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PARADISE IRRIGATION DISTRICT
6332 Clark Road, Paradise CA 95969 | Phone (530)877-4971 | Fax (530)876-0483

"Paradise Irrigation District (PID) is dedicated to the business of producing and delivering a safe, dependable supply of quality water in an efficient, cost effective manner with service that meets or exceeds the expectation of our customers."

Please consider how this agenda item relates to our mission.

TO: **Board of Directors**

FROM: **Ed Fortner, District Manager**
Jim Passanisi, Treatment Superintendent

DATE: **October 17, 2018 (Regular Board Meeting)**

RE: **Public Health Goals Report – Notice of Public Hearing**

Public water systems that are required to prepare a triennial Public Health Goals Report pursuant to the California Health and Safety Code Section 116470(b) shall hold a public hearing for the purpose of accepting and responding to oral or written public comment. A public hearing is scheduled for November 19, 2018 during a special board meeting at the District's office at 6:30 PM at 6332 Clark Road, Paradise, CA 95969. A notice of the scheduled public hearing is attached, which will be published twice, a week apart, in the Paradise Post newspaper.

The 2018 Triennial Public Health Goals Report is available for review at PID's District Office, the Paradise Branch of the Butte County Library, 5922 Clark Road, or by visiting the District's website at www.paradiseirrigation.com.

Each contaminant of concern evaluated in the report compares the District's drinking water quality level to its non-enforceable public health goal (PHG) level, and includes the following: Total Coliform Bacteria; Hexavalent Chromium, Bromodichloromethane; Dichloroacetic Acid, and Trichloroacetic Acid. The report includes the following information:

(1) Identifies each contaminant detected in the District's drinking water that exceeds its PHG level;
(2) Discloses the numerical public health risk for each contaminant;
(3) Identifies the category of risk to public health associated with exposure to the contaminant;
(4) Describes the best available technology to remove or reduce the concentration of the contaminant below the PHG level;
(5) Estimates the aggregate cost and the cost per customer of utilizing the technology described in paragraph (4); and
(6) Briefly describe what action, if any, the District intends to take to reduce the concentration of the contaminant in the drinking water and the basis for that decision.

The recommended form of motion is:

"I move to authorize staff to release the Draft 2018 Triennial Public Health Goals Report and notice a public hearing date as November 19, 2018 at 6:30 p.m. to consider public comment regarding the draft report."

PARADISE IRRIGATION DISTRICT

NOTICE OF PUBLIC HEARING

REGARDING THE DRAFT 2018 TRIENNIAL PUBLIC HEALTH GOALS REPORT

NOTICE IS HEREBY GIVEN that the Paradise Irrigation District (PID) will hold a public hearing regarding review and adoption of its 2018 Triennial Public Health Goals Report. The report provides information on contaminants and the level of each the District has found in its drinking water, which exceeds a non-enforceable Public Heath Goal (PHG), or a Maximum Contaminant Level Goal if there is no PHG. The intent of this report is to give public water system customers access to information, so a consumer is aware of the types of health risk that might be posed by the presence of these contaminants. The report also provides an estimate of the cost for treatment to reduce the level of each contaminant below the PHG level.

The purpose of the hearing is to accept and respond to public comment. The public may present oral or written comments as part of the public hearing in compliance with the requirements set forth in the California Health and Safety Code Section 116470(b). The Board of Directors of the District shall adopt the report subsequent to the completion of the public hearing, or direct staff to revise the report based on the comments received from the public. The Public Hearing will be held as part of a special meeting of the PID Board of Directors, which is scheduled on Monday, November 19, 2018 at 6:30 p.m. in the PID Board Room, 6332 Clark Road, Paradise, California.

The Triennial Public Health Goals Report is available for review at PID's District Office, the Paradise Branch of the Butte County Library, 5922 Clark Road, or by visiting the District's website at www.paradiseirrigation.com. If you have questions, please call 530-876-2067.

PARADISE IRRIGATION DISTRICT
Ed Fortner, District Manager
Dated October __, 2018

Publish Dates: **October __, 2018**
October __, 2018

PARADISE IRRIGATION DISTRICT
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2018 Triennial Comparison of Public Health Goals to the District's Water Quality

This report was prepared with assistance from the March 2016, Association of California Water Agencies (ACWA) guidance document titled, "Suggested Guidelines for the Preparation of Required Reports on Public Health Goals (PHGs) to Satisfy Requirements of California Health and Safety Code Section 116470(b)."

What is a Public Health Goal (PHG)?

A PHG is the level of a chemical contaminant in drinking water that does not pose a significant risk to health. The levels are established by the California Environmental Protection Agency's (Cal-EPA) Office of Environmental Health Hazard Assessment (OEHHA). PHGs are <u>not</u> drinking water regulatory standards. However, state law requires the State Water Resource Control Board (SWRCB) to set drinking water standards for chemical contaminants as close to the corresponding PHG as is economically and technologically feasible. In some cases, it may not be feasible for SWRCB to set the drinking water standard for a contaminant at the same level as the PHG. The technology to treat the chemicals may not be available, or the cost of treatment may be very high. SWRCB must consider these factors when developing a drinking water standard.

How Does OEHHA Establish a Public Health Goal?

The process for establishing a PHG for a chemical contaminant in drinking water is very rigorous. OEHHA scientists first compile all relevant scientific information available, which includes studies of the chemical's effects on laboratory animals and studies of humans who have been exposed to the chemical. The scientists use data from these studies to perform a health risk assessment, in which they determine the levels of the contaminant in drinking water that could be associated with various adverse health effects. When calculating a PHG, OEHHA uses all the information it has compiled to identify the level of the chemical in drinking water that would not cause significant adverse health effects in people who drink that water every day for 70 years.

OEHHA must also consider any evidence of immediate and severe health effects when setting the PHG. For cancer-causing chemicals, OEHHA typically establishes the PHG at the "one-in-one million" risk level. At that level, not more than one person in a population of one million people drinking the water daily for 70 years would be expected to develop cancer as a result of exposure to that chemical.

A complete list of PHGs, updated January 10, 2018, is included in the Appendix - Attachment No. 1.

