San Francisco Water System
2019 Public Health Goals Report

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Acronyms and Abbreviations

ACWA	Association of California Water Agencies
ACRP	Alameda Creek Recapture Project
BAT	Best Available Technology
CHSC	California Health and Safety Code
Cr(VI)	Hexavalent chromium
DBP	Disinfection byproduct
DDW	Division of Drinking Water
DLR	Detection Limit for the Purposes of Reporting
Gross Alpha	Gross Alpha Particle Activity
HTWTP	Harry Tracy Water Treatment Plant
IQ	Intelligence quotient
LUSL	Lead user service line
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
MGD	Million gallons per day
MRL	Method Reporting Limit
O&M	Operations and maintenance
OEHHA	Office of Environmental Health Hazard Assessment
P/A	Presence/Absence
pCi/L	picoCuries per liter
PHG	Public Health Goal
ppb	parts per billion

RO	Reverse osmosis
SDWA	Safe Drinking Water Act
SFDPH	San Francisco Department of Public Health
SFGW	San Francisco Groundwater Project
SFPUC	San Francisco Public Utilities Commission
SFWS	San Francisco Water System
SVWTP	Sunol Valley Water Treatment Plant
SWRCB	State Water Resources Control Board
USEPA	United States Environmental Protection Agency
UV	Ultraviolet

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This report is divided into the following sections:

I. Introduction

A. Background

California Health and Safety Code (**CHSC**) §116470(b) (Attachment A) requires public water utilities serving more than 10,000 service connections to prepare a written report for every three years providing information about contaminants detected at levels exceeding Public Health Goals (**PHGs**). A PHG of a drinking water contaminant is a health-based level established by the California Office of Environmental Health Hazard Assessment (**OEHHA**); PHGs are goals that are not enforceable. PHGs are typically set at values significantly lower than the corresponding Maximum Contaminant Levels (**MCLs**), which are enforceable drinking water standards adopted by the United States Environmental Protection Agency (**USEPA**) and/or the Division of Drinking Water (**DDW**) of the State Water Resources Control Board (**SWRCB**). MCLs are set at levels as close to their PHGs as technically and economically feasible. For some contaminants, California enforces treatment techniques rather than MCLs.

Maximum Contaminant Level Goals (**MCLGs**) are the federal equivalent of PHGs; they are non-enforceable, health-based goals set by the USEPA. CHSC §116470(b)-(f) requires that contaminants with both a state Primary Drinking Water Standard (either an MCL or a treatment technique) and either a PHG or federal MCLG be evaluated for inclusion in PHG reports. Contaminant levels are to be compared against PHGs only if both an MCL (or treatment technique) and a PHG exist. If there is no PHG but an MCLG exists, then the MCLG is to be used for evaluation.

Water quality data from compliance locations were reviewed in preparation for this report. These data were collected by the San Francisco Public Utilities Commission (**SFPUC**) between January 1, 2016 and December 31, 2018 (herein the reporting period). Six of the 95 contaminants reviewed were detected above their PHGs or MCLGs. These six contaminants are discussed in section IV of this report.

B. Purpose

The purpose of this report is to give San Francisco Water System (**SFWS**) customers information about contaminant levels even if they meet the enforceable drinking water standards. For each of the six contaminants that exceeds its PHG/MCLG, this report provides the following information: level(s) of detection, health risks and risk category associated with the contaminant, the Best Available Technology

(**BAT**) to reduce the contaminant level to the PHG level along with an estimated cost of treatment (if applicable and available), and the current and any future programs in which the SFPUC engages to reduce the concentration of the contaminant. The SFPUC prepared its last PHG report for the SFWS in 2016.

C. <u>Guidelines Used</u>

In April 2019, the Association of California Water Agencies (**ACWA**) released suggested guidelines to help public water systems in preparing the PHG reports. These guidelines were considered in the preparation of this report. No guidance was available from state regulatory agencies.

II. Elements of the PHG Report

This section discusses the key elements of the report that will help explain the significance of a PHG exceedance. These include: the definitions of key terms, target drinking water levels and health risks, identified BATs and cost estimates, and SFPUC programs.

A. <u>Target Drinking Water Contaminant Levels</u>

A few terms and the associated definitions related to target drinking water goals, MCLs, and Detection Limits for the Purposes of Reporting (**DLRs**) are described below.

1. PHG and MCLG

A PHG is the level of a contaminant in drinking water that poses no significant risk to public health if consumed for a lifetime. For carcinogens, the PHG is set at a level below which the health risk is not significant (i.e., statistically, less than 1 in 1,000,000) to individuals consuming the water on a daily basis over a 70-year lifetime exposure. For non-carcinogens, the PHG is set with a margin of safety at a concentration at which no known or anticipated adverse health effects would occur.

A PHG is based solely on public health risk using current risk assessment principles and methods, without consideration of practical risk-management factors, which are used by the SWRCB-DDW to set enforceable drinking water standards. An MCLG is determined by the USEPA using a similar process. However, the USEPA sets the MCLGs of all carcinogens at zero, even though the goal of zero is difficult or impossible to meet. ***PHGs and MCLGs are non-enforceable goals that are not required to be met by public water systems***.

2. MCL

In California, the SWRCB-DDW is responsible for adopting drinking water standards, including primary MCLs for health protection and secondary MCLs for aesthetic concerns (e.g., taste and odor). The primary MCLs, which are used for comparison and discussion in this report, take into account not only health risks but also factors such as the ability to detect contaminants, treatability, and costs of treatment.

CHSC §116365(a) requires the SWRCB-DDW to establish a contaminant's MCL as close as possible to its PHG while considering technological and economic feasibility. This approach emphasizes the protection of public health against all but very low to negligible risk. Adopted MCLs are the criteria for regulatory compliance, not MCLGs or PHGs.

To ensure that customers receive high-quality drinking water, the SFPUC sets its own operational water quality targets at levels more stringent than the MCLs. Figure 1 illustrates the relationship between the SFPUC's water quality targets, PHGs and/or MCLGs and MCLs.

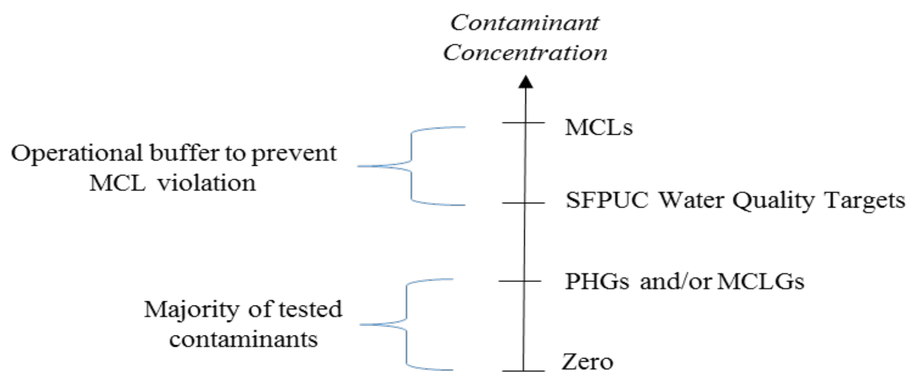

Figure 1. SFPUC Water Quality Targets vs. PHGs and MCLs

3. DLR

Along with an MCL, a contaminant regulated by the SWRCB-DDW also has a DLR. The DLR is established at a level that provides high confidence in a value being reported and that most laboratories have the analytical capabilities to meet the DLR. In other words, DLRs are not laboratory-specific and cannot be changed by laboratories. In addition, DLRs do not depend on the analytical method used. As such, the availability of a new or improved analytical method does not automatically result in the revision of a DLR (Attachment B). Nevertheless, advancements in measuring techniques and instruments allow many laboratories to use detection limits lower than the DLRs for many contaminants in drinking water. Laboratories sometimes report a sample result using a Method Reporting Limit (**MRL**).

DLRs are used by the SWRCB-DDW to determine compliance with MCLs. A contaminant found in a compliance sample at a level above its DLR is considered "detected". If a contaminant's DLR is less than or equal to its PHG or MCLG, the status of exceedance can be easily determined (Figure 2).

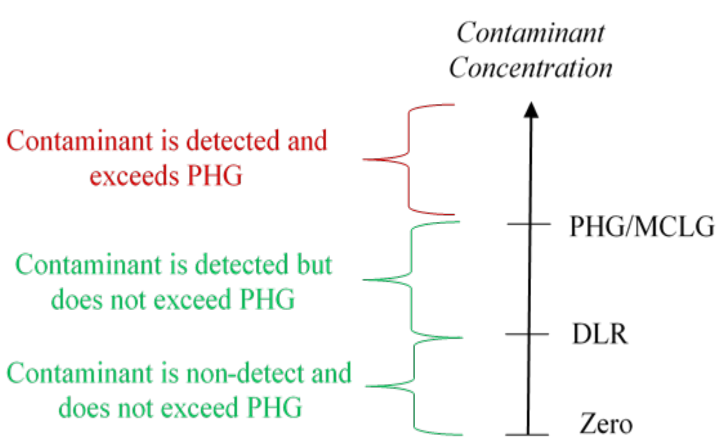

Figure 2. Comparison of PHG with DLR: PHG > DLR

In contrast, if the DLR or MRL is above the PHG or MCLG and the sample result is reported as non-detect, then it may not be possible to know whether or not the contaminant's concentration exceeds its PHG or MCLG (Figure 3). Attachment B includes further discussion of this scenario.

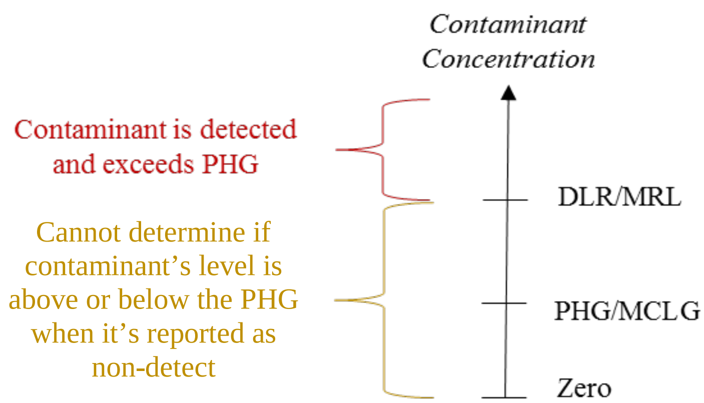

Figure 3. Comparison of PHG with DLR: PHG < DLR

When PHG < DLR, the ACWA guidelines state that a concentration reported as less than the detection limit should be considered zero. This approach is consistent with the SWRCB-DDW protocol for treating non-detected results as zero.

