2019 PUBLIC HEALTH GOALS REPORT

Prepared For:

Sacramento County Department of Water Resources

Prepared By:

Sacramento County Water Agency

July 2019

Background:

The California Health and Safety Code section 116470(b) (see Attachment #1) specifies that large (> 10,000 service connections) public water systems must prepare a brief written report in plain language every three years if their water quality measurements have exceeded one or more of the Public Health Goals (PHGs). The PHG report must be prepared on or before July 1, 2019 and must document information on contaminants detected in drinking water that exceed the PHG.

If a constituent was detected in Sacramento County Water Agency's Laguna/ Vineyard/ CCE/ Grantline 99 water system, also known as South Service Area (SSA) & Central Service Area (CSA), between 2016 and 2018 at a level greater than the applicable PHG or the maximum Contaminant Level Goal (MCLG), this report provides the information required by 116470(b) HS. Disclosed is the health risk category (e.g., carcinogenicity or neurotoxicity) associated with exposure to each regulated contaminant and the numerical public health risk associated with both the maximum contaminant level (MCL) and the PHG for each contaminant identified. The report includes a cost estimate to install and maintain the best available treatment (BAT) technology to remove or reduce the concentration of the contaminant to a level at or below the public health goal, if it is appropriate and feasible.

PHGs are non-enforceable goals established by the California EPA's Office of Environmental Health Hazard Assessment (OEHHA). The law also requires that where OEHHA has not adopted a PHG for a constituent, the water suppliers are to use the MCLGs adopted by USEPA. Only constituents which have a California primary drinking water standard and for which either a PHG or MCLG has been set are to be addressed (see Attachment #2 – listed regulated constituents with the MCLs and PHGs or MCLGs).

The U.S. EPA and the California State Water Resources Control Board (SWRCB) Division of Drinking Water (DDW) establish MCLs at very conservative levels to provide protection to consumers against health risk. MCLs are USEPA's and SWRCB's definition of what is safe. The adopted MCLs are the criteria for water agencies to be in compliance, not the proposed MCLGs or PHGs.

In addition to this report, the Sacramento County Water Agency continues to report annually in great depth on the quality of water it serves and SCWA's adherence to regulatory compliance adopted by SWRCB and USEPA.

What are Public Health Goals (PHG) and Maximum Contaminant Level Goals (MCLG)?:

A PHG represents the level of a contaminant in drinking water that would pose no significant risk to public health if consumed for a lifetime. The adoption of the PHGs are based solely on public health risk considerations using current risk assessment principles and methods, not the practical risk-management factors considered and used when establishing enforceable drinking water standards (i.e., MCLs). These factors include analytical detection capability, treatment technology availability, and benefits and costs. In a process similar to the OEHHA determining the PHG, USEPA determines Maximum Contaminant Level Goals (MCLGs). MCLGs are often set at zero because the contaminants are carcinogenic and USEPA considers no amount of exposure to these contaminants to be without risk. MCLGs are the federal equivalent to PHGs. For the purposes of this report, if a constituent has no PHG, the public water system will use the MCLG. *PHGs and MCLGs are non-enforceable goals and are not required to be met by public water systems*.

What is Best Available Technology (BAT)?:

BATs are the best identified treatment processes to mitigate the contaminant levels to the MCL or to safe levels. California Health and Safety Code (116370) requires that at the time of the development of a Maximum Contaminant Level (MCL), treatment technologies are identified by DDW as being best available technology (BAT) for the specific constituent being regulated. These are to be included in the regulation with the MCL. The DDW shall include consideration of costs and benefits of the BAT. The treatment technology must also be "proven effective under full-scale field applications; however, BATs are not a treatment technique that is proven to work on every water source for the identified contaminant.

Cost Estimates:

BATs are shown to work on some sources if designed and operated properly. This is why very preliminary cost estimating for such technology is appropriate and necessary for the PHG report. Since the PHGs & MCLGs are set much lower than the MCL, it is not always possible or feasible to determine what treatment is needed to mitigate a contaminant further or to nearly zero. If a zero level can be achieved, it cannot be measured by the practically available analytical methods. In some cases, installing treatment to mitigate already very low levels of one contaminant may have a negative impact on other aspects of water quality.

What are Detection Limits for Purposes of Reporting (DLRs) and Reporting Limits (RL)?:

Detection Limits for Purposes of Reporting (DLR) is a level that is decided by the State for each regulated constituent or contaminant. The DLR is not laboratory specific and it is not dependent on the analytical method(s) used. It is not the lowest concentration of a constituent that can be detected by the laboratories, but it is the lowest concentration of the constituent that laboratories report for determining compliance. It is expected that a laboratory can achieve a reporting limit (RL) that is lower than or equal to the DLR set by the State. The RL is the lowest concentration at which an analyte can be detected in a sample and its concentration can be reported with a reasonable degree of accuracy and precision.

