b. interested parties described in III.H.8.a. are included in the public participation process; and

c. site information is forwarded from the approving agency to the Regional Water Board so that sites for which Technical Impracticability Waivers have been approved can be included in the master listings described in Section III.H.10.;

8. The Regional Water Board shall comply with the following public participation requirements, in addition to any other legal requirements for notice and public participation, prior to the designation of a containment zone:

a. Public notice of an intention to designate a containment zone shall be provided to all known interested persons, including the owner of the affected property(s), owners and residents of properties adjacent to the containment zone, and agencies identified in Section III.H.9, at least 45 days prior to the proposed designation of a containment zone;

b. Interested persons shall be given the opportunity to review the application, including the proposed management plan, and any other available materials and to comment on any proposed designation of a containment zone. These materials, which contain information upon which the proposed designation of a containment zone is based, must be available for review at least 45 days prior to the proposed designation of a containment zone;

c. The proposed designation of a containment zone shall be placed on the agenda for consideration at a Regional Water Board meeting;

9. At least 45 days prior to the proposed designation of a containment zone, the Regional Water Board shall invite a technical advisory committee to review any proposed designation and shall meet as a committee at the request of any committee member. The committee or any committee member shall provide advice to the Regional Water Board as to the appropriateness of the requested designation and such designation will become part of the public record. No person or agency shall be made a member of the committee who is employed by or has a financial interest with the discharger seeking the designation. The following agencies shall be invited to participate in the advisory committee:

a. The California Department of Toxic Substances Control;

b. The California Department of Health Services, Drinking Water Branch;

c. The California Department of Fish and Game;

d. The local health authority;

e. The local water purveyor, in the event ground water is used or planned to be used as a source of water supply;

f. Any local ground water management agency including an appointed water master;

g. The United States Environmental Protection Agency; and

h. The California Coastal Commission if the site is located within the coastal zone of California.

10. The Regional Water Boards shall keep a master listing of all designated containment zones. The

master listing shall describe the location and physical boundaries of the containment zone, the pollutants which exceed applicable water quality objectives, and any land use controls associated with the containment zone designation. The Regional Water Board shall forward the information on the master list to the State Water Board and to the local well permitting agency whenever a new containment zone is designated. The State Water Board will compile the lists from the Regional Water Boards into a comprehensive master list;

11. To assure consistency of application of this Policy, the State Water Board will designate a Containment Zone Review Committee consisting of staff from the State Water Board and each of the Regional Water Boards. This review committee shall meet quarterly for two years and review all designation actions taken. The committee shall review problems and issues and make recommendations for consistency and improved procedures. In any event the State Water Board shall review the containment zone issue not later than five years after the adoption of Section III.H... and periodically thereafter. Such review shall take place in a public proceeding;

12. In the event that a Regional Water Board finds that water quality objectives within the containment zone have been met, after public notice, the Regional Water Board will rescind the designation of the containment zone and issue a closure letter; and

13. The Regional Water Board s cost associated with review of applications for containment zone designation will be recoverable pursuant to Section 13304 of the Water Code, provided a separate source of funding has not been provided by the discharger.

14. Designation of a containment zone shall have no impact on a Regional Water Board s discretion to take appropriate enforcement actions except for the provisions of Section III.H.4.

IV. The Regional Water Board shall determine schedules for investigation, and cleanup and abatement, taking into account the following factors:

A. The degree of threat or impact of the discharge on water quality and beneficial uses;

B. The obligation to achieve timely compliance with cleanup and abatement goals and objectives that implement the applicable Water Quality Control Plans and Policies adopted by the State Water Board and Regional Water Boards;

C. The financial and technical resources available to the discharger; and

D. Minimizing the likelihood of imposing a burden on the people of the state with the expense of cleanup and abatement, where feasible.

V. The State and Regional Water Boards shall develop an expedited technical conflict resolution process so when disagreements occur, a prompt appeal and resolution of the conflict is accomplished.

Appendix to Section III.H.

Application for a Containment Zone Designation

The discharger is responsible for submitting an application for designation of a containment zone. Supporting information which is readily available to the Regional Water Board and which would be cumbersome or costly to reproduce can be included in the application by reference. In order to facilitate

the preparation of an acceptable application, the discharger may request that the Regional Water Board provide a preliminary review of a partial application. The partial application should be detailed enough to allow the Regional Water Board to determine if the site passes the threshold criteria for establishment of a containment zone (e.g., it is not reasonable to achieve water quality objectives at that site, plume management measures are likely to be effective, etc.). As appropriate, the application shall include:

a) Background information (location, site history, regulatory history);

b) Site characterization information, including a description of the nature and extent of the discharge. Hydrogeologic characterization must be adequate for making the determinations necessary for a containment zone designation;

c) An inventory of all wells (including abandoned wells and exploratory boreholes) that could affect or be affected by the containment zone;

d) A demonstration that it is not reasonable to achieve water quality objectives;

e) A discussion of completed source removal and identification of any additional sources that will be addressed during implementation of the management plan;

f) A discussion of the extent to which pollutant mass has been reduced in the aquifer and identification of any additional mass removal that will be addressed during implementation of the management plan;

g) If necessary, information related to the availability of funds to implement the provisions of the management plan throughout the expected duration of the containment zone designation;

h) The proposed boundaries for the proposed containment zone pursuant to Section III.H.3.a.;

i) An evaluation of potential impacts to water quality, human health and the environment pursuant to Sections III.H.3.b. and c.;

j) A statement that the discharger believes that the site is not located in a critical recharge area, as required by Section III.H.3.d.;

k) Copies of maps and cross sections that clearly show the boundaries of the proposed containment zone and that show the locations where land use restrictions will apply. Maps must include at least four points of reference near the map corners. Reference points must be identified by latitude and longitude (accurate to within 50 feet), as appropriate for possible inclusion in a geographic information system (GIS) database; and

l) A management plan for review and approval. The management plan must contain provisions for:

1) source removal as appropriate;

2) pollutant mass removal from the aquifer as appropriate;

3) land use or engineering controls necessary to prevent the migration of pollution, including the proper abandonment of any wells within the vicinity of the containment zone that could provide a conduit for pollution migration beyond the containment zone boundary;

4) land use or engineering controls necessary to prevent water quality impacts and risks to human health and the environment;

5) mitigation measures, an implementation schedule for mitigation, and reporting requirements for compliance with mitigation measures;

6) a detailed description of the proposed monitoring program;

7) a detailed description of the method to be used by the discharger to evaluate monitoring data;

8) a specific protocol for actions to be taken if there is evidence that water quality objectives have been exceeded outside the containment zone as a result of the migration of pollutants from within the containment zone;

9) a detailed description of the frequency and content of reports to be submitted to the Regional Water Board;

10) detailed procedures and designs for well maintenance, replacement and decommissioning;

11) a protocol for submittal to and approval by the Executive Officer of minor modifications to the management plan as necessary to optimize monitoring and containment; and

12) a description of file and database maintenance requirements.

CERTIFICATION

The undersigned, Administrative Assistant to the Board, does hereby certify that the foregoing is full, true, and correct copy of a resolution duly and regularly adopted at a meeting of the State Water Resources Control Board held on June 18, 1992, and amended at meetings of the State Water Resources Control Board held on April 21, 1994, and October 2, 1996.

/s/

Maureen Marché

Administrative Assistant to the Board

FOOTNOTES:

1. For the purposes of this section, "land use controls" means recorded instruments, proposed by the discharger and agreed to by the owner of the affected property, restructing the present and future uses of the affected property, including, but not limited to, recorded easements, convenants, restrictions or servitudes, or any combination thereof, as appropriate. Land use controls shall run with the land from the date of recordation, shall bind all of the owners of the land, and their heirs, successors, and assignees, and the agents, employees, and lessees of the owners, heirs, successors, and assignees. Such instruments shall provide for (a) amendment or rescission of the restruction upon application of the holder of fee interest in the property and upon the approval of the Regional Water Board if warranted by changed circumstances (e.g., new information demonstrates that a modification to land use restriction is appropriate, the containment zone designation has been rescinded because water quality objectives have

been attained throughout the containment zone, etc.), and (b) except for the restriction contained in the instrument, the establishment of a containment zone shall not prohibit the full use of enjoyment of the property.

2. For the purposes of this section, "engineering controls" means measures to prevent migration of pollutants and to prevent, minimize or mitigate environmental damage which may otherwise result from a release of threatened release, including, but not limited to , caps, covers, dikes, trenches, leachate collection systems, treatment systems, and ground water containment systems or procedures and decomissioning of wells.

3. For the purposes of this section, these agreements could be formal, private agreements between parties related to the property use, existing or potential water use, etc.

ADDITIONAL INFORMATION RELATED TO ADOPTION OF CONTAINMENT ZONE POLICY

1. ADDITIONAL PROVISIONS OF RESOLUTION NO. 96-079

State Water Resources Control Board (SWRCB) Resolution No. 96-079, which adopted the Containment Zone Policy Amendment to Resolution No. 92-49, also:

o Directs the Containment Zone Review Committee established pursuant to Section III.H.11. of the amendment to review the implementation of this policy and the incorporation of risk assessment into this policy and provide recommendations to the SWRCB by May 1, 1997, on any further adjustments to the policy.

o Expands the Containment Zone Review Committee to include other public officials and private individuals as determined by the State Board.

2. ANTICIPATED FUTURE MINOR CHANGES TO BE MADE TO CONTAINMENT ZONE PROVISIONS OF RESOLUTION NO. 92-49

On October 2, 1996, the SWRCB adopted Resolution No. 96-079 which amended SWRCB Resolution No. 92-49 to include provisions for a containment zone policy.

Pursuant to Government Code Section 11355, this amendment was submitted to the Office of Administrative Law (OAL) for review and approval. Staff of OAL approved this amendment on January 13, 1997 and brought to our attention two minor matters which need correction. In the first sentence of Section III.H.4., the word "pollutant" should be substitued for the word "chemical". In the second sentence of Section III.H.9. the word "advice" should be substituted for the word "designation".

These minor changes will be corrected the next time Resolution No. 92-49 is revised.

EXHIBIT “P”

--*-*-* Copy of Memo (Beginning) -*-*-*-*-

State of California
Memorandum

To: Regional Board Executive Officers **Date:** December 2, 1992

From: /s/
William R. Attwater
Chief Counsel
OFFICE OF THE CHIEF COUNSEL
STATE WATER RESOURCES CONTROL BOARD
901 P Street, Sacramento, CA 95814
Mail Code: G-8

Subject: **RESPONSIBLE PARTY ORDERS**

Attached is a summary of principles established in State Water Board orders regarding who should be named in ground water cleanup orders.

Attachment

cc: Walt Pettit
Executive Director

Redding, Fresno, and Victorville Branch Offices

--- BEGININNING PAGE 2 OF 2 ---

STATE BOARD ORDERS: WHO SHOULD BE NAMED IN GROUND WATER CLEANUP ORDERS

Summary of Principles

- In general, name all persons who have caused or permitted a discharge (Orders Nos. WQ 85-7 and 86-16).

- "Discharge" is to be construed broadly to include both active discharges and continuing discharges (Order No. WQ 86-2).

- There must be reasonable basis for naming a responsible party (i.e., substantial evidence). It is inappropriate to name persone who are only remotely related to the problem such as suppliers and distributors of gasoline (WQ 85-7, 86-16, 87-1, 89-13, and 90-3).

- Persons who are in current possession, ownership or control of the property should be named, including current landowners and lessees (numerous orders, including WQ 84-6, 86-11, 86-18, 89-1, 89-8, 89-13 and 90-3). Lessees/sublessors may be responsible (WQ 86-15).

- Generally, Regional Water Boards should not try to apportion responsibility between parties (WQ 86-2 and 88-2).

- However, in some cases, current landowners should only be named as secondarily liable. Factors: landowner did not cause or know of actual discharge; tenant, lessee or prior owner is responsible; cleanup is proceeding; and lease is long-term (WQ 86-11, 86-18, 87-6, and 92-13). Secondary responsibility is also appropriate where landowner is trustee-type of governmental agency such as Forest Service (WQ 87-5).

- Prior landowners and lessees should be named if they owned or were in posession of the site at the time of discharge, had knowledge of the activities which resulted in the discharge, and had the legal authority to prevent the discharge (numerous orders, including WQ 85-7, 86-15, 91-7 and 92-13). Narrow exceptions based on such factors as: site owned or leased for short time, person did not cause actual discharge, are other responsible parties, person did not use property, no or minimal knowledge of problem (WQ 92-4 and 92-13).

- It is appropriate to name government as responsible parties (WQ 88-2, 89-12, and 90-3).

- Corporations should be named even where a dissolved corporation (WQ 89-14) or a successor in interest (WQ 89-

8).