B. <u>Health Risks</u>

The OEHHA evaluates toxicological data from scientific literature to assess health risks for each contaminant in categories (Attachment C) including, among others, the following:

- Carcinogenic: capable of producing cancer.
- Cardiovascular toxicity: adverse effects on the structure or function of the heart or the vascular system following exposure to a chemical substance.
- Developmental toxicity: adverse effects on a developing organism that may result from exposure prior to conception (either parent), during prenatal development, or postnatally to the time of sexual maturation. Adverse developmental effects may be detected at any point in the life span of the organism. The major manifestations include (1) death of the developing organism, (2) structural abnormality (birth defects), (3) altered growth, and (4) functional deficiency.
- Neurotoxicity: capable of adversely affecting or destroying parts of the nervous system or interfering with nerve signal transmission. Effects may be reversible (for example, effects on chemicals that carry nerve signals across gaps between nerve cells) or irreversible (for example, destruction of nerve cells).
- Reproductive toxicity: adverse effects on the reproductive system of females or males. The toxicity may cause changes to the female or male reproductive organs, the regulating endocrine system, or pregnancy outcomes.

The OEHHA calculates numerical risks associated with a contaminant's non-carcinogenic and carcinogenic effects, if any, on human health. The PHG is then developed as a public health-protective concentration based on the most sensitive health effects. For contaminants with non-carcinogenic effects, PHGs are set at concentrations at which no known or anticipated adverse health effects occur. For carcinogens, PHGs are set at concentrations that do not pose a significant risk to health (usually less than 1 in 1,000,000 additional cases resulting in adverse health effects). By regulation, OEHHA cannot set a PHG at zero. MCLGs, however, are published by the USEPA, which assumes there is no safe level of exposure to carcinogens. Therefore, the USEPA sets MCLGs for carcinogens at zero.

Section IV of this report provides information about the health risk category and numerical health risks associated with each of the six contaminants that exceeded their PHGs or MCLGs.

C. Best Available Technologies (BATs) and Cost Estimates

For drinking water, both the USEPA and the SWRCB-DDW have specified BATs that have been determined to be the best available methods for reducing contaminant levels to MCLs. Costs can be readily estimated for such technologies. However, since most PHGs and MCLGs are set much lower than the corresponding MCLs (and some MCLGs are set at zero), it is not always possible to determine what treatment could further reduce a contaminant down to the PHG or MCLG level. Estimating the cost to reduce a contaminant to absolute zero is impossible, because it is not technically feasible to verify by existing analytical methods that the level has truly been lowered to zero. Only very preliminary cost estimates are required in PHG reports.

To assist utilities in preparing PHG reports, ACWA compiled unit cost estimates (dollars per thousand gallons treated) for BATs from various sources. For presenting cost estimates, ACWA guidelines suggest including both total project cost and the cost per customer. However, because the amount of water used by each SFWS customer varies, this report presents costs as a percent increase in a customer's water bill. As approximately two-thirds of SFPUC surface water is supplied to wholesale agencies, only one third of surface water treatment costs is assumed to be passed on to SFWS retail customers. All costs for San Francisco Groundwater Project (SFGW) treatment facilities are solely borne by SFWS retail customers.

It should be noted that installing a treatment technology to reduce already low levels of a single contaminant could have unexpected and adverse consequences on other aspects of water quality.

D. SFPUC Programs

Other than the applicable BATs, the SFPUC also engages in various programs to protect and maintain drinking water quality. These programs typically focus on source water protection, public outreach, and treatment chemical quality assurance. Section IV highlights the appropriate SFPUC programs in place for the contaminants that exceed their PHGs or MCLGs.

III. SFPUC Data and Analysis

Monitoring data collected in the reporting period at compliance locations, for both compliance and operational purposes, including those collected under the USEPA's fourth Unregulated Contaminant Monitoring Rule, were reviewed. Additionally, data collected from the last monitoring event for the contaminants that are subject to SWRCB-DDW's monitoring waiver were also considered**.** Attachment D of this report summarizes SFWS water quality data in conjunction with the corresponding DLRs, MCLs, PHGs and MCLGs. Concentrations of analytes in treated water delivered to SFWS customers in 2016, 2017, and 2018 were summarized in the corresponding Annual Water Quality Reports (a.k.a. Consumer Confidence Reports) in Attachment E. Overall, six contaminants were detected above their PHGs or MCLGs (Table 1). There were 51 contaminants that were detected below PHGs or MCLGs (Table 2), and 34 non-detected contaminants that have the PHGs or MCLGs below the corresponding DLRs (Table 3). Although the actual concentrations, if any, of the 34 ND contaminants might be above or below the PHGs or MCLGs, the SWRCB-DDW protocol and ACWA guidance recommend zero values for any NDs. Thus, a total of 85 contaminants did not exceed their PHGs or MCLGs.

A. Contaminants Detected above PHGs/MCLGs

Table 1 shows the monitoring results of six contaminants that were detected at levels above the applicable PHGs or MCLGs during the reporting period.

Table 1. Contaminants Detected above PHGs/MCLGs in SFWS and Supply Sources[a]

Contaminant	Unit	MCL	DLR	PHG	MCLG	Concentration Range	Number of Samples[a]
Arsenic	ppb	10	2	0.004	0	ND – 2.3	304
Bromate	ppb	10	5	0.1	0	ND – 5.3	144
Gross Alpha Particle Activity	pCi/L	15	3	N/A	0	ND – 6.8	16
Hexavalent Chromium	ppb	N/A	N/A	0.02	N/A	ND – 0.93	462
Lead	ppb	15[b]	5	0.2	0	ND	142
Total coliform	P/A	5%	N/A	N/A	0	0.6%[c]	10,218

Notes: (a) All samples (both non-detect and detected) collected at compliance locations.

(b) 15 ppb is the Action Level for lead. Lead does not have a MCL.

(C) This is the maximum monthly percentage of total coliform positive results.

Key: N/A = not available ND = non-detect P/A = Presence/Absence
pCi/L = picoCuries per liter ppb = parts per billion

- Arsenic exceeding its PHG in raw water samples from Calaveras Reservoir.
- Bromate exceeding its PHG in treated water samples from the Harry Tracy Water Treatment Plant (**HTWTP**) effluent and the San Andreas Pipeline #3.
- Gross Alpha Particle Activity exceeding its MCLG in a single raw water sample at Pond F2.
- Hexavalent chromium [**Cr(VI)**] exceeding its PHG in SFWS reservoirs, the SFWS distribution system, treated surface water effluent, and raw surface water. The exact locations of these exceedances are listed in Table 4 of Section IV.

- Lead exceeding its PHG in customer tap water samples collected by the SFPUC in its 2018 Lead and Copper Rule monitoring; it was non-detect in the distribution system.
- Total coliform (a bacteriological indicator) exceeding its MCLG in the SFWS distribution system's treated water in one month in 2018.

B. Contaminants Detected below PHGs/MCLGs

Table 2 shows 51 contaminants that have PHGs or MCLGs above their DLRs. Some were ND and others were detected below these goals. Therefore, no PHG exceedances occurred for these contaminants.

Table 2. Contaminants Detected below PHGs/MCLGs in SFWS and Supply Sources

1,1,1-Trichloroethane	Copper	Monochlorobenzene
1,1-Dichloroethane	Cyanide	Nickel
1,1-Dichloroethylene	Dalapon	Nitrate
1,2,4-Trichlorobenzene	Di(2-ethylhexyl)adipate	Nitrate + Nitrite
1,2-Dichlorobenzene	Di(2-ethylhexyl)phthalate	Nitrite
1,2-Dichloropropane	Dichloromethane	Oxamyl
1,4-Dichlorobenzene	Dinoseb	Pentachlorophenol
2,4,5-TP (Silvex)	Diquat	Picloram
2,4-Dichlorophenoxyacetic acid	Endothal	Selenium
Alachlor	Endrin	Simazine
Aluminum	Ethylbenzene	Styrene
Asbestos	Fluoride	Thiobencarb
Barium	Freon 113	Toluene
Bentazon	Glyphosate	trans-1,2-Dichloroethylene
Chlorite	Hexachlorocyclopentadiene	Trichloroethylene
Chromium, Total	Mercury (inorganic)	Trichlorofluoromethane
cis-1,2-Dichloroethylene	Methyl tertiary butyl ether	Xylenes

C. Non-detect Contaminants

For the contaminants that have existing MCLs, the SFPUC did not detect 34 of them[1] that have either PHGs or MCLGs below the corresponding DLRs (Table 3). Although the contaminants might be present at levels below the DLRs, levels were neither quantifiable nor reportable per the State drinking water standards. In the absence

[1] Two contaminants (radium-226 at the SFGW West Sunset Well and strontium-90 at the SFGW Lake Merced Well) were detected above their respective PHG but below their DLR in the raw groundwater.

of any known sources in the SFWS and in accordance with ACWA guidelines, these contaminants were considered to have no PHG or MCLG exceedances during the reporting period.

Table 3. Non-detect Contaminants in SFWS and Supply Sources

1,1,2,2-Tetrachloroethane	Carbofuran	Perchlorate
1,1,2-Trichloroethane	Carbon Tetrachloride	Polychlorinated Biphenyls
1,2,3-Trichloropropane	Chlordane	Radium-226 + Radium-228
1,2-Dichloroethane	Dibromochloropropane	Strontium-90
1,3-dichloropropene	Ethylene Dibromide	Tetrachloroethylene
2,3,7,8-TCDD (Dioxin)	Gross Beta Particles	Thallium
Antimony	Heptachlor	Toxaphene
Atrazine	Heptachlor Epoxide	Tritium
Benzene	Hexachlorobenzene	Uranium
Benzo(a)pyrene	Lindane	Vinyl Chloride
Beryllium	Methoxychlor	
Cadmium	Molinate	

D. Contaminants that Meet Requirements for Treatment Techniques

For pathogenic microorganisms—*Cryptosporidium*, *Giardia lambia*, *Legionella*, and viruses—that are regulated under the Surface Water Treatment Rule (SWTR) and Long-Term 2 Enhanced Surface Water Treatment Rule (LT2SWTR), the drinking water standard is met if the water supplier uses specified treatment techniques. The OEHHA does not establish PHG for pathogenic microorganisms. Although the MCLG for the microorganism contaminants is zero, the USEPA does not mandate monitoring because there are limitations in existing analytical methods that can specifically point to an individual infective pathogen. In accordance with ACWA guidelines, these contaminants are considered to not have exceeded their MCLGs because the SFPUC uses the required treatment techniques.

IV. Evaluation of Contaminants Exceeding PHGs or MCLGs

Over the last three years, San Francisco's drinking water has met all MCLs and applicable Action Levels (in the case of copper and lead) adopted by the USEPA and SWRCB-DDW. However, four contaminants (arsenic, bromate, Cr(VI), and lead) exceeded corresponding PHGs, and two contaminants (gross alpha particle activity and total coliform) exceeded MCLGs. Therefore, these six contaminants are addressed in this report. The following sections discuss water quality monitoring results and the applicable health goals, associated health risks, identified BATs and preliminary cost estimates, and programs in place or to be implemented by the SFPUC to address these contaminants.

A. Arsenic

The OEHHA established a very low PHG of 0.004 ppb for arsenic, which is significantly below the DLR of 2 ppb and the MCL of 10 ppb. The content of arsenic in the Earth's crust is about five grams per ton, with most existing in combined forms. The occurrence of arsenic in surface water is generally associated with soil erosion, seasonal run-off within the local watersheds, and/or treatment chemical impurities.