Water Quality Data Considered:

All of the water quality data collected by the Sacramento County Water Agency for the CSA/ SSA water system between 2016 and 2018 for purposes of determining compliance with drinking water standards was considered. The water quality monitoring data for both our surface water (Vineyard Surface Water Treatment Plant) and groundwater that serves water to the system was collected and reviewed.

Guidelines Followed:

The Association of California Water Agencies (ACWA) formed a workshop which prepared guidelines for water utilities to use in preparing PHG reports. The most recent guidelines "ACWA – Suggested Guidelines for Preparation of Required Reports on PHGs to satisfy requirements of California 116470(b) HS, April 2019"- were used to prepare this report along with "USEPA – Arsenic Treatment Technology Evaluation Handbook for Small Systems, July 2003" and "Technologies and Costs for Removal of Arsenic from Drinking Water (USEPA, 2000)."[1] The OEHHA publication (Health Risk Information for PHG Exceedance Reports, Feb 2019) was used (see Attachment #3). No guidance materials are available from the state regulatory agencies regarding preparation of PHG reports.

Constituents Detected That Exceed a PHG (or MCLG):

Table 1 identifies the constituents that were detected by the Sacramento County Water Agency above a PHG or an MCLG during 2016- 2018. Over the last three years, Sacramento County Water Agency's drinking water has met all MCLs and safe drinking water standards adopted by the USEPA and DDW; however, three contaminants (arsenic, nickel and uranium) exceeded PHGs, and two (gross alpha particle activity and total coliform) exceeded MCLGs. Therefore, these five contaminants are addressed in this report. The following sections present SCWA's water sample results relating to PHG, associated risks, identified BATs and preliminary cost estimates, and actions in place or to be implemented by SCWA to address the contaminants.

Table 1
Constituents Detected Above PHG or MCLG
(2016-2019)

Constituent	PHG (MCLG)	MCL
Arsenic	0.004 µg/L	10 µg/L
Nickel	12 µg/L	100 µg/L
Uranium	0.43 pCi/L	20 pCi/L
Gross alpha	(0)	15 pCi/L
Coliform Bacteria (include *E. coli*)	(0)	5.0%

µg/L = micrograms per liter (equivalent to parts per billion, ppb)
pCi/L = picoCuries per liter (one trillionth of a curie)

[1] ACWA guidelines were used in conjunction with USEPA's Evaluation Handbook. Cost Estimates for Treatment Technologies from the ACWA guide were then matched/ corroborated with Planning-Level Treatment Costs section of "Technologies and Costs for Removal of Arsenic from Drinking Water (USEPA, 2000)."

Inorganic Chemicals:

Arsenic: Although the inorganic form of arsenic tends to be more predominant than organic forms, contamination of a drinking water source by arsenic can result from either natural or human activities. Typically, arsenic occurrence in water is caused by the weathering and dissolution of arsenic bearing rocks, minerals and ores. Arsenic contamination in water is also caused by its use in industry for wood preservatives, paints, drugs, dyes, soaps, metals and semi-conductors. Agricultural applications, mining and smelting also contribute to arsenic release.

The Public Health Goal for arsenic is 0.004 µg/L (or 4 ng/L, which is 4 parts per trillion). The federal and state MCL for arsenic is 10 µg/L (the federal MCLG is 0 µg/L). The DLR for arsenic is 2 µg/L and currently, there are no laboratory analytical methods available that can reliably measure arsenic as low as the PHG. The health risk category associated with arsenic is carcinogenicity. At the PHG, the theoretical cancer risk is 1×10^{-6}. This means one excess cancer case per million people exposed to the PHG level for a lifetime of 70 years. At the federal and state MCL of 10 µg/L, the theoretical cancer risk is 2.5×10^{-3}. This means 2.5 excess cancer cases per one thousand people exposed to the MCL for a lifetime of 70 years.

USEPA published a final rule in the Federal Register in January 2001 (USEPA 2001) which established a revised arsenic MCL from 50 µg/L to 10 µg/L. This rule identified the following as Best Available Technologies (BATs) for achieving compliance with this regulatory level:

- Ion Exchange (IX)
- Activated Alumina (AA)
- Oxidation/ Filtration
- Reverse Osmosis (RO)
- Electrodialysis Reversal
- Enhanced Coagulation/ Filtration
- Enhanced Lime Softening

The cost estimate will be based on using ion exchange (IX) at three of the well sites (Wells 62, 63 & 110 will be called "**3 Wells**") and Activated Alumina (AA) at the remaining seven (Wells 41, 42, 43, 47, 52, 74 & 65 will be called "**7 Wells**"). The water quality parameters which exist in the 3 Wells closely match parameters suggested for IX treatment to be most effective. The 7 Wells have nitrate levels, although below the MCL and PHG, which hinder the efficiency of the IX process.[2]

Activated Alumina is a porous, granular material with ion exchange properties and demonstrates greater than 98% arsenic removal when the pH range is 5.5 – 6.0 for influent raw

[2] USEPA – Arsenic Treatment Technology Evaluation Handbook for Small Systems, July 2003, Page 24.

water. Pre-oxidation (i.e., pH adjusted to 6.0) using hydrochloric acid or sulfuric acid would be necessary with the **7 Wells** which have a higher natural pH range (7.9 – 8.15 pH). AA treatment under natural pH conditions is an option, but the media does not last as long and is not as efficient (arsenic removal rates are lower). For the purposes of this report, we prepared the cost estimate which includes a pre- and post-treatment pH adjustment scenario using sulfuric acid which achieves the most efficient use of media.

