GROUNDWATER INFORMATION SHEET

Trichloroethylene (TCE)

The purpose of this groundwater information sheet is to provide general information regarding a specific constituent of concern (COC). The following information is pulled from a variety of sources and data relates mainly to drinking water. For additional information, the reader is encouraged to consult the references cited at the end of the information sheet.

GENERAL INFORMATION	
Constituent of Concern	Trichloroethylene (TCE)
Synonyms	Ethylene trichloride, Acetylene trichloride, Triclene, Trichloroethene, 1,1,2-Trichloroethylene
Chemical Formula	C_2HCl_3
CAS No.	79-01-6
Storet No.	39180
Summary	The California Department of Public Health (CDPH) regulates TCE as a drinking water contaminant. The Maximum Contaminant Level (MCL) for TCE, set by the California Department of Public Health (CDPH) is 5 μg/L. TCE is primarily used as a solvent to remove grease from metal parts. TCE is present in groundwater in dissolved form and as a free product that sinks below the water table in form of dense non-aqueous phase liquid (DNAPL). Based on CDPH data through 2008, TCE has been detected above the MCL in 245 active and standby public groundwater sources (of approximately 16,000 sampled). Most TCE detections have occurred in Los Angeles (134), San Bernardino (32) and Fresno Counties (9).

REGULATORY AND WATER QUALITY LEVELS[1] TCE		
Type	**Agency**	**Concentration**
Federal MCL	US Environmental Protection Agency (US EPA)	5 μg/L
State MCL	CDPH	5 μg/L
Detection Limit for Purposes of Reporting (DLR)	CDPH	0.5μg/L
Others: Public Health Goal (PHG) Public Health Goal (PHG), *Draft 2009* Draft Soil Screening Level for Groundwater Protection	 OEHHA OEHHA US EPA, Region 9	 0.8 μg/L 1.7 μg/L 2.5E-03 mg/kg

[1]These levels generally relate to drinking water, other water quality levels may exist. For further information, see: Compilation of Water quality Goals (Marshack 2008) at: http://www.waterboards.ca.gov/water_issues/programs/water_quality_goals/docs/wq_goals_2008.pdf

SUMMARY OF DETECTIONS IN PUBLIC DRINKING WATER WELLS[2]	
Detection Type	**Number of Sources**
Number of active and standby public groundwater sources[3] with TCE concentration ≥ 5 μg/L.	245 of approximately 16,000
Top 3 counties having public drinking water wells[3] with PCE concentration ≥ 5 μg/L.	Los Angeles, San Bernardino, Fresno

[2]Based on DHS data collected from 1984-2008 (GeoTracker GAMA), see Figures 1 and 2.

[3]In general, drinking water from active and standby sources is treated or blended so consumers are not exposed to chemicals exceeding MCLs. Private domestic wells and groundwater sources for small water systems not regulated by CDPH are not included in these numbers and figures.

ANALYTICAL INFORMATION		
Method	**Detection Limit**	**Note**
EPA Method 524.2 (GC/MS)	0.2-1.6 µg/L	CDPH approved for public drinking water systems
EPA Method 502.2	0.01-3.0 µg/L	CDPH approved for public drinking water systems
EPA Method 8260B (GC/MS)	0.02 to 0.19 µg/L	
Known Limitations to Analytical Methods	Sample must be cooled to 4° C upon collection and analyzed within 14 days. Sample must be free of air bubbles.	
Public Drinking Water Testing Requirements	TCE is a regulated chemical for drinking water sources, with monitoring and compliance requirements (Title 22, Section 64431, et seq.).	