1. SFPUC Water Sample Results

Between 2016 and 2018, arsenic was not detected in any treated water samples. It was, however, detected in raw water samples below the MCL but above the PHG at the Calaveras Reservoir (2.08 ppb – 2.30 ppb). These levels of detection are consistent with those detected between 2010 and 2012, and the 2013 PHG report included a similar evaluation and discussion.

2. Health Risk Category and Level

Arsenic is classified as a carcinogen. It is also known to have other non-cancer adverse health and developmental effects including, but not limited to, hypertension, neurotoxicity, respiratory disease, and skin disease. According to the OEHHA, daily consumption of water at the PHG of 0.004 ppb for 70-year translates into an increased lifetime cancer risk of one per million. Water consumed at the MCL of 10 ppb translates into a lifetime cancer risk of one per four hundred.

3. BATs and Treatment Cost

The SFPUC's 2010 and 2013 PHG reports discussed the BAT for arsenic as reverse osmosis (**RO**) treatment. Although the USEPA identified seven BATs in the final Arsenic Rule, RO treatment demonstrated the best removal rate. Theoretically, RO treatment is potentially capable of reducing arsenic to the PHG with a removal rate >95%[2]. Discussion on potential arsenic BATs and associated costs for RO treatment are presented in Attachment F.

As arsenic was detected in samples from Calaveras Reservoir, of which the supply is treated at the Sunol Valley Water Treatment Plant (**SVWTP**), costs were estimated based on the SVWTP's maximum capacity of 160 Million gallons per day (**MGD**).

Based on ACWA guidelines on cost estimates, the up-front, lump sum capital cost for RO treatment at the SVWTP is estimated at $862 million. The 20-year annualized cost (which includes both capital and operation and maintenance [**O&M**] costs) is estimated at $149 million. Furthermore, there are other significant additional costs that include, but are not limited to:

- Construction, operation, and evaluation of a pilot plant to determine the feasibility and design parameters of the selected treatment technology.
- Filtration pretreatment requirements.
- Evaluating and implementing pretreatment to change arsenic speciation for effective removal.
- Excess capacity for redundancy.

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[2] City of San Diego, *Advanced Water Purification Facility Study Report*, January 2013

- Acquisition, development, and treatment of additional water sources to replace the water lost as brine. A brine production rate of more than 25% (up to 61 MGD) is anticipated.
- Operations related to the disposal of brine, such as constructing an additional facility to treat the brine or off-hauling brine to a permitted disposal facility.
- Land acquisition, permitting, environmental mitigations, and O&M costs associated with items above.

It should be noted that the efficacy of this BAT is only proven at the MCL level. Since the PHG for arsenic is 2,500 times lower than the MCL, even RO cannot be guaranteed to be effective at this level and at such a large scale. Furthermore, the analytical technology currently prevalent in the industry is not capable of detecting arsenic at the PHG level. In other words, the success of a new RO facility to reduce arsenic to the PHG level would be impossible to measure.

4. SFPUC Programs

The SFPUC will continue monitoring efforts and protecting water sources, as required by state and federal regulations through its watershed management/protection program and treatment chemical quality control program. Arsenic is monitored on an annual basis, which is more frequent than the SWRCB-DDW required triennial monitoring. These efforts, together with a proactive water quality monitoring program, are more efficient and practical mechanisms for reducing contaminants, including arsenic, than constructing an expensive treatment facility with no guarantee of meeting the performance goal.

B. Bromate

The OEHHA established a PHG of 0.1 ppb for bromate, which is 1% of the MCL (10 ppb). Bromate salts are used as a food ingredient and a neutralizing agent in hair products. Bromate is usually not found in water sources. In drinking water, bromate is typically formed as a disinfection byproduct from ozonation when naturally-occurring bromide reacts with ozone.

1. SFPUC Water Sample Results

In July 2017, the SFPUC detected bromate in the treated water from the HTWTP effluent (5.2 ppb – 5.3 ppb) and in a sample collected at the San Andreas Pipeline #3 (5.17 ppb), which receives HTWTP water. Bromate is sampled monthly at the HTWTP. This contaminant was generally not detected, as indicated by the non-detect results in the other 35 monthly compliance samples during the reporting period.

2. Health Risk Category and Level

Bromate is classified as a carcinogen. Acute symptoms of bromate ingestion include nausea, vomiting, diarrhea, central nervous system depression, tinnitus, deafness, and renal failure. The OEHHA primarily identifies hyperplasia as a non-cancer risk associated with bromate in drinking water. Cancer risk associated with lifetime consumption of water at the PHG translates into one per one million excess cancer cases. Cancer risk at the MCL is approximately one per ten thousand excess cancer cases.

3. BATs and Treatment Cost

It is technically possible to remove bromate after formation using several treatment approaches, including activated ferrous iron addition, UV irradiation, or membrane and anion exchange resins[3]. However, these methods have been evaluated primarily at bench-scale and pilot level. Information on full-scale application and associated treatment and O&M costs are rare. The USEPA and SWRCB-DDW have both identified control of the ozone treatment process as the BAT for reducing bromate formation. Therefore, no additional BAT and associated cost estimate for bromate was evaluated.

4. SFPUC Programs

Bromide ion is the major precursor of bromate. Bromide levels in the San Andreas and Lower Crystal Springs reservoirs were below 50 ppb based on the past 10 years of data from the SFPUC Annual Monitoring. Raw water from San Andreas Reservoir is treated at HTWTP.

The HTWTP uses ozone for primary disinfection and pre-oxidation. In 2013, SFPUC upgraded its ozone system at the HTWTP to enhance the control of ozone dosing. The enhancement allows the SFPUC to optimize ozone dosage and its residual to meet the disinfection byproducts requirements.

The SFPUC will continue to optimize the ozone dose at the HTWTP to minimize the formation of bromate in the treated water. Additionally, the SFPUC will implement monthly monitoring of bromide at the HTWTP's influent for a year to track the bromide levels for a baseline study, as bromide is the major precursor of bromate formation. Together with the SFPUC's existing watershed management/protection program, these monitoring efforts will prove to be more efficient and effective in addressing the formation of bromate than constructing an expensive treatment facility with uncertain performance results and treatment costs.

C. Hexavalent Chromium

Chromium is a naturally occurring inorganic element that is used in many industrial processes. For decades, both the USEPA and California have enforced drinking water limits of 100 ppb and 50 ppb, respectively, for total chromium which includes trivalent, hexavalent, and other forms of chromium. In 2011, California established a PHG for Cr(VI) of 0.02 ppb. In 2014, the SWRCB-DDW adopted a MCL of 10 ppb for Cr(VI) accompanied with a DLR of 1 ppb. The MCL was subsequently withdrawn by the SWRCB-DDW in 2017 in response to a superior court ruling that the SWRCB-DDW did not adequately document that the MCL was economically feasible. In other words, the MCL was withdrawn because of an administrative procedure issue in the rulemaking process. The court did not make any finding about whether the MCL adequately protected public health, nor did it conclude whether the MCL was too low or too high.

Although the ACWA guidelines suggest only examining contaminants with a MCL and a PHG (or MCLG, if applicable), Cr(VI) was still evaluated for the purpose of this report. This is primarily because Cr(VI) is a potential contaminant of concern with the recent addition of groundwater to the SFWS.

[3] Health Canada, *Guidelines for Canadian Drinking Water Quality: Guideline Technical Document – Bromate*, October 2016

1. SFPUC Water Sample Results

The SFPUC detected Cr(VI) in the distribution system reservoirs in 2017 and 2018, when monitoring of the treated water began with the initiation of the SFGW project. Cr(VI) was regularly detected at low levels below the previous DLR of 1 ppb. The highest concentration detected was 0.93 ppb (Table 4), which is above the PHG of 0.02 ppb. Cr(VI) was also detected in the raw groundwater with a concentration range of 6.1 ppb and 25.1 ppb. The SFPUC utilizes State-approved blending treatment to reduce groundwater concentrations of Cr(VI) far below the previous MCL and DLR level. As such, this section will not further evaluate raw groundwater Cr(VI) concentrations; instead, it focuses on treated water in the SFWS.

Table 4. Maximum Cr(VI) Levels Detected at Monitoring Locations in SFWS and Supply Sources

Compliance Location	Sample Type	Maximum Level Detected (ppb)	Number of Samples
Sunset Reservoir (North) outlet	Treated	0.925	123
Sunset Reservoir (South) outlet	Treated	0.577	106
Sutro Reservoir outlet	Treated	0.529	88
HTWTP	Treated	0.190	3
SVWTP	Treated	0.130	3
Alameda East	Treated	0.039	3
Crystal Springs Pipeline #2	Treated	0.034	1
San Andreas Reservoir	Raw	0.210	3
Lower Crystal Springs Reservoir	Raw	0.200	3
Pond F2	Raw	0.160	1
Pond F3E	Raw	0.120	3
San Antonio Reservoir	Raw	0.120	3
Calaveras Reservoir	Raw	0.096	3
Pilarcitos Reservoir	Raw	0.087	3
Cherry Lake Reservoir	Raw	0.025	3

Cr(VI) was detected in both raw and treated surface water during the SFPUC's annual monitoring in 2016, 2017, and 2018 using a detection limit of 0.02 ppb. The concentrations present in the raw and the treated waters are at similar levels, as the two water treatment plants are not specifically designed for Cr(VI) removal. The raw surface water had Cr(VI) concentrations between <0.02 ppb and 0.21 ppb, whereas the plant effluents had concentrations between 0.023 ppb and 0.190 ppb. All detected concentrations were below 1 ppb.

2. Health Risk Category and Level

The OEHHA characterizes Cr(VI) as carcinogenic. However, most studies of chromium toxicity relate to inhaling airborne Cr(VI) in the workplace rather than ingesting it in drinking water. Non-carcinogenic risks have also been associated with inhalation and/or oral ingestion of Cr(VI), including reproductive toxicity (developmental, male reproductive, and female reproductive toxicity), liver toxicity (mild chronic inflammation, fatty changes), and toxicity of blood-forming tissues.

The OEHHA calculated health-protective levels based on carcinogenic and non-carcinogenic effects. The health-protective level for carcinogenic effects is one-hundredth of the level based on non-carcinogenic effects; thus, the carcinogenic risk was used to calculate the PHG. The cancer risk associated with lifetime consumption of water at the PHG is one in one million excess cancer cases. Cancer risk at the MCL is five per ten thousand excess cancer cases.

3. BATs and Treatment Cost

The SWRCB-DDW previously listed three treatment processes as BATs for Cr(VI) MCL compliance before withdrawing the MCL in 2017. There is little information available about their treatment performance and costs pertaining to large drinking water systems comparable to the SFWS. However, ACWA guidelines provide the unit costs of leading technologies for treating Cr(VI). Theoretically, anion exchange is potentially capable of reducing Cr(VI) to the PHG level.