Enhanced lime softening conversely requires a much higher pH range (10.5 – 11 pH) to be effective. Also, lime softening solely for arsenic removal is considered uneconomical and cost-prohibitive.[3] Oxidation Filtration is most effective if the source water being treated has a high iron concentration (>300 µg/L). The wells in question show the most recent range for iron concentration to be ND - 80 µg/L, with an average of Non-Detected. Reverse osmosis was not selected for this report due to the high amount of water lost as concentrated brine solution and waste (20 – 40% of feed water).[4] Coagulation/ filtration was not examined for this report as it requires more labor to operate and maintain as well as more land space than what is available at these individual well sites.

Arsenic was detected above the PHG (0.004 µg/L), but below the MCL (10 µg/L), in ten (10) of the thirty-two (32) groundwater wells serving the CSA/ SSA water system. Nine of those ten wells feed directly into the distribution system and receive no treatment other than disinfection and fluoridation. The remaining well (W-110) blends with two other groundwater wells and feeds the Poppy Ridge water treatment plant, which treats for iron and manganese. The average of all groundwater source monitoring for arsenic conducted from January 1, 2016 to December 31, 2018 in the CSA/ SSA water system was Non-Detect (ND). The weighted average of all arsenic monitoring in our groundwater and surface water sources in the CSA/ SSA water system was ND. Table 2 details the 10 wells that exceeded the arsenic PHG during 2016 – 2018. The water quality analysis in Table 2 indicates arsenic levels average of 3.58 µg/L, with a range of 2.2 µg/L to 6.2 µg/L.

The total estimated capital cost to provide activated alumina treatment at the seven wells and ion exchange treatment at the three additional wells at their respective design flow rate during 2016 – 2018 is approximately $36,000,000. The total annual O&M costs would be approximately $4,210,000/year. Capital and O&M costs were estimated with the goal of achieving the arsenic 0.004 µg/L PHG; however, there is no information available to indicate that activated alumina or ion exchange treatment would reduce arsenic concentrations to such a low level. It is worth noting, the DLR determined by the State Water Resources Control Board is 2 µg/L and there is no analytical method available to precisely measure arsenic in drinking water to 0.004 µg/L.

[3] Ibid., Page 32.
[4] Ibid., p. 30

Table 2
Well Monitoring Where Arsenic Detected Above PHG or MCLG
(2016-2019)

Well Number	Arsenic Concentration (µg/L)	Design Flow (gpm)	Treatment	Capital ($M)	Annual O&M ($M/Year)
W41	4.4	676	AA	2.91	0.43
W42	6.2	760	AA	3.24	0.48
W43	3.5	1000	AA	4.20	0.63
W47	3.4	1030	AA	4.30	0.64
W52	3.1	1192	AA	4.93	0.74
W74	2.6	600	AA	2.61	0.39
W62	2.2	1100	IX	2.60	0.13
W63	3.3	1119	IX	3.70	0.18
W65	4.9	560	AA	2.45	0.36
W110	2.2	1535	IX	5.10	0.23
Average:	3.58		Total:	36.0	4.21

gpm = gallons per minute
$M = dollars in millions
O&M = operation and maintenance
AA = Activated Alumina
IX = ion exchange

Nickel: The PHG for nickel is 0.012 mg/L. The state MCL for nickel is 0.1 mg/L. The DLR for nickel is 0.01 mg/L. The health risk category associated with nickel is developmental toxicity (causes increased neonatal deaths). Cancer risk cannot be calculated and the PHG is set at a level that is believed to be without significant public health risk to individuals exposed to the chemical over a lifetime.

One sample exceeded the nickel PHG during 2016 – 2018 at W55 (Lakeside Well). In May 2017, a sample taken for nickel at W55 for reporting purposes to the state returned at a level of 0.014 mg/L, below the MCL of 0.1 mg/L. The sample taken for nickel at W55 in 2014 returned Non-Detect. W55 is one of three wells which feed SCWA's Lakeside Water Treatment Plant (WF02). WF02 has been off-line and not connected to the distribution system since 2014. No water from W55 entered the distribution system during 2016 – 2018. The average of all groundwater source monitoring for nickel conducted from January 1, 2016 to December 31, 2018 in the CSA/SSA water system was Non-Detect (ND).