Five (5) contaminants in the District's drinking water exceeded a PHG or the United States Environmental Protection Agency (USEPA) Maximum Contaminant Level Goal (MCLG), and are listed on Page 4 in this report.

Background:

Effective July 1, 1998, Section 116470b of the California Health and Safety Code (see page 3) requires all public water systems with more than 10,000 service connections to prepare a Public Health Goal (PHG) Report by July 1, every three years. This report satisfies Paradise Irrigation District's (District) requirement for 2018 by evaluating the District's water quality in 2015, 2016 and 2017.

The purpose of the legislative requirement behind this report is to give public water system customers access to information about PHG levels of contaminants below their enforceable (mandatory) MCLs. PHGs are non-enforceable goals. This information includes: the numerical public health risk associated with the MCL and PHG or MCLG, the category or type of risk to health that could be associated with each contaminant, the best treatment technology available that could be used to reduce the contaminant's level, and an estimate of the cost of treatment if it is appropriate and feasible.

Section 116470(b) requires public water systems to use the Maximum Contaminant Level Goal (MCLG) adopted by USEPA for a contaminant where OEHHA has not yet adopted a PHG. This report includes the required information for contaminants that have a California primary drinking water standard, a PHG or MCLG and were detected above both the respective PHG (or MCLG) and the Detection Level for the Purposes of Reporting (DLR).

The SWRCB, Division of Drinking Water (DDW) adopts primary drinking water standards, or maximum contaminant levels (MCLs) for chemicals. MCLs are enforceable regulatory standards to which all public water systems in the state must adhere to. The USEPA and the SWRCB DDW establish MCLs at very conservative levels to provide protection to consumers against all but very low to negligible risk. In other words, MCLs are the regulatory definition of what is "safe." Conversely, PHGs and MCLGs are strictly health-based goals that do not consider the limits of detection and feasible treatment technologies or the cost to treat. As such, many PHGs and MCLGs are set at a level which water systems cannot usually meet.

This report is required in addition to the extensive public reporting of water quality information that public water systems are required to provide annually in the federally mandated Consumer Confidence Report (CCR). Hence, the District has also prepared the 2015, 2016, and 2017 CCRs, which cover detectable water quality data in the drinking water in greater depth.

There are some contaminants that are routinely detected in the drinking water for which no PHG or MCLG has been adopted by OEHHA or the USEPA, including Total Trihalomethanes or Haloacetic Acids. OEHHA has not, but USEPA did adopt individual MCLGs for bromodichloromethane, dichloroacetic acid, and trichloroacetic acid; however there are no individual DDW MCLs for each one. Therefore, this report shall discuss the three contaminants of concern just listed.

Neither the DDW nor OEHHA have issued any guidelines regarding this report. In fact, while OEHHA has a mandate to determine and provide information on “numerical health risk,” they have no involvement or authority regarding this report.

California Health and Safety Code Section 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; and
(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.

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.

The State Division of Drinking Water (DDW) shall not require a public water system to take any action to reduce or eliminate any exceedance of a public health goal. Enforcement of this section does not require the DDW to amend a public water system's operating permit.

List of five (5) contaminants in the District's drinking water, which exceed the Public Health Goals (or MCLGs) during 2015, 2016 and 2017

See Appendix Attachment No. 1 for a complete list of MCLs, DLRs, PHGs and MCLGs for regulated drinking water contaminants (last updated January 10, 2018)

Category and Source for each Contaminant

Microbiological:

1. Total Coliform Bacteria — Naturally present in the environment

Inorganic Chemical:

2. Hexavalent Chromium — Erosion of natural deposits

Trihalomethanes (THMs):

3. Bromodichloromethane — Byproduct of drinking water disinfection

Haloacetic Acids (HAA5s):

4. Dichloroacetic Acid — Byproduct of drinking water disinfection
5. Trichloroacetic Acid — Byproduct of drinking water disinfection

Comparison of MCL & PHG (MCLG) concentration (ppb) for each Contaminant

	MCL	PHG (MCLG)	Concentration (Year)
Total Coliform Bacteria (1)	5% of monthly samples	(0)	2.5% during one month (2016)
Bromodichloromethane	80 as TTHMs	(0)	2.0 - 3.6 (2015 - 2017)
Dichloroacetic Acid	60 ppb as HAA5s	(0)	6.8 - 20.0 (2015 - 2017)
Trichloroacetic Acid	60 ppb as HAA5s	(20.0)	12.0 - 33.0 (2015 - 2017)

Note (1): District's requirement - 5% of 40 samples per month is 2 samples. During 2016, one sample was total coliform positive.

			Concentration (Year)	
			Surface Water	Groundwater
Hexavalent Chromium	No MCL	0.02	0.1	2.5 - 3.4 (2015)

Best Available Treatment Technology and Cost Estimates

Both the USEPA and DDW adopt what are known as Best Available Technologies (BAT) that are the accepted technologies of reducing contaminant levels to the MCL. Costs can be estimated for such technologies. However, since many PHGs and all MCLGs are set much lower than the MCL, it is not always possible or feasible to determine what treatment or costs are needed to further reduce a contaminant downward to or near the PHG or MCLG, many of which are set at zero.

A list of treatment technologies with cost estimates for many contaminants not listed and listed in this report are described in the "Cost Estimates for Treatment Technologies" tables provided by the Association of California Water Agencies (ACWA) in their guidance document mentioned at the beginning of this report. See Appendix - Attachment No. 2.

The Health and Safety Code Section 116470(b), does not require an evaluation of all possible technologies for each contaminant to compare costs. For example if two technologies are possible to lower the level of a particular contaminant to the "zero" PHG/MCLG level, it is appropriate to specify and estimate costs for the technology that may be used, keeping in mind there are significant uncertainties based on a variety of factors. General "order of magnitude" estimates are adequate. It is assumed that all costs including capital, land, construction, engineering, planning, environmental, contingency, and O&M costs should be included, but general assumptions can be made for most of these items.

Estimating the costs to reduce a contaminant to zero is difficult, because it is not possible to verify by analytical means that the level has been lowered to zero. In some cases, installing treatment to further reduce very low levels of one contaminant may have adverse effects on other aspects of water quality.