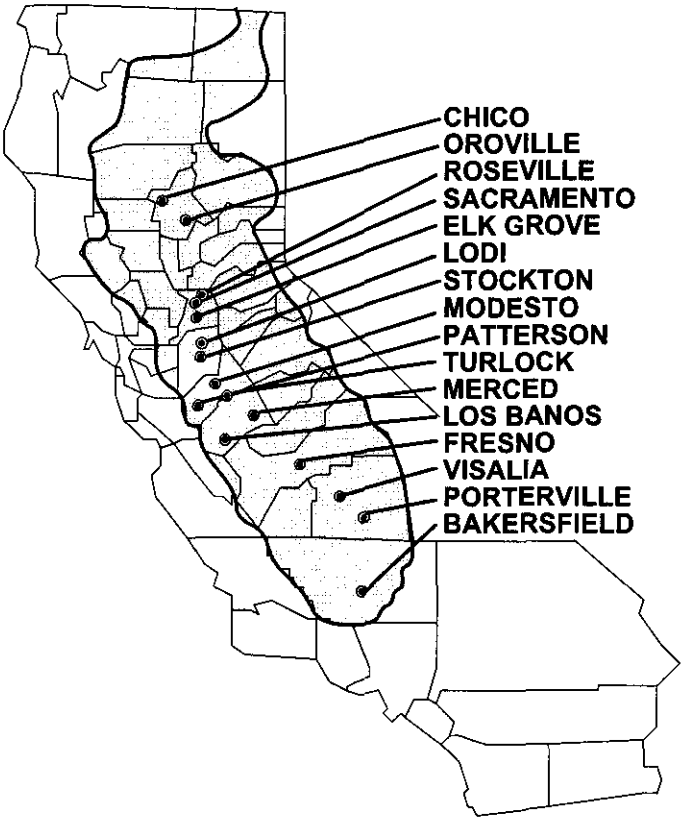
--- END OF PAGE 2 OF 2 ---
END OF MEMO & ATTACHMENT

EXHIBIT “Q”

DRY CLEANERS— A MAJOR SOURCE OF PCE IN GROUND WATER

27 March 1992

CENTRAL VALLEY
CITIES WHERE MUNICIPAL WELLS ARE AFFECTED BY
TETRACHLOROETHYLENE (PCE)



WELL INVESTIGATION PROGRAM

STATE OF CALIFORNIA
Pete Wilson, Governor

CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY
James M. Strock, Secretary

REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL VALLEY REGION
John S. Corkins, Chair
Karl E. Longley, Vice Chair
Hank Abraham, Member
A. Vernon Conrad, Member
Hugh V. Johns, Member
W. Steve Tompkins, Member
Clifford C. Wisdom, Member

William H. Crooks, Executive Officer

~~3443 Routier Road, Suite A~~
~~Sacramento, California 95827-3098~~

~~Phone: (916) 361-5600~~
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Current address & phone:
11020 Sun Center Drive #200
Rancho Cordova, CA 95670
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DISCLAIMER

This publication is a technical report by staff of
the California Regional Water Quality Control Board,
Central Valley Region.
No policy or regulation is either expressed or intended.

DRY CLEANERS—A MAJOR SOURCE OF PCE IN GROUND WATER

VICTOR J. IZZO
Associate Engineering Geologist

Approved by the California Regional Water Quality Control Board, Central Valley Region on 27 March 1992

INDEX

EXECUTIVE SUMMARY

Tetrachloroethylene (PCE), a known carcinogen, has degraded at least 215 wells in the Central Valley of California. Figure 1 illustrates the extent of the problem. The majority of these wells are large system municipal wells of 200 connections of more. The Chico, Sacramento, Modesto, Fresno, Turlock, Lodi and Merced areas all have wells with levels of PCE above 0.8 ppb which is the estimated one in a million incremental cancer risk (8). The Maximum Contaminant Level (MCL) set by the Department of Health Services for drinking water is five ppb. Forty-seven of the 215 wells have PCE levels above the MCL.

The Well Investigation Program of the Central Valley Regional Water Quality Control Board so far has identified the likely PCE sources in 21 of the wells; in 20 of those wells, dry cleaners are the likely source. In areas where PCE well investigations were done, dry cleaners are the only present large quantity users of this volatile organic chemical (VOC). The Halogenated Solvent Industry Alliance 1987 white paper on PCE states that dry cleaners use 56% of the PCE used in United States (5). All dry cleaners in the vicinity of degraded supply wells show evidence of major ground water degradation. Monitoring wells drilled adjacent to dry cleaners had concentration from 120 ppb to 32,000 ppb, well above the MCL.

The main discharge point for dry cleaners is the sewer line. The discharge from most dry cleaning units contains primarily water with dissolved PCE, but also contains some pure cleaning solvent and solids containing PCE. Being heavier than water, PCE settles to the bottom of the sewer line and exfiltrates through it. This liquid can leak through joints and cracks in the line. PCE, being volatile, also turns into gas and penetrates the sewer wall. Sewer lines are not designed to contain gas. The PCE then travels through the vadose zone to the ground water.

Where a source investigation has been done in connection with PCE contamination, the evidence has shown that dry cleaners have degraded the ground water. The data strongly indicate that leakage through

CENTRAL VALLEY
CITIES WHERE MUNICIPAL WELLS ARE AFFECTED BY PCE

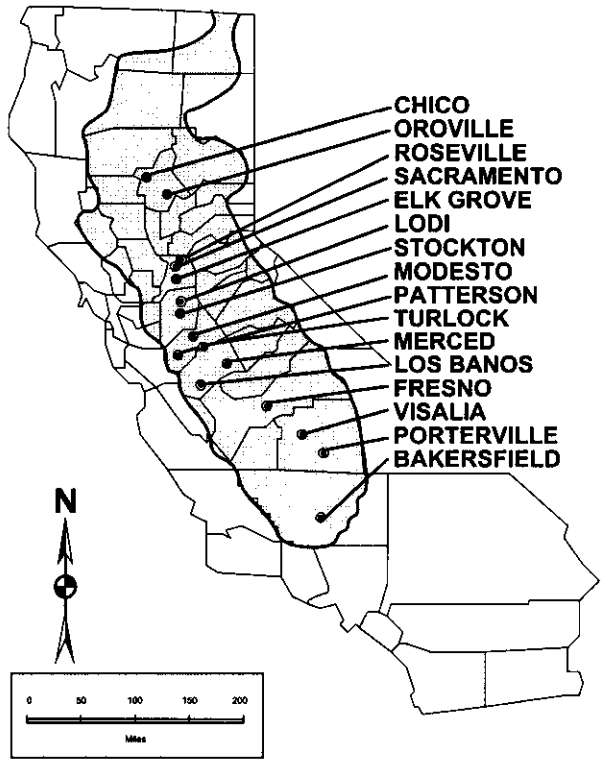


Figure 1

the sewer lines is the major avenue through which PCE is introduced to the subsurface. With approximately 285 dry cleaners in just the metropolitan areas of Sacramento, Chico, Lodi, Modesto, Turlock, Stockton and Merced, one would expect that many more wells will be degraded by PCE in the future. Most of the wells degraded by PCE and most of the dry cleaners are in residential and retail areas. Based on the data collected to date and the location of most of the degraded wells with confirmed PCE, a great majority of these wells will have dry cleaners as the source.

The solution to part of the problem is to halt the disposal of waste from dry cleaning units to the sewer line. Regulation of this discharge to the sewer could be achieved through new legislation and city ordinance. Since this problem exists throughout the state, a statewide policy seems appropriate.

The other part of the problem is ground water cleanup

which is required so that cities can continue to provide safe water. A state wide fund may be needed to help pay for cleanup.

INTRODUCTION

Over 750 wells have been reported to the California Regional Water Quality Control Board, Central Valley Region, with confirmed levels of volatile organic chemicals (VOCs). Greater than 35% of the reported wells contain tetrachloroethylene (PCE). Municipal drinking water supplies have been affected by PCE throughout the Central Valley (Figure 1). At least one city is already treating contaminated ground water in order to continue its water supply.

This report discusses some of the data and conclusions about PCE movement to ground water, the source of the PCE, and possible solutions. The report is divided into six sections.

*Introduction

* Tetrachloroethylene (PCE)
  A brief description of the use of PCE and its physical and chemical properties.

* Source Identification for PCE Degraded Wells
  A description of how Board staff determines the source of VOC(s) in a well and the results of PCE source investigations.

* Dry Cleaning Operations and Discharge Locations
  General discussion of dry cleaning operations and waste discharge points.

* Evidence and Theory on How PCE is Leaving the Sewer

* Conclusion and Recommendations

TETRACHLOROETHYLENE (PCE)

PCE was first formulated in 1821 (22). By the 1960's and early 1970's, it had become a widely used solvent in dry cleaning, metal degreasing and other industries (18). In the late 1970's, most industries moved away from the use of PCE. The exception was the dry cleaning industry. By the early 1980's, dry cleaners used the majority of the PCE in this nation (18). In the late 1980's, dry cleaners used 56% of the PCE used in United States (5).

Compared to many VOCs, PCE is very mobile, with relatively low solubility and vapor pressure. In its liquid state, it is heavier and less viscous than water and will sink through it. In the vapor phase, PCE's density is greater than air. PCE biodegradability is low in the subsurface. The following are some of the physical and chemical properties of PCE: [3]

Molecular Weight	165.85 g
Solubility	150 mg/l at 25°C
Vapor Pressure	14 torr
Density	1.63 g/cm
Boiling Point	121 °C
Kinematic Viscosity	0.54 (water=l)
Henry's Law Constant	0.0131 atm-m /mole
Vapor Density	5.83 (air=1)
Specific Gravity	1.63 at 20° (water=l)
Relative Velocity	1.8 (water=l)

PCE is generally found in three phases in the subsurface: liquid, vapor, and dissolved in water. More than one phase usually exists in the subsurface after discharge. Figure 2 shows three possible scenarios at a discharge point.

VOCs will not adsorb to subsurface materials to any significant degree when those materials are nearly pure minerals which contain little organic matter. Most high-yield aquifers are nearly free of organic matter. The majority of fresh water aquifers and the vadose zone in the Central Valley are fan deposits from the Sierra Nevada and the Coast Range, and are composed primarily of low organic soils and substrata. Therefore, retention of VOCs in the Central Valley by soil and subsurface strata probably is very low.

PCE is a known carcinogen. The Water Quality Advisories for a l-in-a-million incremental cancer risk

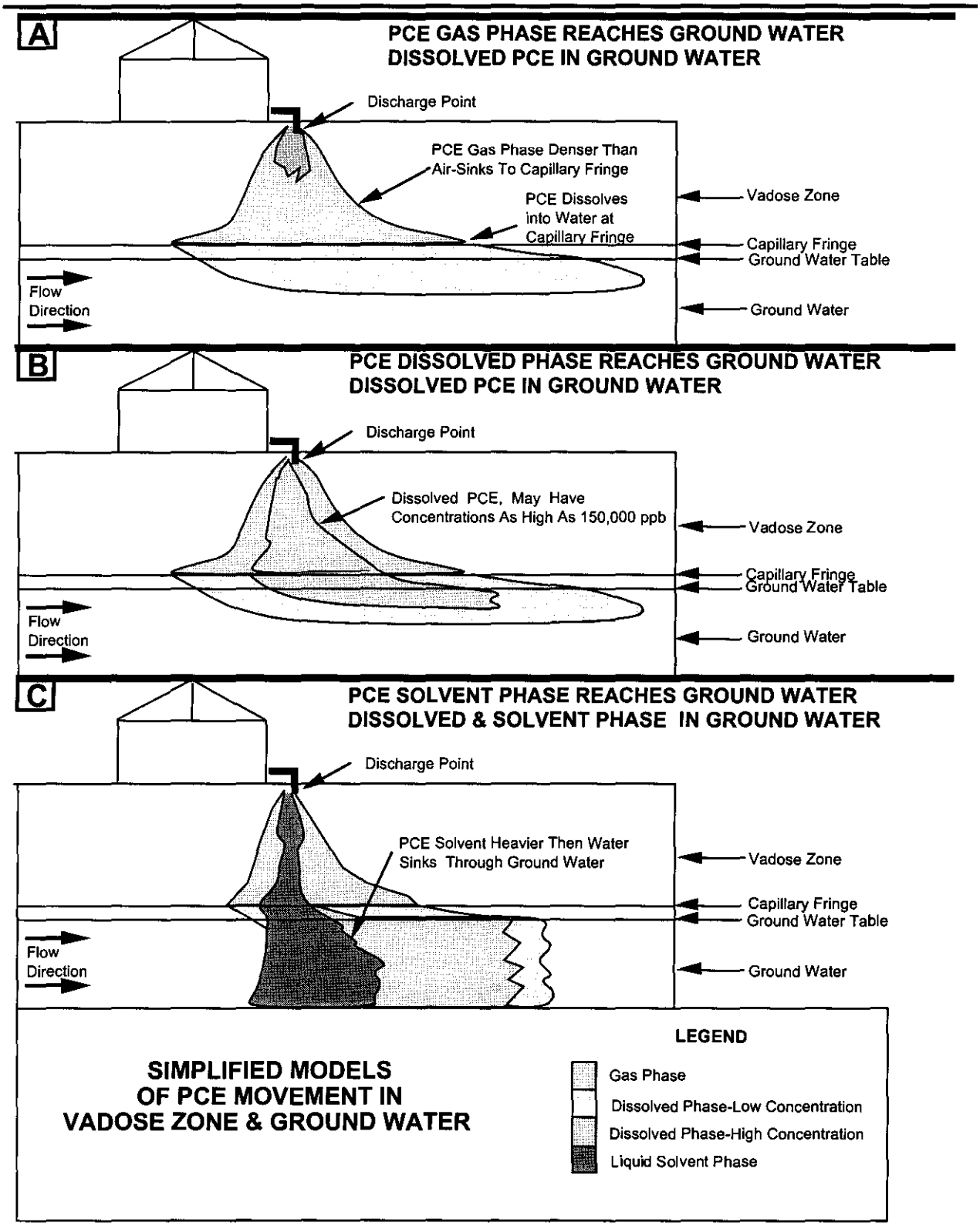

A
PCE GAS PHASE REACHES GROUND WATER
DISSOLVED PCE IN GROUND WATER
Discharge Point
PCE Gas Phase Denser Than
Air-Sinks To Capillary Fringe
PCE Dissolves
into Water at
Capillary Fringe
Vadose Zone
Capillary Fringe
Ground Water Table
Flow
Direction
Ground Water
B
PCE DISSOLVED PHASE REACHES GROUND WATER
DISSOLVED PCE IN GROUND WATER
Discharge Point
Dissolved PCE, May Have
Concentrations As High As 150,000 ppb
Vadose Zone
Capillary Fringe
Ground Water Table
Flow
Direction
Ground Water
C
PCE SOLVENT PHASE REACHES GROUND WATER
DISSOLVED & SOLVENT PHASE IN GROUND WATER
Discharge Point
PCE Solvent Heavier Then Water
Sinks Through Ground Water
Vadose Zone
Capillary Fringe
Ground Water Table
Flow
Direction
Ground Water
SIMPLIFIED MODELS
OF PCE MOVEMENT IN
VADOSE ZONE & GROUND WATER
LEGEND
Gas Phase
Dissolved Phase-Low Concentration
Dissolved Phase-High Concentration
Liquid Solvent Phase

Figure 2

estimate is 0.8 ppb (8). The State of California Department of Health Services Maximum Contaminant Level (MCL) for PCE is five ppb.

