TO: Santa Ana Office Staff

FROM: M. Hunter/D. Quigley

DATE: June 17, 1993

SUBJECT: Notes From LARWQCB Well Investigation Program Soil Gas Seminar

On May 26, 1993 the Regional Water Quality Control Board, Los Angeles Region, held a one-day seminar on soil-gas applications. This seminar was directed mainly at consultants and was intended to summarize soil-gas methodology and provide the rationale behind the Board's emphasis on soil-gas measurements and the procedures for the Well Investigation Program (WIP), as described in their "Work Plan Requirements for Active Soil Gas Investigations" and related documents (issued November 5, 1992).

The morning session agenda (see attached) included an introduction by Phil Chandler (the Board's key staff member responsible for the San Gabriel Valley), discussions of soil-gas theory and technology by various consultants, and presentation of the Board's soil-gas investigation requirements and guidelines by various Board personnel.

The afternoon session agenda consisted of several case histories by regulatory personnel and discussions by consultants on various aspects of fate and transport, modeling, and state-of-the-art soil-gas applications.

Question and answer periods came at the end of both sessions. Phil Chandler served as master of ceremonies, providing commentary between speakers and answering most of the questions. Often his comments or stated positions directly contradicted previous statements by the invited speakers.

Summarized below are some notes from the seminar, grouped loosely into the following three categories: 1) the Board's position on soil-gas investigations, 2) WIP soil-gas guidelines, and 3) technical notes.

<u>The Board's Position on Soil-Gas Investigations</u> - (inconsistencies were generally acknowledged but ignored by Chandler).

- The Board feels it needs to force soil-gas on consultants because of a lack of acceptance.
- Soil-gas is not just screening; it's not academic: Soil-gas is the method of choice for investigating VOCs because of the difficulties in collecting and analyzing representative soil matrix samples.
- The Board's methodology is more stringent and quantative than in other areas of the country, where they are still "catching up."
- Quantitative data are necessary for defensible arguments.
- Soil matrix samples are now referred to as "companion" samples, and fewer will be required for VOC analysis at future WIP sites.
- Onsite, real-time analysis of soil-gas samples is required; offsite analysis results in degraded data. Offsite laboratory quality control is felt to be less effective than at onsite mobile labs.

- Contaminated soil gas usually represents contaminated soil, even if companion soil matrix sample analyses are clean. The Board has little faith in soil matrix samples analyzed for VOCs.

- Soil gas moves downward and contaminates groundwater. Movement is by barometric pumping, diffusion, and gravity.

- Soil gas does not move upward from dissolved phase VOCs in groundwater.

- No values were given for soil-gas concentrations requiring remediation; but less than 1 $\mu g/l$ will probably not require remediation. The Board's main consideration is the impact to groundwater.

- The presence of soil-gas contamination is evidence enough for requiring remediation, location of NAPL is not required. The Board does not require the definition of the exact path of contamination and or partitioning between the phases. Modelling results may be considered but will not be solely relied upon.

- Zero detection is not required for closure; the Board aims for "nominal zero" defined by asymtoptic rebound concentrations (when the remediation system has been turned off and then restarted several times).

- MCLs for groundwater are the Board's "health-based risk assessment"; no other values are necessary or considered. The Board wants no discharges to water (nondegradation policy).

- Groundwater will respond positively (concentrations will decrease) if the soil gas is cleaned up, providing no offsite slugs move through.

- A previously closed site may be reopened by the Board if no soil-gas investigation was performed. But there would have to be some indication of a need to do so.

- A limited number of soil matrix samples are required to confirm soil remediation that has been indicated by soil-gas monitoring. Soil samples from fine-grained horizons are preferred because that is where residual concentrations are likely to be highest.

- The Board has not yet granted closure on any sites with vapor extraction systems.

- Typical WIP site characterization sequence:

  - Shallow soil-gas survey
  - Companion soil matrix sampling
  - Vertical profiling by soil-gas monitoring wells
  - Groundwater monitoring wells

- SVE cleanup performance measurement:

  - Multilevel gas probes showing decreasing/nondetectable gas concentrations.

- Diminishing / asymtoptic rebound curves for extracted vapors (i.e., is it financially feasible to continue?).
- Negligible immobile residual soil matrix concentrations.
- Correspondence of empirical data to modeling results.
- Reduction in groundwater concentrations over time.