The estimates for specific treatment technologies do not include other factors such as permitting and waste disposal. Furthermore, before any treatment system is approved by DDW, the District is required to conduct a California Environmental Quality Act (CEQA) review to assess potential environmental impacts that may be related to the project. The results of that assessment could add significant costs to mitigate potential concerns, or could preclude using a specific treatment technology altogether. Waste disposal costs associated with various treatment technologies vary widely. Some waste disposal costs are known and can be estimated as part of the routine operations and maintenance of the system. Others requiring direct discharge to the sanitary sewer or hauling of potentially hazardous waste would have to be determined on a case-by-case basis.

Heath Risks

Determination of health risk at the PHG or MCLG low levels (i.e. sometimes zero) is theoretical based on risk assessments with multiple assumptions and mathematical extrapolations. Many contaminants are considered to be carcinogenic and USEPA's policy is to set the applicable MCLGs at zero because they consider no amount of these contaminants to be without risk. It is understood by all that zero is an unattainable goal and cannot be measured by the practically available analytical methods. OEHHA cannot set a PHG at zero, and must calculate a numerical level to address risk, even though it may be unattainable or impossible to measure.

A complete list of numerical health risks for this Public Health Goal Exceedance Report is provided in the Appendix - Attachment No. 3.

Evaluation of contaminants in the District's Drinking Water (2015, 2016 & 2017) that exceeded the PHG or MCLG

Five (5) contaminants in the District's drinking water exceed the PHGs or the MCLGs.

Total Coliform Bacteria

Microbiological: Naturally present in the environment

	MCL	PHG (MCLG)	Concentration (Year)
Total Coliform Bacteria	5% of monthly samples	(0)	2.5% during one month (2016)

The District collects 40 coliform bacteria samples per month to meet the monitoring requirements of the Total Coliform Rule. One sample during 2016 was found to be positive for total coliform bacteria, and the three repeat samples were negative. The District's water quality standard for the total coliform bacteria MCL is two positive samples of all samples per month (i.e. 5%), and the MCLG is zero.

Coliform bacteria are ubiquitous in nature, and are not generally considered harmful. They are used because of the ease in monitoring and analysis. If a positive sample is found, it indicates a potential problem that needs to be investigated and follow-up sampling done. It is not at all unusual for a system to have an occasional positive sample. It is difficult, if not impossible to assure that a system will never get a positive sample. In all cases of detection in District's drinking water, follow-up samples were negative for total coliform bacteria indicating good water quality and no system contamination.

The District utilizes 12.5% industrial bleach (sodium hypochlorite i.e. "chlorine") as a primary disinfectant in the treatment process to achieve the requisite microbial inactivation outlined in the Surface Water Treatment Rule to assure that the drinking water is microbiologically safe. Before delivery to the distribution system, chorine is added at a carefully controlled residual level to provide the best health protection without causing the water to have undesirable taste and odor, or increasing disinfection byproducts (DBPs). This careful balance of treatment processes is essential to continue supplying our customers with safe drinking water.

Other equally important measures that the District has implemented include: 1. cross-connection control program; 2. disinfectant residual throughout our system; 3. Flushing; 4. effective monitoring and surveillance program; and 5. maintaining positive pressures in the distribution system. The District has taken all of these steps identified by DDW as best available technology for coliform bacteria treatment.

The reason for the total coliform drinking water standard is to minimize the possibility of the water containing pathogens, which are organisms that cause waterborne disease. Because total coliform bacteria are a surrogate indicator of the potential presence of pathogens, it is not possible to state a specific numerical health risk. While USEPA normally sets MCLGs "at a level where no known or anticipated adverse effects on persons would occur", they indicate that they cannot do so with total coliform bacteria.

The one single action that would most likely decrease the possibility of having zero % positive coliform would be to significantly increase the disinfectant residual. This would likely result in increased DBPs which have adverse health consequences. This focuses on the risk-tradeoff issue – protection from acute risks versus potential harm from chronic risks. In some cases, installing treatment to further reduce very low levels of one contaminant may have adverse effects on other aspects of water quality. To provide any additional treatment to reach the MCLG level for total coliform bacteria would not be effective and is not proposed in this report. Therefore, no estimate of cost has been included for this contaminant.

Hexavalent Chromium (Cr+6) – There is currently no MCL

Inorganic Chemical: Erosion of natural deposits

	MCL	PHG (MCLG)	Concentration (Years)	
			Surface Water	Groundwater
Hexavalent Chromium	No MCL	0.02	0.1	2.5 - 3.4

Chromium (Cr) is a naturally-occurring element that is found in rocks, soils, plants and animals. Cr has a variety of industrial uses that include: steel making, metal plating, corrosion inhibitors, paints and wood preservatives. The most common forms of Cr in the environment are trivalent (Cr+3) and hexavalent (Cr+6). Cr+3 is an essential nutrient for humans and is the more common form found in surface waters. In areas where igneous rocks are present, the major source of Cr+6 in groundwater is from the oxidation of naturally-occurring Cr. Cr+6 can also result in groundwater from the oxidation of Cr+3 during the disinfection process. Anthropogenic sources of Cr+6 in groundwater typically result from leakage, poor storage and improper disposal practices.

OEHHA's July 2011, Fact Sheet titled: "Final Public Health Goal for Hexavalent Chromium" summarizes the health effects observed from studies involving drinking water with high levels of Cr+6. They include significant numbers of gastrointestinal tumors in rats and mice as well as increased rates of stomach cancer in humans. There is also evidence that Cr+6 can damage DNA. Exposure to airborne Cr+6 is 1,000 times more potent than exposure from drinking water. The health effects language states that: "Some people who drink water containing Cr+6 in excess of the MCL over many years may have an increased risk of getting cancer." The numerical health (cancer) risk for drinking water with Cr+6 at the MCL is estimated at 5 in 10,000. The numerical health (cancer) risk for drinking water with Cr+6 at the PHG of 0.02 ppb is 1 in 1,000,000. See Appendix page 25.

The District's Well D; at Tank D, pumps at 450 gallons per minute and is used off peak for about three months each year. This amounts to about 8,000,000 gallons of drinking water per year, or 0.4% of the total water produced by the District (1,700,000,000 gallons) per year.

