soil Vapor Point Method for Soil Vapor Sampling

The shallow soil vapor point method for soil vapor sampling utilizes a hand auger or drill rig to advance a boring for the installation of a soil vapor sampling point. Once the boring is hand augered to the final depth, a 6-inch slotted probe, capped on either end with brass or Swagelok fittings, is placed within 12-inches of number 2/16 filter sand (Figure A). Nylon tubing of ¼-inch inner-diameter of known length is attached to the probe. A 2-inch to 12-inch layer of unhydrated bentonite chips is placed on top of the filter pack. Next pre-hydrated granular bentonite is then poured into the hole to approximately and topped with another 2-inch layer of unhydrated bentonite chips or concrete, depending if the boring will hold one probe or multiple probes. The tube is coiled and placed within a wellbox finished flush to the surface. Soil vapor samples will be collected no sooner than one week after installation of the soil-vapor points to allow adequate time for representative soil vapors to accumulate. Soil vapor sample collection will not be scheduled until after a minimum of three consecutive precipitation-free days and irrigation onsite has ceased. Figure B shows the soil vapor sampling apparatus. A measured volume of air will be purged from the tubing using a vacuum pump and a tedlar bag. Immediately after purging, soil-vapor samples will be collected using the appropriate size Summa canister with attached flow regulator and sediment filter. The soil-vapor points will be preserved until they are no longer needed for risk evaluation purposes. At that time, they will be destroyed by extracting the tubing, hand augering to remove the sand and bentonite, and backfilling the boring with neat cement. The boring will be patched with asphalt or concrete, as appropriate.

Vapor Sample Storage, Handling, and Transport

Samples are stored and transported under chain-of-custody to a state-certified analytic laboratory. Samples should never be cooled due to the possibility of condensation within the canister.



Schematic Not to Scale

FIGURE

A

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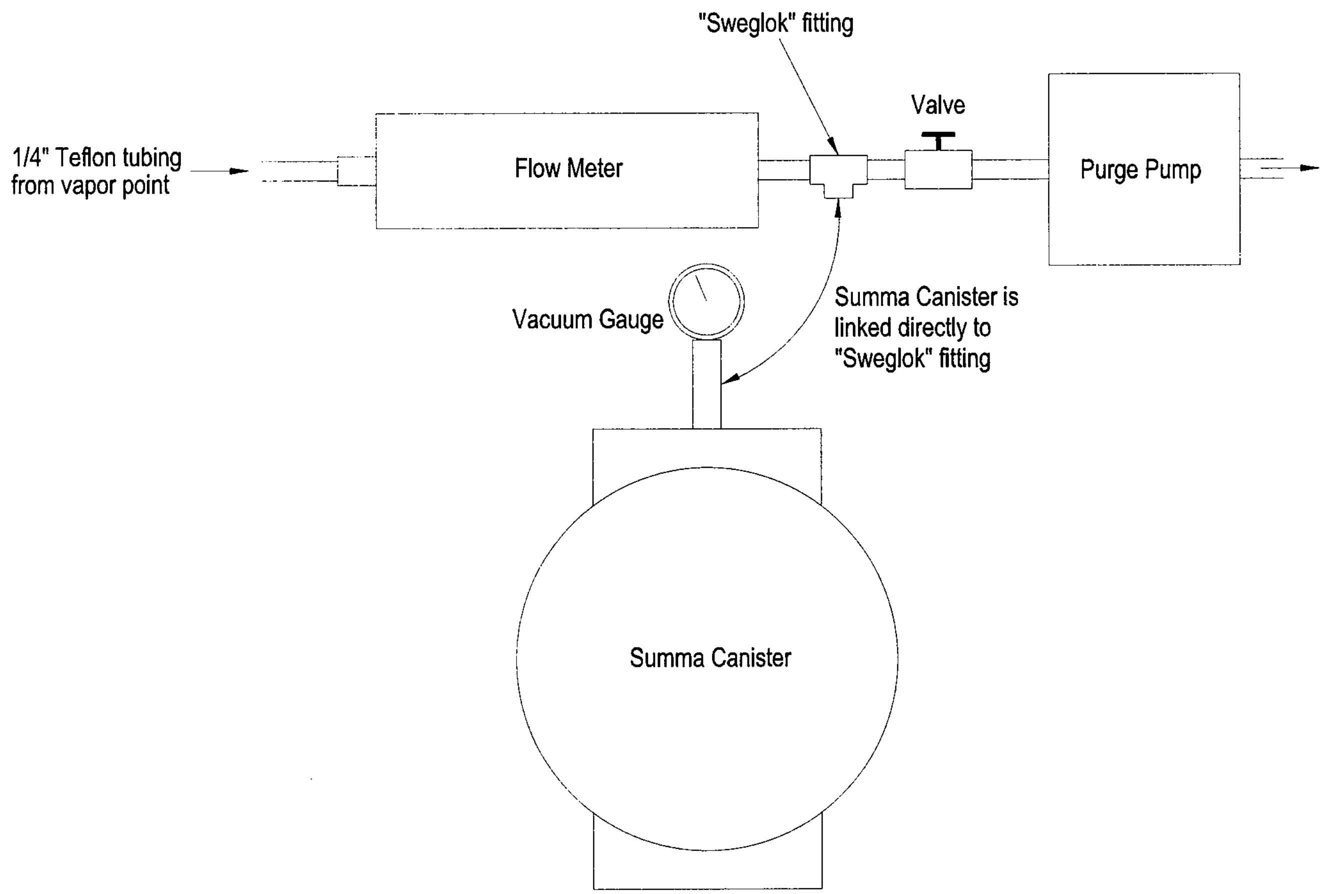
Soil Vapor Point



Schematic Not to Scale

FIGURE

B

S:\0-TEXACO\TEX-SITES\211273\FIGURES\VAPOR-DIAG.DWG

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Soil Vapor Sampling Apparatus Diagram