- The Board wants to negotiate with consultants over the use of models and assumptions to be made for predicting fate and transport of contaminants. There has been no effort to standardize the models used.

WIP Soil-Gas Guidelines - In general, the guidelines are straightforward and relatively easy to understand. Some clarifications and highlights are listed below.

- List of "Approved" labs (see attached) means that the lab has simply submitted a QA/QC package, which has been accepted as complete by the Board. Some labs are good, some are bad. The Board does not certify labs.

- Chemical standards are a definite problem. Labs sometimes do not know where they are coming from or what they are.

- Instrument calibration continues to be a problem. GCs must be calibrated to a linear range capable of quantifying the samples injected.

- "Independent confirmation" of compounds means that at least once during the program, a sample needs to analyzed by GC-MS or second-column GC for compound identification only. The Board will accept samples submitted to outside labs for this purpose.

- It is the consultant's responsibility to make sure the lab data is accurate (i.e., data validation).

- An informal audit by the Board discovered differences in detected concentrations between labs of up to several orders of magnitude. The Board will show up at sites and ask the mobile lab to run their standards.

- Low purge volumes (less than 3 probe volumes) are required to prevent atmospheric contamination of the sample.

- Sampling events should not be scheduled within 7 days after a rain.

- Standards for permanent vapor probes will come out soon.

Soil-Gas Technical Notes - Made by guest speakers, do not necessarily agree with Board positions stated above.

- Soil-gas sampling is the best method of investigating soil contaminated by VOCs; but this must be by quantitative analysis.

- "Heavy gas molecules" do not move down by gravity (Chandler believes they do).

- Generally, soils with a hydraulic conductivity of greater than 10^{-6} cm/sec can be sampled.
- Five-foot sampling depth usually avoids atmospheric interference.
- Nature is not in equilibrium; you can have clean soil with "dirty" gas.
- Small-diameter (1/8") plastic tubing instead of steel or PVC pipe can be used for permanent vapor probes and is cheaper, with lower purge volumes, and easier to install.
- Soil moisture content variations (5% - 35%) have relatively little effect on soil-gas concentrations (less than 10%) for most common VOCs. Rains can cause advective movements of soil gas.
- The EPA has an internal conflict in that it believes soil gas is the best method for assessing VOCs, but it traditionally has not been allowed to use soil-gas data in risk assessments. Region 9 apparently now has internal authorization to use soil gas in risk assessments.
- EPA is worried about the threat to groundwater posed by soil gas present in soil. Data from sites in Arizona indicate most of VOCs in soil are present in the vapor phase.
- EPA does not require soil matrix sampling if a soil gas precedent exists in the area.
- EPA has used kriging on shallow soil-gas data to locate deeper nested wells.
- EPA has used modelling (VLEACH) to assess the vadose zone threat to groundwater at Arizona Superfund sites. Geologic considerations are very important to EPA and must be incorporated into the model.
- VLEACH (developed by CH_2M Hill for EPA) considers liquid advection, sorption-desorption, gas diffusion, and volatilization. It can apply to a known soil-gas concentration profile above the saturated zone. It assumes complete mixing of the contaminant mass transferred to the saturated unit.
- EPA can now use presumptive remedies (such as vapor extraction) to avoid having to do a feasibility study.
- One-dimensional vadose zone models (such as VLEACH) may be overly conservative (ignore lateral spreading).
- For modelling, if appreciable water is present in the vadose zone, the partitioning of soil gas to soil can be ignored. Henry's law (partitioning between soil gas and soil moisture) may apply at low concentrations. Raoult's law (vapor pressure proportional to mole fraction) may apply at higher concentrations.
- Degradation of hydrocarbon VOCs is dependent on metabolic pathways and redox potentials and occurs under specific conditions, not guaranteed. Methane and carbon dioxide can be indicators of biological processes taking place.

- Partitioning of VOCs from groundwater into the vadose zone has been observed in nested monitoring wells.

- Possible indicators of NAPLS:

  - Soil-gas concentrations exceed saturated vapor density.
  - Soil-gas concentrations imply water concentrations exceed solubility limits.