The BATs for treating Cr+6 includes the following treatment methods:

1. Coagulation/Filtration
2. Ion Exchange (IX)
3. Reverse Osmosis

Ion Exchange (IX), specifically, Weak Base Anion Exchange Resin may be the most prudent method to be used to reduce Cr+6 in District wells to levels below the DLR, and closer to the PHG. Cost estimates for IX range from $1.62 to $6.78 per 1,000 gallons of water treated.

If IX treatment were considered for Well D, the annualized capital and O&M costs could range from approximately $13,000 to $55,000 per year. That may result in an assumed increased cost for each customer ranging from $1.30 to $ 5.50 per year.

If IX treatment were considered for the District's surface water treatment plant to treat the total annual production, the annualized capital and O&M costs could range from approximately $2,754,000 to $11,526,000 per year. This may result in an assumed increased cost for each customer ranging from $275 to $1,153 per year.

Bromodichloromethane, Dichloroacetic Acid & Trichloroacetic Acid

Trihalomethanes (THMs):

Bromodichloromethane	Byproduct of drinking water disinfection

Haloacetic Acids (HAA5s):

Dichloroacetic Acid	Byproduct of drinking water disinfection
Trichloroacetic Acid	Byproduct of drinking water disinfection

	MCL	PHG (MCLG)	Concentration (Years)
Bromodichloromethane	80 as THMs	(0)	2.0 - 3.6 (2015 - 2017)
Dichloroacetic Acid	60 ppb as HAA5s	(0)	6.8 - 20.0 (2015 - 2017)
Trichloroacetic Acid	60 ppb as HAA5s	(20.0)	12.0 - 33.0 (2015 - 2017)

Chlorine is used at the treatment plant for disinfection of the drinking water. Chlorination of waters containing natural organic materials (NOM) causes the formation of disinfection byproducts (DBPs). The principal DBPs of health concern are low molecular weight chlorinated and brominated compounds including total trihalomethanes (TTHMs) and haloacetic acids (HAA5s).

The District's drinking water has TTHMs and HAA5 levels that are about half of the MCL. This may be attributed to the District's high quality surface water from a small and sparsely developed watershed regarding the following: 1. low pH ranging from 7.1 to 7.3; 2. low level of NOM and TTHM & HAA5 formation potential, and 3. short residence time of the surface water in the watershed that would limit accumulation NOM, and TTHM and HAA5 formation potential.

OEHHA does not have PHGs for three contaminants listed above or for TTHMs or HAA5s. However, EPA has established MCLGs for the three contaminants. Therefore, numerical OEHHA health cancer risk for the contaminants is not available. See Appendix page 35.

Some people who drink water containing trihalomethanes (i.e. bromodichloromethane) in excess of the MCL over many years may experience liver, kidney, or central nervous system problems, and may have an increased risk of getting cancer.

Some people who drink water containing haloacetic acids (i.e. dichloroacetic Acid & trichloroacetic acid) in excess of the MCL over many years may have an increased risk of getting cancer.

When chlorine is used as a disinfectant, reducing the formation of DBPs can be accomplished by the removal of NOM upstream of the chlorination process at the treatment plant. NOM removal techniques include the following: 1. optimized coagulation with adjustments to pH, and the type of coagulant and dose; 2. adsorption with powder or granular activated carbon; 3. adsorption onto specialty resins; and 5. biodegradation within filters; and 6. membrane filtration.

Other ways of reducing the formation of DBPs is to disinfect the water with the limited use of chlorine by using alternative oxidants, such as ozone, chloramination, or chlorine dioxide. These oxidants can be used upstream of chlorination to minimize the chlorine demand (NOM) of the water, thereby reducing DBP formation. Ozone or chloramination are more commonly used in the United States to reduce high level of DBPs. Ultra-violet light can also be used ahead of the chlorination process to disinfect the source water thereby reducing the amount of chorine needed to assure the drinking water is bacteriologically safe.

The last two paragraphs provide numerous ways to reduce DBPs in the drinking water. The selection of one method over another can be a rigorous process that would result in pilot testing to validate its effectiveness. All of the treatment methods can be expensive.

The BAT selected and costs include the following:

Ozonation and chemical addition reduces TTHM and HAA5 concentrations.
Estimated treated unit cost ranges from $0.09 to $0.19 per 1,000 gallons.
Estimated capital and O&M cost to treat 1,700,000,000 gallons per year is $153,000 to $323,000. This may result in an assumed increased cost for each customer ranging from $15 to $32 per year.

Because the District's TTHMs and HAA5s content are already considered low, this report does not recommend further treatment.

Recommendations for Further Action

None. The District's drinking water quality meets all DDW and USEPA primary standards set to provide safe drinking. The levels of contaminants identified in this report are below the primary MCLs. Further reductions in these levels would require additional costly treatment processes, and the ability of these processes to provide significant additional reductions in contaminant levels is uncertain. In addition, the health protection benefits of these possible reductions are not at all clear and may not be quantifiable even during pilot testing. Therefore, no action is proposed at his time.

The next report of the triennial comparison of Public Health Goals (MCLGs) to the District's water quality presented in the 2018, 2019 and 2020 Consumer Confidence Reports will be completed August 2021.

For additional information, please contact Mr. Jim Passanisi, Paradise Irrigation District, Water Treatment Superintendent, at jpassanisi@paradiseirrigation.com or call him at (530) 876-2067, you may also write to Paradise Irrigation District, 6332 Clark Road, Paradise, CA 95969. This report is posted on Paradise Irrigation District's website at www.PIDwater.com
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PARADISE IRRIGATION DISTRICT
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2018 Triennial Comparison of Public Health Goals to the District's Water Quality

Appendix

Attachment No. 1
MCLs, DLRs, and PHGs for Regulated Drinking Water Contaminants

Attachment No. 2
2012 ACWA PHG Cost Estimates for Treatment Technologies

Attachment No. 3
Health Risk Information for Public Health Goal Exceedance Reports

