San Jose Water
Water Quality
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Report on Water Quality Relative to Public Health Goals

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Contents

Background

California Health and Safety Code provisions require that water utilities serving more than 10,000 service connections prepare a special report by July 1, every three years if water quality measurements on water supplied to consumers have exceeded any Public Health Goals (PHGs). PHGs are non-enforceable goals established by the California Environmental Protection Agency's (Cal-EPA's) Office of Environmental Health Hazard Assessment (OEHHA). They are developed as goals because they are purely health-based objectives and may not be technically or economically feasible to achieve.
The law also requires that where OEHHA has not adopted a PHG for a constituent, the water suppliers are to use the Maximum Contaminant Level Goals (MCLGs) adopted by United States Environmental Protection Agency (USEPA). MCLGs are also non-enforceable, strictly health-based constituent levels. A Maximum Contaminant Level (MCL) is the legal threshold limit set by the USEPA or the California Division of Drinking Water (DDW) that water systems must comply with MCLs based on health concerns are referred to as Primary MCLs, and MCLs based on aesthetic concerns are referred to as Secondary MCLs (SMCLs). Only constituents which have a primary MCL and either a PHG or MCLG are to be addressed in this report. Attachment No. 1 is a list of all regulated constituents and their MCLs and PHGs or MCLGs.

If a constituent was detected in SJW's water supply between 2022 and 2024 at a level exceeding an applicable PHG or MCLG, this report provides the legally required information on those constituents.

What are PHGs?

PHGs are set by the California Office of Environmental Health Hazard Assessment (OEHHA) and are based solely on public health risk considerations. None of the risk management factors that are considered by the USEPA or the DDW in setting drinking water quality standards is considered in setting the PHGs. These factors include analytical detection capability, treatment technology availability, benefits, and costs. When calculating a PHG, OEHHA identifies the level of the chemical in drinking water that would not cause significant adverse health effects in people who drink two liters of that water every day for 70 years. The PHGs are not enforceable and are not required to be met by any public water system. MCLGs are the federal equivalent to PHGs, but may not be identical.

Water Quality Data Considered

All of the water quality data collected by SJW for purposes of determining compliance with drinking water standards during the years 2022, 2023, and 2024 was considered for this report. These data were summarized in our 2022, 2023, and 2024 Annual Water Quality Reports. These reports are made available to all of our customers annually. The most recent Annual Water Quality report is posted on our website at http://www.sjwater.com/ccr.

Most of the constituents monitored are not listed or reported in the water quality report because they were not detected. This means that either the constituent was below the detection threshold of the laboratory instruments or that it was detected at a level less than the *detection level for purposes of reporting* (DLR). The DLR is the level above which any analytical finding of a contaminant in drinking water resulting from required monitoring must be reported to DDW.

Guidelines Followed

The Association of California Water Agencies (ACWA) formed a workgroup that prepared guidelines for water utilities to use in preparing these reports. These guidelines were used in the preparation of our report. Health risk information was provided by the OEHHA (Attachment 2). No other guidance was available from state regulatory agencies.

Best Available Treatment Technology and Cost Estimates

Both the USEPA and the DDW adopt what are known as Best Available Technologies (BATs), which are the best known methods of reducing contaminant levels to the MCL. Costs can be estimated for such technologies, and a table of known costs for instances where BATs have been implemented is included in Appendix 3. Many PHGs and MCLGs are set significantly lower than the MCL. In such cases, BATs may not be feasible to reduce a contaminant's levels down to the PHG or MCLG, many of which are set at zero. Since there is little data available to estimate cost of treatment to achieve absolute zero levels, rough estimates of BATs may be used, but implementation of BATs still may not achieve the PHG or MCLG, and the costs to do so may be prohibitive.

Constituents Detected that Exceed a PHG or a MCLG

The following is a discussion of constituents that were detected in one or more of SJW's drinking water sources during monitoring for years 2022, 2023, and 2024 compliance at levels above the PHG, or above the MCLG if there is no PHG. Table 1 below summarizes the constituents detected above the PHGs in SJW water samples collected in 2022-2024.

Table 1. Constituents detected above PHGs between 2022 and 2024

Contaminant	Sample Date	Unit	MCL/[AL]	PHG/MCLG	Detections
1,1,2-Trichloroethane	2022-2024	mg/L	0.005	0.0003	ND-0.003600
Arsenic	2022-2024	mg/L	0.01	0.000004	ND-0.004000
Cadmium	2022-2024	mg/L	0.005	0.00004	ND-0.001200
Chromium, hexavalent	2022-2024	mg/L	0.01	0.00002	ND-0.008200
Copper	2022-2024	mg/L	1.3	0.3	ND-2.000000
Lead	2022-2024	mg/L	0.015	0.0002	ND-0.110000
Perfluorooctanoic Acid (PFOA)	2022-2024	mg/L		0.00000007	ND-0.000003
Perfluorooctyl Sulfonate (PFOS)	2022-2024	mg/L		0.000001	ND-0.000009
Radium 228	2022-2024	pCi/L		0.019	ND- 3.09 pCi/L
Uranium	2022-2024	pCi/L	20 pCi/L	0.43 pCi/L	ND-1.5 pCi/L

Unit Conversion Note:

Concentrations in Table 1 are presented in milligrams per liter (mg/L), consistent with regulatory reporting standards. For clarity, the narrative sections of this report refer to contaminant levels in micrograms per liter (µg/L), where 1 mg/L = 1,000 µg/L.

Volatile Organic Compounds (VOCs)

Volatile Organic Compounds (VOCs) are synthetic chemicals commonly used in industrial applications such as degreasing, chemical manufacturing, and solvent production. These compounds can contaminate drinking water sources through industrial discharge, leaking underground storage tanks, improper chemical disposal, and degradation of older infrastructure. VOCs are of public health concern due to their potential to cause liver and kidney damage, reproductive effects, and increased cancer risk with long-term exposure.

Between 2022 and 2024, San Jose Water conducted VOC monitoring in its groundwater wells and detected one regulated VOC: 1,1,2-Trichloroethane. This compound, historically used as an industrial solvent and degreasing agent, was detected at a maximum concentration of 3.6 µg/L. This level exceeds the California Public Health Goal (PHG) of 0.3 µg/L but remains below the Maximum Contaminant Level (MCL) of 5 µg/L. No other regulated VOCs outside the disinfection byproduct category (e.g., trihalomethanes) were detected during the monitoring period.

To mitigate the presence of VOCs in drinking water, the Division of Drinking Water (DDW) recommends Best Available Technologies (BATs) such as granular activated carbon (GAC), packed tower aeration (PTA), and air stripping. For the purpose of planning-level cost estimation and consistent treatment performance, GAC was selected as the preferred method to reduce concentrations of VOCs like 1,1,2-Trichloroethane to levels below both regulatory limits and health-based goals.

Inorganic Chemicals

Uranium Inorganic chemicals (IOCs) are elements and minerals that occur naturally in soil and rock but can also enter drinking water through industrial activities, mining, corrosion of plumbing materials, and agricultural runoff. While some IOCs are essential nutrients at low levels, elevated concentrations in drinking water can cause a variety of adverse health effects, including neurological damage, kidney toxicity, developmental disorders, and increased cancer risk.

Between 2022 and 2024, San Jose Water conducted monitoring at its groundwater wells and detected several IOCs: Arsenic, Cadmium, Chromium (hexavalent), Copper, Lead, and Uranium.