SOURCE IDENTIFICATION FOR PCE DEGRADED WELLS

A source investigation is conducted by Board staff to identify the source(s) of contaminant found in a drinking water supply well. This section is divided into two parts: a description of the steps in a source investigation and a general discussion of the results of a PCE source investigation.

SOURCE INVESTIGATION

There are five general steps conducted in a source investigation as follows:

1. Well reported degraded by VOCs
2. Identify possible sources of the VOCs
3. Inspect the users of the VOCs
4. Identify ground water characteristics
5. Conduct a soil gas survey

In step 1, a drinking water well is reported degraded by a VOC to the Board. The main sources of this information are the California Department of Health Services, counties, municipalities and private water companies. The information starts the Board's formal source investigation.

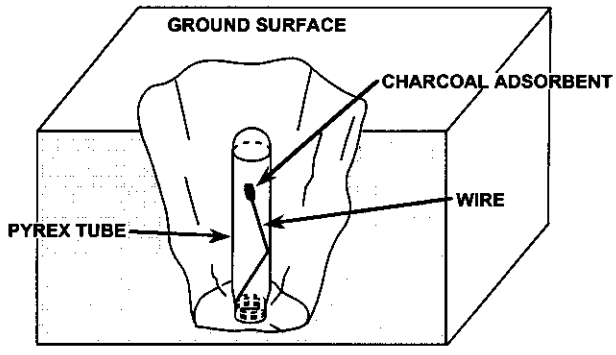
In step 2, staff attempts to identify all possible uses of the VOC(s) of concern. For example, is it used as solvent or refrigerant? Then they identify the type of businesses that would use the VOC(s). At this point staff does research using business directories, phone books, and county and city records to identify those facilities (potential sources) in the past and present that might use or have used the VOC(s) found in the well. This search for potential sources is done for an area approximately 1/2 mile in radius around the well. Some record searches for have gone as far back as the 1930's.

In step 3, inspecting possible sources, a questionnaire is first mailed to potential sources asking the facility operators about their uses of VOCs. This is the initial screening and reduces the quantity of field inspections. For example, if a facility is listed as a dry cleaner in the phone book and the questionnaire response says it is only a transfer station and no solvents are used, then the site would be removed from the potential source list and not inspected.

Staff inspects the facilities that use VOCs and determines if the potential source should be investigated further. If an investigation continues on a facility, then staff samples all discharges leaving the facility (discharges to land, water and sewer).

In step 4, identifying ground water characteristics, staff collects information from government and private ground water studies. The data collected from these studies are correlated to give a general understanding of the stratigraphy and ground water characteristics. This is not site-specific and is done after identifying possible sources so there is not a bias to upgradient sources.

In step 5, the soil gas survey is used to identify areas of VOCs in the soil and ground water. A survey involves placing glass tubes, each containing a carbon coated wire, open end down, 10-12 inches below the soil surface (Figure 3). After placement, the tubes are covered with soil. The evaporating VOC gasses disperse through the soils and reach the survey



SOIL GAS TUBE

Figure 3

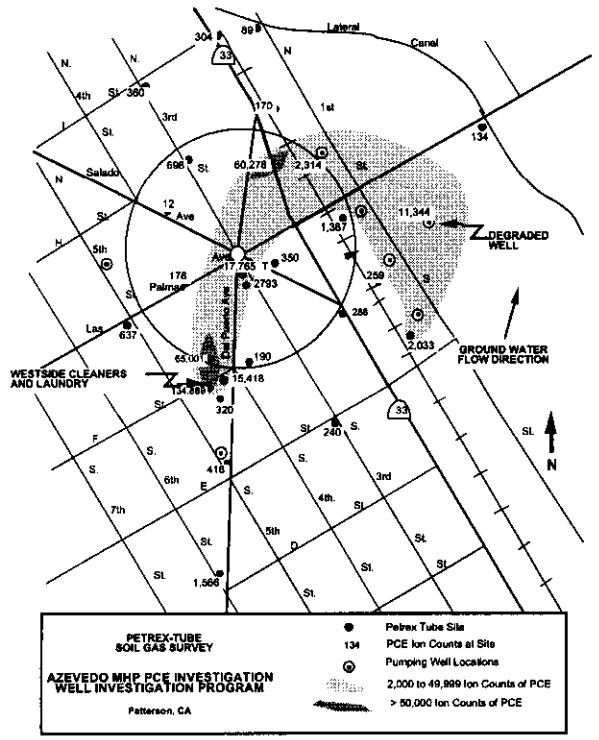


Figure 4

equipment. Approximately six week later, the tubes are removed and sent to the laboratory for VOC analysis. The results are in numbers of a specific VOC molecule retained by the carbon coated wire. The numbers are not concentrations, but are relative to each other. Locations with high counts have more of that VOC in the soil vapor than areas with low counts. Figure 4 is an example of the results of one of these surveys.

At this point the potential sources have been reduced to a few likely sources. It is at this time that site investigations are requested from the likely sources.

RESULTS OF PCE SOURCE INVESTIGATIONS

Staff source investigations have found that PCE is used in several industries (Figure 5) and is a component of several over-the-counter products such as brake and carburetor cleaners and spot removers. Staff surveys of industries other than dry cleaners which used these products show that PCE is not the main constituent in most of them. These products are usually less than 30% PCE, while dry cleaning solvent

IDENTIFIED SOLVENT USERS

- ***Auto/Boat Industry**
  - Service Stations
  - Auto Dealerships
  - Boat Dealerships
  - Truck Repairs
  - Auto Maintenance Facilities
- ***Telephone Companies**
- **Elevator Service Companies**
- **Public Schools**
- **Mobile Home Parks**
- ***Dry Cleaners**
- **Laundries**
- **Print Shops**
  - Newspapers
  - *Copying and Printing Businesses
- **Machine Shops**
  - Electric Motor Repair
  - Sheet Metal & Welding
- **Lumber/Timber Industry**
- ***Over-the-Counter Products**
- **Furniture**
  - Strippers
  - Antique Shops
  - Upholstery Repair
- **Power Stations**
- **Paint Dealers**

* - Industries where at least one product has PCE

Figure 5

is 100% PCE. Dry cleaning uses a large quantity of PCE solvent compared to other potential sources. The typical cleaner uses between 15 and 40 gallons a month of pure PCE. Many of the other industries also collect the solvent after use for recycling and do not discharge waste liquids to the land or sewer. Also, many of the solvents used that contain PCE are in aerosol cans. The solvent is sprayed on the part to remove grease and as the part dries, the PCE volatilizes into the air. Most industries other than dry cleaners which use solvents have no daily discharge of waste liquids containing PCE.

The staff soil gas surveys, which include all solvent users, show dry cleaners as the source areas. Figures 6 and 7 are two examples. None of the soil gas surveys have shown PCE vapor plumes near other solvent users.

Based on questionnaires, inspections, handling practices and soil gas surveys, staff concludes that dry cleaning is a major source of PCE ground water degradation in the Central Valley.

LODI

SEWER LINES

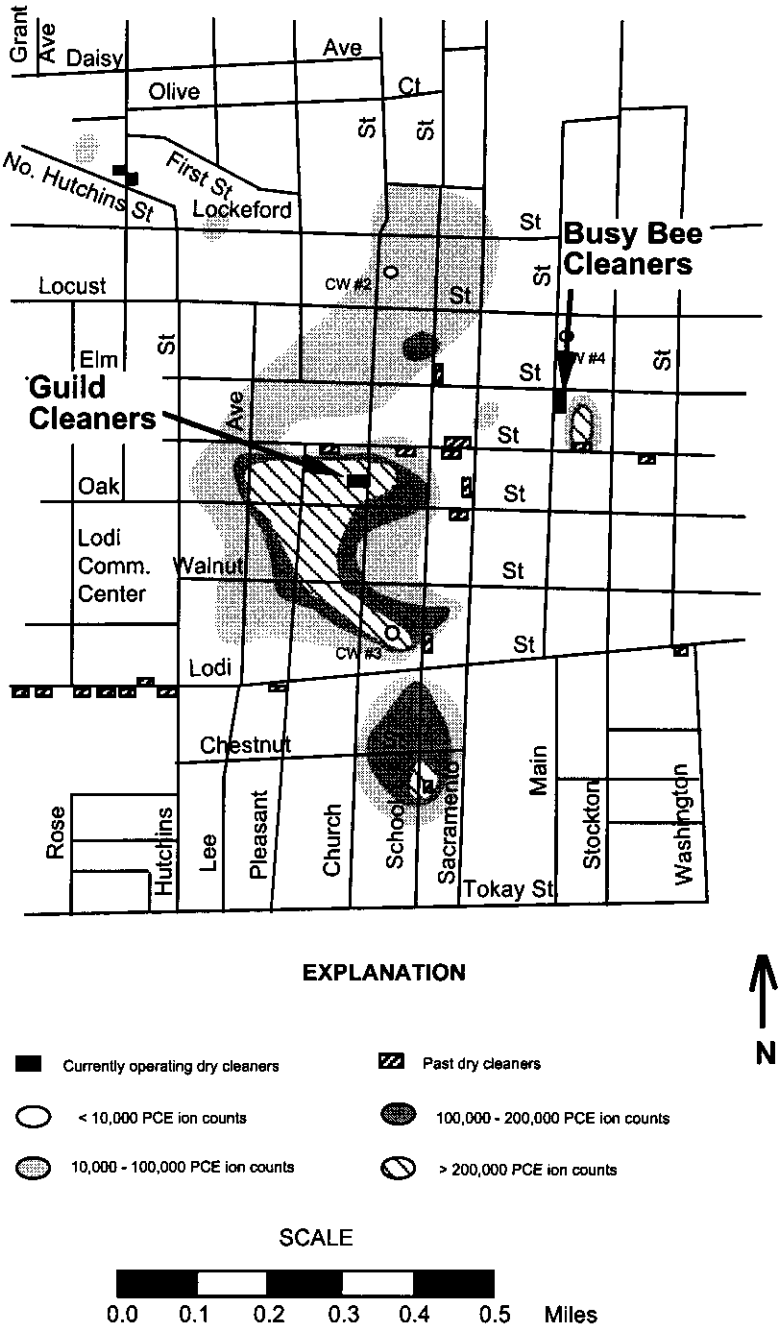


Figure 6

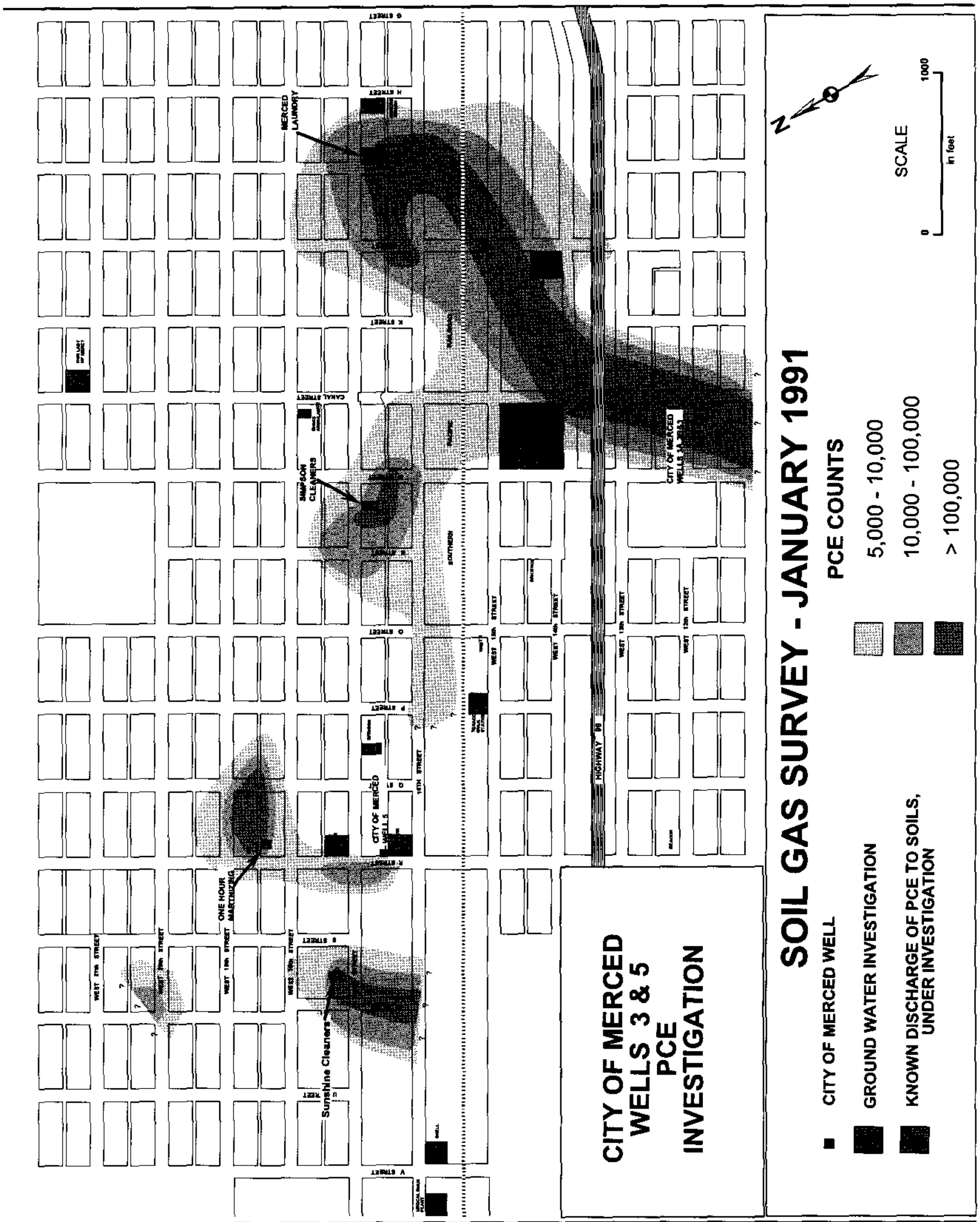
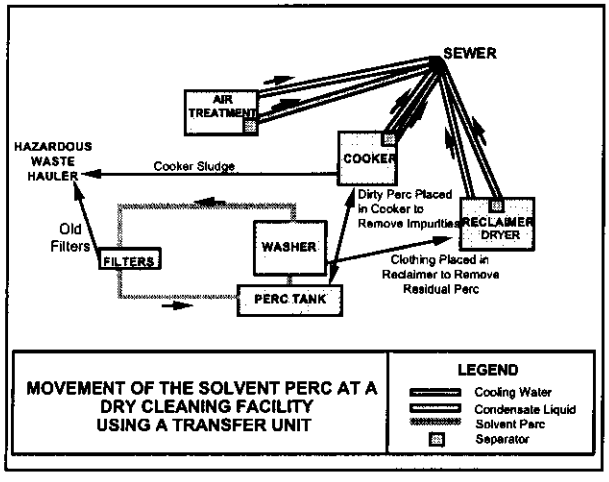

