GROUNDWATER INFORMATION SHEET

Mercury

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 INORMATION	
Constituent of Concern	Mercury (Inorganic)
Synonyms	Quicksilver, Liquid Silver, and Hydrargyrum
Chemical Formula:	Hg
CAS No.	7439-97-6
Storet No.	71900
Summary	The current State and Federal Maximum Contaminant Level (MCL) for inorganic mercury is 2 micrograms per liter (μg/L). Mercury occurs as a native metal or is bound to other elements in minerals. Common sources of mercury include discharges from metal processing, incineration of coal, medical and other waste, and mining of gold and mercury ores. Based on GeoTracker public well data from 2006 to 2016, there were 15 active and standby public groundwater sources (12,144 public well tested) that have had one or more detections of mercury above the MCL of 2 μg/L. Mercury levels above the MCL in public groundwater sources were primarily found in Los Angeles (3), Napa (2) San Bernardino (2) and Kern (2) counties, with a maximum concentration of 28 μg/L in Monterey county.

FORMS OF MERCURY

Mercury is found naturally in rock deposits as a native element, and bound to other elements in minerals. Mercury in these forms is referred to as "inorganic mercury." Under certain conditions, inorganic mercury may combine with one carbon and three hydrogen atoms (CH_3), which is referred to as a methyl group. Mercury that has combined with at least one such methyl group is referred to as both "methyl mercury" and/or "organic mercury."

The Federal and State MCL for mercury is 2 µg/L (inorganic mercury). Methyl mercury can be more toxic than inorganic mercury. However, there is no Federal or State MCL for methyl mercury. In 2000, US EPA promulgated water quality criteria for priority toxic pollutants in California's inland surface waters in the California Toxics Rule (CTR). The CTR has established human health criteria for mercury that includes both organic and inorganic forms of mercury. Due to the toxicity of organic (methyl) mercury, and its tendency to accumulate more quickly in fish and other animals, the CTR mercury Human Health criteria for consumption of water and organisms is lower than the established MCL for inorganic mercury.

REGULATORY AND WATER QUALITY LEVELS

Type	Agency	Concentration
Federal MCL	US EPA[1]	2 µg/L
State MCL	SWRCB[2]	2 µg/L
Detection Limit for Purposes of Reporting (DLR)	SWRCB[2]	1 µg/L
Public Health Goal (PHG)	OEEHA[3]	1.2 µg/L
Others: California Toxic Rule Criteria Human Health Criteria for Consumption of Water and Organisms (total mercury, including organic forms)	US EPA	0.050 µg/L
Reference dose for methyl mercury RfD[4]		0.1 µg/kg/day

[1]US EPA – US Environmental Protection Agency

[2] SWRCB: The California Department of Public Health Drinking Water Program was transferred to the State Water Resources Control Board Division of Drinking Water (DDW) in 2014.

[3] OEHHA – Office of Environmental Health Hazard Assessment

[4]RfD - Assumes 70 kg body weight, 2 liters/day drinking water consumption rate, and 20% relative source contribution from drinking water.

SUMMARY OF DETECTIONS IN PUBLIC GROUNDWATER SOURCES[5]	
Detection Type	**Number of Sources**
Number of active and standby public groundwater sources[6] with mercury concentrations above 2 µg/L	15
Top 4 counties with mercury detections above 2 µg/L	Los Angeles (3), Napa (2), Kern (2), San Bernardino (2)

[5]Based on 2006-2016 public well (groundwater sources) data (GeoTracker-GAMA).

[6] Water from active and standby wells is typically treated to prevent exposure to chemical concentrations above the MCL or other health based benchmarks. Data from private domestic wells and wells with less than 15 service connections are not available.

ANALYTICAL INFORMATION	
Analytical Test Method	US EPA methods: 200.7 (ICP/AES), 200.8 (ICP/MS), 1631 (Cold Vapor Atomic Absorption)
Detection Limit	Most methods can attain a detection limit of 0.2 µg/L. EPA Method 1631 is able to achieve lower detection limits at 0.002 µg/L.
Known Limitations to Analytical Methods	Proper sample handling is required for samples tested by EPA Method 1631, where even minor contamination may greatly affect the results.
Public Drinking Water Testing Requirements	Mercury is a regulated chemical for drinking water sources, with monitoring and compliance requirements (Title 22, Section 64431, et seq.).