Radionuclides:

During 2016 to 2018, two naturally occurring radionuclides (uranium and gross alpha) were detected in four wells (W56, W75, W76 & W129). Three of the wells (W56, W75 & W76) feed the Lakeside Water Treatment Plant (WF02), which has been off-line since 2014. These feeder wells were tested only for purposes of reporting to the DDW. The fourth well (W129) is one of two wells to feed the Big Horn Water Treatment Plan (WT07). The following sections present an evaluation of the health risks and treatment costs for reducing the levels of these two constituents in W129.

Uranium: Uranium is a naturally occurring radionuclide. The PHG for uranium is 0.43 pCi/L (picoCuries per liter) and the DLR is 1 pCi/L. The MCL for uranium is 20 pCi/L. The health risk category associated with uranium is carcinogenicity. At the PHG, the theoretical cancer risk is 1 $x10^{-6}$. This means one excess cancer case per million people exposed to the PHG level for a lifetime of 70 years. At the state MCL of 20 pCi/L, the theoretical cancer risk is 5×10^{-5}. This means 5 excess cancer cases per one hundred-thousand (100,000) people exposed to the MCL for a lifetime of 70 years.

The State Water Resources Control Board DDW has identified the following treatment technologies as Best Available Technology for reducing uranium levels in drinking water:

- Ion Exchange (IX)
- Reverse Osmosis (RO)
- Lime softening
- Coagulation/ Filtration

From the above list treatment technology, the cost evaluation will be conducted using reverse osmosis, given that reverse osmosis is also the best available technology for gross alpha levels in drinking water (also detected in W129).

During 2016-2018, W129 had a uranium measurement above the PHG. The uranium result was 2.7 pCi/L (below the MCL of 20 pCi/L). The total estimated capital cost for reverse osmosis treatment at W129 would be $6,386,040 (the cost estimate includes the capital costs and annual O&M costs).[5] RO treatment produces a concentrated waste product that Sacramento County Water Agency would need to dispose. The estimated costs do not include the costs of disposal, nor the costs to replace the lost water.

[5] Based on ACWA's Estimates for Treatment Technologies document, the estimated total annualized cost for RO treatment for plants of similar size to Well 129 was $2.70 per 1,000 gallons of water treated.

Gross Alpha: Gross Alpha Particle Activity refers to a group of alpha-emitting radionuclides rather than one specific contaminant. OEHHA has not established a PHG for gross alpha activity because gross alpha does not represent a specific constituent and its results are used as a screening tool for naturally occurring radionuclides. The federal MCLG for gross alpha is 0 pCi/L due to the classification of gross alpha radioactivity as carcinogenic. The cancer health risk at 0 pCi/L is zero. The MCL for gross alpha activity is 15 pCi/L. Gross alpha measurements can indicate the presence of a number of alpha emitting radionuclides, such as uranium and radium. OEHHA indicates that depending upon which isotopes are present, the numerical cancer health risk at the MCL of 15 pCi/L could be 1 x 10^{-3}. This means one excess case of cancer per 1,000 people exposed for a lifetime of 70 years.

The DDW has identified reverse osmosis (RO) as the Best Available Technology for reducing gross alpha levels in drinking water. The cost evaluation was conducted using reverse osmosis given that no other technology has been identified as best available technology. During 2016 – 2018, Well 129 had a gross alpha measurement above the MCLG. The gross alpha result was 3.0 /Ci/L (below the MCL of 15 pCi/L). The total estimated capital cost for reverse osmosis treatment at W129 is given above in the estimate for uranium treatment.

<u>Coliform Bacteria</u>

The total coliform MCL specifies that no more than 5% of all coliform samples collected from the distribution system in any given month can be positive. There is no PHG set for coliforms but USEPA set an MCLG of zero. Coliform bacteria are an indicator organism that are naturally present everywhere and are not generally considered harmful. They are used because of the ease in monitoring and analysis. If a positive sample is found, follow up sampling is required. It is difficult, if not impossible, to assure that a system will never get a positive sample. As required during 2016-2018, the Sacramento County Water Agency collects approximately 131 samples each month throughout the CSA/ SSA distribution system for coliform analysis (approximately 1,575 samples are collected each year).

Because coliform bacteria are only a surrogate indicator of the potential presence of pathogens, it is not possible to state a specific numerical health risk. Table 3 presents the monthly results from 2016-2018 when at least one monthly sample was positive for total coliforms:

Table 3
Months with One or More Total Coliform Positive Sample(s)
(2016-2018)

2016		2017		2018	
Month	**% Positive**	**Month**	**% Positive**	**Month**	**% Positive**
March	0.65%	February	0.81%	January	1.28%
June	0.65%	March	0.81%	April	0.81%
July	0.81%	July	0.81%	July	1.28%
December	0.81%			September	1.59%
				October	1.59%
				November	0.81%

Table 4 presents the total number of samples collected, the total number of positive coliform samples detected, and the percent of the total number of samples that were positive for each year during 2016 – 2018.