SOIL GAS SURVEY - JANUARY 1991
PCE COUNTS
5,000 - 10,000
10,000 - 100,000
> 100,000
CITY OF MERCED WELL
GROUND WATER INVESTIGATION
KNOWN DISCHARGE OF PCE TO SOILS, UNDER INVESTIGATION
CITY OF MERCED
WELLS 3 & 5
PCE
INVESTIGATION
SCALE
0
1000
in feet
N
MERCED LAUNDRY
SIMPSON CLEANERS
ONE HOUR MARTINIZING
Sunshine Cleaners
CITY OF MERCED WELLS 3
CITY OF MERCED WELL 5
HIGHWAY 99

Figure 7

DRY CLEANERS OPERATION AND DISCHARGE LOCATIONS

There are two basic types of dry cleaning machines, transfer and dry-to-dry. Both have similar types of discharges with the dry-to-dry machine being more efficient. The only major difference is that the dry-to-dry unit does the washing and drying of the clothing in the same machine, while a transfer unit use separate machines. The following section is a general description of a facility containing a transfer unit.

Dry cleaning transfer systems include a dry cleaning wash unit, PCE storage tank (generally part of the wash unit), reclaimer (dryer), cooker and vapor condenser (Figure 8). Pure PCE solvent is added directly from the PCE tank to the wash unit. A small amount of water and soap is usually added to remove stains that PCE will not. Most facilities send the spent solvent (after washing cycle) through solid filter canisters to remove solids and then return it to the PCE tank in a closed system. The solvent in the PCE tank also is periodically purified by physical transfer to the cooker, which separates solvent from solids through distillation and forms a sludge at the bottom.



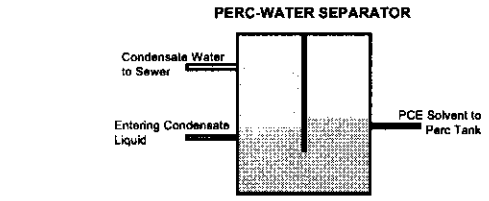


Figure 8

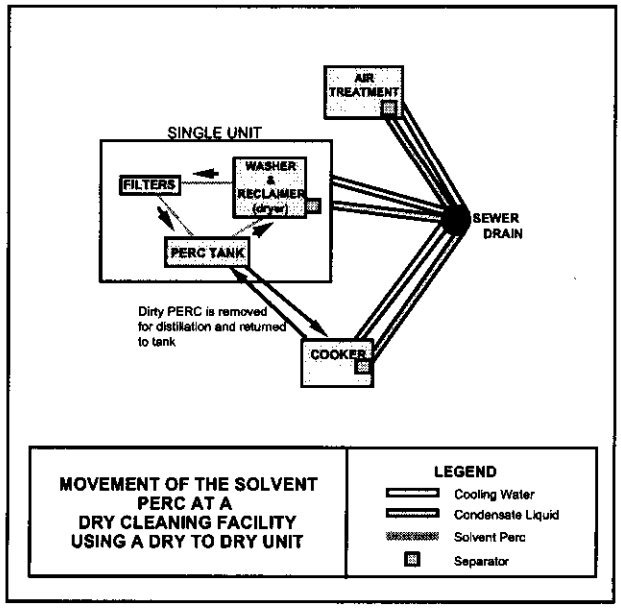
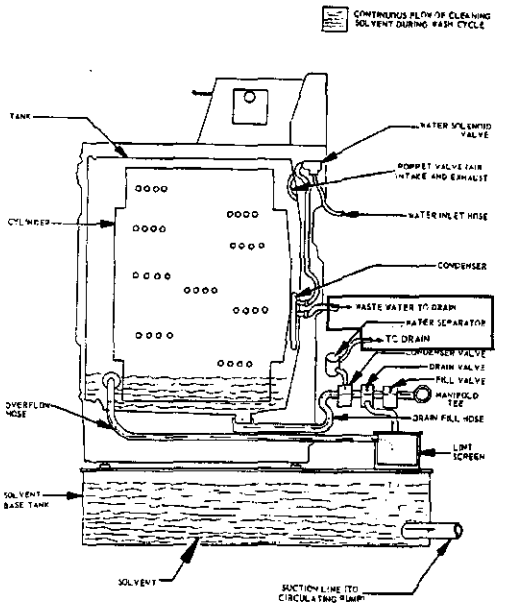


Figure 9

After washing, the clothing is removed from the wash unit and placed in the reclaimer to remove residual solvent. This drying process removes PCE solvent by heating the clothing which causes the solvent and any water to evaporate. The vaporized solvent and water is then removed from the drying portion of the machine and condensed. The PCE-water separator, which is connected to the back of the unit, takes the condensed liquid that contains PCE and water and allows the heavier PCE to settle to the bottom for reuse. The air scrubber (sniffer) extracts and cleans vapors from the other dry cleaning components and the air. These vapors also are condensed and the PCE and water separated.

In general, information provided by dry cleaner operators, inspections done by staff, and manufacturers' service manuals show that dry cleaning equipment is designed to discharge wastewater to the sewer. Figures 8 and 9 are schematics showing the two main types of wastewater discharges from dry cleaning equipment: liquid from the PCE-water separators and cooling water. Figure 10 is a schematic from one manufacturer's service manual that shows that wastewater should be discharged to the drain (11). This is typical of service manuals.



COIN-OP DRY TO DRY UNIT

Graphic From - Norge Sales Corporation, Service Instruction and Parts Catalog, 1961

Figure 10

The water from the PCE-water separators has been in direct contact with PCE. Water samples from separators at some cleaners have had such high concentrations of PCE that after the sample bottle sat for a day, solvent had separated out. As much as 30 percent of some samples has been pure solvent. PCE-water separator waste liquid has had PCE levels up to 1,119,300 ug/l (ppb), with an average of 151,800 ppb and median 64,000 ppb (Figure 11). Cooling water samples at dry cleaners have usually ranged from 3 to 70 ppb PCE, but some have been as high as 4,000 ppb (Figure 12).

EVIDENCE AND THEORY ON HOW PCE IS LEAVING THE SEWER LINES

Based on site inspections, the majority of the cleaners had only one discharge point and that was to the sewer. Because of these discharges, staff investigated sewer lines as a possible discharge point for PCE to the soils. Samples taken from these lines indicated that liquids or sludges with high concentrations of PCE are lying on the bottom of the sewer. Soil gas surveys

DRY CLEANERS SAMPLING RESULTS FROM CONDENSATE LIQUID

CLEANER	CITY	DATE	RESULT in ppb	UNIT
Busy Bee	Lodi	9/11/90	60,699	Reclaimer
Turlock Cleaners	Turlock	4/29/91	62,755	Cooker
Snow White	Turlock	1/26/89	140	Reclaimer
			56	Cooker
Durite Cleaners	Turlock	1/30/89	15,000	Sniffer & Reclaimer II
			150,000	Reclaimer I
Brite Cleaners	Turlock	5/11/89	66,000	Reclaimer
Southgate Norge	Sacramento	3/20/91	247,000	Sniffer & Reclaimer
Tillet Cleaners	Roseville	4/11/89	74,000	Reclaimer
Merced Laundry	Merced	11/29/88	130,000	Sniffer
Modesto Steam	Modesto	4/30/91	1,119,300	Reclaimer
			139,087	Cooker
			8,120	Chiller
			53,618	Recalimer
		Median	64,000	
		Average	151,800	

Figure 11

CONCENTRATION OF ORGANIC CHEMICALS IN COOLING WATER FROM DRY CLEANERS

DRY CLEANERS	CITY	DATE	RESULTS in ppb	
Busy Bee	Lodi	8/24/89	0.66	PCE
			2.1	TCE
			0.69	1,1-DCE
		8/28/90	1.2	PCE
			1	TCE
DuRite	Turlock	11/29/91	6.3	PCE
			4.7	PCE
			1.7	PCE
			5.3	PCE
Turlock	Turlock	5/21/90	0.8	PCE
			1.3	PCE
Bright	Turlock	5/11/89	2.7	PCE
Tillet	Roseville	11/30/88	67	PCE
			32	Chloroform
		2/10/89	1.1	PCE
			23	Chloroform
Deluxe	Roseville	2/26/89	0.8	PCE
			69	Chloroform
Elwood's	Modesto	4/30/91	14	PCE
Parkway	Merced	9/8/88	69	PCE
Simpson	Merced	9/8/88	38	PCE
Southgate Norge	Sacramento	1/12/89	28	PCE
Merced Laundry	Merced	11/29/89	4000	PCE

Figure 12

done by staff and by private consultants illustrate high PCE vapor concentrations along the sewer lines. Work done by the City of Merced shows that intact sewer lines can and have discharged PCE to the soil.

Below are descriptions of sampling done and our interpretation of the data. Following these descriptions is a section on the theories of how PCE escapes from the sewer pipes.

SOIL GAS SURVEYS

Soil gas surveys related to PCE in ground water have been done by Board staff in Sacramento, Lodi, Merced, Modesto, Stockton, Roseville and Turlock. Every place PCE molecules have exceeded 100,000 counts and monitoring wells have been installed, PCE levels in ground water exceeded the MCL. In most cases, the PCE concentration in ground water has exceeded 300 ppb, which is 60 times the MCL. Thus, this survey technique has been very successful.

Figures 13 through 16 are maps showing results of soil gas surveys from Turlock, Modesto, Lodi and Merced which illustrate that PCE vapors are higher along the sewer lines. The highest counts are usually near the cleaners, but the counts continue high from the sites down the sewer line.

Around several dry cleaners near Stockton, a private consultant performed a soil vapor survey for PCE. The consultant extracted a volume of air from the soils