Arsenic, a toxic metalloid naturally present in many geological formations, was detected at a maximum level of 4 µg/L. This value exceeds the extremely low PHG of 0.000004 mg/L but remains below the federal MCL of 10 µg/L and the California MCL of 0.01 mg/L. Long-term exposure to arsenic in drinking water is linked to increased risks of cancer, cardiovascular disease, and diabetes.

Cadmium, a metal that may enter water supplies through corrosion of galvanized pipes or industrial discharge, was detected at 1.2 µg/L. This level is below the MCL of 5 µg/L but exceeds the PHG of 0.00004 mg/L, indicating potential long-term health concerns related to kidney and bone damage.

Chromium (hexavalent), a carcinogenic form of chromium often associated with industrial pollution, was measured at a maximum of 8.2 µg/L. This level is below the former California MCL of 10 µg/L, which was withdrawn in 2017 due to procedural issues, but it is above the extremely low PHG of 0.00002 mg/L. Health effects from prolonged exposure include increased cancer risk and oxidative stress.

Copper, which can leach into water from household plumbing, was detected at a maximum of 2,000 µg/L (2 mg/L), which is below the MCL of 1.3 mg/L when considered as a 90th percentile value in the Lead and Copper Rule context. The PHG for copper is 0.3 mg/L, and while copper is an essential nutrient, high levels can cause gastrointestinal distress and liver toxicity.

Lead, a highly toxic heavy metal primarily introduced through corrosion of lead-containing plumbing, was found at a maximum concentration of 110 µg/L. This exceeds both the PHG of 0.0002 mg/L and the federal Action Level of 0.015 mg/L (15 µg/L), though the MCL is applied differently under the Lead and Copper Rule. Chronic exposure to lead is associated with developmental delays, neurological damage, and cardiovascular issues, especially in children and pregnant individuals.

Uranium, a naturally occurring radioactive metal found in some aquifers, was measured at a maximum of 1.5 pCi/L. This value is well below the California and federal MCL of 20 pCi/L and the PHG of 0.43 pCi/L. While uranium contributes to overall radiological exposure, it also has chemical toxicity that can impact kidney function.

The Division of Drinking Water (DDW) recommends a range of Best Available Technologies (BATs) for removing inorganic contaminants. These include ion exchange, reverse osmosis (RO), coagulation/filtration, and lime softening, depending on the specific contaminant. For the purpose of cost estimation and consistency, reverse osmosis was selected as the primary treatment method to address all detected IOCs, as it is capable of reducing these contaminants below both the MCLs and the PHGs.

Per- and Polyfluoroalkyl Substances (PFAS).

Perfluorooctanoic Acid (PFOA) and Perfluorooctyl Sulfonate (PFOS) are synthetic chemicals in the broader class of per- and polyfluoroalkyl substances (PFAS), which have been widely used in firefighting foams, non-stick cookware, water-repellent fabrics, food packaging, and various industrial applications. These compounds are extremely stable in the environment and do not readily break down, earning them the nickname "forever chemicals." PFOA and PFOS have been detected in drinking water systems throughout the United States and are linked to developmental toxicity, immune suppression, liver damage, and increased risk of kidney and testicular cancer.

Between 2022 and 2024, San Jose Water monitored for PFOA and PFOS in accordance with evolving California and federal guidelines. PFOA was detected at a maximum concentration of 0.0029 µg/L (0.0000029 mg/L), which exceeds the California Public Health Goal (PHG) of 0.00000007 mg/L by more than an order of magnitude. PFOS was found at a maximum concentration of 0.0092 µg/L (0.0000092 mg/L), similarly exceeding its PHG of 0.000001 mg/L. These concentrations, while extremely low, are considered significant due to the long-term persistence, bioaccumulation, and toxicity of PFAS compounds.

As of the monitoring period, there are no enforceable Maximum Contaminant Levels (MCLs) or Detection Limits for Reporting (DLRs) established for PFOA and PFOS in California, although federal MCLs have been proposed. Given the health concerns and regulatory momentum, San Jose Water continues to track state and federal actions closely.

The Division of Drinking Water (DDW) identifies granular activated carbon (GAC), ion exchange resins, and reverse osmosis (RO) as Best Available Technologies (BATs) for PFAS removal. For planning and cost estimation purposes, GAC was selected as the preferred treatment technology capable of reducing PFOA and PFOS to below their PHGs. San Jose Water remains committed to transparent public communication and proactive monitoring as PFAS regulation continues to evolve.

Radiological Contaminants

Radium-228 and Uranium are naturally occurring radioactive elements found in certain types of rock and soil. As groundwater moves through geologic formations, these radionuclides can dissolve and enter drinking water sources. Both are classified as radiological contaminants and are regulated due to their long-term health risks, which include increased risk of cancer and, in the case of uranium, kidney toxicity from chemical exposure.

Between 2022 and 2024, San Jose Water conducted monitoring of Radium-228 and Uranium in its groundwater system in compliance with California and federal radiological standards. Radium-228 was detected at a maximum concentration of 3.09 pCi/L, which is well below the Maximum Contaminant Level (MCL) of 5 pCi/L for combined radium isotopes (Radium-226 and Radium-228), and also below its individual MCL of 5 pCi/L. The California Public Health Goal (PHG) for Radium-228 is 0.019 pCi/L, meaning the detected level, although compliant with the MCL, exceeds the health-protective goal by more than an order of magnitude.

Uranium was detected at a maximum concentration of 1.5 pCi/L, which is significantly below both the California and federal MCL of 20 pCi/L and the PHG of 0.43 pCi/L. In addition to its radiological risk, uranium presents chemical toxicity that can damage kidney function with chronic exposure. While the detected concentrations of uranium pose minimal risk under current conditions, its presence in drinking water continues to be monitored closely.

To reduce levels of naturally occurring radionuclides in drinking water, the Division of Drinking Water (DDW) recommends treatment technologies such as ion exchange, reverse osmosis (RO), lime softening, and coagulation/filtration. For cost estimation and system planning, reverse osmosis was selected as the treatment method capable of reliably reducing Radium-228 and Uranium to concentrations below both the MCLs and PHGs. San Jose Water remains committed to regular monitoring and risk mitigation to ensure compliance and long-term public health protection.

Conclusions

The drinking water provided by San Jose Water meets all State of California and USEPA drinking water standards set to protect public health. Additional costly treatment processes would be required to further reduce the levels of the constituents identified in this report. The effectiveness of these treatment processes is uncertain. The health protection benefits of these further hypothetical reductions are not clear and may not be quantifiable. Therefore, no action is proposed. This assessment is consistent with the recommendations of California Division of Drinking Water.

Appendix 1: MCLs, DLRs, and PHGs for Regulated Drinking Water Contaminants

Last Update: November 2024

This table includes:

- California's maximum contaminant levels (MCLs)
- Detection limits for purposes of reporting (DLRs)
- Public health goals (PHGs) from the Office of Environmental Health Hazard Assessment (OEHHA)
- The PHGs for NDMA, PFOA and PFOS (which are not yet regulated in California) are included at the bottom of this table.
- The Federal MCLs for PFOA and PFOS are also listed at the end of this table.

Units are in milligrams per liter (mg/L), unless otherwise noted.