Because Cr(VI) was detected above its PHG at several compliance monitoring locations for the SFRWS and the SFGW, costs were estimated using three separate surface water treatment facilities and two separate groundwater treatment facilities. With an accuracy range of -50% to +30%, the up-front, lump sum capital cost for treatment at all five sites is estimated at $2.22 billion. The 20-year annualized cost (which includes both capital and O&M costs) is estimated at $1.30 billion. This amount equates to an average SFWS water bill increase of 134%, with a maximum increase of up to 178%. Additional costs may include, but are not limited to, the following:

- Construction, operation, and evaluation of a pilot plant to determine the feasibility and design parameters of the selected treatment technology.
- Pretreatment to reduce pH to a level appropriate for the treatment technology.
- Pretreatment to ensure no additional chemicals and/or contaminants are added or released into treated effluent.
- Post treatment to raise pH back to the level appropriate for corrosion control within the SFWS.
- Excess capacity for redundancy.
- Land acquisition, permitting, environmental mitigations, and O&M costs associated with items above.

It should be noted that anion exchange has only been tested using water with a much higher influent concentration (10-70 ppb) than that considered in this report (< 1 ppb). Lower influent concentrations might affect O&M costs, depending on the performance of the anion exchange resin.

It is impractical to further treat SFWS water for Cr(VI) at this time for the following reasons:

- Cr(VI) concentrations in the treated/drinking water to the SFWS are already very low (no more than one-tenth of the withdrawn MCL).
- Cr(VI) concentrations in the surface water supply are close to the PHG.
- Treatment cost is very high, and performance with large water systems is uncertain.
- Cr(VI) treatment technology is still evolving.
- Treatment with current technology might lead to the increase of other contaminants, such as formaldehyde.[4]

5. SFPUC Programs

Instead of considering expensive Cr(VI) treatment that is questionable in performance and effectiveness, the SFPUC will continue monitoring and protecting water sources, as required by state and federal regulations. Regarding groundwater, the SFPUC currently utilizes State-approved blending treatment to reduce groundwater concentrations of Cr(VI) far below the previous MCL and the DLR level. Regarding surface water, the SFPUC has in place a watershed management/protection program and a chemical quality control program, along with a proactive water quality monitoring program to reduce the likelihood of this contaminant entering into the water. Together, these efforts are significantly far more efficient mechanisms for reducing contaminants than constructing expensive treatment facilities with no assurance of PHG attainment.

D. Gross Alpha Particle Activity

Gross Alpha Particle Activity (herein referred to as **Gross Alpha**) refers to a group of alpha-emitting radionuclides rather than one specific contaminant. Radionuclides are unstable atoms that emit energy in the form of particles or rays, becoming more stable in the process. Radionuclides can be naturally-occurring or manmade. The MCL of 15 pCi/L represents a screening level that, if exceeded, flags the need for further analysis to characterize which alpha-emitters are present. While the OEHHA concluded it would not be practical to adopt a PHG for alpha particle activity, the USEPA has adopted an MCLG of zero pCi/L. The DLR of 3 pCi/L is higher than the MCLG of zero.

1. SFPUC Water Sample Results

Gross Alpha was not detected in the treated water during the reporting period; it was, however, detected in January 2016 at 6.8 pCi/L in a surface water sample collected from Pond F2, a recently approved water source to the SVWTP. The level of detection was below the MCL but above the MCLG of zero.

2. Health Risk Category and Level

Alpha-emitters are carcinogenic, and thus the USEPA has set the MCLG at zero. The increased risk of cancer from alpha-emitters present at the MCL depends on the composition of the alpha-emitters. Theoretically, if the alpha-emitters consisted entirely of the most potent alpha-emitter, Polonium-210, the increased lifetime cancer

[4] During initial testing of one of the resins used for anion exchange in Glendale Project, formaldehyde leached into effluent water above the California Notification Level. A subsequent study showed that pretreatment of resin could reduce formaldehyde levels to below the Notification Level. Different resins would need to be tested with SFWS water to ensure additional chemicals are not inadvertently added to treated effluent.

risk could be as high as one in one thousand. The composition of the alpha-emitters in the single sample from Pond F2 that tested positive in 2016 is unknown, but the sample result was less than one half of the MCL.

3. BATs and Treatment Cost

The USEPA recommends several BATs for treating Gross Alpha. However, only two BATs are potentially capable of treating Gross Alpha beyond the MCL: ion exchange and RO. Theoretically, RO treatment is capable of reducing Gross Alpha to the PHG with a removal rate of 95%[5]. Discussion on potential Gross Alpha BATs and associated costs for RO are presented in Attachment H.

In the previous section discussing BAT for arsenic, a two-pass RO system was evaluated for cost estimation. Since there are no practical treatment methods that can reduce a contaminant, such as Gross Alpha, to zero, this section will evaluate a similar RO system (with the exception that it only requires one-pass) and its treatment cost.

The up-front, lump sum capital cost for a one-pass RO system to treat Gross Alpha from Pond F2 is estimated at $75.2 million. The 20-year annualized cost (which includes both capital and O&M costs) is estimated at $13.0 million. Furthermore, there could be other significant additional costs that are highlighted in the arsenic section.

It should be noted that the efficacy of this BAT is only proven at the MCL level. Since the MCLG is set to zero, even RO cannot be guaranteed to be effective. Furthermore, the analytical technology currently prevalent in the industry is not capable of detecting Gross Alpha at extremely low concentrations. In other words, the success of a new RO facility to reduce Gross Alpha to near the MCLG would be impossible to measure.

In fact, it is impractical to implement treatment to reduce the low levels of Gross Alpha considering that:

- No Gross Alpha was detected in the treated water.
- Treatment cost is high, particularly for a relatively small contribution of water.
- Current available technology and analytical techniques are incapable of completely removing and measuring a zero level of Gross Alpha.

4. SFPUC Programs

The SFPUC has in place a watershed management/protection program and a treatment chemical quality control program to identify and reduce potential contamination sources to the SFWS. Gross Alpha is monitored on an annual basis, which is more frequent than the SWRCB-required triennial monitoring. These efforts, together with a proactive water quality monitoring program, are significantly far more efficient mechanisms for reducing contaminants, including alpha-emitters, than constructing an expensive treatment facility with no assurance of meeting the performance goal.

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[5] Montana, M. Removal of Radionuclides in Drinking Water by Membrane Treatment Using Ultrafiltration, Reverse Osmosis and Electrodialysis Reversal. Journal of Environmental Radioactivity Vol. 125, November 2013, Pages 86-92.

E. Lead

The PHG for lead is 0.2 ppb, which is below the DLR of 5 ppb. The SWRCB-DDW adopted an Action Level of 15 ppb for lead in 1995 and requires that lead concentrations in 90% of water samples collected at customer taps not to exceed the Action Level. The SFPUC laboratory uses a detection limit of 1 ppb, one-fifth of the DLR.

Lead enters drinking water primarily through leaching of lead-containing materials in household plumbing (Figure 4). These materials include lead-based solder used to join copper pipes, brass and/or chrome-plated brass faucets, lead pipe connections from homes to water mains (herein referred to as lead service lines [**LUSL**]), brass/bronze water meters, brass/bronze curb valves, and brass/bronze corporation valves. Corrosion of these materials in a plumbing system can contribute to lead in household drinking water. Note that CHSC §116875 and the Safe Drinking Water Act (**SDWA**) of 2014 require that pipes, fittings, fixtures, solder and flux used in plumbing systems must meet the amended definition of "lead-free", which is more stringent than the previous version specified in the SDWA of 1986.[6] However, older lead-containing materials remain in many households.

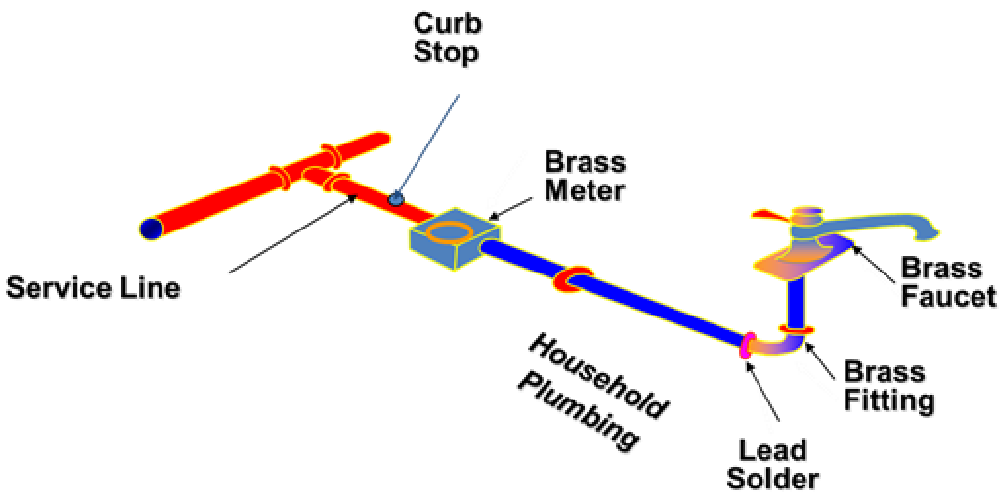

Figure 4. Potential Contributors to Lead in Tap Water from Household Plumbing

There are other lead sources than drinking water present in the environment. For example, lead-based paint was widely used in home painting before 1977. The San Francisco Department of Public Health (**SFDPH**) visits homes of children with elevated blood lead levels to investigate potential environmental causes and inspect for the presence of lead in the home environment. The SFDPH investigations of lead-exposed children in San Francisco have found that the most common sources of environmental lead are lead-based paint, lead-contaminated soil, and take-home exposure of adults employed in the construction industry (Attachment H).

1. SFPUC Water Sample Results

Lead was not detected in raw and treated water samples. The SFPUC conducted its triennial tap water lead and copper monitoring in 2018 according to the schedule approved by the SWRCB-DDW. The monitoring results

[6] Plumbing components are considered "lead-free" if the weighted average lead content of the component's wetted surface area is not more than 0.25%.

showed that the SFWS continues to meet the Action Level for lead at customer taps. However, lead was detected above the PHG of 0.2 ppb in 47 of 90 tap samples. The probable lead source in these tap samples is household plumbing. It is likely that some residences have higher lead levels in their tap water than others because of differences in plumbing materials.

2. Health Risk Category and Values

Lead has multiple toxic effects on the human body. The OEHHA revised the PHG for lead in drinking water from 2 ppb to 0.2 ppb in 2009, based on studies relating to the most sensitive health risks. These are non-carcinogenic, chronic health effects including neurobehavioral effects (decreased intelligence) in children and hypertension (increased blood pressure) in adults. Lead also has the potential to cause kidney disease and cancer. The most sensitive risk is the neurobehavioral effect on children, which is measured using Intelligence Quotient (**IQ**) points. The carcinogenic risks are considered smaller than the risks for chronic toxicity. The public health goal of 0.2 ppb was determined from a maximum daily lead intake of 2.86 micrograms per day, which corresponds to a decrease of one IQ point in children.