Table 4
Positive Coliform Samples
(2016 – 2018)

Year	Total Number of Samples Collected	Number of Positive Samples/ Year	Percent Positive/ Year
2016	1572	4	0.25%
2017	1569	3	0.19%
2018	1587	9	0.57%

Title 22 lists the following Best Available Technology for microbiological contaminants (Section 64447, CCR):

- Protection of wells from coliform contamination by appropriate placement and construction,
- Maintenance of a disinfectant residual throughout the distribution system,
- Proper maintenance of the distribution system, and
- Filtration and disinfection of approved surface water or disinfection of groundwater.

The Sacramento County Water Agency implements the above Best Available Technology for total coliforms. SCWA's surface water source is filtered and disinfected and all wells are disinfected at the source before entering the distribution system. SCWA staff and contracted Regional Sanitation Laboratory staff collect samples on a weekly basis to check for the presence of coliforms and to measure the level of disinfectant in the distribution system. SCWA maintains positive pressure throughout the distribution system to minimize the chance of intrusion of constituents into the drinking water pipes. SCWA maintains an effected cross-connection control program to prevent water used for industrial or irrigation purposes from flowing back into the distribution system. All groundwater wells are properly constructed and operated and are inspected annually by the State Water Resources Control Board Division of Drinking Water.

<u>Summary of Total Costs and Potential Impact on Customer Bills</u>

As required, treatment costs were estimated for regulated constituents that were detected above the PHG but below the MCL. For arsenic, ion exchange (IX) and activated alumina (AA) costs were evaluated based on the existing water quality parameters of the individual wells. For uranium and gross alpha particle activity, reverse osmosis (RO) costs were evaluated for both constituents given RO is one of the Best Available Treatment for both constituents and the only for gross alpha. Table 5 presents the annualized total cost for each well. This is the sum of the annualized capital cost plus the annual O&M costs (when O&M costs are available). For 2016 through 2018, the total capital costs to install AA, IX and RO Best Available Treatment would be approximately $42,300,000 and the annual O&M cost would be $4,200,000. The total annualized capital cost plus the annual O&M costs would be approximately $5,350,000.

The estimated increase in each Sacramento County Water Agency customer water bill would be $107 per year. This estimate is established by dividing the total annualized capital cost plus the annual O&M cost and dividing it equally among all water connections. It does not take into account that customers with larger connections or customers located in a business district will pay a higher rate than customers using smaller connections in a residential area.

Table 5
Summary of Capital and O&M Costs

Well #	Constituents Detected	Treatment	Capital Cost ($M)	Annual O&M ($M/Year)	Annualized Total Cost ($M/Year)[6]
W41	Arsenic	AA	2.9	0.43	0.51
W42	Arsenic	AA	3.2	0.48	0.57
W43	Arsenic	AA	4.2	0.63	0.74
W47	Arsenic	AA	4.3	0.64	0.76
W52	Arsenic	AA	4.9	0.74	0.87
W74	Arsenic	AA	2.6	0.38	0.45
W62	Arsenic	IX	2.6	0.13	0.20
W63	Arsenic	IX	3.7	0.18	0.28
W65	Arsenic	AA	2.4	0.36	0.43
W110	Arsenic	IX	5.1	0.23	0.37
W129	Uranium, Gross alpha	RO	6.4		0.17
		Total:	42.3	4.20	5.35

Recommendations

According to OEHHA literature, a PHG is not a boundary line between a "safe" and "dangerous" level of a contaminant.[7] Drinking water is considered acceptable for public consumption even if it contains contaminants at levels exceeding the PHG, provided the MCLs are met. The drinking water quality of the Sacramento County Water Agency CSA/ SSA meets all State of California and USEPA drinking water standards set to protect public health. To further reduce the levels of the constituents identified in this report that are already below the health-based MCLs established to provide "safe drinking water," would require additional costly treatment processes and would significantly increase the annual customer water bills. Since the SCWA is already practicing the BATs for total coliform, no additional treatments are required to meet the MCLG. In fact, the goal of zero percent of samples containing total coliform cannot be practically met every single month. The health protection benefits of these potential reductions are unclear and may not be quantifiable. SCWA will continue existing initiatives and monitoring the contaminants discussed in this report in a proactive manner to ensure that the MCLs are continuously met.

[6] Annualized total cost is the sum of the annual O&M cost and the amortized capital annual cost. The amortized capital annual cost was calculated assuming a 20-year amortization period and an interest rate of 5%.
[7] "Guide to Public Health Goal (PHGs) for Chemicals in Drinking Water," OEHHA, 2015.

ATTACHMENTS

1. Excerpt from California Health & Safety Code: Section 116470 (b)
2. Table of California Regulated Constituents with MCLs and PHGs
3. Health Risk Information for Public Health Goal Exceedance Reports. Prepared by the Office of Environmental Health Hazard Assessment. February 2019

ATTACHMENT 1

Excerpt from California Health & Safety Code
Section 116470 (b)

116470 (b) On or before July 1, 1998, and every three years thereafter, public water systems serving more than 10,000 service connections that detect one or more contaminants in drinking water that exceed the applicable public health goal, shall prepare a brief written report in plain language that does all of the following:

(1) Identifies each contaminant detected in drinking water that exceeds the applicable public health goal.