Chemicals with MCLs in 22 CCR §64431 — Inorganic Chemicals

Regulated Contaminant	MCL	DLR	PHG	Date of PHG
Aluminum	1	0.05	0.6	2001
Antimony	0.006	0.006	0.001	2016
Arsenic	0.010	0.002	0.000004	2004
Asbestos (MFL = million fibers per liter; for fibers >10 microns long)	7 MFL	0.2 MFL	7 MFL	2003
Barium	1	0.1	2	2003
Beryllium	0.004	0.001	0.001	2003
Cadmium	0.005	0.001	0.00004	2006
Chromium, Total	0.05	0.01	withdrawn Nov . 2001	1999
Chromium, Hexavalent	0.01	0.0001	0.00002	2011
Cyanide	0.15	0.1	0.15	1997
Fluoride	2	0.1	1	1997
Mercury (inorganic)	0.002	0.001	0.0012	1999 (rev2005)*
Nickel	0.1	0.01	0.012	2001
Nitrate (as nitrogen, N)	10 as N	0.4	45 as NO3 (=10 as N)	2018
Nitrite (as N)	1 as N	0.4	1 as N	2018
Nitrate + Nitrite (as N)	10 as N	--	10 as N	2018
Perchlorate	0.006	0.004	0.001	2015
Selenium	0.05	0.005	0.03	2010
Thallium	0.002	0.001	0.0001	1999 (rev2004)

*OEHHA's review of this chemical during the year indicated (rev20XX) resulted in nochange in the PHG.

Radionuclides with MCLs in 22 CCR §64441 and §64443 — Radioactivity

Units are picocuries per liter (pCi/L), unless otherwise stated; n/a = not applicable

Regulated Contaminant	MCL	DLR	PHG	Date of PHG
Gross alpha particle activity - OEHHA concluded in 2003 that a PHG was notpractical	15	3	none	n/a
Gross beta particle activity - OEHHA concluded in 2003 that a PHG was notpractical	4 mrem/yr	4	none	n/a
Radium-226	--	1	0.05	2006
Radium-228	--	1	0.019	2006
Radium-226 + Radium-228	5	--	--	--
Strontium-90	8	2	0.35	2006
Tritium	20,000	1,000	400	2006
Uranium	20	1	0.43	2001

Chemicals with MCLs in 22 CCR §64444 — Organic Chemicals

(a) Volatile Organic Chemicals (VOCs)

Regulated Contaminant	MCL	DLR	PHG	Date of PHG
Benzene	0.001	0.0005	0.00015	2001
Carbon tetrachloride	0.0005	0.0005	0.0001	2000
1,2-Dichlorobenzene	0.6	0.0005	0.6	1997 (rev2009)
1,4-Dichlorobenzene (p-DCB)	0.005	0.0005	0.006	1997
1,1-Dichloroethane (1,1-DCA)	0.005	0.0005	0.003	2003
1,2-Dichloroethane (1,2-DCA)	0.0005	0.0005	0.0004	1999 (rev2005)
1,1-Dichloroethylene (1,1-DCE)	0.006	0.0005	0.01	1999
Cis-1,2-Dichloroethylene	0.006	0.0005	0.013	2018
Trans-1,2-Dichloroethylene	0.01	0.0005	0.05	2018
Dichloromethane (Methylene chloride)	0.005	0.0005	0.004	2000
1,2-Dichloropropane	0.005	0.0005	0.0005	1999
1,3-Dichloropropene	0.0005	0.0005	0.0002	1999 (rev2006)
Ethylbenzene	0.3	0.0005	0.3	1997
Methyl tertiary butyl ether (MTBE)	0.013	0.003	0.013	1999
Monochlorobenzene	0.07	0.0005	0.07	2014
Styrene	0.1	0.0005	0.0005	2010
1,1,2,2-Tetrachloroethane	0.001	0.0005	0.0001	2003
Tetrachloroethylene (PCE)	0.005	0.0005	0.00006	2001
Toluene	0.15	0.0005	0.15	1999
1,2,4-Trichlorobenzene	0.005	0.0005	0.005	1999
1,1,1-Trichloroethane (1,1,1-TCA)	0.2	0.0005	1	2006
1,1,2-Trichloroethane (1,1,2-TCA)	0.005	0.0005	0.0003	2006
Trichloroethylene (TCE)	0.005	0.0005	0.0017	2009
Trichlorofluoromethane (Freon 11)	0.15	0.005	1.3	2014
1,1,2-Trichloro-1,2,2-Trifluoroethane (Freon 113)	1.2	0.01	4	1997 (rev2011)
Vinyl chloride	0.0005	0.0005	0.00005	2000
Xylenes	1.75	0.0005	1.8	1997

(b) Non-Volatile Synthetic Organic Chemicals (SOCs)

Regulated Contaminant	MCL	DLR	PHG	Date of PHG
Alachlor	0.002	0.001	0.004	1997
Atrazine	0.001	0.0005	0.00015	1999
Bentazon	0.018	0.002	0.2	1999 (rev2009)
Benzo(a)pyrene	0.0002	0.0001	0.000007	2010
Carbofuran	0.018	0.005	0.0007	2016
Chlordane	0.0001	0.0001	0.00003	1997 (rev2006)
Dalapon	0.2	0.01	0.79	1997 (rev2009)
1,2-Dibromo-3-chloropropane (DBCP)	0.0002	0.00001	0.000003	2020
2,4-Dichlorophenoxyacetic acid (2,4-D)	0.07	0.01	0.02	2009
Di(2-ethylhexyl) adipate	0.4	0.005	0.2	2003
Di(2-ethylhexyl) phthalate (DEHP)	0.004	0.003	0.012	1997
Dinoseb	0.007	0.002	0.014	1997 (rev2010)
Diquat	0.02	0.004	0.006	2016
Endothal	0.1	0.045	0.094	2014
Endrin	0.002	0.0001	0.0003	2016
Ethylene dibromide (EDB)	0.00005	0.00002	0.00001	2003
Glyphosate	0.7	0.025	0.9	2007
Heptachlor	0.00001	0.00001	0.000008	1999
Heptachlor epoxide	0.00001	0.00001	0.000006	1999
Hexachlorobenzene	0.001	0.0005	0.00003	2003
Hexachlorocyclopentadiene	0.05	0.001	0.002	2014
Lindane	0.0002	0.0002	0.000032	1999 (rev2005)
Methoxychlor	0.03	0.01	0.00009	2010
Molinate	0.02	0.002	0.001	2008
Oxamyl	0.05	0.02	0.026	2009
Pentachlorophenol	0.001	0.0002	0.0003	2009
Picloram	0.5	0.001	0.166	2016
Polychlorinated biphenyls (PCBs)	0.0005	0.0005	0.00009	2007
Simazine	0.004	0.001	0.004	2001
Thiobencarb	0.07	0.001	0.042	2016
Toxaphene	0.003	0.001	0.00003	2003
1,2,3-Trichloropropane	0.000005	0.000005	0.0000007	2009
2,3,7,8-TCDD (dioxin)	$3x10^{-8}$	$5x10^{-9}$	$5x10^{-11}$	2010
2,4,5-TP (Silvex)	0.05	0.001	0.003	2014

Copper and Lead, 22 CCR §64672.3

Values referred to as MCLs for lead and copper are not actually MCLs; instead, they arecalled “Action Levels” under the lead and copperrule

Regulated Contaminant	MCL	DLR	PHG	Date of PHG
Copper	1.3	0.05	0.3	2008
Lead	0.015	0.005	0.0002	2009

Chemicals with MCLs in 22 CCR §64533 — Disinfection Byproducts

Regulated Contaminant	MCL	DLR	PHG	Date of PHG
Total Trihalomethanes	0.080	--	--	--
Bromodichloromethane	--	0.0010	0.00006	2020
Bromoform	--	0.0010	0.0005	2020
Chloroform	--	0.0010	0.0004	2020
Dibromochloromethane	--	0.0010	0.0001	2020
Haloacetic Acids (five) (HAA5)	0.060	--	--	--
Monochloroacetic Acid	--	0.0020	--	--
Dichloroacetic Adic	--	0.0010	--	--
Trichloroacetic Acid	--	0.0010	--	--
Monobromoacetic Acid	--	0.0010	--	--
Dibromoacetic Acid	--	0.0010	--	--
Bromate	0.010	0.0050**	0.0001	2009
Chlorite	1.0	0.020	0.05	2009