TCE OCCURRENCE	
Anthropogenic Sources	TCE is primarily used as a solvent to remove grease from metal parts, particularly in the automotive industry and metal machining industry. As a general solvent or as a component of solvent blends, TCE is used with adhesives, lubricants, paints, varnishes, paint strippers, pesticides, and cold metal cleaners. It can be found in many household products, including paint removers, adhesives, spot removers, and rug-cleaning fluids. It is also used in various chemical manufacturing processes. Historically, TCE was also used in foods, beverages (decaffeination of coffee), pet foods, medicine, pharmaceuticals and cosmetics.
Natural Sources	TCE is a manufactured chemical that does not occur naturally in the environment.
History of Occurrence	TCE has been in use for more than fifty years. The largest sources of TCE in groundwater are releases from chemical waste sites, improper disposal practices, and leaking storage tanks and pipelines. In California alone, an estimated 161,315 pounds of TCE were released to the environment from sites in California. (U.S.EPA Toxic Release Inventory Program). The major sources of TCE to the environment were landfills and air emissions. TCE concentrations above the MCL (5 μg/L) were observed in over 200 public groundwater sources in California, with the majority of occurrences in Los Angeles, San Bernardino, and Fresno counties (see Figures 1 and 2).
Contaminant Transport Characteristics	TCE is moderately soluble in water and soil. TCE is denser than water and free phase TCE will sink to the bottom of an aquifer as a dense non-aqueous phase liquid (DNAPL). TCE can destroy the structure of clayey minerals, making them more permeable to dissolved contaminants. TCE is not readily degraded in groundwater, although some TCE may naturally degrade under anaerobic conditions. However, TCE may degrade into compounds that are toxic and more difficult to

	degrade than TCE, such as dichloroethylene (DCE) and vinyl chloride.

REMEDIATION & TREATMENT TECHNOLOGIES

TCE is typically removed from groundwater using a traditional pump and treat system, where water is treated above ground by air-stripping and activated carbon filtration. Permeable reactive barriers filled with zero-valent iron granules and/or organic matter has been used to remediate and contain TCE plumes in-situ. Innovative methods, such as oxidation using potassium permanganate, thermal remediation using electrodes, steam or enhanced biodegradation are currently being tested.

Drinking water may be treated using various in-line processes. Traditionally, air stripping and activated carbon filters are used to remove TCE and other volatile organic carbons (VOCs) from water. Ultra-violet radiation with the addition of hydrogen peroxide is also used in low-flow systems. Wastewater treatment plants use chemical oxidizers (such as potassium permanganate) and biodegradation processes to remove VOCs from water.

HEALTH EFFECT INFORMATION

Acute overexposure to TCE vapor can cause central nervous system effects (e.g., light-headedness, drowsiness, and headache). Acute exposure may lead to unconsciousness, or in extreme circumstances prove fatal. TCE may irritate the respiratory tract at high vapor concentrations. Prolonged contact with the chemical in liquid form can cause irritation of the skin and eyes.

Chronic (repeated) exposure, in excess of recommended occupational limits, has been associated with damage to the liver, kidneys, and nervous system. TCE is considered a carcinogen to the State of California, and was added to the list of carcinogens in 1988. US EPA classifies TCE as a probable human carcinogen.

KEY REFERENCES

1. California Environmental Protection Agency. Office of Environmental Health Hazard Assessment. Public Health Goal for Trichloroethylene In Drinking Water. February 1999
http://www.oehha.ca.gov/water/phg/pdf/tce_f.pdf
Draft PHG 2009 - http://oehha.ca.gov/water/phg/pdf/TCE020609.pdf

2. California Environmental Protection Agency. Regional Water Quality Control Board, Central Valley Region. August 2000. *A Compilation of Water Quality Goals*. Prepared by Jon B. Marshack.
http://www.swrcb.ca.gov/rwqcb5/available_documents/wq_goals/wq_goals.pdf

3. Fetter, C. W., Applied Hydrogeology. 1988. Merrill Publishing Company.

4. Howard, H. Philip, et al., Environmental Degradation Rates. 1991. Lewis Publisher.

5. Montgomery H. J., Groundwater Chemicals-Desk Reference. 2000. Lewis Publisher

6. National Safety Council. Chemical Backgrounders. *Trichloroethylene.*
http://www.nsc.org/ehc/ew/chems/trichlor.htm (Sept. 2002)

7. U S Environmental Protection Agency. Field Applications of In-Situ Remediation Technologies: Permeable Reactive Barriers. April 1999. EPA 542-R-99-002.