Attachment 1

MCLs, DLRs, and PHGs for Regulated Drinking Water Contaminants (Units are in milligrams per liter (mg/L), unless otherwise noted.) Last Update: January 10, 2018						
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, the PHG for NDMA (which is not yet regulated) is included at the bottom of this table.					For comparison: Federal MCLs and Maximum Contaminant Level Goals (MCLGs) (US EPA)	
	MCL	**DLR**	**PHG**	**Date of PHG**	**MCL**	**MCLG**
Chemicals with MCLs in 22 CCR §64431 —Inorganic Chemicals						
Aluminum	1	0.05	0.6	2001	--	--
Antimony	0.006	0.006	0.001	2016	0.006	0,006
Arsenic	0.010	0.002	0.000004	2004	0.010	zero
Asbestos (MFL = million fibers per liter; for fibers >10 microns long)	7 MFL	0.2 MFL	7 MFL	2003	7 MFL	7 MFL
Barium	1	0.1	2	2003	2	2
Beryllium	0.004	0.001	0.001	2003	0.004	0.004
Cadmium	0.005	0.001	0.00004	2006	0.005	0.005
Chromium, Total - OEHHA withdrew the 0.0025-mg/L PHG	0.05	0.01	withdrawn Nov. 2001	1999	0.1	0.1
Chromium, Hexavalent - 0.01-mg/L MCL & 0.001-mg/L DLR repealed September 2017	--	--	0.00002	2011	--	--
Cyanide	0.15	0.1	0.15	1997	0.2	0.2
Fluoride	2	0.1	1	1997	4.0	4.0
Mercury (inorganic)	0.002	0.001	0.0012	1999 (rev2005) *	0.002	0.002
Nickel	0.1	0.01	0.012	2001	--	--
Nitrate (as nitrogen, N)	10 as N	0.4	45 as NO3 (=10 as N)	1997	10	10
Nitrite (as N)	1 as N	0.4	1 as N	1997	1	1
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	0.05	0.05
Thallium	0.002	0.001	0.0001	1999 (rev2004)	0.002	0.0005
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	1.3	1.3
Lead	0.015	0.005	0.0002	2009	0.015	zero
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	15	zero

Gross beta particle activity - OEHHA concluded in 2003 that a PHG was not practical	4 mrem/yr	4	none	n/a	4 mrem/yr	zero
Radium-226	--	1	0.05	2006		
Radium-228	--	1	0.019	2006		
Radium-226 + Radium-228	5	--	--	--	5	zero
Strontium-90	8	2	0.35	2006	--	--
Tritium	20,000	1,000	400	2006	--	--
Uranium	20	1	0.43	2001	30 µg/L	zero
Chemicals with MCLs in 22 CCR §64444—Organic Chemicals						
(a) Volatile Organic Chemicals (VOCs)						
Benzene	0.001	0.0005	0.00015	2001	0.005	zero
Carbon tetrachloride	0.0005	0.0005	0.0001	2000	0.005	zero
1,2-Dichlorobenzene	0.6	0.0005	0.6	1997 (rev2009)	0.6	0.6
1,4-Dichlorobenzene (p-DCB)	0.005	0.0005	0.006	1997	0.075	0.075
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)	0.005	zero
1,1-Dichloroethylene (1,1-DCE)	0.006	0.0005	0.01	1999	0.007	0.007
cis-1,2-Dichloroethylene	0.006	0.0005	0.1	2006	0.07	0.07
cis-1,2-Dichloroethylene	--	--	0.013	2017 draft	--	--
trans-1,2-Dichloroethylene	0.01	0.0005	0.06	2006	0.1	0.1
trans-1,2-Dichloroethylene	--	--	0.05	2017 draft	--	--
Dichloromethane (Methylene chloride)	0.005	0.0005	0.004	2000	0.005	zero
1,2-Dichloropropane	0.005	0.0005	0.0005	1999	0.005	zero
1,3-Dichloropropene	0.0005	0.0005	0.0002	1999 (rev2006)	--	--
Ethylbenzene	0.3	0.0005	0.3	1997	0.7	0.7
Methyl tertiary butyl ether (MTBE)	0.013	0.003	0.013	1999	--	--
Monochlorobenzene	0.07	0.0005	0.07	2014	0.1	0.1
Styrene	0.1	0.0005	0.0005	2010	0.1	0.1
1,1,2,2-Tetrachloroethane	0.001	0.0005	0.0001	2003	0.1	0.1
Tetrachloroethylene (PCE)	0.005	0.0005	0.00006	2001	0.005	zero
Toluene	0.15	0.0005	0.15	1999	1	1
1,2,4-Trichlorobenzene	0.005	0.0005	0.005	1999	0.07	0.07
1,1,1-Trichloroethane (1,1,1-TCA)	0.2	0.0005	1	2006	0.2	0.2
1,1,2-Trichloroethane (1,1,2-TCA)	0.005	0.0005	0.0003	2006	0.005	0.003
Trichloroethylene (TCE)	0.005	0.0005	0.0017	2009	0.005	zero
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	0.002	zero
Xylenes	1.75	0.0005	1.8	1997	10	10
(b) Non-Volatile Synthetic Organic Chemicals (SOCs)						
Alachlor	0.002	0.001	0.004	1997	0.002	zero
Atrazine	0.001	0.0005	0.00015	1999	0.003	0.003
Bentazon	0.018	0.002	0.2	1999 (rev2009)	--	--
Benzo(a)pyrene	0.0002	0.0001	0.000007	2010	0.0002	zero
Carbofuran	0.018	0.005	0.0007	2016	0.04	0.04
Chlordane	0.0001	0.0001	0.00003	1997 (rev2006)	0.002	zero