(2) Discloses the numerical public health risk, determined by the office, associated with the maximum contaminant level for each contaminant identified in paragraph (1) and the numerical public health risk determined by the office associated with the public health goal for that contaminant.

(3) Identifies the category of risk to public health, including, but not limited to, carcinogenic, mutagenic, teratogenic, and acute toxicity, associated with exposure to the contaminant in drinking water, and includes a brief plainly worded description of these terms.

(4) Describes the best available technology, if any is then available on a commercial basis, to remove the contaminant or reduce the concentration of the contaminant. The public water system may, solely at its own discretion, briefly describe actions that have been taken on its own, or by other entities, to prevent the introduction of the contaminant into drinking water supplies.

(5) Estimates the aggregate cost and the cost per customer of utilizing the technology described in paragraph (4), if any, to reduce the concentration of that contaminant in drinking water to a level at or below the public health goal.

(6) Briefly describes what action, if any, the local water purveyor intends to take to reduce the concentration of the contaminant in public drinking water supplies and the basis for that decision.

(c) Public water systems required to prepare a report pursuant to subdivision (b) shall hold a public hearing for the purpose of accepting and responding to public comment on the report. Public water systems may hold the public hearing as part of any regularly scheduled meeting.

(d) The department shall not require a public water system to take any action to reduce or eliminate any exceedance of a public health goal.

(e) Enforcement of this section does not require the department to amend a public water system's operating permit.

(f) Pending adoption of a public health goal by the Office of Environmental Health Hazard Assessment pursuant to subdivision (c) of Section 116365, and in lieu thereof, public water systems shall use the national maximum contaminant level goal adopted by the United States Environmental Protection Agency for the corresponding contaminant for purposes of complying with the notice and hearing requirements of this section.

ATTACHMENT 2

TABLE OF CALIFORNIA REGULATED CONSTITUENTS WITH MCLs AND PHGs

MCLs, DLRs, and PHGs for Regulated Drinking Water Contaminants

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

Last Update: September 23, 2015

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)

Also, PHGs for NDMA and 1,2,3-Trichloropropane (which are not yet regulated) are included at the bottom of this table.

	MCL	DLR	PHG	Date of PHG
Chemicals with MCLs in 22 CCR §64431—Inorganic Chemicals				
Aluminum	1	0.05	0.6	2001
Antimony	0.006	0.006	0.02	1997
Antimony	--	--	0.0007	2009 draft
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 - OEHHA withdrew the 0.0025-mg/L PHG	0.05	0.01	withdrawn Nov. 2001	1999
Chromium, Hexavalent	0.010	0.001	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)	1997
Nitrite (as N)	1 as N	0.4	1 as N	1997
Nitrate + Nitrite (as N)	10 as N	--	10 as N	1997
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)
Copper and Lead, 22 CCR §64672.3				
Values referred to as MCLs for lead and copper are not actually MCLs; instead, they are called "Action Levels" under the lead and copper rule				
Copper	1.3	0.05	0.3	2008
Lead	0.015	0.005	0.0002	2009

Radionuclides with MCLs in 22 CCR §64441 and §64443—Radioactivity				
[units are picocuries per liter (pCi/L), unless otherwise stated; n/a = not applicable]				
Gross alpha particle activity - OEHHA concluded in 2003 that a PHG was not practical	15	3	none	n/a
Gross beta particle activity - OEHHA concluded in 2003 that a PHG was not practical	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)				
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	0.1	2006
trans-1,2-Dichloroethylene	0.01	0.0005	0.06	2006
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)				
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	0.0017	2000
Carbofuran	--	--	0.0007	2015 draft
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	0.0000017	1999
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	0.015	2000
Diquat	--	--	0.006	2015 draft
Endrin	0.002	0.0001	0.0018	1999 (rev2008)
Endrin	--	--	0.0003	2015 draft
Endothal	0.1	0.045	0.094	2014
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	0.5	1997
Picloram	--	--	0.166	2015 draft
Polychlorinated biphenyls (PCBs)	0.0005	0.0005	0.00009	2007
Simazine	0.004	0.001	0.004	2001
2,4,5-TP (Silvex)	0.05	0.001	0.003	2014
2,3,7,8-TCDD (dioxin)	$3x10^{-8}$	$5x10^{-9}$	$5x10^{-11}$	2010
Thiobencarb	0.07	0.001	0.07	2000
Thiobencarb	--	--	0.042	2015 draft
Toxaphene	0.003	0.001	0.00003	2003

Chemicals with MCLs in 22 CCR §64533—Disinfection Byproducts				
Total Trihalomethanes	0.080	--	0.0008	2010 draft
Bromodichloromethane	--	0.0010	--	--
Bromoform	--	0.0010	--	--
Chloroform	--	0.0010	--	--
Dibromochloromethane	--	0.0010	--	--
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
Chemicals with PHGs established in response to DDW requests. These are not currently regulated drinking water contaminants.				
N-Nitrosodimethylamine (NDMA)	--	--	0.000003	2006
1,2,3-Trichloropropane	--	--	0.0000007	2009
*OEHHA's review of this chemical during the year indicated (rev20XX) resulted in no change in the PHG.				
**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.				