8. US Environmental Protection Agency. Ground Water Currents No. 40. July 2000. EPA 542-N-01-006.

9. US Environmental Protection Agency, Technology Innovation Program, Contaminant Focus, Trichloroethylene, http://www.clu-in.org/contaminantfocus/default.focus/sec/Trichloroethylene_(TCE)/cat/Overview/ (March 2009)

10. US Environmental Protection Agency. PRG Tables (Sept. 2008) aka: RSL tables
http://www.epa.gov/region09/superfund/prg/index.html

11. U.S. Environmental Protection Agency, Technology Innovation Office. Bioremediation of Chlorinated Solvent Contaminated Groundwater. August 1998. Prepared by Megan Grindstaff.
http://207.86.51.66/products/intern/bioremed.htm

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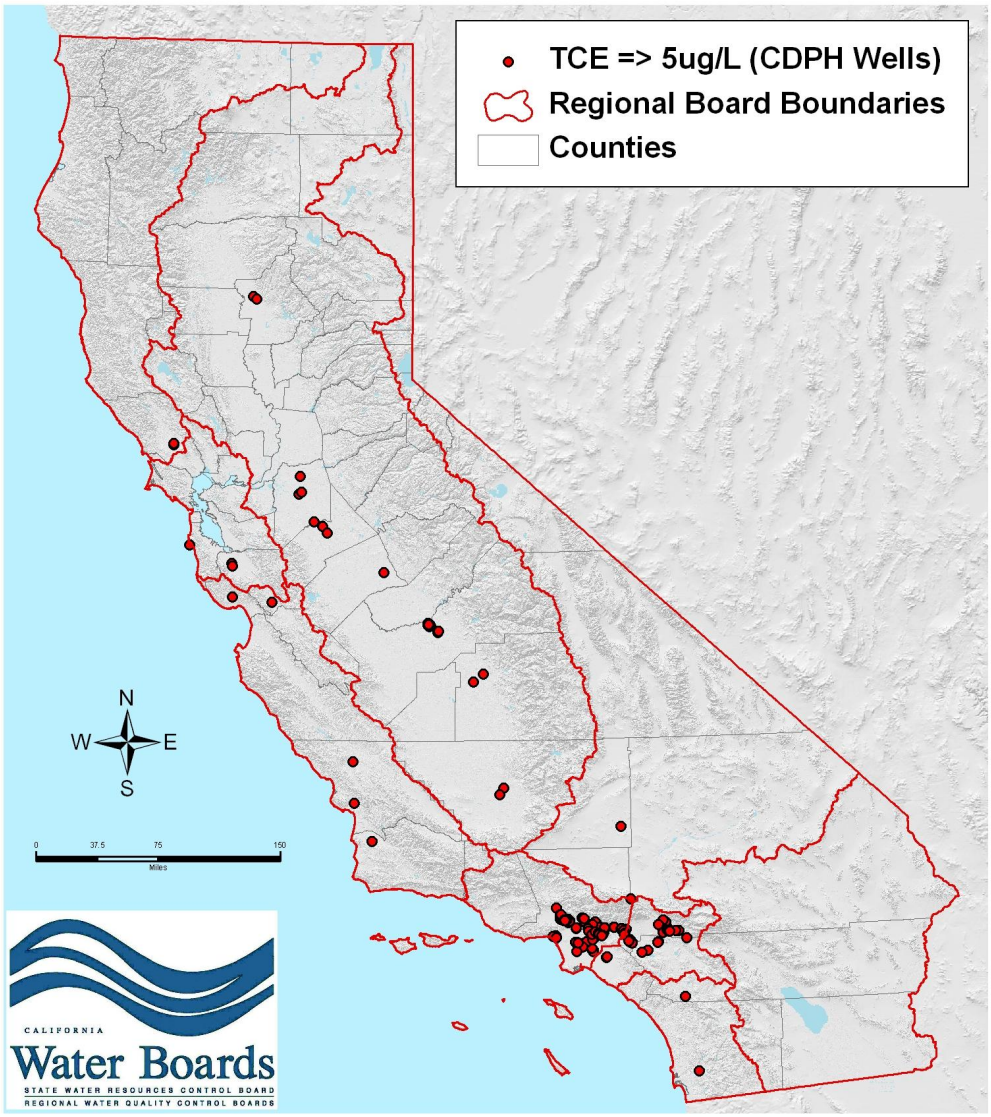