OCCURRENCE	
Natural Sources	Mercury is naturally present in geological formations, soil, water, air, plants, and animals. Elemental mercury can readily volatilize and enter the atmosphere, where it will react with other elements and precipitate. Natural sources of mercury include volcanoes, geologic deposits of mercury, volatilization from the ocean, and some geothermal springs. Approximately half of all mercury released to the environment is natural in origin.
Anthropogenic Sources	Globally, approximately 5,000 tons of mercury is released to the environment per year due to anthropogenic activities. The United States contributes approximately 3 percent of the world's total mercury emissions, with coal combustion responsible for about one-third of the total US contribution (approximately 48 tons per year). Production of electronic products such as dry-cell batteries, fluorescent light bulbs, thermostats, and other equipment account for the remaining industrial contribution of mercury to the environment. Improper handling or disposal of these items results in the release of mercury to the environment. In the past, mercury was used in fungicides and wood preservatives. Trace amounts of mercury may still be found in some wood preservatives and paints. Other sources include smelters and catalyst manufacturing. In the United States the amount of mercury released to the environment from industrial sources has been rapidly declining, and is now less than half the amount released during the 1950s. Other anthropogenic sources of mercury to the environment include wastes and byproducts from dentistry and historic mining. Dental fillings (amalgam) consisting of approximately 50% mercury are widely used throughout the United States. An estimated 35 tons per year of mercury are released to the environment through use of amalgam fillings. In California, historic mercury mining in the Coast Ranges and mercury used for gold ore recovery in the Sierra Nevada are also a continuing source of mercury.
History of Occurrence	Approximately 90% of all mercury used in the United States between 1846 and 1890 (about 115,000 tons) was mined from the California Coast Ranges. Over 11,000 tons of mercury was used in Sierra Nevadan gold mines – because mercury combines with small gold flakes, mercury used in sluices allowed greater gold recovery. Approximately 39,000 tons of mercury

	was released to the environment from mines in the Coast Ranges. Approximately 6,500 tons of mercury entered the environment as the result of mining activity in the Sierra Nevada. Mercury from historical mining continues to enter the environment through stream runoff.
Transport Characteristics	Mercury naturally volatilizes from soil and surface waters and enters the atmosphere. Ambient air concentrations of mercury have been reported to average between 10 to 20 nanograms per cubic meter (ng/m^3). Mercury from the atmosphere is the dominant source to most of the land surface. Most atmospherically deposited mercury will re-volatilize or adsorb to organic material in the soil. As a result, only a very small amount of mercury is transported to groundwater. Mercury can also occur naturally in groundwater, usually at low concentrations. In some cases, elevated mercury in groundwater may result from releases from past mining and chemical spills, or from improper disposal of materials that contain mercury. Groundwater generally contains less than 2 µg/L of mercury, although areas near historic mining districts or where certain geologic conditions are prevalent may have locally higher concentrations. Freshwaters without known sources of mercury contamination generally contains less than 5 ng/L of total mercury in aerobic surface waters. However, surface water contamination is significantly more extensive than groundwater contamination. Inorganic mercury may be converted to methyl mercury, which is soluble, mobile, and quickly enters the aquatic food chain. Methyl mercury accumulates in biological tissue more quickly than inorganic mercury. Concentrations in carnivorous fish tissue at the top of the food chain ("top trophic") may have methyl mercury concentrations from 10,000 to 100,000 times greater than that of the surrounding water. *Bioaccumulation* occurs in organisms when the rate of intake exceeds the rate at which the contaminant is removed from the organism; the bioaccumulation rate of methyl mercury exceeds inorganic mercury. As a result, most of the mercury found in top trophic fish tissue is in the form of methyl mercury. Since methyl mercury is not typically found in groundwater, DDW does not typically require sampling except in rare instances.

REMEDIATION & TREATMENT TECHNOLOGIES

The main types of treatment processes accepted by the EPA for mercury in water are:

- Precipitation — coagulation/filtration (C/F)
- Lime softening (LS)
- Adsorption processes — Granular Activated Carbon (GAC);
- Membrane filtration — reverse osmosis (RO),

In-situ methods include chemical precipitation (immobilization) and impermeable barriers.

HEALTH EFFECT INFORMATION

According to EPA 1996 IRIS database information, mercury is not classifiable as a human carcinogen. There is inadequate evidence in humans for the carcinogenicity of mercury and mercury compounds.