3. BATs and Treatment Cost

The SWRCB-DDW considers optimizing corrosion control as the BAT for reducing lead in drinking water and approved the SFPUC's use of pH adjustment in the drinking water as the optimal corrosion control treatment. The SWRCB-DDW requires that a minimum pH value of 8.2 be maintained throughout the transmission and distribution systems. Because the SFWS continues to meet the Action Level for lead and operates the water system with pH greater than 8.2, the SWRCB-requires no additional corrosion control treatment. As the new groundwater source is added to the SFWS' water supply, the SFPUC is currently conducting an independent expert review of groundwater impact on the existing optimal corrosion treatment.

4. SFPUC Programs

In conjunction with existing monitoring efforts and optimized corrosion control treatment, the SFPUC has also implemented the following actions with the goal of reducing the exposure of San Francisco residents to lead in drinking water.

Replacement of Lead Components

1980s Removed approximately 7,000 lead service lines in the distribution system.

1983 Discontinued "leaded" water main joints in the distribution system.

2003 Began replacing curb stop valves with lead-free units if founded.

2008 Began replacing water meters with lead-free units and now over 98% complete.

Public Outreach and Education

The SFPUC has long taken a proactive approach to educating customers about lead in drinking water, its health effects, and ways to reduce lead exposure in drinking water. Below is a list of outreach activity highlights:

1980 Conducted free lead tests of drinking water taps at the San Francisco Unified School District.

1994 Began providing “Lead Test for a Fee” for consumers, testing tap water for a nominal fee.

1996 Began sending customer-focused communications regarding lead issues in bill inserts and annual Water Quality Reports.

Participated in SFDPH’s Childhood Lead Prevention Program to provide laboratory services and water sampling assistance to help investigate the lead sources for cases of high blood levels in children residing in the City.

1998 Began free lead tests for Women, Infants & Children program participants in partnership with the SFDPH.

1997-2010 Provide lead-free faucets to childcare centers and public schools in San Francisco at no cost; offer significantly discounted lead-free faucets to City and County of San Francisco residents via annual sales at street fairs.

2017-2019 Assisted K-12 schools in the City and County of San Francisco in sampling and analysis of lead in drinking water. As of today, the SFPUC completed lead sampling for a total of 198 public and private K-12 schools, including pre-school facilities on public school properties.

Legislative Action

2006 California AB 1953 (Chan) “Lead Plumbing”:

Advocated with other local utilities for a mandate that only “lead-free” plumbing components be used in drinking water supplies. AB 1953 became state law and effective on January 1, 2010.

2010 HR 5289 (Eshoo/Miller) “Get the Lead Out” legislation:

Supported its lead-free provisions, which were subsequently folded into senate bill S.3874, signed into law by the President on January 4, 2011. This federal lead-free requirement, similar to California AB 1953, became effective on January 1, 2014.

Since 2016, the plumbing components used for human consumption in California have been “lead-free”. However, there are likely some minor fittings and joints in older parts of the SFWS that may still contain lead material. Lead-containing parts and/or service line connections, if found during maintenance/repairs, will be quickly replaced. In 2018, SFPUC completed an inventory of LUSL for the SFWS in accordance with Senate Bill 427. The LUSL inventory reported to the SWRCB-DDW has the following findings:

- No lead pipelines were identified.
- 10,912 service lines made of unknown material.

- 4,988 galvanized[7] steel service lines, of which 4,524 may contain short (2 to 3 feet) sections of lead connectors between the customer service line and the water meter.

Identification of the unknown materials will occur during service line repair and replacements in addition to special surveys of sites with unknown material. The ongoing SFPUC policy is to remove and replace any LUSL promptly upon discovered. It could take up to 30 years to replace all service lines of unknown or galvanized materials, depending on final inventory numbers.

In addition to the above lead reduction activities, the SFPUC is working on the development of the following:

- A long-term, recurring lead monitoring program for the K-12 schools in collaboration with the SF Unified School District and SFDPH.
- Lead monitoring assistance for daycare facilities in the City, pending guidance to be released by the SWRCB-DDW.
- Assisting properties in tracking the lead level in tap water after an identified LUSL was replaced.

F. Total Coliform Bacteria

Coliform bacteria are naturally present and ubiquitous in the environment and are not generally considered harmful. Total coliform is used as a proxy measure of bacterial contamination because it can be easily monitored and analyzed. The total coliform MCL specifies that no more than 5.0% of all coliform samples collected from a distribution system in any given month can be positive. The OEHHA has not set a PHG for coliform, but the USEPA has established a MCLG of zero. Positive samples may indicate a potential problem in the distribution system; investigation and follow-up sampling might be required. In reality, a water system will usually have an occasional coliform-positive result. In fact, it is not possible to assure that a system will never get a positive sample.

1. SFPUC Water Sample Results

There were no total coliform positives in both 2016 and 2017. In 2018, two total coliform positives were reported for the SFWS in June resulted in a maximum percentage of 0.6%. No particular trend or pattern suggested the presence of a contamination source. No *E. coli* was detected in any of the coliform-positive samples.

2. Health Risk Category and Values

Because coliform is only an indicator organism for pathogens in drinking water, its numerical health risk cannot be determined. The USEPA has indicated that it is not possible to do so with coliform, since the actual pathogens are not being measured.

[7] Older galvanized material can corrode, which could potentially allow any lead contained therein to accumulate over time. It is estimated that there are 12,000 potable water (rest are fire, other, or are already scheduled to be replaced in planned projects) lines with unknown material and 5000+ galvanized steel service lines.

3. BATs and Treatment Cost

The SWRCB-DDW has specified BATs for total coliform bacteria. One method for reducing coliform-positive incidence is to maintain effective disinfectant residual in the water distribution system. Increasing chlorine residual levels in the SFWS treated water, however, would likely increase the levels of disinfection byproducts (DBPs), which might have adverse health consequences. To maintain effective disinfectant levels in treated water without increasing the levels of DBPs, the SFPUC converted from free chlorine to chloramine as the residual disinfectant in 2004. The cost of chloramine conversion was approximately $47 million.

4. SFPUC Programs

In conjunction with its watershed controls at Hetch Hetchy Reservoir and local water sources, the SFPUC maintains an effective water main flushing/disinfection program, a reservoir cleaning program, and a cross-connection control program. Disinfectant residuals are routinely monitored, and positive pressures are maintained throughout the distribution system. All of these measures help reduce the potential for coliform bacteria to enter San Francisco water sources and distribution system.

V. Recommendations for Further Actions

In accordance with the OEHHA literature,[8] a PHG is not a boundary line between a “safe” and “dangerous” level of a contaminant. Drinking water is considered acceptable for public consumption even if it contains contaminants at levels exceeding the PHG, provided the MCLs are met.

The benefits of reducing the naturally-occurring contaminants, such as arsenic and gross alpha particle activity to their PHG levels are minimal, as long as their levels are well below their corresponding MCL. In the absence of identifiable anthropogenic sources in the Hetch Hetchy and local watersheds, as well as groundwater-bearing zones, the resources required to reduce arsenic and gross alpha particle activity would be better spent on maintaining high levels of water system operations, surveillance, and monitoring programs to achieve the greatest possible protection of public health.

The SFPUC will not only continue optimizing the ozone dose to prevent bromate formation, but also implement a monthly monitoring program to track the bromide level at the HTWTP's influent for a year.

Although there is currently no MCL for Cr(VI), the SFPUC will continue monitoring this naturally-occurring contaminant in the ground water sources so that its long-term steady-state level can be ascertained. Such monitoring results will help the SFWS determine if any future treatment should be considered.

As the major source of lead in tap water is plumbing fixtures on customer premises, the most effective actions that the SFPUC can take to reduce exposure to lead in drinking water are to maintain optimized corrosion control treatment and continue existing lead abatement and public outreach efforts. Identifying and replacing service lines and components of unknown and galvanized materials will also help ensure that lead is not introduced into drinking water.

[8] OEHAA, *Guide to Public Health Goal for Chemicals in Drinking Water*, 2015.

Since the SFPUC is already practicing the BATs for total coliform, no additional treatments are required to meet the MCLG. In fact, the goal of zero samples containing total coliform cannot be practically met every single month.

In summary, the SFPUC will continue existing surveillance and monitoring programs in a proactive manner to control and reduce contaminants entering the water supply to the SFWS.

Attachment A

Excerpt from California Health and Safety Code,
Section 116470(b)-(f)

Attachment A: Excerpt from California Health and Safety Code: Section 116470(b)—(f), Consumer Confidence Report

(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 B

Memo on PHG Monitoring:
Consideration of Contaminants with DLRs Greater than PHGs

To: Stefani Harrison (MWH)
From: Jeff Soller
Cc:
Date: April 19, 2010
Re: PHG Monitoring: Consideration of contaminants with DLRs greater than PHGs

The purpose of this memorandum is to provide a brief overview of issues relevant to Public Health Goal reporting for contaminants which have Detection Limits for Purposes of Reporting (DLRs) greater than the corresponding Public Health Goals (PHGs).

Background

Public Health Goals:
The California Safe Drinking Water Act of 1996 (Health and Safety Code, Section 116365) requires the Office of Environmental Health Hazard Assessment (OEHHA) to adopt PHGs for contaminants in drinking water based exclusively on public health considerations. PHGs are developed for chemical contaminants based on the best available toxicological data in the scientific literature and are set for contaminants with a Maximum Contaminant Level (MCL), and for those contaminants for which the California Department of Public Health (DPH) will be adopting MCLs[1].

Whereas PHGs are to be based solely on scientific and public health considerations without regard to economic cost considerations or technical feasibility, drinking water standards adopted by DPH consider economic factors and technical feasibility. Each primary drinking water standard adopted by DPH is set at a level that is as close as feasible to the corresponding PHG, placing emphasis on the protection of public health. PHGs are not regulatory in nature and represent non-mandatory goals.

PHGs for cancer-causing substances are set at a level of 10^{-6}, or up to one excess case of cancer per million people per 70-year lifetime exposure (this level is also known as a "de minimis" cancer risk). Public health and environmental regulatory agencies generally set risks within the 10^{-4} to 10^{-6} cancer risk range, and through precedent this range is generally considered “acceptable” or “tolerable”.

For chemicals considered to be non-carcinogens, PHGs are set at a level equivalent to the no observed adverse effect level (NOAEL) divided by an uncertainty factor (UF) that reflects limitation in available scientific information related to the evaluation of effects. For some contaminants, the UF may include an extra 10-fold factor to account for a possibility of cancer-this might occur for example, if the chemical is known to be carcinogenic when inhaled, but hasn't be found to be carcinogenic when ingested.

[1] http://www.cdph.ca.gov/certlic/drinkingwater/Pages/MCLsandPHGs.aspx

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Method Detection Limit (MDL) [2]—The MDL is the lowest concentration at which an analyte can be detected in a sample that does not cause matrix interferences (typically determined using spiked reagent water). In this context, "detected" means that a sample that contains the analyte detected at the MDL can be distinguished from a blank with 99% certainty. The MDL is a laboratory-specific number, dependent on the instrumentation used by a particular laboratory and the skill of the operator. This number may change with time.