OFFICE OF ENVIRONMENTAL HEALTH HAZARD ASSESSMENT

Public Health Goals

Health Risk Information for Public Health Goal Exceedance Reports

February 2019

Pesticide and Environmental Toxicology Branch
Office of Environmental Health Hazard Assessment
California Environmental Protection Agency

Health Risk Information for Public Health Goal Exceedance Reports

Prepared by

Office of Environmental Health Hazard Assessment
California Environmental Protection Agency

February 2019

Under the Calderon-Sher Safe Drinking Water Act of 1996 (the Act), public water systems with more than 10,000 service connections are required to prepare a report every three years for contaminants that exceed their respective Public Health Goals (PHGs).[1] This document contains health risk information on regulated drinking water contaminants to assist public water systems in preparing these reports. A PHG is the concentration of a contaminant in drinking water that poses no significant health risk if consumed for a lifetime. PHGs are developed and published by the Office of Environmental Health Hazard Assessment (OEHHA) using current risk assessment principles, practices and methods.[2]

The water system's report is required to identify the health risk category (e.g., carcinogenicity or neurotoxicity) associated with exposure to each regulated contaminant in drinking water and to include a brief, plainly worded description of these risks. The report is also required to disclose the numerical public health risk, if available, associated with the California Maximum Contaminant Level (MCL) and with the PHG for each contaminant. This health risk information document is prepared by OEHHA every three years to assist the water systems in providing the required information in their reports.

Numerical health risks: Table 1 presents health risk categories and cancer risk values for chemical contaminants in drinking water that have PHGs.

The Act requires that OEHHA publish PHGs based on health risk assessments using the most current scientific methods. As defined in statute, PHGs for non-carcinogenic

[1] Health and Safety Code Section 116470(b)
[2] Health and Safety Code Section 116365

chemicals in drinking water are set at a concentration "at which no known or anticipated adverse health effects will occur, with an adequate margin of safety." For carcinogens, PHGs are set at a concentration that "does not pose any significant risk to health." PHGs provide one basis for revising MCLs, along with cost and technological feasibility. OEHHA has been publishing PHGs since 1997 and the entire list published to date is shown in Table 1.

Table 2 presents health risk information for contaminants that do not have PHGs but have state or federal regulatory standards. The Act requires that, for chemical contaminants with California MCLs that do not yet have PHGs, water utilities use the federal Maximum Contaminant Level Goal (MCLG) for the purpose of complying with the requirement of public notification. MCLGs, like PHGs, are strictly health based and include a margin of safety. One difference, however, is that the MCLGs for carcinogens are set at zero because the US Environmental Protection Agency (US EPA) assumes there is no absolutely safe level of exposure to such chemicals. PHGs, on the other hand, are set at a level considered to pose no *significant* risk of cancer; this is usually no more than a one-in-one-million excess cancer risk (1×10^{-6}) level for a lifetime of exposure. In Table 2, the cancer risks shown are based on the US EPA's evaluations.

For more information on health risks: The adverse health effects for each chemical with a PHG are summarized in a PHG technical support document. These documents are available on the OEHHA website (http://www.oehha.ca.gov). Also, technical fact sheets on most of the chemicals having federal MCLs can be found at http://www.epa.gov/your-drinking-water/table-regulated-drinking-water-contaminants.

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	digestive system toxicity (causes vomiting)	0.02	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)	7 MFL[7] (fibers >10 microns in length)	1×10^{-6}	7 MFL (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)

[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: http://oehha.ca.gov/multimedia/green/pdf/GC_Regtext011912.pdf).
[2] mg/L = milligrams per liter of water or 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
Barium	cardiovascular toxicity (causes high blood pressure)	2	NA	1	NA
Bentazon	hepatotoxicity and digestive system toxicity (harms the liver, intestine, and causes body weight effects[8])	0.2	NA	0.018	NA
Benzene	carcinogenicity (causes leukemia)	0.00015	1×10^{-6}	0.001	7×10^{-6} (seven per million)
Benzo[a]pyrene	carcinogenicity (causes cancer)	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

[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
Carbon tetrachloride	carcinogenicity (causes cancer)	0.0001	1×10^{-6}	0.0005	5×10^{-6} (five per million)
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}	none	NA
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
Diethylhexyl-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).