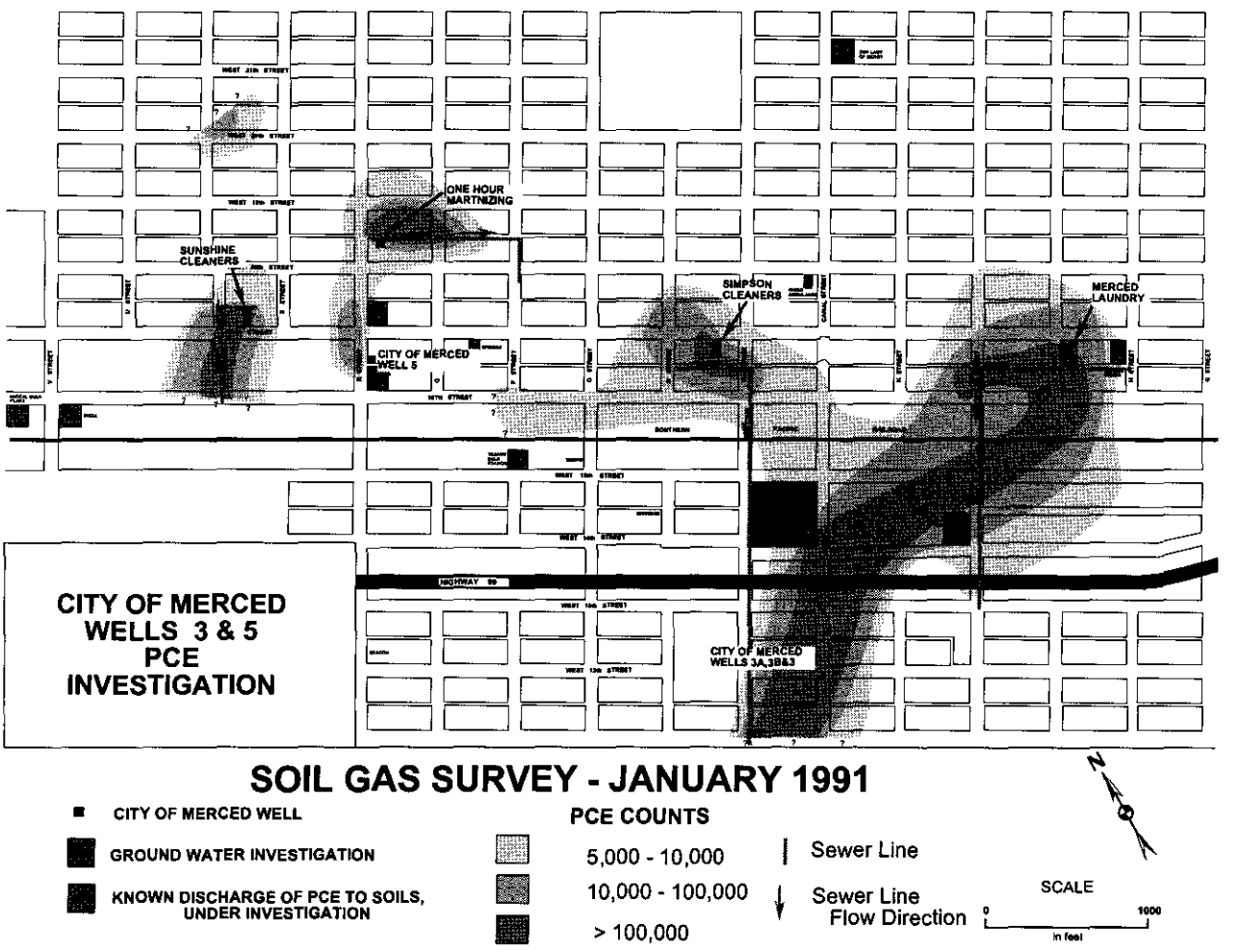


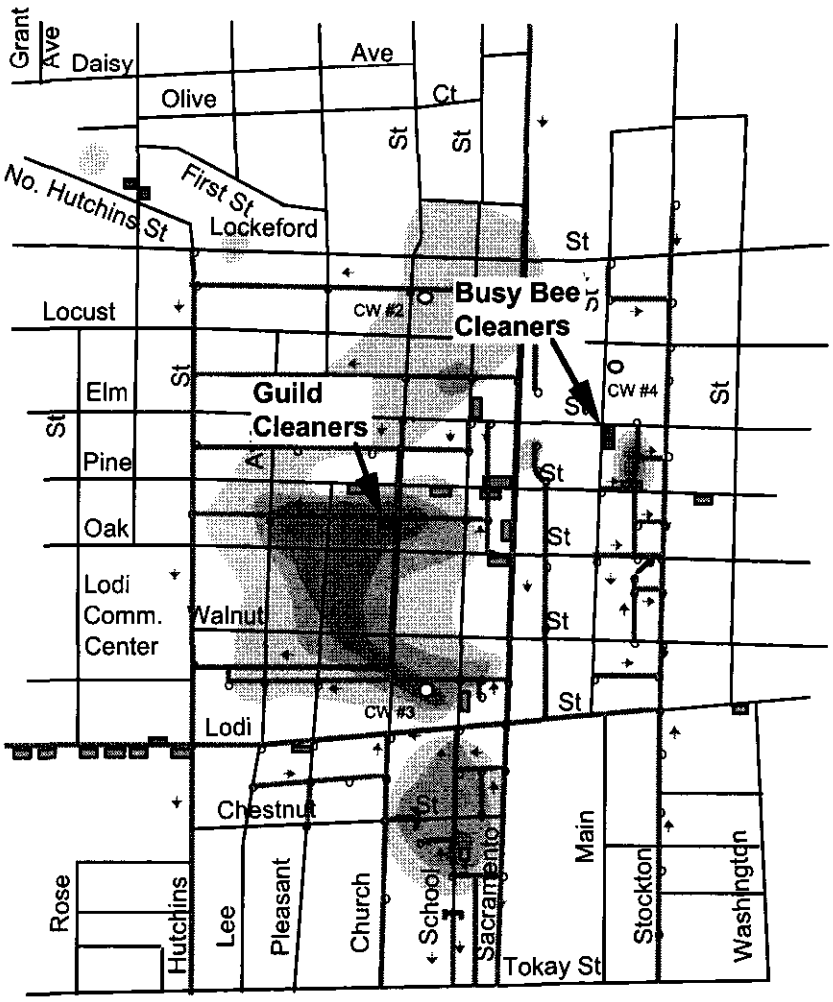
FIGURE 13

CITY OF MODESTO WELL 11, 14 & 21 SOIL GAS SURVEY AND SEWER LINE LOCATIONS	PCE ION COUNTS (in thousands)	
	10 - 50	Municipal Well
	50 - 150	Active Dry Cleaner
	>150	Inactive Dry Cleaner
		Other Buildings
		Sewer Lines

Figure 14

LODI

SEWER LINES



EXPLANATION

N

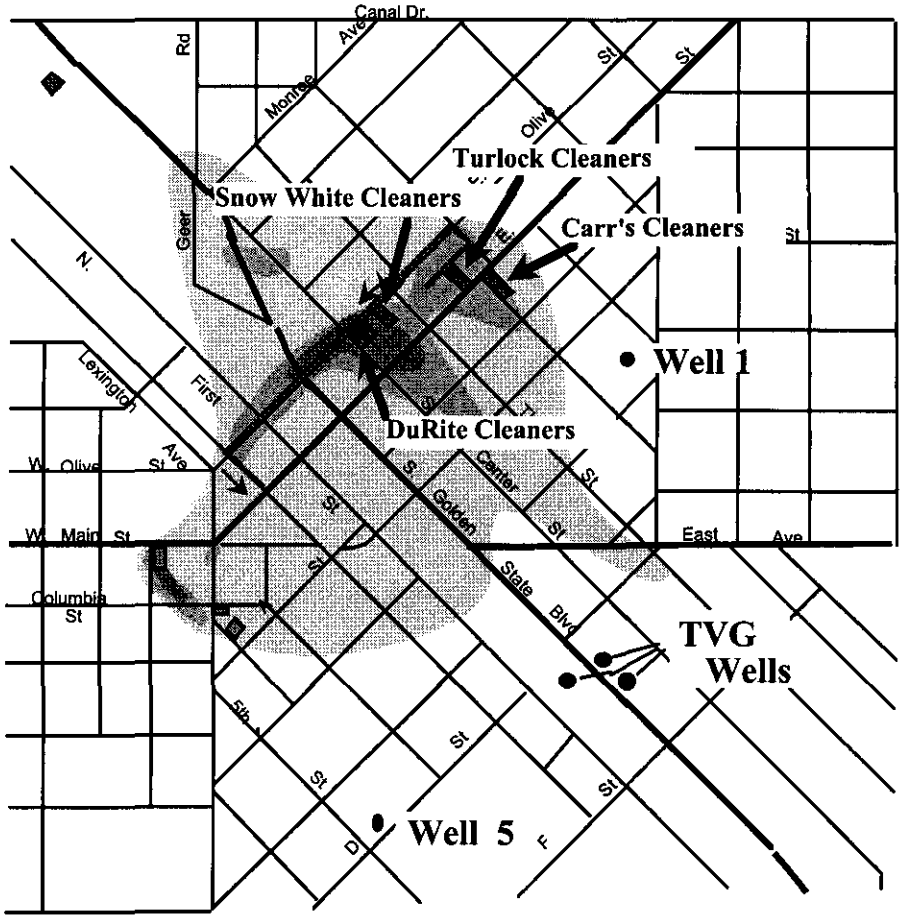
- Currently operating dry cleaners
- Past dry cleaners
- < 10,000 PCE ion counts
- 100,000 - 200,000 PCE ion counts
- 10,000 - 100,000 PCE ion counts
- > 200,000 PCE ion counts
- Sewer lines
- Sewer line flow direction

SCALE

0.0 0.1 0.2 0.3 0.4 0.5 Miles

Figure 15

TURLOCK SOIL GAS SURVEY



- ACTIVE DRY CLEANER
- INACTIVE DRY CLEANER
- WELL
- SEWER LINE
- 10,000-100,000 PCE ION COUNT
- 100,000-200,000 PCE ION COUNT
- >200,000 PCE ION COUNT

0 SCALE 1/2

MILES

N

Figure 16

and ran the sample through a gas chromatograph. This survey also indicates high concentrations of PCE vapor along the sewer line (Figure 17). There are similar surveys done by other private consultants with the same results.

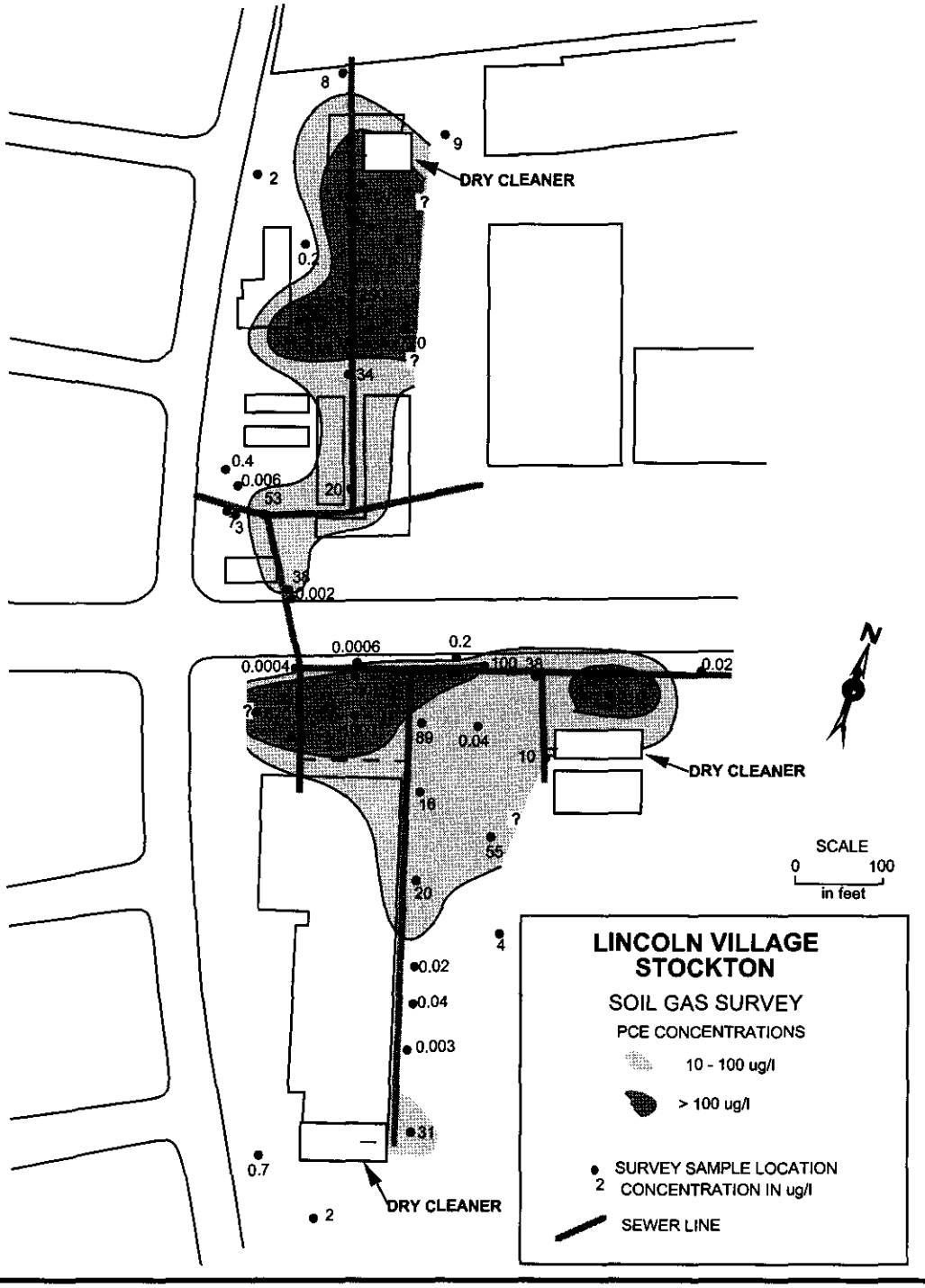


Figure 17

SEWER MAIN SAMPLING

Three samples are usually taken from the sewer: an upgradient, a downgradient and a flush sample. The upgradient (background) and downgradient samples are taken at the sewer access just above and below where the dry cleaner's sewer lateral enters the main (Figure 18). All samples are taken by placing a jar on a pole and scooping liquid into the jar. The liquid is then poured into volatile organic analysis (VOA) bottles and sent to a California certified lab for analysis. The flush sample is taken after stirring up the bottom sediment by adding large quantities of water (and sometimes running a ball down the line). The flush sample is taken at the downgradient sewer access, when an increase of flow is noted (Figure 18).

The concentration of PCE in the downgradient sample has always exceeded that in the upgradient sample, and in most cases PCE in the upgradient sample was not detected. When flush samples were taken, their PCE content almost always exceeded that in the downgradient sample. Since water is being added to the system, one would expect the PCE concentration to decrease in the flush sample because of dilution. Therefore, the increase indicates that PCE liquids or sludges are sitting on the bottom of the sewer line.