Reporting Limit (RL)—The RL, as defined by DPH's Sanitation and Radiation Laboratories Branch, 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. A criterion of ± 20% accuracy and 20% relative standard deviation for replicate determinations is often used to define "reasonable". The acceptable ranges depend on the analytical methodology used. For samples that do not pose a particular matrix problem, the RL is typically three to five times higher than the MDL. Similar to the MDL, the RL is a laboratory-specific number, which may change with time. When a sample has to be diluted before analysis, either because of matrix problems or to get the instrument response within the linear dynamic range, the RL is raised by a factor corresponding to the dilution factor.

Detection Limit for Purposes of Reporting (DLR) —The DLR is a parameter that is set by regulation for each reportable analyte. It is not laboratory specific and it is independent of the analytical method used (in cases where several methods are approved). The DLR cannot be changed by the laboratory. DPH expects that a laboratory can achieve a Reporting Limit (RL, see above) that is lower than or equal to the DLR set by the State.

Basis for the first designation of a DLR

For a particular contaminant in drinking water, the DLR is established along with an MCL via regulation (http://www.cdph.ca.gov/certlic/drinkingwater/Documents/Drinkingwaterlabs/detectionlimitsdefinition.pdf). A DLR is usually established at a level that is approximately five times higher than the MDL. These levels are set such that DPH is confident about the value being reported. The DLR is intentionally set at a value that can be met by most commercial labs, not only the one(s) with the most sensitive equipment or methods.

Revision of a DLR

The most common basis for a revision of a DLR is a change in the MCL for a particular contaminant. Moreover, a revision would only occur if the existing DLR is thought to be inadequate. A DLR is typically not reviewed or revised without an associated change in the contaminant's MCL. However, a change in the MCL for a particular contaminant would not necessarily result in a revised DLR. For example, in 2003 the atrazine MCL was changed and was accompanied by a slight reduction in the DLR. However, the 2008 change in the arsenic MCL was not accompanied by a change in the DLR. DLRs are typically not reviewed or revised solely based on the availability of new or improved analytical methods.

[2] http://www.cdph.ca.gov/certlic/drinkingwater/Documents/Drinkingwaterlabs/detectionlimitsdefinition.pdf

Upcoming revisions to DLRs for specific constituents

Currently, there is not any explicit effort to revise the DLRs for any specific contaminants. Moreover, there does not seem to be an overarching public health concern about the DLRs for any of the contaminants that have DLRs > PHGs.

Laboratories are always seeking to improve detection limits. This is particularly the case for new contaminants, such as the emerging contaminants that are currently the subject of much ongoing research (endocrine disrupting compounds, pharmaceutically active compounds, etc.). These improvements might result in methods that can detect lower concentrations of contaminants, but as indicated above, new or improved methods and the resulting new MDLs would not necessarily lead to lower DLRs. For unregulated contaminants, these improvements would be part of the scientific processes associated with developing a better understanding of the new contaminants. For regulated contaminants, a lower DLR might accompany a change in an MCL, if needed.

Process of changing a DLR

Regulated (or soon to be regulated) contaminants are the only ones with formal DLRs. To revise a DLR, a change would be required in the DPH's regulations. This would occur via the Administrative Procedure Act and thus, would not require new legislation. However, this course of action would be extremely unlikely for a particular DLR without a concurrent change in an MCL, and then would occur only if the existing DLR is thought to be inadequate.

Alternatives for proactive action

In cases where a particular contaminant's DLR is greater than the associated PHG, monitoring results could result in one of three distinct outcomes (depending in part on the RL employed for the analyses): 1) Detectable results above the DLR– these types of results indicate that the PHG is not being met, 2) Detectable results below the DLR – these types of results could lead to ambiguous reporting and interpretation with respect to whether or not the PHG was exceeded and 3) Results which are all below detectable limits – these types of results yield ambiguous interpretation with respect to whether or not the PHG was exceeded.

Currently, there does not seem to be an overarching public health concern from the State health agency about monitoring results of the second or third type. Nevertheless, should a water Agency desire to be proactive with respect to these types of results, there are several viable alternatives.

- For any contaminant of concern, conduct laboratory analyses using analytical methods that have an MDL less than the DLR (provided that such methods are available) and report those results. Representative potential drawbacks to this approach are increased monitoring costs, limited availability of laboratories to conduct the analyses, and increased uncertainty in the reported results.

- Limit the scope of the potential contaminants of concern by evaluating which contaminants (with DLRs > PHGs) could reasonably be present in the water source (For example, banned agricultural pesticides are less likely to be present in an urban environment, and industrial chemicals are less likely in areas where that industry is not present), and use existing source control information or additional source control efforts to provide context about the potential presence of these contaminants.

Attachment C

Health Risk Information for Public Health Goal Exceedance Reports

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 (1.7×10^{-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)	0.013	NA	0.006	NA
1,2-Dichloro-ethylene, trans	immunotoxicity (harms the immune system)	0.05	NA	0.01	NA
Dichloromethane (methylene chloride)	carcinogenicity (causes cancer)	0.004	1×10^{-6}	0.005	1×10^{-6} (one per million)

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

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

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

Chemical	Health Risk Category[1]	California PHG (mg/L)[2]	Cancer Risk[3] at the PHG	California MCL[4] (mg/L)	Cancer Risk at the California MCL
Fluoride	musculoskeletal toxicity (causes tooth mottling)	1	NA	2	NA
Glyphosate	nephrotoxicity (harms the kidney)	0.9	NA	0.7	NA
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	$1x10^{-6}$	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 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://www.oehha.ca.gov/water/reports/grossab.html.
[10] pCi/L = picocuries per liter of water.

Attachment D

PHGs/MCLGs and SFPUC Analytical Results

Table D-1a: List of Contaminants with PHGs and SFPUC 2016-2018 Analytical Results (Raw Water)

	Contaminant with PHG	Unit	OEHHA PHG[1]	DLR	MCL	Max SFPUC Sample Results (Raw Surface Water)			Max SFPUC Sample Results (Raw Groundwater)		
						2016	2017	2018	2016	2017	2018
1	1,1,1-Trichloroethane	ppb	1000	0.5	200	ND	ND	ND	---	---	ND
2	1,1,2,2-Tetrachloroethane	ppb	0.1	0.5	1	ND	ND	ND	---	---	ND
3	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	ppb	4000	10	1200	ND	ND	ND	---	---	ND
4	1,1,2-Trichloroethane	ppb	0.3	0.5	5	ND	ND	ND	---	---	ND
5	1,1-Dichloroethane	ppb	3	0.5	5	ND	ND	ND	---	---	ND
6	1,1-Dichloroethylene	ppb	10	0.5	6	ND	ND	ND	---	---	ND
7	1,2,3-Trichloropropane	ppb	0.0007	0.005	0.005	---	ND	ND	---	---	ND
8	1,2,4-Trichlorobenzene	ppb	5	0.5	5	ND	ND	ND	---	---	ND
9	1,2-Dibromo-3-chloropropane (DBCP)	ppb	0.0017	0.01	0.2	---	---	ND	---	---	ND
10	1,2-Dichlorobenzene	ppb	600	0.5	600	ND	ND	ND	---	---	ND
11	1,2-Dichloroethane	ppb	0.4	0.5	0.5	ND	ND	ND	---	---	ND
12	1,2-Dichloropropane	ppb	0.5	0.5	5	ND	ND	ND	---	---	ND
13	1,3-Dichloropropene	ppb	0.2	0.5	0.5	ND	ND	ND	---	---	ND
14	1,4-Dichlorobenzene	ppb	6	0.5	5	ND	ND	ND	---	---	ND
15	2,3,7,8-TCDD (Dioxin)	ppq	0.05	5	30	---	---	ND	---	---	ND
16	2,4,5-TP (Silvex)	ppb	3	1	50	---	---	ND	---	---	ND
17	2,4-Dichlorophenoxyacetic Acid (2,4-D)	ppb	20	10	70	---	---	ND	---	---	ND
18	Alachlor	ppb	4	1	2	---	---	ND	---	---	ND
19	Aluminum	ppb	600	50	1000	142	142	386	---	---	ND
20	Antimony	ppb	1	6	6	ND	ND	ND	---	---	ND
21	Arsenic	ppb	0.004	2	10	2.08	ND	2.3	---	---	ND
22	Asbestos	MFL	7	0.2	7	---	---	ND	---	---	ND
23	Atrazine	ppb	0.15	0.5	1	---	---	ND	---	---	ND
24	Barium	ppb	2000	100	1000	ND	ND	101	---	---	ND
25	Bentazon	ppb	200	2	18	---	---	ND	---	---	ND
26	Benzene	ppb	0.15	0.5	1	ND	ND	ND	---	---	ND
27	Benzo(a)pyrene	ppb	0.007	0.1	0.2	---	---	ND	---	---	ND
28	Beryllium	ppb	1	1	4	ND	ND	ND	---	---	ND
29	Bromate	ppb	0.1	5	10	---	---	---	---	---	ND
30	Cadmium	ppb	0.04	1	5	ND	ND	ND	---	---	ND
31	Carbofuran	ppb	0.7	5	18	---	---	ND	---	---	ND
32	Carbon tetrachloride	ppb	0.1	0.5	0.5	ND	ND	ND	---	---	0.83
33	Chlordane	ppb	0.03	0.1	0.1	---	---	ND	---	---	ND
34	Chlorite	ppm	0.05	0.02	1	---	---	---	---	---	ND
35	cis-1,2-dichloroethylene	ppb	13	0.5	6	ND	ND	ND	---	---	ND
36	Copper, Cu	ppb	300	50	1300 (AL)[2]	ND	ND	ND	---	---	ND
37	Cyanide	ppb	150	100	150	---	---	ND	---	---	ND
38	Dalapon	ppb	790	10	200	---	---	ND	---	---	ND
39	Di(2-ethylhexyl)adipate	ppb	200	5	400	---	---	ND	---	---	ND
40	Di(2-ethylhexyl)phthalate (DEHP)	ppb	12	3	4	---	---	ND	---	---	ND
41	Dichloromethane (Methylene chloride)	ppb	4	0.5	5	ND	ND	ND	---	---	ND
42	Dinoseb	ppb	14	2	7	---	---	ND	---	---	ND
43	Diquat	ppb	6	4	20	---	---	ND	---	---	ND
44	Endothall	ppb	94	45	100	---	---	ND	---	---	ND
45	Endrin	ppb	0.3	0.1	2	---	---	ND	---	---	ND
46	Ethylbenzene	ppb	300	0.5	300	ND	ND	ND	---	---	ND
47	Ethylene dibromide (EDB)	ppb	0.01	0.02	0.05	---	---	ND	---	---	ND
48	Fluoride	ppm	1	0.1	2	0.70	0.70	0.70	---	---	0.101
49	Glyphosate	ppb	900	25	700	---	---	ND	---	---	ND
50	Heptachlor	ppb	0.008	0.01	0.01	---	---	ND	---	---	ND
51	Heptachlor Epoxide	ppb	0.006	0.01	0.01	---	---	ND	---	---	ND
52	Hexachlorobenzene	ppb	0.03	0.5	1	---	---	ND	---	---	ND

Table D-1a: List of Contaminants with PHGs and SFPUC 2016-2018 Analytical Results (Raw Water)