**The DLR for Bromate is 0.0010 mg/L for analysis performed using EPA Method 317.0 Revision 2.0, 321.8, or 326.0.

Chemicals with PHGs established in response to DDW requests. These are not currently regulated drinking watercontaminants.***

Regulated Contaminant	MCL	DLR	PHG	Date of PHG
N-Nitrosodimethylamine (NDMA)	--	--	0.000003	2006
Perfluorooctanoic acid (PFOA)***	--	--	0.00000007	2024
Perfluorooctane sulfonic acid (PFOS)***	--	--	0.000001	2024

***PFOA and PFOS have US EPA MCLGs and MCLs.

PFOA – MCLG is zero. MCL is 4 ng/L

PFOS – MCLG is zero. MCL is 4 ng/L

Appendix 2: Health Risk Categories and Cancer Risk Values for Chemicals

Table 1: Health Risk Categories and Cancer Risk Values for Chemicals with California Public Health Goals (PHGs)

Chemical	Health Risk Category[1]	California PHG (mg/L)[2]	Cancer Risk[3] at the PHG	California MCL[4] (mg/L)	Cancer Risk at the California MCL
Alachlor	carcinogenicity (causes cancer)	0.004	NA[5,6]	0.002	NA
Aluminum	neurotoxicity and immunotoxicity (harms the nervous and immune systems)	0.6	NA	1	NA
Antimony	hepatotoxicity (harms the liver)	0.001	NA	0.006	NA
Arsenic	carcinogenicity (causes cancer)	0.000004 (4×10^{-6})	1×10^{-6} (one per million)	0.01	2.5×10^{-3} (2.5 per thousand)
Asbestos	carcinogenicity (causes cancer)	7MFL[7] (fibers>10 microns in length)	1×10^{-6}	7MFL (fibers>10 microns in length)	1×10^{-6} (one per million)
Atrazine	carcinogenicity (causes cancer)	0.00015	1×10^{-6}	0.001	7×10^{-6} (seven per million)
Barium	cardiovascular toxicity (causes high blood pressure)	2	NA	1	NA

[1] Based on the OEHHA PHG technical support document unless otherwise specified. The categories are the hazard traits defined by OEHHA for California's Toxics Information Clearinghouse (online at: https://oehha.ca.gov/media/downloads/risk-assessment//gcregtext011912.pdf).

[2] mg/L= milligrams per liter of water, equivalent to parts per million(ppm)

[3] Cancer Risk= Upper bound estimate of excess cancer risk from lifetime exposure. Actual cancer risk may be lower or zero. 1×10^{-6}means one excess cancer case per million people exposed.

[4] MCL = maximum contaminant level.

[5] NA=not applicable. Cancer risk cannot be calculated.

[6] The PHG for alachlor is based on a threshold model of carcinogenesis and is set at a level that is believed to be without any significant cancer risk to individuals exposed to the chemical over a lifetime.

[7] MFL = million fibers per liter of water.

Table 1: Health Risk Categories and Cancer Risk Values for Chemicals with California Public Health Goals (PHGs)

Chemical	Health Risk Category[1]	California PHG (mg/L)[2]	Cancer Risk[3] at the PHG	California MCL[4] (mg/L)	Cancer Risk at the California MCL
Bentazon	hepatotoxicity and digestive system toxicity (harms the liver, intestine, and causes body weight effects[8])	0.2	NA	0.018	NA
Benzene	carcinogenicity (causesleukemia)	0.00015	1×10^{-6}	0.001	7×10^{-6} (seven per million)
Benzo[a]pyrene	carcinogenicity (causescancer)	0.000007 (7×10^{-6})	1×10^{-6}	0.0002	3×10^{-5} (three per hundred thousand)
Beryllium	digestive system toxicity (harms the stomach or intestine)	0.001	NA	0.004	NA
Bromate	carcinogenicity (causes cancer)	0.0001	1×10^{-6}	0.01	1×10^{-4} (one per ten thousand)
Cadmium	nephrotoxicity (harms the kidney)	0.00004	NA	0.005	NA
Carbofuran	reproductive toxicity (harms the testis)	0.0007	NA	0.018	NA
Carbon tetrachloride	carcinogenicity (causes cancer)	0.0001	1×10^{-6}	0.0005	5×10^{-6} (five per million)

[8] Body weight effects are an indicator of general toxicity in animal studies.

Table 1: Health Risk Categories and Cancer Risk Values for Chemicals with California Public Health Goals (PHGs)

Chemical	Health Risk Category[1]	California PHG (mg/L)[2]	Cancer Risk[3] at the PHG	California MCL[4] (mg/L)	Cancer Risk at the California MCL
Chlordane	carcinogenicity (causes cancer)	0.00003	1×10^{-6}	0.0001	3×10^{-6} (three per million)
Chlorite	hematotoxicity (causes anemia) neurotoxicity (causes neurobehavioral effects)	0.05	NA	1	NA
Chromium, hexavalent	carcinogenicity (causes cancer)	0.00002	1×10^{-6}	0.010	5×10^{-4} (five per ten thousand)
Copper	digestive system toxicity (causes nausea, vomiting, diarrhea)	0.3	NA	1.3 (AL[9])	NA
Cyanide	neurotoxicity (damages nerves) endocrine toxicity (affects the thyroid)	0.15	NA	0.15	NA
Dalapon	nephrotoxicity (harms the kidney)	0.79	NA	0.2	NA
Di(2-ethylhexyl) adipate (DEHA)	developmental toxicity (disrupts development)	0.2	NA	0.4	NA
Di(2-ethylhexyl) phthalate (DEHP)	carcinogenicity (causes cancer)	0.012	1×10^{-6}	0.004	3×10^{-7} (three per ten million)

[9] AL = action level. The action levels for copper and lead refer to a concentration measured at the tap. Much of the copper and lead in drinking water is derived from household plumbing (The Lead and Copper Rule, Title 22, California Code of Regulations [CCR] section 64672.3).

Chemical	Health Risk Category[1]	California PHG (mg/L)[2]	Cancer Risk[3] at the PHG	California MCL[4] (mg/L)	Cancer Risk at the California MCL
1,2-Dibromo-3-chloropropane (DBCP)	carcinogenicity (causes cancer)	0.000003 ($3x10^{-6}$)	$1×10^{-6}$	0.0002	$7×10^{-5}$ (seven per hundred thousand)
1,2-Dichloro-benzene (*o*-DCB)	hepatotoxicity (harms the liver)	0.6	NA	0.6	NA
1,4-Dichloro-benzene (*p*-DCB)	carcinogenicity (causes cancer)	0.006	$1×10^{-6}$	0.005	$8×10^{-7}$ (eight per ten million)
1,1-Dichloro-ethane (1,1-DCA)	carcinogenicity (causes cancer)	0.003	$1×10^{-6}$	0.005	$2×10^{-6}$ (two per million)
1,2-Dichloro-ethane (1,2-DCA)	carcinogenicity (causes cancer)	0.0004	$1×10^{-6}$	0.0005	$1×10^{-6}$ (one per million)
1,1-Dichloro-ethylene (1,1-DCE)	hepatotoxicity (harms the liver)	0.01	NA	0.006	NA
1,2-Dichloro-ethylene, cis	nephrotoxicity (harms the kidney)	0.013	NA	0.006	NA
1,2-Dichloro-ethylene, trans	immunotoxicity (harms the immune system)	0.05	NA	0.01	NA
Dichloromethane (methylene chloride)	carcinogenicity (causes cancer)	0.004	$1×10^{-6}$	0.005	$1×10^{-6}$ (one per million)