- Tonto and Transglobal Environmental Geochemistry can provide a combined CPT and soil-gas sampling capability. (Perhaps The Earth Technology as well.)

- Drivepoint air permeability tests (step drawdown) can be performed during purging for soil-gas sampling. In less than 10 minutes, they can measure vacuum and flow rate to calculate air permeability. This can be useful to get a 3-dimension pattern of air permeabilities over a site.

Attachments: RWQCB Well Investigation Program Soil Gas Seminar Outline
Partial List of Soil Gas Consultants

RWQCB WELL INVESTIGATION PROGRAM SOIL GAS SEMINAR
MAY 26, 1993, 8:00 a.m.-4:00 p.m.

1.	Introduction	General remarks as to why measurements are necessary
2.	Soil Vapor Context	Background regarding volatile organic compounds (VOCs) and migration behavior as waste discharge to the ground
3.	Vapor Measurement	Methodologies for obtaining and measuring VOCs in soil gas
4.	Importance of QA/QC	Rationale for emphasis on QA/QC of vapor measurements
5.	Soil Gas vs Soil Matrix?	Requirement for **combination** of soil vapor and soil matrix analyses where VOCs comprise the waste discharge
6.	Technical Requirements	Summary of WIP soil gas guidelines which are provided to assist in developing acceptable investigation or assessment workplans
7.	Open Discussion	Questions directed to staff or outside experts

BREAK FOR LUNCH

8.	Applications	USEPA Cleanup Case History in Arizona
		Total Contaminant Estimation
		Fixed Gas Significance
		Ground Water Mapping/Effects?
		Spatial Pattern Emphasis
		Vertical Continuity
		Cleanup Performance Measures
9.	Open Discussion	Questions directed with respect to specific applications and circumstances
10.	Close	

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PARTIAL LIST OF SOIL GAS CONSULTANTS

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
LOS ANGELES REGION
(February, 1993)

The following non-exclusive list is for the convenience of the public who require assistance to select consultants for active soil gas investigations.

The Board requested these consultants to submit a laboratory data package demonstrating their analytical capabilities. We have found the following companies' analytical testing methods to be acceptable. Although other soil gas consultants not on this list may be used, laboratory capabilities must be demonstrated prior to performing any work.

Please note that retaining a consultant from this list does not assure acceptance of that consultant's work and this Regional Board reserves the authority to review any consultant's work to assure compliance with all applicable statutes, regulations, orders, and guidelines. It is your responsibility to ascertain that the individual directing the field investigation is professionally qualified.

AeroVironment, Inc.
P. O. Box 5031
Monrovia, CA 91017-7131
(818) 357-9983
Mr. Mark Slatten

Environmental Support Technologies
23011 Moulton Parkway, Suite E-6
Laguna Hills, CA 92653
(714) 457-9664
Mr. Kirk Thomson

GeoResearch/GEOTEST
3960 Gilman Street
Long Beach, CA 90815
(310) 597-3977
Mr. Mike Mooradian

Hydro Geo Chem, Inc.
1430 N. Sixth Avenue
Tucson, AZ 85705
(602) 623-6981
Dr. Harold Bentley/Ms. Patricia Schumann

InterPhase
11558 Sorrento Valley Rd.,
San Diego, CA 92121
(619) 481-2200
Dr. Donn L. Marrin

Inland Empire Environmental Services
7291 Ashley Avenue
Colton, CA 92324
(714) 872-0501 or 338-3674
Mr. Lawrence Pearce

Terra Tech Labs, Inc.
1920 E. Deere Avenue, Suite 130
Santa Ana, CA 92705
(714) 757-7022
Mr. Brian Kato

Transglobal Environmental
Geochemistry, Inc.
432 North Cedros Avenue
Solano Beach, CA 92075
(619) 793-0401
Dr. Blayne Hartman

Optimal Technology
6430 Via Real, Suite 6
Carpinteria, CA 93013
(805) 684-6226
Mr. Timothy Thiesen

Centrum Analytical Laboratories, Inc.
290 Tennessee Street
Redlands, CA 92373
(909) 798-9336
Mr. Michael A. Yartzoff

Tracer Research Corporation
1555 Park Avenue, Suite E
Emeryville, CA 94608
(510) 654-0714
Mr. Stephen Jensen

APC: 2/1/93