Dalapon	0.2	0.01	0.79	1997 (rev2009)	0.2	0.2
1,2-Dibromo-3-chloropropane (DBCP)	0.0002	0.00001	0.0000017	1999	0.0002	zero
2,4-Dichlorophenoxyacetic acid (2,4-D)	0.07	0.01	0.02	2009	0.07	0.07
Di(2-ethylhexyl)adipate	0.4	0.005	0.2	2003	0.4	0.4
Di(2-ethylhexyl)phthalate (DEHP)	0.004	0.003	0.012	1997	0.006	zero
Dinoseb	0.007	0.002	0.014	1997 (rev2010)	0.007	0.007
Diquat	0.02	0.004	0.006	2016	0.02	0.02
Endothal	0.1	0.045	0.094	2014	0.1	0.1
Endrin	0.002	0.0001	0.0003	2016	0.002	0.002
Ethylene dibromide (EDB)	0.00005	0.00002	0.00001	2003	0.00005	zero
Glyphosate	0.7	0.025	0.9	2007	0.7	0.7
Heptachlor	0.00001	0.00001	0.000008	1999	0.0004	zero
Heptachlor epoxide	0.00001	0.00001	0.000006	1999	0.0002	zero
Hexachlorobenzene	0.001	0.0005	0.00003	2003	0.001	zero
Hexachlorocyclopentadiene	0.05	0.001	0.002	2014	0.05	0.05
Lindane	0.0002	0.0002	0.000032	1999 (rev2005)	0.0002	0.0002
Methoxychlor	0.03	0.01	0.00009	2010	0.04	0.04
Molinate	0.02	0.002	0.001	2008	--	--
Oxamyl	0.05	0.02	0.026	2009	0.2	0.2
Pentachlorophenol	0.001	0.0002	0.0003	2009	0.001	zero
Picloram	0.5	0.001	0.166	2016	0.5	0.5
Polychlorinated biphenyls (PCBs)	0.0005	0.0005	0.00009	2007	0.0005	zero
Simazine	0.004	0.001	0.004	2001	0.004	0.004
Thiobencarb	0.07	0.001	0.042	2016	--	--
Toxaphene	0.003	0.001	0.00003	2003	0.003	zero
1,2,3-Trichloropropane	0.000005	0.000005	0.0000007	2009	--	--
2,3,7,8-TCDD (dioxin)	$3x10^{-8}$	$5x10^{-9}$	$5x10^{-11}$	2010	$3x10^{-8}$	zero
2,4,5-TP (Silvex)	0.05	0.001	0.003	2014	0.05	0.05
Chemicals with MCLs in 22 CCR §64533 —Disinfection Byproducts						
Total Trihalomethanes	0.080	--	0.0008	2010 draft	0.080	--
Bromodichloromethane	--	0.0010	--	--	--	zero
Bromoform	--	0.0010	--	--	--	zero
Chloroform	--	0.0010	--	--	--	0.07
Dibromochloromethane	--	0.0010	--	--	--	0.06
Haloacetic Acids (five) (HAA5)	0.060	--	--	--	0.060	--
Monochloroacetic Acid	--	0.0020	--	--	--	0.07
Dichloroacetic Adic	--	0.0010	--	--	--	zero
Trichloroacetic Acid	--	0.0010	--	--	--	0.02
Monobromoacetic Acid	--	0.0010	--	--	--	--
Dibromoacetic Acid	--	0.0010	--	--	--	--
Bromate	0.010	0.0050**	0.0001	2009	0.01	zero
Chlorite	1.0	0.020	0.05	2009	1	0.8
Chemicals with PHGs established in response to DDW requests. These are not currently regulated drinking water contaminants.						
N-Nitrosodimethylamine (NDMA)	--	--	0.000003	2006	--	--

*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.

Attachment 2

Reference: 2012 ACWA PHG Survey

COST ESTIMATES FOR TREATMENT TECHNOLOGIES

(INCLUDES ANNUALIZED CAPITAL AND O&M COSTS)

No.	Treatment Technology	Source of Information	Estimated Unit Cost 2012 ACWA Survey Indexed to 2015* ($/1,000 gallons treated)
1	Ion Exchange	Coachella Valley WD, for GW, to reduce Arsenic concentrations. 2011 costs.	1.99
2	Ion Exchange	City of Riverside Public Utilities, for GW, for Perchlorate treatment.	0.96
3	Ion Exchange	Carollo Engineers, anonymous utility, 2012 costs for treating GW source for Nitrates. Design souce water concentration: 88 mg/L NO_3. Design finished water concentration: 45 mg/L NO_3. Does not include concentrate disposal or land cost.	0.72
4	Granular Activated Carbon	City of Riverside Public Utilities, GW sources, for TCE, DBCP (VOC, SOC) treatment.	0.48
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.	0.34
6	Granular Activated Carbon, Liquid Phase	LADWP, Liquid Phase GAC treatment at Tujunga Well field. Costs for treating 2 wells. Treament for 1,1 DCE (VOC). 2011-2012 costs.	1.47
7	Reverse Osmosis	Carollo Engineers, anonymous utility, 2012 costs for treating GW source for Nitrates. Design souce water concentration: 88 mg/L NO_3. Design finished water concentration: 45 mg/L NO_3. Does not include concentrate disposal or land cost.	0.78
8	Packed Tower Aeration	City of Monrovia, treatment to reduce TCE, PCE concentrations. 2011-12 costs.	0.42
9	Ozonation+ Chemical addition	SCVWD, STWTP treatment plant includes chemical addition + ozone generation costs to reduce THM/HAAs concentrations. 2009-2012 costs.	0.09

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COST ESTIMATES FOR TREATMENT TECHNOLOGIES

(INCLUDES ANNUALIZED CAPITAL AND O&M COSTS)

No.	Treatment Technology	Source of Information	Estimated Unit Cost 2012 ACWA Survey Indexed to 2015* ($/1,000 gallons treated)
10	Ozonation+ Chemical addition	SCVWD, PWTP treatment plant includes chemical addition + ozone generation costs to reduce THM/HAAs concentrations, 2009-2012 costs.	0.19
11	Coagulation/Filtration	Soquel WD, treatment to reduce manganese concentrations in GW. 2011 costs.	0.73
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.	0.83
13	Blending (Well)	Rancho California WD, GW blending well, 1150 gpm, to reduce fluoride concentrations.	0.69
14	Blending (Wells)	Rancho California WD, GW blending wells, to reduce arsenic concentrations, 2012 costs.	0.56
15	Blending	Rancho California WD, using MWD water to blend with GW to reduce arsenic concentrations. 2012 costs.	0.67
16	Corrosion Inhibition	Atascadero Mutual WC, corrosion inhibitor addition to control aggressive water. 2011 costs.	0.09

*Costs were adjusted from date of original estimates to present, where appropriate, using the Engineering News Record (ENR) annual average building costs of 2015 and 2012. The adjustment factor was derived from the ratio of 2015 Index/2012 Index.