	Contaminant with PHG	Unit	OEHHA PHG(1)	DLR	MCL	Max SFPUC Sample Results (Raw Surface Water)			Max SFPUC Sample Results (Raw Groundwater)		
						2016	2017	2018	2016	2017	2018
53	Hexachlorocyclopentadiene	ppb	2	1	50	---	---	ND	---	---	ND
54	Hexavalent Chromium	ppb	0.02	--	--	0.18	0.21	0.16	---	7.9	25.1
55	Lead, Pb	ppb	0.2	5	15 (AL) (2)	ND	ND	ND	---	---	ND
56	Lindane	ppb	0.032	0.2	0.2	---	---	ND	---	---	ND
57	Mercury (inorganic)	ppb	1.2	1	2	ND	ND	ND	---	---	ND
58	Methoxychlor	ppb	0.09	10	30	---	---	ND	---	---	ND
59	Methyl t-butyl ether (MTBE)	ppb	13	3	13	ND	ND	ND	---	---	ND
60	Molinate	ppb	1	2	20	---	---	ND	---	---	ND
61	Monochlorobenzene	ppb	70	0.5	70	ND	ND	ND	---	---	ND
62	Nickel	ppb	12	10	100	ND	ND	ND	---	---	ND
63	Nitrate (as NO3)	ppm	10	0.4	10	ND	ND	ND	---	5.77	11.5
64	Nitrite (as N)	ppm	1	0.4	1	ND	ND	ND	---	---	ND
65	Nitrate + Nitrite (as N)	ppm	10	0.4	10	ND	ND	ND	---	---	ND
66	Oxamyl	ppb	26	20	50	---	---	ND	---	---	ND
67	Pentachlorophenol	ppb	0.3	0.2	1	---	---	ND	---	---	ND
68	Perchlorate	ppb	1	4	6	ND	ND	ND	---	---	ND
69	Picloram	ppb	166	1	500	---	---	ND	---	---	ND
70	Polychlorinated biphenyls (PCBs)	ppb	0.09	0.5	0.5	---	---	ND	---	---	ND
71	Selenium	ppb	30	5	50	ND	ND	ND	---	---	ND
72	Simazine	ppb	4	1	4	---	---	ND	---	---	ND
73	Strontium-90	pCi/L	0.35	2	8	ND	---	ND	---	---	ND
74	Styrene	ppb	0.5	0.5	100	ND	ND	ND	---	---	ND
75	Tetrachloroethylene (PCE)	ppb	0.06	0.5	5	ND	ND	ND	---	---	1.86
76	Thallium, Tl	ppb	0.1	1	2	ND	ND	ND	---	---	ND
77	Thiobencarb	ppb	42	1	70	---	---	ND	---	---	ND
78	Toluene	ppb	150	0.5	150	ND	ND	ND	---	---	ND
79	Toxaphene	ppb	0.03	1	3	---	---	ND	---	---	ND
80	trans-1,2-Dichloroethylene	ppb	50	0.5	10	ND	ND	ND	---	---	ND
81	Trichloroethylene (TCE)	ppb	1.7	0.5	5	ND	ND	ND	---	---	ND
82	Trichlorofluoromethane (F-11)	ppb	1300	5	150	ND	ND	ND	---	---	ND
83	Tritium	pCi/L	400	1000	20000	ND	---	ND	---	---	ND
84	Uranium	pCi/L	0.43	1	20	ND	---	ND	---	---	ND
85	Vinyl chloride	ppb	0.05	0.5	0.5	ND	ND	ND	---	---	ND
86	Xylene (total: p, m, o)	ppb	1800	0.5	1750	ND	ND	ND	---	---	ND

ND = Not detected at levels above the DLR
pCi/L = picocuries per liter
ppb = parts per billion
ppm = parts per million
ppq = parts per quintillion
--- = not analyzed during reporting period

Notes:

(1) OEHHA PHGs as of February 2019. Data source: OEHHA's website: http://www.oehha.ca.gov

(2) AL = Action Levels as defined in Title 22, Section 64671.0.5

Table D-1b: List of Contaminants with PHGs and SFPUC 2016-2018 Analytical Results (Treated Water)

	Contaminant with PHG	Unit	OEHHA PHG[1]	DLR	MCL	Max SFPUC Sample Results (Treated Water)		
						2016	2017	2018
1	1,1,1-Trichloroethane	ppb	1000	0.5	200	ND	ND	ND
2	1,1,2,2-Tetrachloroethane	ppb	0.1	0.5	1	ND	ND	ND
3	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	ppb	4000	10	1200	ND	ND	ND
4	1,1,2-Trichloroethane	ppb	0.3	0.5	5	ND	ND	ND
5	1,1-Dichloroethane	ppb	3	0.5	5	ND	ND	ND
6	1,1-Dichloroethylene	ppb	10	0.5	6	ND	ND	ND
7	1,2,3-Trichloropropane	ppb	0.0007	0.005	0.005	ND	ND	--
8	1,2,4-Trichlorobenzene	ppb	5	0.5	5	ND	ND	ND
9	1,2-Dibromo-3-chloropropane (DBCP)	ppb	0.0017	0.01	0.2	---	---	--
10	1,2-Dichlorobenzene	ppb	600	0.5	600	ND	ND	ND
11	1,2-Dichloroethane	ppb	0.4	0.5	0.5	ND	ND	ND
12	1,2-Dichloropropane	ppb	0.5	0.5	5	ND	ND	ND
13	1,3-Dichloropropene	ppb	0.2	0.5	0.5	ND	ND	ND
14	1,4-Dichlorobenzene	ppb	6	0.5	5	ND	ND	ND
15	2,3,7,8-TCDD (Dioxin)	ppq	0.05	5	30	---	---	--
16	2,4,5-TP (Silvex)	ppb	3	1	50	---	---	--
17	2,4-Dichlorophenoxyacetic Acid (2,4-D)	ppb	20	10	70	---	---	--
18	Alachlor	ppb	4	1	2	---	---	ND
19	Aluminum	ppb	600	50	1000	88.7	243	ND
20	Antimony	ppb	1	6	6	ND	ND	ND
21	Arsenic	ppb	0.004	2	10	ND	ND	ND
22	Asbestos	MFL	7	0.2	7	---	---	--
23	Atrazine	ppb	0.15	0.5	1	---	---	ND
24	Barium	ppb	2000	100	1000	ND	ND	ND
25	Bentazon	ppb	200	2	18	---	---	--
26	Benzene	ppb	0.15	0.5	1	ND	ND	ND
27	Benzo(a)pyrene	ppb	0.007	0.1	0.2	---	---	ND
28	Beryllium	ppb	1	1	4	ND	ND	ND
29	Bromate	ppb	0.1	5	10	ND	5.3	ND
30	Cadmium	ppb	0.04	1	5	ND	ND	ND
31	Carbofuran	ppb	0.7	5	18	---	---	--
32	Carbon tetrachloride	ppb	0.1	0.5	0.5	ND	ND	ND
33	Chlordane	ppb	0.03	0.1	0.1	---	---	ND
34	Chlorite	ppm	0.05	0.02	1	ND	ND	ND
35	cis-1,2-dichloroethylene	ppb	13	0.5	6	ND	ND	ND
36	Copper, Cu	ppb	300	50	1300 (AL)[2]	ND	ND	ND
37	Cyanide	ppb	150	100	150	ND	---	---
38	Dalapon	ppb	790	10	200	---	---	---
39	Di(2-ethylhexyl)adipate	ppb	200	5	400	---	---	ND
40	Di(2-ethylhexyl)phthalate (DEHP)	ppb	12	3	4	---	---	ND
41	Dichloromethane (Methylene chloride)	ppb	4	0.5	5	ND	ND	ND
42	Dinoseb	ppb	14	2	7	---	---	---
43	Diquat	ppb	6	4	20	---	---	---
44	Endothall	ppb	94	45	100	---	---	---
45	Endrin	ppb	0.3	0.1	2	---	---	ND
46	Ethylbenzene	ppb	300	0.5	300	ND	ND	ND
47	Ethylene dibromide (EDB)	ppb	0.01	0.02	0.05	---	---	---
48	Fluoride	ppm	1	0.1	2	0.80	0.81	0.92
49	Glyphosate	ppb	900	25	700	---	---	---
50	Heptachlor	ppb	0.008	0.01	0.01	---	---	ND

Table D-1b: List of Contaminants with PHGs and SFPUC 2016-2018 Analytical Results (Treated Water)

	Contaminant with PHG	Unit	OEHHA PHG[1]	DLR	MCL	Max SFPUC Sample Results (Treated Water)		
						2016	2017	2018
51	Heptachlor Epoxide	ppb	0.006	0.01	0.01	---	---	ND
52	Hexachlorobenzene	ppb	0.03	0.5	1	---	---	ND
53	Hexachlorocyclopentadiene	ppb	2	1	50	---	---	ND
54	Hexavalent Chromium	ppb	0.02	--	--	0.110	0.208	0.925
55	Lead, Pb	ppb	0.2	5	15 (AL)[2]	ND	ND	ND
56	Lindane	ppb	0.032	0.2	0.2	---	---	---
57	Mercury (inorganic)	ppb	1.2	1	2	ND	ND	ND
58	Methoxychlor	ppb	0.09	10	30	---	---	ND
59	Methyl t-butyl ether (MTBE)	ppb	13	3	13	ND	ND	ND
60	Molinate	ppb	1	2	20	---	---	ND
61	Monochlorobenzene	ppb	70	0.5	70	ND	ND	ND
62	Nickel	ppb	12	10	100	ND	ND	ND
63	Nitrate (as NO3)	ppm	10	0.4	10	ND	ND	0.436
64	Nitrite (as N)	ppm	1	0.4	1	ND	ND	ND
65	Nitrate + Nitrite (as N)	ppm	10	0.4	10	ND	ND	ND
66	Oxamyl	ppb	26	20	50	---	---	---
67	Pentachlorophenol	ppb	0.3	0.2	1	---	---	---
68	Perchlorate	ppb	1	4	6	ND	ND	ND
69	Picloram	ppb	166	1	500	---	---	---
70	Polychlorinated biphenyls (PCBs)	ppb	0.09	0.5	0.5	---	---	ND
71	Selenium	ppb	30	5	50	ND	ND	ND
72	Simazine	ppb	4	1	4	---	---	ND
73	Strontium-90	pCi/L	0.35	2	8	---	---	---
74	Styrene	ppb	0.5	0.5	100	ND	ND	ND
75	Tetrachloroethylene (PCE)	ppb	0.06	0.5	5	ND	ND	ND
76	Thallium, Tl	ppb	0.1	1	2	ND	ND	ND
77	Thiobencarb	ppb	42	1	70	---	---	ND
78	Toluene	ppb	150	0.5	150	ND	ND	ND
79	Toxaphene	ppb	0.03	1	3	---	---	ND
80	trans-1,2-Dichloroethylene	ppb	50	0.5	10	ND	ND	ND
81	Trichloroethylene (TCE)	ppb	1.7	0.5	5	ND	ND	ND
82	Trichlorofluoromethane (F-11)	ppb	1300	5	150	ND	ND	ND
83	Tritium	pCi/L	400	1000	20000	---	---	---
84	Uranium	pCi/L	0.43	1	20	---	---	---
85	Vinyl chloride	ppb	0.05	0.5	0.5	ND	ND	ND
86	Xylene (total: p, m, o)	ppb	1800	0.5	1750	ND	ND	ND