Table 1: Health Risk Categories and Cancer Risk Values for Chemicals with California Public Health Goals (PHGs)

Chemical	Health Risk Category[1]	California PHG (mg/L)[2]	Cancer Risk[3] at the PHG	California MCL[4] (mg/L)	Cancer Risk at the California MCL
2,4-Dichloro-phenoxyacetic acid (2,4-D)	hepatotoxicity and nephrotoxicity (harms the liver and kidney)	0.02	NA	0.07	NA
1,2-Dichloro-propane (propylene dichloride)	carcinogenicity (causes cancer)	0.0005	1×10^{-6}	0.005	1×10^{-5} (one per hundred thousand)
1,3-Dichloro-propene (Telone II©)	carcinogenicity (causes cancer)	0.0002	1×10^{-6}	0.0005	2×10^{-6} (two per million)
Dinoseb	reproductive toxicity (harms the uterus and testis)	0.014	NA	0.007	NA
Diquat	ocular toxicity (harms the eye) developmental toxicity (causes malformation)	0.006	NA	0.02	NA
Endothall	digestive system toxicity (harms the stomach or intestine)	0.094	NA	0.1	NA
Endrin	neurotoxicity (causes convulsions) hepatotoxicity (harms the liver)	0.0003	NA	0.002	NA
Ethylbenzene (phenylethane)	hepatotoxicity (harms the liver)	0.3	NA	0.3	NA
Ethylene dibromide (1,2-Dibromoethane)	carcinogenicity (causes cancer)	0.00001	1×10^{-6}	0.00005	5×10^{-6} (five per million)

Table 1: Health Risk Categories and Cancer Risk Values for Chemicals with California Public Health Goals (PHGs)

Chemical	Health Risk Category[1]	California PHG (mg/L)[2]	Cancer Risk[3] at the PHG	California MCL[4] (mg/L)	Cancer Risk at the California MCL
Fluoride	musculoskeletal toxicity (causes tooth mottling)	1	NA	2	NA
Glyphosate	nephrotoxicity (harms the kidney)	0.9	NA	0.7	NA
Haloaceticacids: dibromoacetic acid	carcinogenicity (causes cancer)	0.00003	1×10^{-6}	0.06*	2×10^{-3} (two per thousand)[10]
Haloaceticacids: dichloroacetic acid	carcinogenicity (causes cancer)	0.0002	1×10^{-6}	0.06*	3×10^{-4} (three per ten thousand)[11]
Haloaceticacids :monobromo-acetic acid	musculoskeletal toxicity (causes muscular degeneration)	0.025	NA	0.06*	NA
Haloaceticacids :monochloro-acetic acid	general toxicity (causes body and organ weightchanges[8])	0.053	NA	0.06*	NA
Haloaceticacids: trichloroacetic acid	carcinogenicity (causes cancer)	0.0001	1×10^{-6}	0.06*	6×10^{-4} (six per ten thousand)[12]
Heptachlor	carcinogenicity (causes cancer)	0.000008 (8×10^{-6})	1×10^{-6}	0.00001	1×10^{-6} (one per million)

* For total haloacetic acids (the sum of dibromoacetic acid, dichloroaceticacid, monobromoaceticacid, monochloroacetic acid, and trichloroacetic acid). There are no MCLs for individual haloacetic acids.

[10] Basedon0.060 mg/L dibromoacetic acid; the risk will vary with different combinations and ratios of the other haloacetic acids in a particular sample.

[11] Basedon0.060 mg/L dichloroacetic acid; the risk will vary with different combinations and ratios of the other haloacetic acids in a particular sample.

[12] Basedon0.060 mg/L trichloroacetic acid; the risk will vary with different combinations and ratios of the other haloacetic acids in a particular sample.

Table 1: Health Risk Categories and Cancer Risk Values for Chemicals with California Public Health Goals (PHGs)

Chemical	Health Risk Category[1]	California PHG (mg/L)[2]	Cancer Risk[3] at the PHG	California MCL[4] (mg/L)	Cancer Risk at the California MCL
Heptachlor epoxide	carcinogenicity (causes cancer)	0.000006 (6×10^{-6})	1×10^{-6}	0.00001	2×10^{-6} (two per million)
Hexachloro-benzene	carcinogenicity (causes cancer)	0.00003	1×10^{-6}	0.001	3×10^{-5} (three per hundred thousand)
Hexachloro-cyclopentadiene (HCCPD)	digestive system toxicity (causes stomach lesions)	0.002	NA	0.05	NA
Lead	developmental neurotoxicity (causes neuro behavioral effects in children) cardiovascular toxicity (causes high blood pressure) carcinogenicity (causes cancer)	0.0002	$<1\times10^{-6}$ (PHG is not based on this effect)	0.015 (AL[9])	2×10^{-6} (two per million)
Lindane(γ-BHC)	carcinogenicity (causes cancer)	0.000032	1×10^{-6}	0.0002	6×10^{-6} (six per million)
Mercury (inorganic)	nephrotoxicity (harms the kidney)	0.0012	NA	0.002	NA
Methoxychlor	endocrine toxicity (causes hormone effects)	0.00009	NA	0.03	NA
Methyltertiary-butyl ether (MTBE)	carcinogenicity (causes cancer)	0.013	1×10^{-6}	0.013	1×10^{-6} (one per million)

Table 1: Health Risk Categories and Cancer Risk Values for Chemicals with California Public Health Goals (PHGs)

Chemical	Health Risk Category[1]	California PHG (mg/L)[2]	Cancer Risk[3] at the PHG	California MCL[4] (mg/L)	Cancer Risk at the California MCL
Molinate	carcinogenicity (causes cancer)	0.001	1×10^{-6}	0.02	2×10^{-5} (two per hundred thousand)
Monochloro-benzene (chlorobenzene)	nephrotoxicity (harms the kidney)	0.07	NA	0.07	NA
Nickel	developmental toxicity (causes increased neonatal deaths)	0.012	NA	0.1	NA
Nitrate	hematotoxicity causes methemoglobinemia)	45 as nitrate	NA	10 as nitrogen (=45 as nitrate)	NA
Nitrite	hematotoxicity (causes methemoglobinemia)	3 as nitrite	NA	1 as nitrogen (=3 as nitrite)	NA
Nitrate and Nitrite	hematotoxicity (causes methemoglobinemia)	10 as nitrogen[13]	NA	10 as nitrogen	NA
N-nitroso-dimethyl-amine (NDMA)	carcinogenicity (causes cancer)	0.000003 (3×10^{-6})	1×10^{-6}	none	NA
Oxamyl	general toxicity (causes body weight effects)	0.026	NA	0.05	NA

[13] The joint nitrate/nitrite PHG of 10 mg/L (10 ppm,expressed as nitrogen) does not replace the individual values, and the maximum contribution from nitrite should not exceed 1 mg/L nitrite-nitrogen.