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Table 2
Reference: Other Agencies

COST ESTIMATES FOR TREATMENT TECHNOLOGIES
(INCLUDES ANNUALIZED CAPITAL AND O&M COSTS)

No.	Treatment Technology	Source of Information	Estimated Unit Cost 2012 Other References Indexed to 2015* ($/1,000 gallons treated)
1	Reduction - Coagulation-Filtration	Reference: February 28, 2013, Final Report Chromium Removal Research, City of Glendale, CA. 100-2000 gpm. Reduce Hexavalent Chromium to 1 ppb.	1.58 - 9.95
* 2	IX - Weak Base Anion Resin	Reference: February 28, 2013, Final Report Chromium Removal Research, City of Glendale, CA. 100-2000 gpm. Reduce Hexavalent Chromium to 1 ppb.	1.62 - 6.78
3	IX	Golden State Water Co., IX w/disposable resin, 1 MGD, Perchlorate removal, built in 2010.	0.50
4	IX	Golden State Water Co., IX w/disposable resin, 1000 gpm, perchlorate removal (Proposed; O&M estimated).	1.08
5	IX	Golden State Water Co., IX with brine regeneration, 500 gpm for Selenium removal, built in 2007.	7.08
6	GFO/Adsorption	Golden State Water Co., Granular Ferric Oxide Resin, Arsenic removal, 600 gpm, 2 facilities, built in 2006.	1.85 -1.98
7	RO	Reference: Inland Empire Utilities Agency : Chino Basin Desalter. RO cost to reduce 800 ppm TDS, 150 ppm Nitrate (as NO3); approx. 7 mgd.	2.43
8	IX	Reference: Inland Empire Utilities Agency : Chino Basin Desalter. IX cost to reduce 150 ppm Nitrate (as NO3); approx. 2.6 mgd.	1.35

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9	Packed Tower Aeration	Reference: Inland Empire Utilities Agency : Chino Basin Desalter. PTA-VOC air stripping, typical treated flow of approx. 1.6 mgd.	0.41
10	IX	Reference: West Valley WD Report, for Water Recycling Funding Program, for 2.88 mgd treatment facility. IX to remove Perchlorate, Perchlorate levels 6-10 ppb. 2008 costs.	0.56 - 0.80
11	Coagulation Filtration	Reference: West Valley WD, includes capital, O&M costs for 2.88 mgd treatment facility- Layne Christensen packaged coagulation Arsenic removal system. 2009-2012 costs.	0.37
12	FBR	Reference: West Valley WD/Envirogen design data for the O&M + actual capitol costs, 2.88 mgd fluidized 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.	1.67 - 1.76

*Costs were adjusted from date of original estimates to present, where appropriate, using the Engineering News Record (ENR) annual average building costs of 2015 and 2012. The adjustment factor was derived from the ratio of 2015 Index/2012 Index.

Table 3
Reference: Updated 2012 ACWA Cost of Treatment Table

COST ESTIMATES FOR TREATMENT TECHNOLOGIES
(INCLUDES ANNUALIZED CAPITAL AND O&M COSTS)

No.	Treatment Technology	Source of Information	Estimated 2012 Unit Cost Indexed to 2015* ($/1,000 gallons treated)
1	Granular Activated Carbon	Reference: 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	0.57-1.08
2	Granular Activated Carbon	Reference: Carollo Engineers, estimate for VOC treatment (PCE), 95% removal of PCE, Oct. 1994,1900 gpm design capacity	0.26
3	Granular Activated Carbon	Reference: 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	1.25
4	Granular Activated Carbon	Reference: CH2M Hill study on San Gabriel Basin, for 135 mgd central treatment facility for VOC and SOC removal by GAC, 1990	0.49-0.71
5	Granular Activated Carbon	Reference: Southern California Water Co. - actual data for "rented" GAC to remove VOCs (1,1-DCE), 1.5 mgd capacity facility, 1998	2.24
6	Granular Activated Carbon	Reference: Southern California Water Co. - actual data for permanent GAC to remove VOCs (TCE), 2.16 mgd plant capacity, 1998	1.46
7	Reverse Osmosis	Reference: 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	1.68-3.22
8	Reverse Osmosis	Reference: 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	3.98
9	Reverse Osmosis	Reference: 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	2.45
10	Reverse Osmosis	Reference: 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	2.65
11	Reverse Osmosis	Reference: 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	2.05
12	Reverse Osmosis	Reference: Arsenic Removal Study, City of Scottsdale, AZ - CH2M Hill, for a 1.0 mgd plant operated at 40% of design capacity, Oct. 1991	6.65

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COST ESTIMATES FOR TREATMENT TECHNOLOGIES

(INCLUDES ANNUALIZED CAPITAL AND O&M COSTS)

No.	Treatment Technology	Source of Information	Estimated 2012 Unit Cost Indexed to 2015* ($/1,000 gallons treated)
13	Reverse Osmosis	Reference: Arsenic Removal Study, City of Scottsdale, AZ - CH2M Hill, for a 1.0 mgd plant operated at 100% of design capacity, Oct. 1991	3.92
14	Reverse Osmosis	Reference: Arsenic Removal Study, City of Scottsdale, AZ - CH2M Hill, for a 10.0 mgd plant operated at 40% of design capacity, Oct. 1991	2.94
15	Reverse Osmosis	Reference: Arsenic Removal Study, City of Scottsdale, AZ - CH2M Hill, for a 10.0 mgd plant operated at 100% of design capacity, Oct. 1991	1.82
16	Reverse Osmosis	Reference: CH2M Hill study on San Gabriel Basin, for 135 mgd central treatment facility with RO to remove nitrate, 1990	1.83-3.22
17	Packed Tower Aeration	Reference: Analysis of Costs for Radon Removal... (AWWARF publication), Kennedy/Jenks, for a 1.4 mgd facility operating at 40% of design capacity, Oct. 1991	1.06
18	Packed Tower Aeration	Reference: Analysis of Costs for Radon Removal... (AWWARF publication), Kennedy/Jenks, for a 14.0 mgd facility operating at 40% of design capacity, Oct. 1991	0.56
19	Packed Tower Aeration	Reference: 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 stripping operation, 1900 gpm design capacity, Oct. 1994	0.28
20	Packed Tower Aeration	Reference: 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	0.29
21	Packed Tower Aeration	Reference: CH2M Hill study on San Gabriel Basin, for 135 mgd central treatment facility - packed tower aeration for VOC and radon removal, 1990	0.45-0.74
22	Advanced Oxidation Processes	Reference: 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	0.55
23	Ozonation	Reference: 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	0.13-0.26
24	Ion Exchange	Reference: CH2M Hill study on San Gabriel Basin, for 135 mgd central treatment facility - ion exchange to remove nitrate, 1990	0.61-0.80

*Costs were adjusted from date of original estimates to present, where appropriate, using the Engineering News Record (ENR) annual average building costs of 2015 and 2012. The adjustment factor was derived from the ratio of 2015 Index/2012 Index.