Figure 1. Active and Standby CDPH Wells with at Least One Detection of TCE => 5 ug/L, CA-MCL (245 wells)

Source: 1998-2008 CDPH Data (Rev. 3/30/09by J. Stepek)

GeoTracker-GAMA

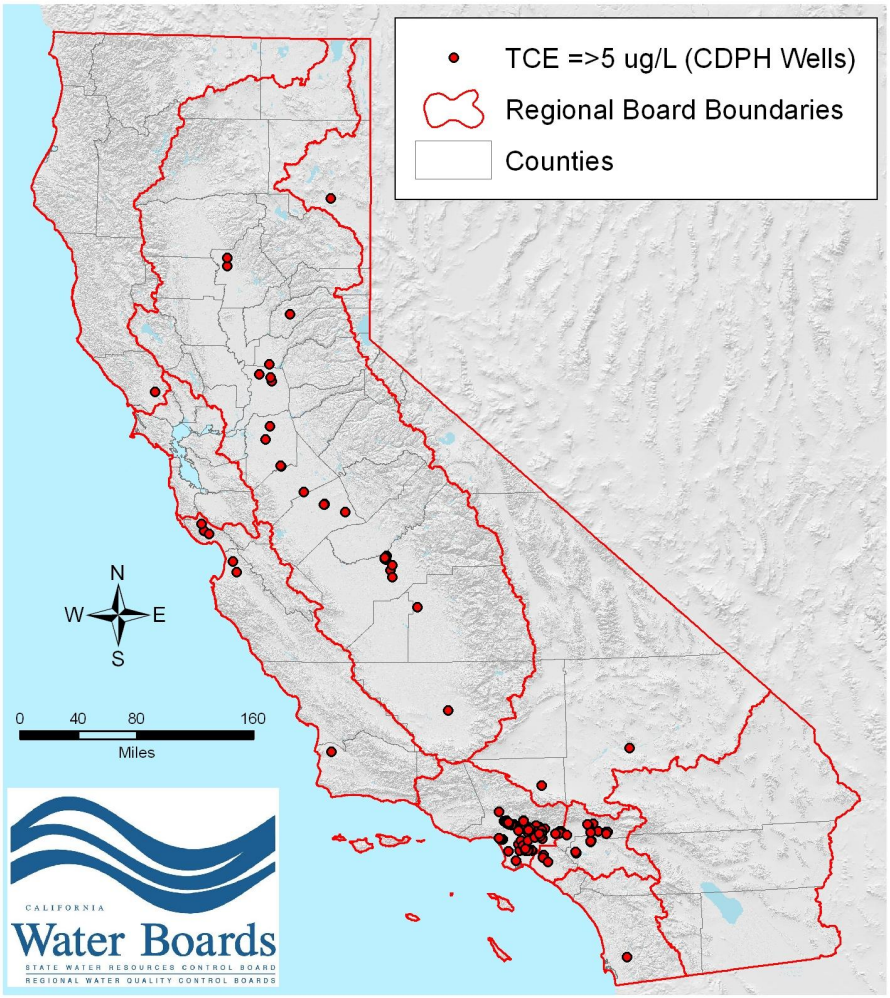

Figure 2. Abandoned, Destroyed and Inactive CDPH Wells with at Least One Detection of TCE at => 5 ug/L, CA-MCL (178 wells)

Source: 1998-2008 CDPH Data (Rev. 03/31/09 by J. Stepek)

GeoTracker-GAMA