

## GROUNDWATER INFORMATION SHEET

### Tetrachloroethylene (PCE)

*The purpose of this groundwater information sheet is to provide general information regarding a specific constituent of concern (COC). The information provided herein relates to wells (groundwater sources) used for public drinking water, not water served at the tap.*

GENERAL INFORMATION	
<b>Constituent of Concern</b>	Tetrachloroethylene (PCE)
<b>Aliases</b>	Tetrachloroethene, Perchloroethylene, Carbon Dichloride, Perchlor, Antisol 1, Ankilostin
<b>Chemical Formula</b>	C <sub>2</sub> Cl <sub>4</sub>
<b>CAS No.</b>	127-18-4
<b>Storet No.</b>	34475
<b>Summary</b>	<p>PCE is a regulated contaminant with an established Maximum Contaminant Level (MCL) for drinking water at 5 micrograms per liter (µg/L). Common anthropogenic sources of PCE include discharges related to dry cleaning operations and metal degreasing processes. Data from active and standby public water wells sampled between 2006 and 2016 indicate that there are 182 active and standby public water wells (of 12,237 sampled) that have had at least one detection of PCE above the MCL (5 µg/L). Most detections occur in Los Angeles, San Bernardino and Tulare counties.</p>

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<b>REGULATORY AND WATER QUALITY LEVELS<sup>1</sup></b>		
<b>Type</b>	<b>Agency</b>	<b>Concentration</b>
Federal MCL	US EPA <sup>2</sup>	5 µg/L
State MCL	SWRCB-DDW <sup>3</sup>	5 µg/L
Detection Limit for Purposes of Reporting (DLR)	SWRCB-DDW <sup>3</sup>	0.5 µg/L
Public Health Goal (PHG)	OEHHA <sup>4</sup>	0.06 µg/L

<sup>1</sup>These levels generally relate to drinking water. Other water quality levels may exist. For more information, see *A Compilation of Water Quality Goals*, 17<sup>th</sup> Edition (Marshack, 2016).

<sup>2</sup>US EPA - US Environmental Protection Agency

<sup>3</sup>SWRCB: The California Department of Public Health Drinking Water Program was transferred to the State Water Resources Control Board Division of Drinking Water in 2014.

<sup>4</sup>OEHHA – Office of Environmental Health Hazard Assessment

<b>SUMMARY OF DETECTIONS IN PUBLIC WATER WELLS<sup>5</sup></b>	
<b>Detection Type</b>	<b>Number of Wells</b>
Number of active and standby public wells <sup>6</sup> with PCE detections.	PCE was detected in 667 wells (12,237 tested)
Number of active and standby public wells with PCE concentrations > 5 µg/L.	Concentrations detected above the MCL in 182 public wells.
Top 3 counties with PCE detection in public wells above the MCL.	Los Angeles (131), San Bernardino (11) and Tulare (6)

<sup>5</sup>Based on the 2006-2016 public standby and active well data collected by SWRCB-DDW.

<sup>6</sup>Water from active and standby public wells is typically treated to prevent exposure to chemical concentrations above MCLs. Data from private domestic wells and wells with less than 15 service connections are not available.

<b>ANALYTICAL INFORMATION</b>	
<b>Analytical Test Methods</b>	US EPA Methods 502.2, 524.2, 551.1
<b>Detection Limit</b>	0.04 µg/L(EPA 502.2), 0.05 µg/L (EPA 524.2), 0.002 µg/L (EPA 551.1)
<b>Known Limitations to Analytical Methods</b>	Sample must be cooled to 4 °C upon collection, analyzed within 14 days and free of air bubbles.
<b>Public Drinking Water Testing Requirements</b>	Groundwater sources must be initially monitored for PCE during four consecutive quarterly sampling events. If PCE is not detected the groundwater system must take annual samples for a minimum of three consecutive years. The groundwater system may then reduce monitoring to one sample per each compliance period. If granted a waiver for VOC monitoring, a system using groundwater shall collect a minimum of one sample every six years. If PCE is detected in groundwater, the site will have to be monitored for vinyl chloride during each compliance period.