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
1,2-Dibromo-3-chloropropane (DBCP)	carcinogenicity (causes cancer)	0.0000017 ($1.7x10^{-6}$)	$1{\times}10^{-6}$	0.0002	$1{\times}10^{-4}$ (one per ten 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	$1{\times}10^{-6}$	0.005	$8{\times}10^{-7}$ (eight per ten million)
1,1-Dichloro-ethane (1,1-DCA)	carcinogenicity (causes cancer)	0.003	$1{\times}10^{-6}$	0.005	$2{\times}10^{-6}$ (two per million)
1,2-Dichloro-ethane (1,2-DCA)	carcinogenicity (causes cancer)	0.0004	$1{\times}10^{-6}$	0.0005	$1{\times}10^{-6}$ (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	$1{\times}10^{-6}$	0.005	$1{\times}10^{-6}$ (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
Heptachlor	carcinogenicity (causes cancer)	0.000008 (8×10^{-6})	1×10^{-6}	0.00001	1×10^{-6} (one per million)
Heptachlor epoxide	carcinogenicity (causes cancer)	0.000006 (6×10^{-6})	1×10^{-6}	0.00001	2×10^{-6} (two per million)
Hexachloroben-zene	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 neurobehavioral effects in children) cardiovascular toxicity (causes high blood pressure) carcinogenicity (causes cancer)	0.0002	$<1 \times 10^{-6}$ (PHG is not based on this effect)	0.015 (AL[8])	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

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
Methoxychlor	endocrine toxicity (causes hormone effects)	0.00009	NA	0.03	NA
Methyl tertiary-butyl ether (MTBE)	carcinogenicity (causes cancer)	0.013	1×10^{-6}	0.013	1×10^{-6} (one per million)
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[10]	NA	10 as nitrogen	NA

[10] 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
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
Pentachloro-phenol (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
Picloram	hepatotoxicity (harms the liver)	0.166	NA	0.5	NA
Polychlorinated biphenyls (PCBs)	carcinogenicity (causes cancer)	0.00009	1×10^{-6}	0.0005	6×10^{-6} (six per million)
Radium-226	carcinogenicity (causes cancer)	0.05 pCi/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}	8 pCi/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) endocrine 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 (Freon 113)	hepatotoxicity (harms the liver)	4	NA	1.2	NA
Tritium	carcinogenicity (causes cancer)	400 pCi/L	$1\text{x}10^{-6}$	20,000 pCi/L	$5\text{x}10^{-5}$ (five per hundred thousand)
Uranium	carcinogenicity (causes cancer)	0.43 pCi/L	1×10^{-6}	20 pCi/L	5×10^{-5} (five per hundred thousand)
Vinyl chloride	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

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)	Cancer Risk[3] @ MCLG	California MCL[4] (mg/L)	Cancer Risk @ California MCL
Disinfection byproducts (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
Disinfection byproducts: haloacetic acids (HAA5)					
Monochloroacetic acid (MCA)	general toxicity (causes body and organ weight changes[8])	0.07	NA	none	NA
Dichloroacetic acid (DCA)	carcinogenicity (causes cancer)	0	0	none	NA

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

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)	Cancer Risk[3] @ MCLG	California MCL[4] (mg/L)	Cancer Risk @ California MCL
Trichloroacetic acid (TCA)	hepatotoxicity (harms the liver)	0.02	NA	none	NA
Monobromoacetic acid (MBA)	NA	none	NA	none	NA
Dibromoacetic acid (DBA)	NA	none	NA	none	NA
Total haloacetic acids (sum of MCA, DCA, TCA, MBA, and DBA)	general toxicity, hepatotoxicity and carcinogenicity (causes body and organ weight changes, harms the liver and causes cancer)	none	NA	0.06	NA
Disinfection byproducts: trihalomethanes (THMs)					
Bromodichloro-methane (BDCM)	carcinogenicity (causes cancer)	0	0	none	NA
Bromoform	carcinogenicity (causes cancer)	0	0	none	NA
Chloroform	hepatotoxicity and nephrotoxicity (harms the liver and kidney)	0.07	NA	none	NA
Dibromo-chloromethane (DBCM)	hepatotoxicity, nephrotoxicity, and neurotoxicity (harms the liver, kidney, and nervous system)	0.06	NA	none	NA

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)	Cancer Risk[3] @ MCLG	California MCL[4] (mg/L)	Cancer Risk @ California MCL
Total trihalomethanes (sum of BDCM, bromoform, chloroform and DBCM)	carcinogenicity (causes cancer), hepatotoxicity, nephrotoxicity, and neurotoxicity (harms the liver, kidney, and nervous system)	none	NA	0.08	NA
Radionuclides					
Gross alpha particles[9]	carcinogenicity (causes cancer)	0 (^{210}Po included)	0	15 pCi/L[10] (includes ^{226}Ra but not radon and uranium)	up to $1x10^{-3}$ (for ^{210}Po, the most potent alpha emitter
Beta particles and photon emitters[9]	carcinogenicity (causes cancer)	0 (^{210}Pb included)	0	50 pCi/L (judged equiv. to 4 mrem/yr)	up to $2x10^{-3}$ (for ^{210}Pb, the most potent beta-emitter)

[9] 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.
[10] pCi/L = picocuries per liter of water.