The kidney appears to be the critical organ of toxicity for the ingestion of mercuric salts. Acute renal failure has been observed in a number of case studies of mercuric chloride ingestion. The other major target organ for metallic and organic mercury is the nervous system. A range of neurological changes are produced by inhalation or ingestion of both high and low levels of food, fish and marine mammals contaminated with methyl mercury.

KEY REFERENCES

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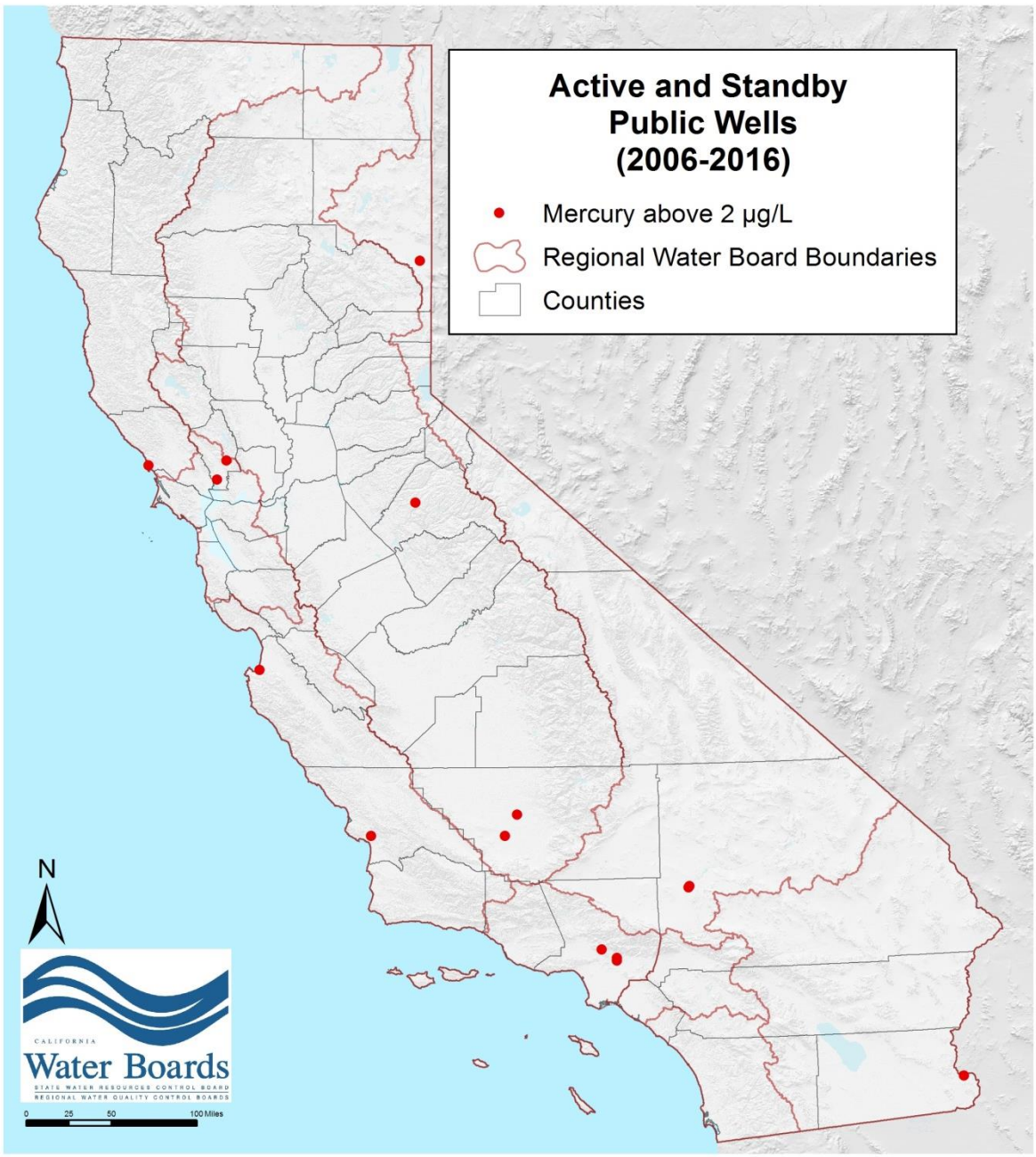

Active and Standby Public Wells with at least one mercury detection above the 2 µg/L MCL (15 wells). *Source: February 2016 query of public well data (GeoTracker-GAMA)*