SEWER SAMPLING ADJACENT TO DRY CLEANERS

	Upgradient in ppb	Downgradient in ppb	Flush in ppb
MERCED			
Merced Laundry	-	180	-
One Hour Martinizing "R"	NF	110	23,000
One Hour Martinizing "G"	NF	730	96,000
Simpson Cleaners	-	-	6,300
Sunshine Cleaners	NF	-	167,000
Parkway Cleaners	NF	853	280,000
SACRAMENTO			
Southgate Norge Cleaners	NF	350	830
ROSEVILLE			
Deluxe Cleaners	-	120	260
Tillets Cleaners	NF	28	380
TURLOCK			
Carr's Cleaners	<0.5	14	2.5
Snow White Cleaners	1,800	3,800	220
Turlock Cleaners	NF	3,500	<25
Bright Cleaners	<0.5	0.6	23,000
Durite Cleaners	35	190	<5
LODI			
Busy Bee	NF	700	280,000
Woodlake Cleaners	-	620	210,000
Guild Cleaners	<0.5	24	<5
	Median	190	3,565
	Average	748	67,937

NF - NO FLOW

Figure 18

CITY OF MERCED

Between 12 January and 2 February 1989, the City of Merced conducted soil sampling near four dry cleaners. The City staff did a video scan of the sewer lines at each of the cleaners to check for possible leaks. After these scans, they drilled a soil boring adjacent to the sewer line downgradient of each facility where a problem was seen on the video tape. If the tape showed no problem, they drilled adjacent to the sewer line near the dry cleaner. In each boring they took several soil samples and had them analyzed for VOCs by EPA Method 8010. They also took soil vapor measurements using a Sensidyne-Gastec system (similar to Draeger tubes) with a detection limit of 400 ppb.

In addition to the City's work, each dry cleaning facility had a monitoring well (MW) drilled as required by staff. Soil samples were taken every five feet during drilling and analyzed for VOCs using EPA Method 8010. One ground water sample was taken from each well and analyzed for VOCs using EPA Method 601.

Parkway Cleaners

Figure 19 contains the data from the Parkway Cleaners site. The MW was drilled approximately 22 feet from Parkway's sewer lateral and 15 feet from the sewer main. Soil samples from the well boring had low levels of PCE (<5 ppb). The concentration of PCE in the ground water was 160 ppb.

The City's video scan of the sewer main showed no breaks in the clay pipe. Because of this, the City arbitrarily selected a soil boring site adjacent to the sewer line, six feet downgradient from Parkway Cleaners' sewer lateral. The PCE concentration in the soil sample in the City soil boring was 120 times

PARKWAY CLEANERS

MERCED

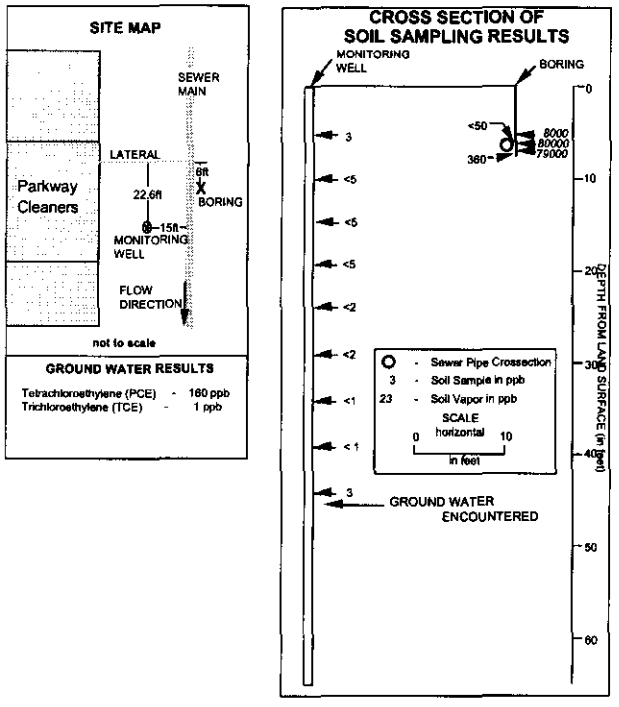


Figure 19

higher than was found in the MW. Also, soil vapor samples in the City boring contained up to 80,000 ppb PCE.

At this location the levels in the soil are much higher adjacent to the sewer line than in the MW. Also the data from the sampling adjacent to the sewer line indicate that PCE has moved from the line into the adjacent soils.

Simpson's Cleaners

Figure 20 illustrates the data from the Simpson's Cleaners site. Soil samples taken during the drilling of the MW at the southwest corner of the facility had PCE levels from non-detect to 71 ppb. The shallow ground water sample had 270 ppb PCE and also contained 29 ppb trichloroethylene (TCE), 65 ppb cis-1,2dichloroethene (DCE), two ppb trans-1,2-DCE, and 6 ppb 1,2-dichloroethane, all of which are breakdown

SIMPSON'S CLEANERS

MERCED

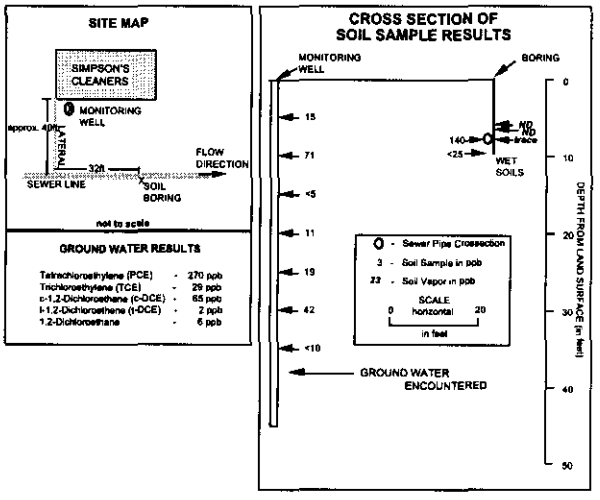


Figure 20

products of PCE. The MCL for TCE is 5 ppb and for DCE is 6 ppb.

The City's video scan of the clay sewer main adjacent to the cleaners showed a break at one of the joints. This break is approximately 40 feet downstream along the sewer line from the southeast corner of Simpson's Cleaners. While drilling alongside this joint the soil became very wet. One of the soil samples had 140 ppb PCE, higher than samples taken from the MW boring. The soil gas measurement readings were non-detect.

Again the soil sample adjacent to the sewer line contained higher PCE levels than samples taken from the MW boring. One probable reason the soil gas measurements were non-detect at the joint was the soils were very wet, which means the soil pores were probably full of water leaving no available room for the soil vapor.

Sunshine Cleaners

Figure 21 contains the data from the Sunshine Cleaners site. The MW was drilled near the northeast corner of the cleaners, 9.5 feet from its sewer lateral. The soil samples from the MW had PCE concentrations up to

SUNSHINE CLEANERS

MERCED

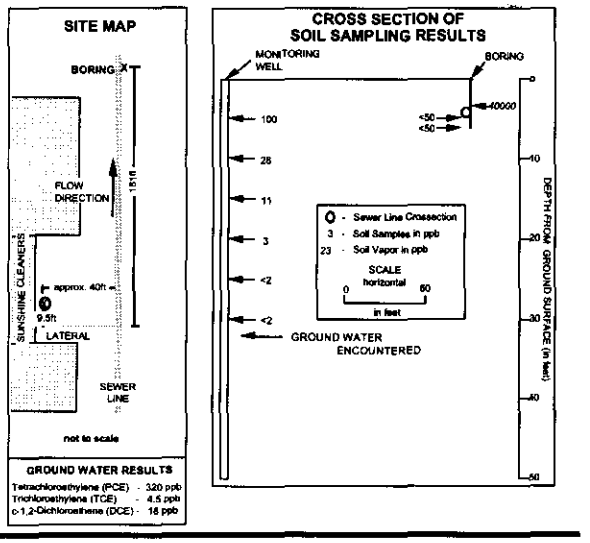


Figure 21

100 ppb. The ground water sample had 320 ppb PCE, 4.5 ppb TCE and 18 ppb DCE.

The City's video scan of the sewer line showed no breaks in the concrete sewer main. The City personnel chose a sag in the sewer main where the water pools for the location of the adjacent soil boring. This site was 181 feet downgradient of the cleaner's sewer lateral. PCE in the soil samples was nondetect, but the detection limit was high at 50 ppb. The Sensidyne-Gastec vapor system had a reading of 40,000 ppb in the boring.

The high levels detected by the Sensidyne-Gastec system indicates even at a distance of 181 feet downgradient from the dry cleaner, the concentration of PCE in the soil gas is significant. No comparison of soil samples between the MW and City's soil boring can be made because of the high detection limit from the City's samples.

One Hour Martinizing "R" Street

Figure 22 shows the data from the One Hour Martinizing "R" Street site. The MW was drilled eight feet northwest of the sewer line approximately 16 feet

ONE HOUR MARTNIZING

R STREET, MERCED

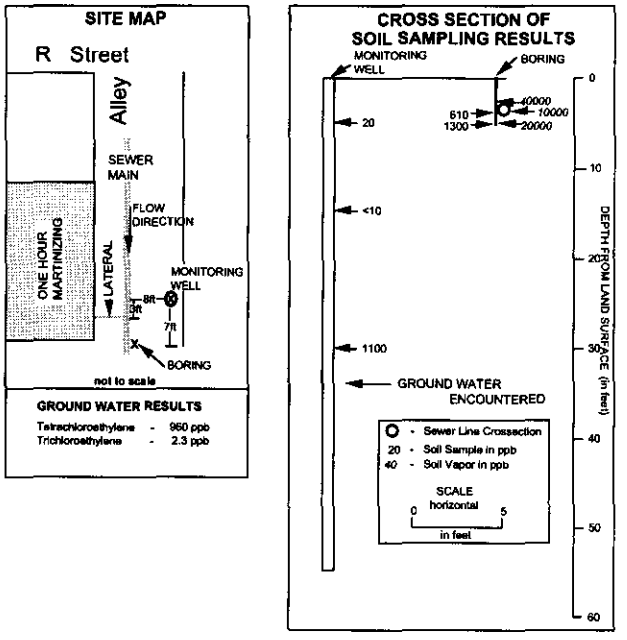


Figure 22

from the cleaner's northwest wall. PCE levels in the soil samples taken during drilling of the MW were low in the upper 20 feet ranging from nondetect to 20 ppb, but near the ground water a soil sample had 1,100 ppb PCE. The ground water sample had PCE and TCE with concentrations of 960 ppb and 2.3 ppb, respectively.

The City's video scan of the clay sewer line showed no breaks. The City personnel decided to drill adjacent to a bell joint four feet downgradient from where the cleaner's sewer lateral intersects the sewer main. Soil samples in this boring had PCE at 610 ppb (depth 461') and 1,300 ppb (depth 63"). The City took three Sensidyne-Gastec system measurements at the following depths from the surface: 361' (above the main), 461' (bottom side of pipe) and 631' (below the main), and the readings were 40,000 ppb, 10,000 ppb and 20,000 ppb, respectively.

Along the sewer main, the soil gas measurements and

the soil samples had high levels of PCE, indicating that at this location the sewer main is discharging PCE.

THEORIES ON HOW PCE LEAKS FROM SEWER LINES

Based on staff field work and research, there are five likely methods by which PCE can penetrate the sewer line:

1. Through breaks or cracks in the sewer pipes
2. Through pipe joints and other connections
3. By leaching in liquid form directly through sewer lines into the vadose zone
4. By saturating the bottom of the sewer pipe with a high concentration of PCE-containing liquid and then PCE volatilizing from the outer edge of the pipe into the soils
5. By penetrating the sewer pipe as a gas

The literature indicates that all sewer lines leak to some extent. According to Metcalf and Eddy, Inc., "When designing for presently unsewered areas or relief of overtaxed existing sewers, allowance must be made for unavoidable infiltration..." (6). If the soils become saturated and liquids can infiltrate, then a conclusion can be made that liquids on the inside of the pipe can exfiltrate when soils are not saturated.

Below is a brief description of the five methods.

Methods 1 and 2

Methods 1 and 2 are similar in that leakage of liquid is caused by a failure of the sewer pipe system. The failure could be catastrophic, causing large volumes of liquids to leave the system, or could consist of many small leaks causing constant smaller flow. These discharged liquids then would move down through the vadose zone to the ground water. Methods 1 and 2 also apply to PCE in vapor form which can move easily through breaks, cracks, joints, and other connections.

Many of the sewer lines have low spots in which liquids accumulate. These low spots are caused by settlement or poor construction which causes the sewer line to bend. Sewer pipes are brittle, so when the line bends, fractures are likely to occur, increasing the leakage of the pipe. Since PCE is heavier than water (1.63 times the weight of water at 20°C), it tends to collect in these low spots and then flow through the pipe fractures into the vadose zone.

At pipe joints and other connections, PCE can move out of the sewer as liquid or gas. Also, as the pipes shift after installation, they could separate at the joints, allowing PCE to discharge even more easily to the vadose zone. Current gasket technology and reduction in leakage factors of pipes by the industry has reduced discharges at this point. But most commercial and retail districts in the cities of the Central Valley have pipes that predate this technology.

Method 3

By this method, PCE-containing wastewater or PCE liquid penetrates a sewer pipe without any breaks. In this case liquid leaves the pipe and enters the vadose zone (Figure 23). Sewer pipe is not impermeable to water or PCE. When liquid collects in a low spot of the sewer pipe, it cause an increase in the hydraulic head in the line. This extra head provides a larger driving force downward through the pipe.

From sewer sampling we know that PCE-containing sludges and/or liquids collect on the bottom of the sewer line. Video taping of sewer mains have shown that almost all lines have low points where liquids and sludges collect. Because PCE is heavier than water and is attracted to organic matter, it would have a tendency to collect in these low spots. Also, PCE viscosity is less than that of water (0.9 for PCE versus 1 for water), making it flow easier through a pipe wall than water. This makes the pipe more permeable for PCE.