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<b>PCE OCCURRENCE</b>	
<b>Anthropogenic Sources</b>	PCE is a contaminant in the environment associated with dry cleaning, textile operations, and metal degreasing activities. It was also widely used in the production of CFC-113 (Freon-113) and other fluorocarbons. PCE is also used in rubber coatings, solvent soaps, printing inks, adhesives and glues, sealants, polishes, lubricants and pesticides.
<b>Natural Sources</b>	PCE is a manufactured chemical and does not occur naturally in the environment.
<b>History of Occurrence</b>	PCE has been used as a metal degreaser by military services and industry since the 1940s. Later, PCE was also used in dry cleaning processes. Due to poor handling and disposal practices, solvents such as PCE and trichloroethylene (TCE) entered the environment through evaporation, leaks, and improper disposal. U.S. EPA has found tetrachloroethylene in at least 945 of the 1,699 current or former National Priority List (NPL) sites. In California, numerous solvent plumes have originated from dry cleaning facilities in the Central Valley, Southern California, and San Francisco Bay Area.
<b>Contaminant Transport Characteristics</b>	Mobility of PCE is described as moderate to high with an average solubility in groundwater of 150 mg/L (at 20 deg. C), soil sorption coefficient of 2.4 (log $K_{oc}$ ), and octanol/water partition coefficient of 2.5 (log $K_{ow}$ ). PCE is a dense non-aqueous phase liquid (DNAPL). A DNAPL is denser than and immiscible in water. In the presence of water, it will form a separate phase. The half-life degradation rate in groundwater is estimated to be between 1 to 2 years, based on aqueous aerobic biodegradation (Howard et al 1991) but may be considerably longer under certain conditions.

<b>REMEDATION &amp; TREATMENT TECHNOLOGIES</b>	
<b>Groundwater Remediation</b>	<p>Treatment of groundwater containing PCE includes traditional pump-and-treat technology (using air stripping or activated carbon filtration), <i>in situ</i> chemical oxidation with peroxide or ozone, de-chlorination by Hydrogen-Releasing Compound (HRC) and emerging biodegradation techniques. An important part of PCE DNAPL remediation is source removal. This is accomplished often by integrating various methods of DNAPL mobilization using co-solvents, surfactants or thermal treatment and subsequent source removal - either by pump and treat or air sparging and soil vapor extraction. The bacteria strain (<i>Dehalococcoides ethenogenes</i> strain 195) preferentially uses PCE as a source of energy. Slow natural biodegradation of PCE may occur under anaerobic conditions when microorganisms are acclimated. However, the biodegradation process degrades PCE to TCE and eventually to vinyl chloride, which are also considered human carcinogens.</p>
<b>Drinking Water and Wastewater Treatment</b>	<p>Drinking water can be treated by various in-line processes. Traditionally, air stripping and activated carbon filters are used to remove PCE and other volatile organic carbons (VOCs) from water. Ultra-violet radiation is also used for low-flow systems. Wastewater treatment plants use chemical oxidation and are increasingly using biodegradation processes to remove VOCs from water.</p>