Attachment 3

Available at: http://oehha.ca.gov/water/phg/pdf/2016phgexceedancereport012816.pdf

Health Risk Information for Public Health Goal Exceedance Reports

Prepared by

Office of Environmental Health Hazard Assessment
California Environmental Protection Agency

February 2016

Under the Calderon-Sher Safe Drinking Water Act of 1996 (the Act), water utilities are required to prepare a report every three years for contaminants that exceed public health goals (PHGs) (Health and Safety Code Section 116470 (b)(2)). The numerical health risk for a contaminant is to be presented with the category of health risk, along with a plainly worded description of these terms. The cancer health risk is to be calculated at the PHG and at the California maximum contaminant level (MCL). This report is prepared by the Office of Environmental Health Hazard Assessment (OEHHA) to assist the water utilities in meeting their requirements.

PHGs are concentrations of contaminants in drinking water that pose no significant health risk if consumed for a lifetime. PHGs are developed and published by OEHHA (Health and Safety Code Section 116365) using current risk assessment principles, practices and methods.

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 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 a no more than 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 Web site (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]	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[6] (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 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. Risk cannot be calculated. The PHG is set at a level that is believed to be without any significant public health risk to individuals exposed to the chemical over a lifetime.
[6] 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[7])	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)	0.0017	NA	0.018	NA

[7] 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}	0.01	5×10^{-4} (five per ten thousand)
Copper	digestive system toxicity (causes nausea, vomiting, diarrhea)	0.3	NA	1.3 (AL[8])	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

[8] 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 (1.7×10^{-6})	1×10^{-6}	0.0002	1×10^{-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	1×10^{-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)	0.1	NA	0.006	NA
1,2-Dichloro-ethylene, trans	hepatotoxicity (harms the liver)	0.06	NA	0.01	NA
Dichloromethane (methylene chloride)	carcinogenicity (causes cancer)	0.004	1×10^{-6}	0.005	1×10^{-6} (one per million)
2,4-Dichloro-phenoxyacetic acid (2,4-D)	hepatotoxicity and nephrotoxicity (harms the liver and kidney)	0.02	NA	0.07	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
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)
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)
Dinoseb	reproductive toxicity (harms the uterus and testis)	0.014	NA	0.007	NA
Dioxin (2,3,7,8-TCDD)	carcinogenicity (causes cancer)	5×10^{-11}	1×10^{-6}	3×10^{-8}	6×10^{-4} (six per ten thousand)
Diquat	ocular toxicity (harms the eye) developmental toxicity (causes malformation)	0.015	NA	0.02	NA
Endothall	digestive system toxicity (harms the stomach or intestine)	0.094	NA	0.1	NA
Endrin	hepatotoxicity (harms the liver) neurotoxicity (causes convulsions)	0.0018	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
Ethylbenzene (phenylethane)	hepatotoxicity (harms the liver)	0.3	NA	0.3	NA
Ethylene dibromide	carcinogenicity (causes cancer)	0.00001	1×10^{-6}	0.00005	5×10^{-6} (five per million)
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)
Hexachlorobenzene	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	$<1\times10^{-6}$ (PHG is not based on this effect)	0.015 (AL[8])	2×10^{-6} (two 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
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
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)	1 as nitrogen	NA	1 as nitrogen	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
Nitrate and Nitrite	hematotoxicity (causes methemoglobinemia)	10 as nitrogen	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
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)	0.5	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)

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
Selenium	integumentary toxicity (causes hair loss and nail damage)	0.03	NA	0.05	NA
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-Tetrachloroethane	carcinogenicity (causes cancer)	0.0001	1×10^{-6}	0.001	1×10^{-5} (one per hundred thousand)
Tetrachloroethylene (perchloroethylene, 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
Thiobencarb	general toxicity (causes body weight effects) hematotoxicity (affects red blood cells)	0.07	NA	0.07	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
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)
Trichlorofluoro-methane (Freon 11)	accelerated mortality (increase in early death)	1.3	NA	0.15	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
1,2,3-Trichloro-propane (1,2,3-TCP)	carcinogenicity (causes cancer)	0.0000007 (7×10^{-7})	1×10^{-6}	none	NA
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	1×10^{-6}	20,000 pCi/L	5×10^{-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]	U.S. 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)					
Chloroacetic acid	general toxicity (causes body and organ weight changes[8])	0.07	NA	none	NA

[1] Health risk category based on the U.S. EPA MCLG document or California MCL document unless otherwise specified.
[2] MCLG = maximum contaminant level goal established by U.S. 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]	U.S. EPA MCLG[2] (mg/L)	Cancer Risk[3] @ MCLG	California MCL[4] (mg/L)	Cancer Risk @ California MCL
* Dichloroacetic acid	carcinogenicity (causes cancer)	0	0	none	NA
* Trichloroacetic acid	hepatotoxicity (harms the liver)	0.02	0	none	NA
Bromoacetic acid	NA	none	NA	none	NA
Dibromoacetic acid	NA	none	NA	none	NA
Total haloacetic acids	carcinogenicity (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
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

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

Chemical	Health Risk Category[1]	U.S. EPA MCLG[2] (mg/L)	Cancer Risk[3] @ MCLG	California MCL[4] (mg/L)	Cancer Risk @ California MCL
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 1×10^{-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 2×10^{-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://oehha.studio-weeren.com/media/downloads/water/chemicals/phg/grossalphahealth.pdf.

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