Table 1: Health Risk Categories and Cancer Risk Values for Chemicals with California Public Health Goals (PHGs)

Chemical	Health Risk Category[1]	California PHG (mg/L)[2]	Cancer Risk[3] at the PHG	California MCL[4] (mg/L)	Cancer Risk at the California MCL
Pentachloro-phe-nol (PCP)	carcinogenicity (causes cancer)	0.0003	1×10^{-6}	0.001	3×10^{-6} (three per million)
Perchlorate	endocrine toxicity (affects the thyroid) developmental toxicity (causes neurodevelop-mental deficits)	0.001	NA	0.006	NA
Perfluorooctane-sulfonic acid (PFOS)	carcinogenicity (causes cancer)	1×10^{-6}	1×10^{-6}	NA	NA
Perfluoro-octanoi-cacid (PFOA)	carcinogenicity (causes cancer)	7×10^{-9}	1×10^{-6}	NA	NA
Picloram	hepatotoxicity (harms the liver)	0.166	NA	0.5	NA
Polychlorinatedbi-phenyls (PCBs)	carcinogenicity (causes cancer)	0.00009	1×10^{-6}	0.0005	6×10^{-6} (six per million)
Radium-226	carcinogenicity (causes cancer)	0.05pCi/L	1×10^{-6}	5 pCi/L (combined $Ra^{226+228}$)	1×10^{-4} (one per ten thousand)
Radium-228	carcinogenicity (causes cancer)	0.019 pCi/L	1×10^{-6}	5 pCi/L (combined $Ra^{226+228}$)	3×10^{-4} (three per ten thousand)
Selenium	integumentary toxicity (causes hair loss and nail damage)	0.03	NA	0.05	NA

Table 1: Health Risk Categories and Cancer Risk Values for Chemicals with California Public Health Goals (PHGs)

Chemical	Health Risk Category[1]	California PHG (mg/L)[2]	Cancer Risk[3] at the PHG	California MCL[4] (mg/L)	Cancer Risk at the California MCL
Silvex (2,4,5-TP)	hepatotoxicity (harms the liver)	0.003	NA	0.05	NA
Simazine	general toxicity (causes body weight effects)	0.004	NA	0.004	NA
Strontium-90	carcinogenicity (causes cancer)	0.35 pCi/L	1×10^{-6}	8pCi/L	2×10^{-5} (two per hundred thousand)
Styrene (vinylbenzene)	carcinogenicity (causes cancer)	0.0005	1×10^{-6}	0.1	2×10^{-4} (two per ten thousand)
1,1,2,2-Tetrachloro-ethane	carcinogenicity (causes cancer)	0.0001	1×10^{-6}	0.001	1×10^{-5} (one per hundred thousand)
2,3,7,8-Tetra-chlorodibenzo-*p*-dioxin (TCDD,or dioxin)	carcinogenicity (causes cancer)	5×10^{-11}	1×10^{-6}	3×10^{-8}	6×10^{-4} (six per ten thousand)
Tetrachloro-ethylene (perchloro-ethylene, or PCE)	carcinogenicity (causes cancer)	0.00006	1×10^{-6}	0.005	8×10^{-5} (eight per hundred thousand)
Thallium	integumentary toxicity (causes hair loss)	0.0001	NA	0.002	NA

Table 1: Health Risk Categories and Cancer Risk Values for Chemicals with California Public Health Goals (PHGs)

Chemical	Health Risk Category[1]	California PHG (mg/L)[2]	Cancer Risk[3] at the PHG	California MCL[4] (mg/L)	Cancer Risk at the California MCL
Thiobencarb	general toxicity (causes body weight effects) hematotoxicity (affects red blood cells)	0.042	NA	0.07	NA
Toluene (methylbenzene)	hepatotoxicity (harms the liver) endocrne toxicity (harms the thymus)	0.15	NA	0.15	NA
Toxaphene	carcinogenicity (causes cancer)	0.00003	1×10^{-6}	0.003	1×10^{-4} (one per ten thousand)
1,2,4-Trichloro-benzene	endocrine toxicity (harms adrenal glands)	0.005	NA	0.005	NA
1,1,1-Trichloro-ethane	neurotoxicity (harms the nervous system) reproductive toxicity (causes fewer offspring) hepatotoxicity (harms the liver) hematotoxicity (causes blood effects)	1	NA	0.2	NA
1,1,2-Trichloro-ethane	carcinogenicity causes cancer)	0.0003	$1\text{x}10^{-6}$	0.005	2×10^{-5} (two per hundred thousand)
Trichloro-ethylene (TCE)	carcinogenicity (causes cancer)	0.0017	1×10^{-6}	0.005	3×10^{-6} (three per million)

Table 1: Health Risk Categories and Cancer Risk Values for Chemicals with California Public Health Goals (PHGs)

Chemical	Health Risk Category[1]	California PHG (mg/L)[2]	Cancer Risk[3] at the PHG	California MCL[4] (mg/L)	Cancer Risk at the California MCL
Trichlorofluoro-methane (Freon 11)	accelerated mortality (increase in early death)	1.3	NA	0.15	NA
1,2,3-Trichloro-propane (1,2,3-TCP)	carcinogenicity (causes cancer)	0.0000007 (7×10^{-7})	$1\text{x}10^{-6}$	0.000005 (5×10^{-6})	7×10^{-6} (seven per million)
1,1,2-Trichloro-1,2,2-trifluoro-ethane (Freon113)	hepatotoxicity (harms the liver)	4	NA	1.2	NA
Trihalomethanes: Bromodichloro-methane	carcinogenicity (causes cancer)	0.00006	$1\text{x}10^{-6}$	0.080[#]	1.3×10^{-3} (1.3 per thousand)[14]
Trihalomethanes: Bromoform	carcinogenicity (causes cancer)	0.0005	$1\text{x}10^{-6}$	0.080[#]	2×10^{-4} (two per ten thousand)[15]
Trihalomethanes: Chloroform	carcinogenicity (causes cancer)	0.0004	$1\text{x}10^{-6}$	0.080[#]	2×10^{-4} (two per ten thousand)[16]

[#] For total trihalomethanes (the sum of bromodichloromethane, bromoform, chloroform, and dibromochloromethane). There are no MCLs for individual trihalomethanes.
[14] Based on 0.080 mg/L bromodichloromethane; the risk will vary with different combinations and ratios of the other trihalomethanes in a particular sample.
[15] Based on 0.080 mg/L bromoform; the risk will vary with different combinations and ratios of the other trihalomethanes in a particular sample.
[16] Based on 0.080 mg/L chloroform; the risk will vary with different combinations and ratios of the other trihalomethanes in a particular sample.

Table 1: Health Risk Categories and Cancer Risk Values for Chemicals with California Public Health Goals (PHGs)

Chemical	Health Risk Category[1]	California PHG (mg/L)[2]	Cancer Risk[3] at the PHG	California MCL[4] (mg/L)	Cancer Risk at the California MCL
Trihalomethanes: Dibromochloro-methane	carcinogenicity (causes cancer)	0.0001	$1x10^{-6}$	0.080[#]	8×10^{-4} (eight per ten thousand)[17]
Tritium	carcinogenicity (causes cancer)	400pCi/L	$1x10^{-6}$	20,000 pCi/L	5×10^{-5} (five per hundred thousand)
Uranium	carcinogenicity (causes cancer)	0.43pCi/L	1×10^{-6}	20pCi/L	5×10^{-5} (five per hundred thousand)
Vinylchloride	carcinogenicity (causes cancer)	0.00005	1×10^{-6}	0.0005	1×10^{-5} (one per hundred thousand)
Xylene	neurotoxicity (affects the senses, mood, and motor control)	1.8 (single isomer or sum of isomers)	NA	1.75 (single isomer or sum of isomers)	NA

[#] For total trihalomethanes (the sum of bromodichloromethane, bromoform, chloroform,and dibromochloro-methane). There are no MCLs for individual trihalomethanes.