Method 4

This is similar to Method 3 except that the hydraulic head in the pipe is not large enough to force liquid

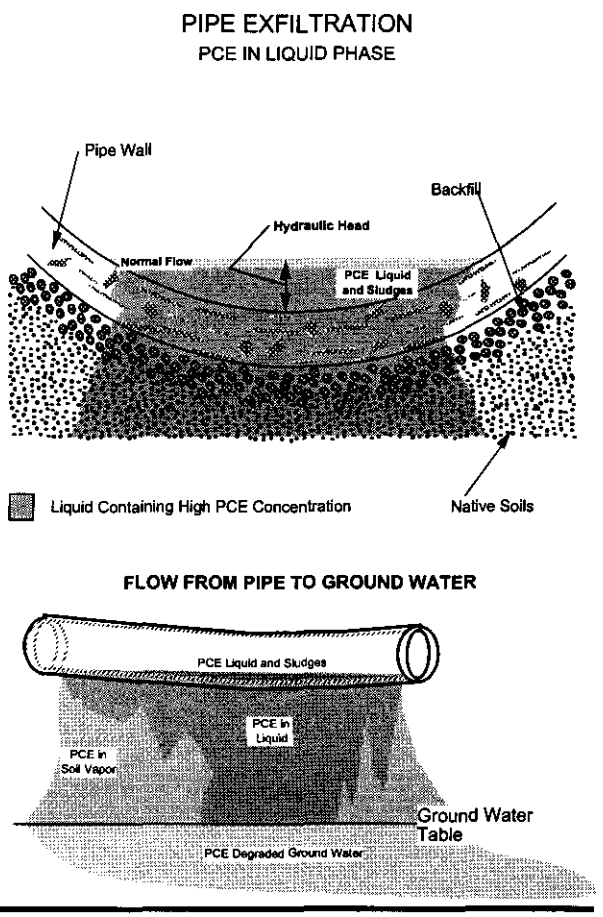


Figure 23

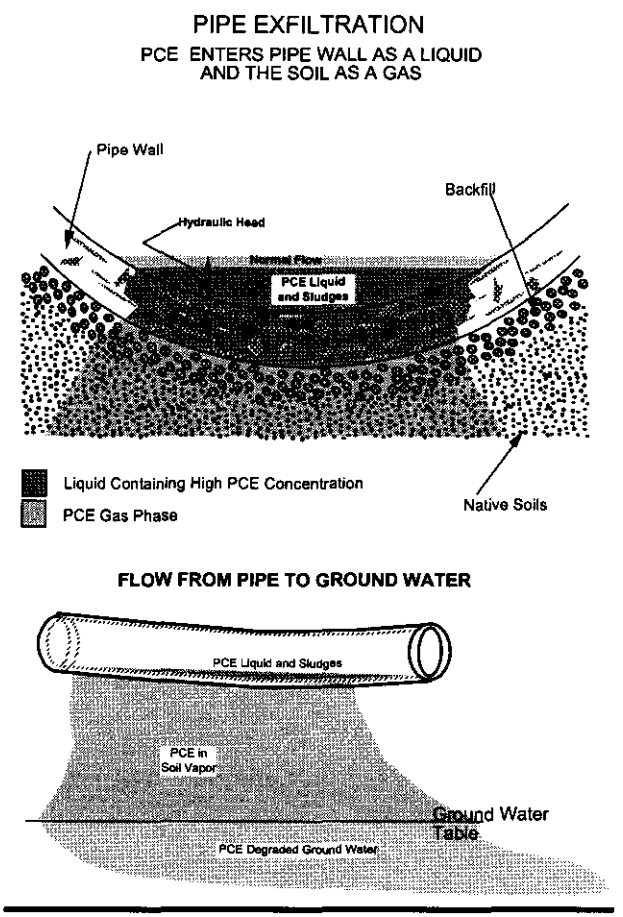


Figure 24

into the vadose zone. In this method, the pipe walls still have a high concentration of PCE-containing liquids (Figure 24). Being volatile, PCE turns into a gas at the liquid-soil vapor interface at the outer edge of the pipe. Since the vapor density of PCE is 5.83 times greater than air, the PCE gas in soil vapor would sink towards ground water, causing ground water degradation.

Method 5

In this method, PCE volatilizes inside the pipe and moves as a gas through the sewer pipe wall (Figure 25). The piping material is not designed to contain gas. The concentration of PCE gas in the pipe is greater than in the surrounding soils causing a concentration gradient. This causes a dispersion through the sewer pipe to the less concentrated area.

Another reason gas will penetrate the pipe is due to pressure. The gasses inside the pipe may increase the pressure above atmospheric. This would cause a pressure gradient from higher pressure in the pipe to lower pressure in the vadose zone. The gradient would force PCE gas into the vadose zone. As described above, PCE gas is heavier than air and so would tend to sink towards ground water.

Summary of Methods

Methods 3, 4 and 5 probably occur in all piping. They would cause a constant influx of PCE into the vadose zone downgradient from a dry cleaner. This liquid containing PCE or PCE in gas form then moves downward and eventually degrades the ground water.

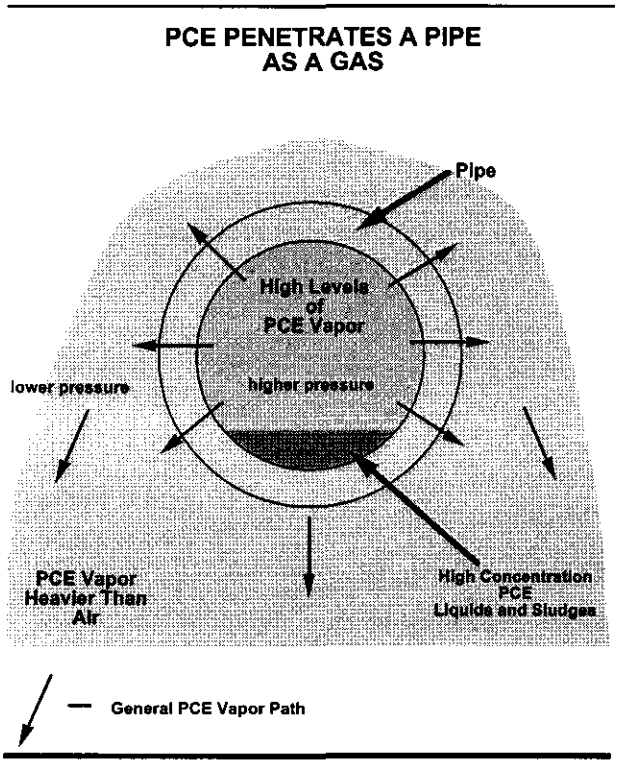


Figure 25

Leakage through small fractures in Method 1 is likely in most of these brittle pipes as they settle. Small fractures occur causing an increase in the permeability of the pipe. This would cause a constant leakage. These small fractures cannot be seen by video taping the inside of the sewer pipe.

CONCLUSION AND RECOMMENDATION

The Board has identified the potential sources of PCE in 21 wells, and 20 of those are affected by one or more dry cleaners. Because of the location of the remaining wells (i.e. in residential and retail areas), the staff expects that the majority of the wells with PCE will have dry cleaners as the source.

The evidence from five years of investigations shows PCE has been found in the ground water and vadose zone near dry cleaners throughout the Central Valley. In most dry cleaners, the only liquid discharge of PCE-containing wastewater is to the sewer line. The substantial evidence collected by dry cleaners' consultants, muncipalities, and staff, shows or demonstrates that PCE has discharged from the sewer lines directly into the vadose zone. The PCE then migrates through the unsaturated subsurface to the ground water. Based on information collected from operators of dry cleaners, dry cleaning literature and staff site inspections, the dry cleaning equipment at most facilities is designed to discharge to sewer lines.

Presently, all the dry cleaners investigated in a well source investigation have been identified as sources of PCE in the ground water. All of the dry cleaners that have drilled monitoring wells have had shallow ground water contamination well above the MCL of 5 ppb set by the State Department of Health Services (monitoring well levels range from 120 - 32,000 ppb). With approximately 285 dry cleaners in the cities of Sacramento, Chico, Lodi, Modesto, Turlock, Stockton and Merced, and numerous more in other cities, staff expects that many more wells will be degraded by PCE in the future.

In conclusion, the PCE discharges from dry cleaners to sewer laterals, then to sewer systems and then to soils have caused soil and ground water degradation.

Two major issues need to be resolved on the dry cleaners' PCE discharges:

1. Who should define the extent of ground water degradation and do the cleanup?

2. How do we prevent further degradation of the ground water by dry cleaners?

Ground water cleanup is required so that water supply agencies can continue to provide safe water. Deciding who should investigate and cleanup ground water is a complex political/legal issue since the PCE discharges from the dry cleaners were all approved, standard practice and those from the sewers were unsuspected. Because most dry cleaners are small businesses, which may not have the financial capability to define the contamination plume and conduct cleanup, other resources may be needed. A statewide cleanup fund may be appropiate. If no one else cleans

up the ground water, water supply agencies will have to do it by default.

To prevent further degradation, the most obvious solutions are to set a limit for PCE discharge levels to the sewer line that will protect ground water or to disallow all future discharges to the sewers from dry cleaning. Two possible ways to accomplish this:

1. State legislation to set limits or prohibit discharge of PCE from dry cleaning facilities to sewer systems.

2. City ordinances to set limits or prohibit any discharge of PCE from a dry cleaning facility to the sewer line.

Since dry cleaners exist throughout the state a state-wide policies are needed.

REFERENCES

1. California Regional Water Quality Control Board, Central Valley Region, Well Investigation Program files

2. Devitt, D.A., R.B. Evans, W.A. Jury and T.H. Starks, Soil Gas Sensing for Detection and Mapping of Volatile Organics, National Water Well Association, 1987

3. Freeze, R.A. and John A. Cherry, Groundwater, Prentice-Hall, Inc. 1979

4. Hotchkiss, William R., Generalized Subsurface Geology of Water Bearing Deposits Northern San Joaquin Valley, California, U.S. Geological Survey Open-File Report, 12 May 1972

5. Halogenated Solvents Industry Alliance, White Paper, Perchloroethylene, August 1987, 3p

6. Installation, Operation & Maintenance Instructions for VIC Kamero Models 402 & 403 (VMC 1025-A), Vic Manufacturing Campany, November 1971

7. Lowry, Polly, Personal Communications (1991), Associate Engineering Geologist, California Regional Water Quality Control Board, Central Valley Region

8. Marshack, Jon, A Compilation of Water Quality Goals, California Regional Water Quality Control Board, Central Valley Region, September 1991, 29p

9. Mendoza, C.A. and Todd A. McAlary, Modeling of Ground-Water Contamination Caused By Organic Solvent Vapors, Ground Water, Vol. 38 No. 2, March-April 1990, p199-206

10. Metcalf & Eddy, Inc., Revised by George Tchobanoglous, Wastewater Engineering-Treatment/Disposal/Reuse, 2nd Edition, McGraw-Hill, Inc., 1979

11. Norge Service Instructions and Part Catalog (DCSMP-61), Norge Sales Corporation, August 1961

12. Page, R.W., Appraisal of Ground-Water Condition in Merced, California, and Vicinity, U.S. Geological Survey Open-File Report 77-454, December 1977

13. Schwille, Friedrich, Dense Chlorinated Solvents in Porous and Fractured Media, Lewis Publisher, Inc. 1988 , 144p

14. Sittig, Marshall, Handbook of Environmental Data On Organic Chemicals, Second Edition, Van Nostrand Reinhold Company, 1983

15. Tillman, N., K. Ranlet and T.J. Meyer, Soil Gas Surveys: Part 1, Pollutant Engineering, July 1989, p86-89

16. Tolby, L.G., Personal Communications (1991), District Manager-Technical Services, National Clay Pipe Institute

17. U.S. Environmental Protection Agency, January 1980, Ambient Water Quality Criteria for Tetrachloroethylene, EPA-440/5-80-073, 38p

18. U.S. Environmental Protection Agency, January 1982, Health Assessment Document for Tetrachloroethylene, EPA-600/8-82-005, 193p

19. Verschuerren, Korel, Handbook of Environmental Data on Organic Chemicals, Second Edition, Van Nostrand Reinhold Company, 1983

20. Walker, Scott, June 1989, Well Investigation Program Assessment Report, City of Merced Wells 3A, 3B, 5, 2A and 2B Merced County, California Regional Water Quality Control Board, Central Valley Region, 29p

21. Weast, R.C., Editor, CRC Handbook of Chemistry and Physics, 70th Edition, CRC Press Inc., 1989

22. Windholz, Editor, The Merck Index, Merck and Co., Inc., 1976

EXHIBIT "R"

Subject: Normans-Informational Items
From: "Dave Parson" <DParson@waterboards.ca.gov>
Date: Wed, 01 Aug 2007 10:31:02 -0700
To: <JMark.Inglis@chevron.com>, <SERGIOBORGIOTTI@chevron.com>, <byoung@ci.eureka.ca.gov>, <MVerhey@co.humboldt.ca.us>, <jhking@downeybrand.com>, <KBaugh@ensr.aecom.com>, <amortl@glynnfinley.com>, <Jan@grebenlaw.com>, <ghokkanen@hokenv.com>, <kfd50@sbcglobal.com>, <gps@tscgroup-inc.com>, <peterk@westenvironmental.com>, <peterm@westenvironmental.com>
CC: "David Evans" <DEvans@waterboards.ca.gov>, "Tuck Vath" <TVath@waterboards.ca.gov>

Good Morning Project Team Members

I send this email and attachments in an ongoing effort to keep all project team members current.

1). Mr. Daer has made initial contact with St. Bernards high School regarding using their facilities for the upcoming public meeting. I understand that after August 6th we will have more details on the use of this facility.