**HEALTH EFFECT INFORMATION**

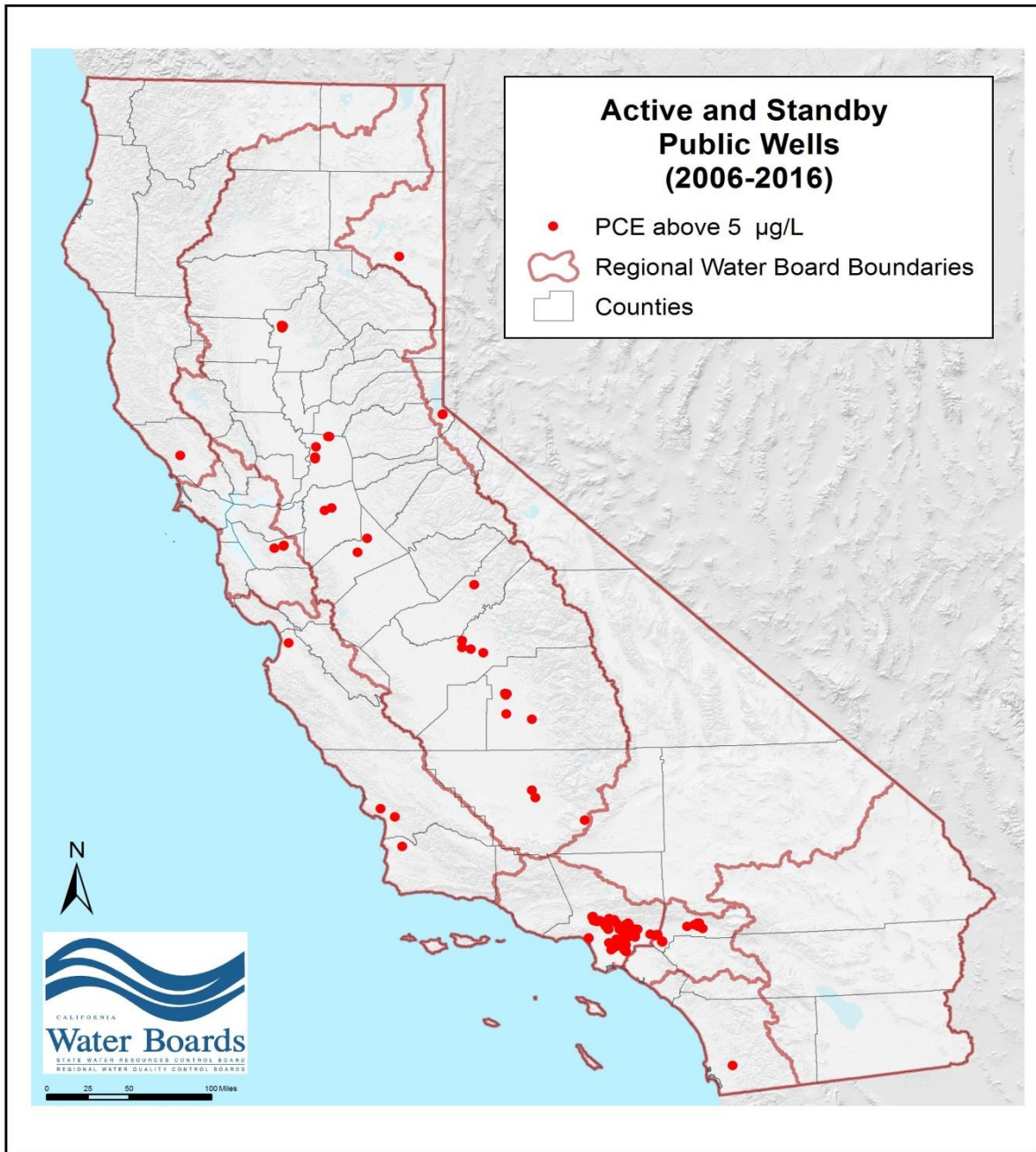
**Acute:** At levels above 100-200 mg/L in air, PCE may cause eye irritation and light-headedness; above 400 mg/L, eye and nasal irritation, lack of coordination within 2 hours; 600 mg/L, dizziness within 10 minutes; 1,500 mg/L, extreme irritation to eyes and respiratory tract, dizziness within 2 minutes, unconsciousness within 30 minutes.

**Chronic:** Long-term exposures in drinking water above the MCL (5 µg/L) can cause adverse effects to the liver, kidneys, and central nervous system. Prolonged dermal exposure can cause irritation, dryness, and dermatitis.

**Carcinogen:** Scientific evidence shows PCE may cause cancer from prolonged exposure even at levels below the MCL. The US EPA classifies PCE as a probable human carcinogen. The calculated PHG of 0.06 µg/L represents a negligible risk of contracting cancer from drinking water containing PCE in a household environment over a lifetime.

**KEY REFERENCES**

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**Active and Standby Public Wells with at least one PCE detection above the 5 µg/L MCL (182 wells).** (Source: Public well data using GeoTracker GAMA).