[17] Based on 0.080 mg/L dibromochloromethane; the risk will vary with different combinations and ratios of the other trihalomethanes in a particular sample.

Table 2: Health Risk Categories and Cancer Risk Values for Chemicals without California Public Health Goals

Chemical	Health Risk Category[1]	US EPA MCLG[2] (mg/L)[2]	Cancer Risk[3] at the PHG	California MCL[4] (mg/L)	Cancer Risk at the California MCL
Disinfection by products (DBPs)					
Chloramines	acute toxicity (causes irritation) digestive system toxicity (harms the stomach) hematotoxicity (causes anemia)	4[5,6]	NA[7]	none	NA
Chlorine	acute toxicity (causes irritation) digestive system toxicity (harms the stomach)	4[5,6]	NA	none	NA
Chlorine dioxide	hematotoxicity (causes anemia) neurotoxicity (harms the nervous system)	0.8[5,6]	NA	none	NA
Radionuclides					

[1] Health risk category based on the US EPA MCLG document or California MCL document unless otherwise specified.
[2] MCLG = maximum contaminant level goal established by US EPA.
[3] Cancer Risk = Upper estimate of excess cancer risk from lifetime exposure. Actual cancer risk may be lower or zero. 1×10^{-6} means one excess cancer case per million people exposed.
[4] California MCL = maximum contaminant level established by California.
[5] Maximum Residual Disinfectant Level Goal, or MRDLG.
[6] The federal Maximum Residual Disinfectant Level (MRDL), or highest level of disinfectant allowed in drinking water, is the same value for this chemical.
[7] NA=not available.

Table 2: Health Risk Categories and Cancer Risk Values for Chemicals without California Public Health Goals

Chemical	Health Risk Category[1]	US EPA MCLG[2] (mg/L)[2]	Cancer Risk[3] at the PHG	California MCL[4] (mg/L)	Cancer Risk at the California MCL
Gross alpha particles[8]	carcinogenicity (causes cancer)	0 (^{210}Po included)	0	15 pCi/L[9] (includes radium but not radon and uranium)	up to $1x10^{-3}$ (for ^{210}Po, the most potent alpha emitter)
Beta particles and photon emitters[8]	carcinogenicity (causes cancer)	0 (^{210}Pb included)	0	50 pCi/L (judged equiv. to 4 mrem/yr)	upto$2x10^{-3}$ (for ^{210}Pb, the most potent beta-emitter)

[8] MCLs for gross alpha and beta particles are screening standards for a group of radionuclides. Corresponding PHGs were not developed for gross alpha and beta particles. See the OEHHA memoranda discussing the cancer risks at these MCLs at http://www.oehha.ca.gov/water/reports/grossab.html.
[9] pCi/L= picocuries per liter of water.

Appendix 3: Cost Estimates

Table 1 – Cost Estimates for Treatment Techologies (2012 ACWA PHG Survey)

No.	Treatment Technology	Source of Information	Estimated Cost 2012 Survey Indexed to 2024* ($/1,000 gallons treated)
1	Ion Exchange	Coachella Valley WD, for GW, to reduce Arsenic concentrations . 2011 costs .	2.68
2	Ion Exchange	City of Riverside Public Utilities, for GW, for Perchlorate treatment .	1.30
3	Ion Exchange	Carollo Engineers, anonymous utility, 2012 costs for treating GW source for Nitrates . Design souce waterconcentration: 88 mg/L NO_3 Design finished water concentration: 45 mg/L NO_3 . Does not include concentrate disposal or land cost .	0.98
4	Granular Activated Carbon	City of Riverside Public Utilities, GW sources, for TCE, DBCP (VOC, SOC) treatment.	0.65
5	Granular Activated Carbon	Carollo Engineers, anonymous utility, 2012 costs for treating SW source for TTHMs . Design souce water concentration: 0.135 mg/L. Design finished water concentration: 0.07 mg/L . Does not include concentrate disposal or land cost .	0.47
6	Granular Activated Carbon, Liquid Phase	LADWP, Liquid Phase GAC treatment at Tujunga Wellfield. Costs for treating 2 wells. Treament for 1,1 DCE (VOC). 2011-2012 costs .	1.99
7	Reverse Osmosis	Carollo Engineers, anonymous utility, 2012 costs for treating GW source for Nitrates . Design souce waterconcentration: 88 mg/L NO_3 Design finished water concentration: 45 mg/L NO_3 . Does not include concentrate disposal or land cost .	1.05
8	Packed Tower Aeration	City of Monrovia, treatment to reduce TCE, PCE concentrations . 2011-12 costs .	0.58
9	Ozonation+ Chemical addition	SCVWD, STWTP treatment plant includes chemical addition + ozone generation costs to reduce THM/HAAs concentrations. 2009-2012 costs.	0.12
10	Ozonation+ Chemical addition	SCVWD, PWTP treatment plant includes chemical addition + ozone generation costs to reduce THM/HAAs concentrations, 2009-2012 costs.	0.26
11	Coagulation/ Filtration	Soquel WD, treatment to reduce manganeseconcentrations in GW . 2011 costs .	0.98
12	Coagulation/ Filtration Optimization	San Diego WA, costs to reduce THM/Bromate, Turbidity concentrations, raw SW a blend of State Water Project water and Colorado River water, treated at Twin Oaks Valley WTP.	1.12
13	Blending (Well)	Rancho California WD, GW blending well, 1150 gpm, to reduce fluoride concentrations.	0.93
14	Blending (Wells)	Rancho California WD, GW blending wells, to reducearsenic concentrations, 2012 costs.	0.76
15	Blending	Rancho California WD, using MWD water to blend with GW to reduce arsenic concentrations . 2012 costs .	0.91
16	CorrosionInhibition	Atascadero Mutual WC, corrosion inhibitor addition to control aggressive water . 2011 costs .	0.11

* Costs were adjusted from date of original estimates to present using the Engineering News Record (ENR) 20-City average Construction Cost Index of 13,571 for 2024.

Table 2 – Cost Estimates for Treatment Techologies (Other Agencies)