2). On July 25th many of the project team participated in this conference call to discuss the detailed schedule. From my perspective this meeting was very helpful as there are a lot of activities occurring in the near term and some of these activities have specific time lines and documentation requirements to comply with existing regulatory requirements. I proposed alternate dates for team members who could not attend on July 25th and had only one proponent, Mr. Sergio Borgiotti of Chevron. Due to the solo response and part of the Chevron Team (Mr. Kent Baugh) participating on July 25th no action was taken to host a second date. At the end of conference call I encouraged all parties to obtain and read the "Izzo Report." This report is about 10 years old, was prepared by State employee Victor Izzo, and is available in electronic format on the web. It is all about dry cleaners and other sources of PCE. It forms a verifiable and repeatable basis for the SWRCB and regional boards evaluating PCE discharge sources and conceptual models. I recommend it as a must read prior to our August 20 meeting here to solely discuss the technical aspects of existing dynamic conceptual site model.

3). The CRWQCB had received an official public records request from ENSR on behalf of Chevron to review and copy the project files. Most recently that request was superceded based on a similar request from Ms. Trisch Bonheyo with Glynn & Finley, LLP. Project team members know that Mr. Andrew Mortl represents Chevron and is with Glynn & Finley, LLP. We are in the process of making arrangements with Ms. Bonheyo in this regard.

4). The CRWQCB received an official referral from the Humboldt County Department of Health and Human Services, Division of Environmental Health regarding local oversight jurisdiction. A PDF of this transmittal is attached for your files. The CRWQCB is agreeing with this referral letter and a letter documenting this is being prepared. ENSR has let the CRWQCB know that their quarterly monitoring efforts will be temporally impacted due to access issues. We acknowledge this temporary situation exists and that it will be corrected through the issuance of the CAO and MRP for the project.

5). On July 27, 2007, Mr. Krasnoff sent out West Environmental Services & Technology, Inc. (WEST) response to ENSR Comments on the FS-PS Work Plan and written responses to technical questions that were posed to me by the City of Eureka's consultant.

6). Ms. Soniya Ziegler with the Chevron Team has provided written notice to the project team that she is no longer part of the project team as she has been replaced by Mr. Sergio Borgiotti.

I trust that these informational items are helpful to all project team members.

Sincerely
David W. Parson PG 6037, CEG 1889
CRWQCB, North Coast Region
Cleanups Division

No virus found in this incoming message.
Checked by AVG Free Edition.
Version: 7.5.476 / Virus Database: 269.11.0/929 - Release Date: 7/31/2007 5:26 PM

HUMCO_DEH_Referral_7242007.pdf	**Content-Type:** application/pdf **Content-Encoding:** base64

Part 1.3	**Content-Description:**	"AVG certification"
	Content-Type:	text/plain
	Content-Encoding:	quoted-printable

EXHIBIT “S”

Subject: Fwd: FW: Encroachment Permit for 2907 "E" Street, Eureka plume investigation
From: "Dave Parson" <DParson@waterboards.ca.gov>
Date: Thu, 15 Nov 2007 10:53:34 -0800
To: <JMark.Inglis@chevron.com>, <SergioBorgiotti@chevron.com>, <byoung@ci.eureka.ca.gov>, <sschaffner@ci.eureka.ca.gov>, <MVerhey@co.humboldt.ca.us>, <cbolcom@dblawsf.com>, <mdavidovitz@dblawsf.com>, <dpeacock@ensr.aecom.com>, <KBaugh@ensr.aecom.com>, <amortl@glynnfinley.com>, <jan@grebenlaw.com>, <rjuncal@groundzeroanalysis.com>, <ghokkanen@hokenv.com>, <KFD50@sbcglobal.net>, <gps@tscgroup-inc.com>, "David Evans" <DEvans@waterboards.ca.gov>, "Kim Niemeyer" <KNiemeyer@waterboards.ca.gov>, "Tuck Vath" <TVath@waterboards.ca.gov>, <peterk@westenvironmental.com>, <peterm@westenvironmental.com>

Dear Project Team Members

At the request of Peter Krasnoff I am forwarding this email to project team members.

I had hoped that some flexibility might exist toward keeping the project on schedule and still being able to meeting holiday shopping needs. For example, I could envision starting and completing each day before stores open.

Sincerely
David W. Parson, PG 6037, CEG 1889
CRWQCB, North Coast Region
Cleanups Division

| | | <peterk@westenvironmental.com> 11/15/2007 9:40 AM >>>

Can you please forward to Team.

Thanks

Peter

---- Original Message ----
From: "Gary Boughton" <gboughton@ci.eureka.ca.gov>
Date: 11/13/07 3:58 pm
To: "Peter Krasnoff" <peterk@westenvironmental.com>
Cc: "Brent Siemer" <bsiemer@ci.eureka.ca.gov> ; "Sheryl Schaffner" <sschaffner@ci.eureka.ca.gov>
Subj: Encroachment Permit for 2907 "E" Street, Eureka plume investigation
Peter,

I have received Sheryl Schaffner's e-mail to you regarding your intended work during the holiday season from November 26th to December 14th. Work during this time period would greatly affect the local businesses in Henderson Center. Many businesses livelihood depend on sales during this time period.

We hope you see the need to postpone the work until after the beginning of the new year.

We are reviewing the traffic control and will have a couple of changes required. These should be coming to you either Wednesday or Thursday of this week.

A heads up on a couple of the changes: 1. We will require 10-foot lanes on "E" Street which is a collector street; 2. Some minor changes to signage; 3. arrows on the first cone indicating the lane to enter.

Thanks for your understanding and will be in contact soon.

Gary D. Boughton, P.E.

Deputy City Engineer

EXHIBIT "T"

Subject: Meeting with City of Eureka
From: "Kim Niemeyer" <KNiemeyer@waterboards.ca.gov>
Date: Fri, 19 Oct 2007 11:24:59 -0700
To: <JMark.Inglis@chevron.com>, <SergioBorgiotti@chevron.com>, <byoung@ci.eureka.ca.gov>, <sschaffner@ci.eureka.ca.gov>, <MVerhey@co.humboldt.ca.us>, <cbolcom@dblawsf.com>, <mdavidovitz@dblawsf.com>, <dpeacock@ensr.aecom.com>, <KBaugh@ensr.aecom.com>, <amortl@glynnfinley.com>, <jan@grebenlaw.com>, <rjuncal@groundzeroanalysis.com>, <ghokkanen@hokenv.com>, <KFD50@sbcglobal.net>, <gps@tscgroup-inc.com>, "David Evans" <DEvans@waterboards.ca.gov>, "Dave Parson" <DParson@waterboards.ca.gov>, "Kim Niemeyer" <KNiemeyer@waterboards.ca.gov>, "Tuck Vath" <TVath@waterboards.ca.gov>, <peterk@westenvironmental.com>, <peterm@westenvironmental.com>

Yesterday the Regional Water Board met with the City of Eureka. The attendees were: Regional Water Board - Kim Niemeyer, Dave Parson, David Evans, Tuck Vath and Luis Rivera; City of Eureka - Mike Knight, Burce Young, Sheryl Schaffner, Moris Davidovitz and Russell Juncal. The prupose of the meeting was to allow the City to express its concerns regarding whether it should be named in the CAO. The City has a new team working on this project, and it wanted the opportunity to present, what it believes, are issues that the Regional Water Board should consider before naming the City in the CAO. We have asked that the City put those comments into writing, and those will be shared with the group. To prepare those comments, the City has asked that the videotape, log and map be made available to it. I assume that West and and Norman's drycleaning are ok with that, and will tell the City how those documents can be made available.

Kimberly McFarlin Niemeyer
Staff Counsel
State Water Resources Control Board

1001 I Street
P.0. Box 95812-0100
Sacramento, CA 95814

(916) 341-5547 (phone)
(916) 341-5199 (fax)
kniemeyer@waterboards.ca.gov

EXHIBIT "U"

Subject: RB Case No 1NHU630
From: "Kim Niemeyer" <KNiemeyer@waterboards.ca.gov>
Date: Fri, 16 Nov 2007 15:44:12 -0800
To: <JMark.Inglis@chevron.com>, <SergioBorgiotti@chevron.com>, <byoung@ci.eureka.ca.gov>, <sschaffner@ci.eureka.ca.gov>, <mverhey@co.humboldt.ca>, <cbolcom@dblawsf.com>, <mdavidovitz@dblawsf.com>, <dpeacock@ensr.aecom.com>, <KBaugh@ensr.aecom.com>, <amortl@glynnfinley.com>, <Jan@GrebenLaw.com>, <rjuncal@groundzeroanalysis.com>, <ghokkanen@hokenv.com>, <KFD50@sbcglobal.net>, <gps@tscgroup-inc.com>, "David Evans" <DEvans@waterboards.ca.gov>, "Dave Parson" <DParson@waterboards.ca.gov>, "Kim Niemeyer" <KNiemeyer@waterboards.ca.gov>, "Tuck Vath" <TVath@waterboards.ca.gov>, <peterk@westenvironmental.com>, <peterm@westenvironmental.com>

All:

The purpose of this email is 1) to respond to the letter sent to me by Mr. Greben on October 24, 2007, which offered several suggestions for future interactions between the team members, and comments on that letter by Union Oil dated 10/26 and by the City of Eureka dated 10/29, and 2) to respond to the requests for discovery amongst the parties and 3) Union Oil's request for a meeting with the Regional Board on December 3, 2007 to present its conceptual site model.

Mr. Greben's letter was prompted by a meeting between members of the Regional Water Board staff and management and representatives of the City of Eureka that was not made open to other members of the team. Mr. Greben expressed his concern that such meetings were not consistent with the team approach that Dave Parson has been working to foster. After consideration of this issue, the Regional Water Board management has agreed that for this project the Regional Water Board will not have any meetings with members of the team without notifying all parties and allowing all team members to be present. Mr. Greben's suggestion of having the party asking for the meeting provide a 10-day notice and agenda is reasonable, and I request that parties follow such procedure, to the extent possible. This is not, however, a hard-and-fast rule. As Ms. Schaffner pointed out, there may be times when it is necessary for the Regional Water Board staff to have conversations with team members, and a 10-day notice period and agenda is

just not reasonable. To the extent that individual conversations with the Regional Water Board staff take place regarding substantive issues on the clean up, the Regional Water Board commits to following through with Ms. Schaffner's proposal - we will provide the other team members a summary of that conversation and make available any "evidence" being considered or relied upon (directly or indirectly) to the other team members within a reasonable time period after the conversation occurs. This will allow the other team members the opportunity to consider the information and provide comments before that information is relied upon.

Mr. Greben has also raised concerns regarding the schedule of the cleanup. As team members identify additional sampling that needs to be done, there is concern that the cleanup schedule will get pushed further and further back. To address the concerns of keeping the cleanup on schedule and still providing team members the opportunity to have more sampling, Dave Parson has created an approach that appears to address both concerns. Dave has suggested that we try to keep the "remedial" issues needed for the cleanup (ie what constituents are where) somewhat separate from the "forensic" issues (those issues that identify who is responsible for what). The work needed to resolve the remedial issues needs to keep moving ahead, and the Regional Water Board is committed to making that happen. The forensic issues, however, are not as pressing, and the Regional Water Board does not have a problem allowing the team members additional time for sampling and discovery. I am therefore not inclined to grant Mr. Greben's request for a firm deadline for addressing the City's data concerns as they relate to the forensic issues.

Even though the Regional Water Board is suggesting a dual track, we recognize that there is efficiency in coordinating those two tracks wherever possible. Mr. Greben has suggested that any work done by a team member at the project site, including work that the team member has control over, such as sewer work, be subject to 10 days notice to all team members, and providing other team members the opportunity to attend and collect split samples or conduct other necessary work, if they so wish. The Regional Water Board endorses this proposal as it provides greater efficiency, and it is my understanding that the team members have recently been cooperating in this way. Similarly, the Regional Water Board supports Mr. Greben's request that team members identify what criteria will be used to evaluate their findings. This is important because before the Regional Water Board is able to rely on any evidence, it must know and approve of the

criteria and protocols followed for any sampling and testing. The message here is simply for the team members to communicate and coordinate with one another.

The Regional Water Board has been considering the requests for a "discovery" process by the City and Union Oil. Although the Regional Water Board recognizes that there could be some useful information that comes out of such a process, the Regional Water Board needs to balance that against the burden of such a process. The Regional Water Board is considering allowing the team members to provide the Regional Water Board with a list of questions that they would like the other team member(s) to answer and their rationale for their questions. The Regional Water Board would then choose those questions that it believes would provide information useful for the Regional Water Board's process, and issue orders to the team members pursuant to Water Code section 13267(b), requiring the answers to those questions be provided. I would like feedback from the team members on this proposal and a time period that would work best (ie after January 1, next week).

In summary:

- The Regional Water Board will not have any meetings without all team members being given notice of the meeting and invited to attend. Exceptions to this rule may become necessary. In such circumstances, the information exchanged will be provided to team members and their comments considered. Notice and agenda should be provided 10 days in advance, where possible.

- The Regional Water Board will be meeting with Union Oil on December 3rd at our offices and requests that a representative from Union Oil provide an agenda to the team members by November 26 (less than 10 days due to holiday, but should provide sufficient time). Although all team members are invited to attend, Union Oil will be the only team member making a presentation.

- The Regional Water Board is committed to keeping the cleanup on schedule. Additional opportunities for sampling and discovery related to "forensic" information will continue; however, sampling and discovery requests related to "remedial" issues must be limited in order to keep the cleanup moving forward.

-Team members must give 10 days notice prior to any sampling work, and must provide opportunity for others to also collect split samples or conduct other

necessary work.

-The Regional Water Board is considering a discovery process and requests that team members provide comments on the proposal and suggest a time frame for the process.

I appreciate all of the thoughtful comments that the team members have been providing. I think that it makes for a better process. Also, Dave reports that there has been a greater amount of cooperation between the team members, and I thank you for your willingness to work together to ensure the site is cleaned up.

Kimberly McFarlin Niemeyer
Staff Counsel
State Water Resources Control Board

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Sacramento, CA 95814

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kniemeyer@waterboards.ca.gov

EXHIBIT “V”