No.	Treatment Technology	Source of Information	Estimated Cost 2012 Survey Indexed to 2024* ($/1,000 gallons treated)
1	Reduction – Coagulation – Filtration	February 28, 2013, Final Report Chromium Removal Research, City of Glendale,CA. 100-2000 gpm. Reduce Hexavalent Chromium to 1 ppb .	2.14 – 13.38
2	IX - Weak Base Anion Resin	February 28, 2013, Final Report Chromium Removal Research, City of Glendale,CA. 100-2000 gpm. Reduce Hexavalent Chromium to 1 ppb .	2.19 – 9.16
3	IX	Golden State Water Co., IX w/disposable resin, 1MGD, Perchlorate removal, built in 2010.	0.67
4	IX	Golden State Water Co., IX w/disposable resin, 1000 gpm, perchlorate removal (Proposed; O&M estimated).	1.47
5	IX	Golden State Water Co., IX with brine regeneration, 500 gpm for Selenium removal, builtin 2007.	9.59
6	GFO/Adsorption	Golden State Water Co., Granular Ferric Oxide Resin, Arsenic removal, 600 gpm, 2 facilities, builtin 2006.	2.51 – 2.67
7	RO	Inland Empire Utilities Agency : ChinoBasin Desalter. RO cost to reduce 800 ppm TDS, 150 ppm Nitrate (as NO_3); approx. 7 mgd.	3.28
8	IX	Inland Empire Utilities Agency : ChinoBasin Desalter. IX cost to reduce 150 ppm Nitrate (as NO_3); approx. 2.6 mgd.	1.82
9	Packed Tower Aeration	Inland Empire Utilities Agency : ChinoBasin Desalter . PTA-VOC air stripping, typical treated flow of approx. 1.6 mgd.	0.55
10	IX	West Valley WD Report, for WaterRecycling Funding Program, for 2.88 mgd treatment facility. IX to remove Perchlorate, Perchlorate levels 6-10 ppb. 2008 costs.	0.76 – 1.08
11	Coagulation Filtration	West Valley WD, includes capital, O&M costs for 2.88 mgd treatment facility – Layne Christensen packaged coagulation Arsenic removal system. 2009-2012 costs.	0.50
12	FBR	West Valley WD/Envirogen design data for the O&M + actual capitol costs, 2.88 mgdfluidized bed reactor (FBR) treatment system, Perchlorate and Nitrate removal, followed by multimedia filtration & chlorination, 2012. NOTE: The capitol cost for the treatment facility for the first 2,000 gpm is $23 million annualized over 20 years with ability to expand to 4,000 gpm with minimal costs in the future. $17 million funded through state and federal grants with the remainder funded by WVWD and the City of Rialto.	2.26 – 2.38

* Costs were adjusted from date of original estimates to present using the Engineering News Record (ENR) 20-City average Construction Cost Index of 13,571 for 2024.

Table 3 – Cost Estimates for Treatment Techologies (Updated 2012 ACWA Cost of Treatment)

No.	Treatment Technology	Source of Information	Estimated Cost 2012 Survey Indexed to 2024* ($/1,000 gallons treated)
1	Granular Activated Carbon	Malcolm Pirnie estimate for California Urban Water Agencies, large surface water treatment plants treating water from the State Water Project to meet Stage 2 D/DBP and bromate regulation, 1998	0.77 – 1.47
2	Granular Activated Carbon	Carollo Engineers, estimate for VOC treatment (PCE), 95% removal of PCE, Oct. 1994, 1900 gpm design capacity	0.36
3	Granular Activated Carbon	Carollo Engineers, est. for a large No. Calif. surf. water treatment plant (90 mgd capacity) treating water from the State Water Project, to reduce THM precursors, ENR construction cost index = 6262 (San Francisco area) – 1992	1.69
4	Granular Activated Carbon	CH2M Hill study on San Gabriel Basin, for135 mgd central treatment facility for VOC and SOC removal by GAC, 1990	0.66 – 0.96
5	Granular Activated Carbon	Southern California Water Co . – actual data for "rented" GAC to remove VOCs (1,1-DCE), 1.5 mgd capacity facility, 1998	3.03
6	Granular Activated Carbon	Southern California Water Co . – actual data for permanent GAC to remove VOCs (TCE), 2.16 mgd plant capacity, 1998	1.96
7	Reverse Osmosis	Malcolm Pirnie estimate for California Urban Water Agencies, large surface water treatment plants treating water from the State Water Project to meet Stage 2 D/DBP and bromate regulation, 1998	2.28 – 4.35
8	Reverse Osmosis	Boyle Engineering, RO cost to reduce 1000 ppm TDS in brackish groundwater in So. Calif., 1.0 mgd plant operated at 40% of design flow, high brine line cost, May 1991	5.37
9	Reverse Osmosis	Boyle Engineering, RO cost to reduce 1000 ppm TDS in brackish groundwater in So. Calif., 1.0 mgd plant operated at 100% of design flow, high brine line cost, May 1991	3.31
10	Reverse Osmosis	Boyle Engineering, RO cost to reduce 1000 ppm TDS in brackish groundwater in So. Calif., 10.0 mgd plant operated at 40% of design flow, high brine line cost, May 1991	3.58
11	Reverse Osmosis	Boyle Engineering, RO cost to reduce 1000 ppm TDS in brackish groundwater in So. Calif., 10.0 mgd plant operated at 100% of design flow, high brine line cost, May 1991	2.77
12	Reverse Osmosis	Arsenic Removal Study, City of Scottsdale, AZ – CH2M Hill, for a 1.0 mgd plant operated at 40% of design capacity, Oct. 1991	8.99
13	Reverse Osmosis	Arsenic Removal Study, City of Scottsdale, AZ – CH2M Hill, for a 1.0 mgd plant operated at 100% of design capacity, Oct. 1991	5.31
14	Reverse Osmosis	Arsenic Removal Study, City of Scottsdale, AZ – CH2M Hill, for a 10.0 mgd plant operated at 40% of design capacity, Oct. 1991	3.97

* Costs were adjusted from date of original estimates to present using the Engineering News Record (ENR) 20-City average Construction Cost Index of 13,571 for 2024.

Table 3 (Continued) – Cost Estimates for Treatment Techologies (Updated 2012 ACWA Cost of Treatment)

No.	Treatment Technology	Source of Information	Estimated Unit Cost 2012 ACWA Survey Indexed to 2024* ($/1,000 gallons treated)
15	Reverse Osmosis	Arsenic Removal Study, City of Scottsdale, AZ – CH2M Hill, for a 10.0 mgd plant operated at 100% of design capacity, Oct. 1991	2.46
16	Reverse Osmosis	CH2M Hill study on San Gabriel Basin, for135 mgd central treatment facility with RO to remove nitrate, 1990	2.48 – 4.35
17	Packed Tower Aeration	Analysis of Costs for Radon Removal . . . (AWWARF publication), Kennedy/Jenks, for a 1.4 mgd facility operating at 40% of design capacity, Oct. 1991	1.42
18	Packed Tower Aeration	Analysis of Costs for Radon Removal . . . (AWWARF publication), Kennedy/Jenks, for a 14.0 mgd facility operating at 40% of design capacity, Oct. 1991	0.76
19	Packed Tower Aeration	Carollo Engineers, estimate for VOC treatment (PCE) by packed tower aeration, without off-gas treatment, O&M costs based on operation during 329 days/year at 10% downtime, 16 hr/day air strippingoperation, 1900 gpm design capacity, Oct. 1994	0.38
20	Packed Tower Aeration	Carollo Engineers, for PCE treatment by Ecolo-Flo Enviro-Tower air stripping, without off-gas treatment, O&M costs based on operation during 329 days/year at 10% downtime, 16 hr/day air stripping operation, 1900 gpm design capacity, Oct. 1994	0.39
21	Packed Tower Aeration	CH2M Hill study on San Gabriel Basin, for135 mgd central treatment facility – packed tower aeration for VOC and radon removal, 1990	0.63 – 1.01
22	Advanced Oxidation Processes	Carollo Engineers, estimate for VOC treatment (PCE) by UV Light, Ozone, Hydrogen Peroxide, O&M costs based on operation during 329 days/year at 10% downtime, 24 hr/day AOP operation, 1900 gpm capacity, Oct. 1994	0.75
23	Ozonation	Malcolm Pirnie estimate for CUWA, large surface water treatment plants using ozone to treat water from the State Water Project to meet Stage 2 D/DBP and bromate regulation, *Cryptosporidium* inactivation requirements,1998	0.17 – 0.36
24	Ion Exchange	CH2M Hill study on San Gabriel Basin, for 135 mgd central treatment facility – ion exchange to remove nitrate, 1990	0.82 – 1.08

* Costs were adjusted from date of original estimates to present using the Engineering News Record (ENR) 20-City average Construction Cost Index of 13,571 for2024.