ND = Not detected at levels above the DLR
pCi/L = picocuries per liter
ppb = parts per billion
ppm = parts per million
ppq = parts per quintillion
--- = not analyzed during reporting period

Notes:

(1) OEHHA PHGs as of February 2019. Data source: OEHHA's website: http://www.oehha.ca.gov

(2) AL = Action Levels as defined in Title 22, Section 64671.0.5

Table D-2a: List of Contaminants with MCLGs (but no PHGs) and SFPUC 2016-2018 Analytical Results (Raw Water)

	Contaminant with PHG	Unit	USEPA MCLG(1)	DLR	MCL	Max SFPUC Sample Results (Raw Surface Water)			Max SFPUC Sample Results (Raw Groundwater)		
						2016	2017	2018	2016	2017	2018
1	Chromium, Total	ppb	100	10	50	ND	ND	ND	---	---	21.6
2	*Cryptosporidium*	ppb	zero	--	TT	---	---	---	---	---	---
3	*Giardia lamblia*	ppb	zero	--	TT	---	---	---	---	---	---
4	Gross Alpha particles	pCi/L	zero	3	15	6.8	---	ND	---	---	ND
5	Gross Beta particles	mrem/yr	zero	4 (pCi/L)	4	ND	---	ND	---	---	ND
6	*Legionella*	ppb	zero	--	TT	---	---	---	---	---	---
7	Radium-226 + Radium-228	pCi/L	zero	--	5	ND	--	ND	---	---	ND
8	Total Coliform(4)	%	zero	--	5	---	---	---	---	---	0%
9	Viruses	ppb	zero	--	TT	---	---	---	---	---	---

ND = Not detected at levels above the DLR
mrem/yr = millirem per year
pCi/L = picocuries per liter
ppb = parts per billion
--- = not analyzed during reporting period

Notes:

(1) Maximum Contaminant Level Goal established by the USEPA

(2) TT = The MCL is a treatment technique, no monitoring is required. SFPUC meets the requirements of the Surface Water Treatment Rule, and thus the MCLG is considered to be met.

Table D-2a: List of Contaminants with MCLGs (but no PHGs) and SFPUC 2016-2018 Analytical Results (Treated Water)

	Contaminant with PHG	Unit	USEPA MCLG[(1)]	DLR	MCL	Max SFPUC Sample Results (Treated Water)		
						2016	2017	2018
1	Chromium, Total	ppb	100	10	50	ND	ND	ND
2	*Cryptosporidium*	ppb	zero	--	TT	Note 2	Note 2	Note 2
3	*Giardia lamblia*	ppb	zero	--	TT	Note 2	Note 2	Note 2
4	Gross Alpha particles	pCi/L	zero	3	15	--	--	--
5	Gross Beta particles	mrem/yr	zero	4 (pCi/L)	4	--	ND	--
6	*Legionella*	ppb	zero	--	TT	Note 2	Note 2	Note 2
7	Radium-226 + Radium-228	pCi/L	zero	--	5	--	--	--
8	Total Coliform[(4)]	%	zero	--	5	0%	0%	0.60%
9	Viruses	ppb	zero	--	TT	Note 2	Note 2	Note 2

ND = Not detected at levels above the DLR   mrem/yr = millirem per year   pCi/L = picocuries per liter

ppb = parts per billion   --- = not analyzed during reporting period

Notes:

(1) Maximum Contaminant Level Goal established by the USEPA

(2) TT = The MCL is a treatment technique, no monitoring is required. SFPUC meets the requirements of the Surface Water Treatment Rule, and thus the MCLG is considered to be met.

Attachment E

SFPUC Water Quality Reports 2016, 2017, and 2018

Key Water Quality Terms

Following are definitions of key terms referring to standards and goals of water quality noted on the adjacent data table.

Public Health Goal (PHG): The level of a contaminant in drinking water below which there is no known or expected risk to health. PHGs are set by the California Environmental Protection Agency.

Maximum Contaminant Level Goal (MCLG): The level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs are set by the USEPA.

Maximum Contaminant Level (MCL): The highest level of a contaminant that is allowed in drinking water. Primary MCLs are set as close to the PHGs or MCLGs as is economically and technologically feasible. Secondary MCLs (SMCLs) are set to protect the odor, taste, and appearance of drinking water.

Maximum Residual Disinfectant Level (MRDL): The highest level of a disinfectant allowed in drinking water. There is convincing evidence that addition of a disinfectant is necessary for control of microbial contaminants.

Maximum Residual Disinfectant Level Goal (MRDLG): The level of a drinking water disinfectant below which there is no known or expected risk to health. MRDLGs do not reflect the benefits of the use of disinfectants to control microbial contaminants.

Primary Drinking Water Standard (PDWS): MCLs and MRDLs for contaminants that affect health along with their monitoring and reporting requirements, and water treatment requirements.

Regulatory Action Level: The concentration of a contaminant which, if exceeded, triggers treatment or other requirements that a water system must follow.

Treatment Technique (TT): A required process intended to reduce the level of a contaminant in drinking water.

Turbidity: A water clarity indicator that measures cloudiness of the water, and is also used to indicate the effectiveness of the filtration system. High turbidity can hinder the effectiveness of disinfectants.

Cryptosporidium is a parasitic microbe found in most surface water. We regularly test for this waterborne pathogen, and found it at very low levels in source water and treated water in 2016. However, current test methods approved by the USEPA do not distinguish between dead organisms and those capable of causing disease. Ingestion of *Cryptosporidium* may produce symptoms of nausea, abdominal cramps, diarrhea and associated headaches. *Cryptosporidium* must be ingested to cause disease, and it may be spread through means other than drinking water.

This report contains important information about your drinking water. Translate it, or speak with someone who understands it.

Este informe contiene información muy importante sobre su agua potable. Tradúzcalo o hable con alguien que lo entienda bien.

Mahalaga ang impormasyong ito. Mangyaring ipasalin ito.

این اطلاعیه شامل اطلاعات مهمی راجع به آب آشامیدنی است.اگر نمیتوانید این اطلاعات را بزبان انگلیسی بخوانید لطفا از کسی که میتواند یاری بگیرید تا مطالب را برای شما به فارسی ترجمه کند.

Cé rapport contient des information importantes concernant votre eau potable. Veuillez traduire, ou parlez avec quelqu' un qui peut le comprendre.

"هذا ألتقرير يحتوي على معلوماَ ت مهمّة تتعلق بمياه ألشفة (أو ألشرب).
ترجم ألتقرير, أو تكلم مع شخص يستطيع أن يفهم ألتقرير."

Этот отчет содержит важную информацию о вашей питьевой воды. Переведите его или поговорите с тем, кто это понимает.

הדו"ח הזה מכיל מידע חשוב לגבי מי השתייה שלך
תרגם את הדו"ח או דבר עם מישהו שמבין אותו

此份水質報告, 內有重要資訊。請找他人為你翻譯和解說清楚。

Chi tiết này thật quan trọng. Xin nhờ người dịch cho quý vị.

Dieser Bericht enthält wichtige Information über Ihr Trinkwasser. Bitte übersetzen Sie ihn oder sprechen Sie mit jemandem, der ihn versteht.

Questo rapporto contiene informazioni importanti che riguardano la vostra aqua potabile. Traducetelo, o parlate con una persona qualificata in grado di spiegarvelo.

この報告書には上水道に関する重要な情報が記されております。翻訳を御依頼なされるか、内容をご理解なさっておられる方にお尋ね下さい。

यह सूचना महत्वपूर्ण है । कृपा करके किसी से :सका अनुवाद करायें ।

이 안내는 매우 중요합니다. 본인을 위해 번역인을 사용하십시오.

Η κατωθεν αναφορα παρουσιαζη σπουδαιες πληροφορειες για το ποσιμο νερο σας. Πρακαλω να το μεταφρασετε η να το σζολειασετε με καποιον που το καταλαβαινη απολητως.

City of San Francisco - Water Quality Data for 2016

The table below lists all 2016 detected drinking water contaminants and the information about their typical sources. Contaminants below detection limits for reporting purposes are not shown, in accord with regulatory guidance. We hold a SWRCB-DDW monitoring waiver for some contaminants and therefore their monitoring frequencies are less than annual. *Visit **www.sfwater.org** for a list of water quality parameters we monitored in raw water and treated water in 2016.*

DETECTED CONTAMINANTS	UNIT	MCL	PHG OR (MCLG)	RANGE OR LEVEL FOUND	AVERAGE OR [MAX]	MAJOR SOURCES IN DRINKING WATER
TURBIDITY						
Unfiltered Hetch Hetchy Water	NTU	5	N/A	0.3 - 0.5 (1)	[3.2]	Soil runoff
Filtered Water from Sunol Valley Water Treatment Plant (SVWTP)	NTU	1 (2)	N/A	-	[1]	Soil runoff
	-	Min 95% of samples ≤ 0.3 NTU (2)	N/A	98% - 100%	-	Soil runoff
Filtered Water from Harry Tracy Water Treatment Plant (HTWTP)	NTU	1 (2)	N/A	-	[0.06]	Soil runoff
	-	Min 95% of samples ≤ 0.3 NTU (2)	N/A	100%	-	Soil runoff
DISINFECTION BYPRODUCTS AND PRECURSOR						
Total Trihalomethanes	ppb	80	N/A	27 - 68	[55] (3)	Byproduct of drinking water disinfection
Haloacetic Acids	ppb	60	N/A	12 - 65	[45] (3)	Byproduct of drinking water disinfection
Total Organic Carbon (4)	ppm	TT	N/A	1.6 - 5.3	2.4	Various natural and man-made sources
MICROBIOLOGICAL						
Total Coliform	-	NoP ≤5.0% of monthly samples	(0)	-	[0.3%]	Naturally present in the environment
Giardia lamblia	cyst/L	TT	(0)	0 - 0.11	0.03	Naturally present in the environment
INORGANICS						
Fluoride (source water) (5)	ppm	2.0	1	ND - 0.8	0.3 (6)	Erosion of natural deposits; water additive to promote strong teeth
Chloramine (as chlorine)	ppm	MRDL = 4.0	MRDLG = 4	<0.1 - 3	[2.5] (7)	Drinking water disinfectant added for treatment

CONSTITUENTS WITH SECONDARY STANDARDS	UNIT	SMCL	PHG	RANGE	AVERAGE	MAJOR SOURCES OF CONTAMINANT
Aluminum (8)	ppb	200	600	ND - 55	ND	Erosion of natural deposits; some surface water treatment residue
Chloride	ppm	500	N/A	<3 - 16	8.8	Runoff / leaching from natural deposits
Color	unit	15	N/A	<5 - 11	<5	Naturally-occurring organic materials
Specific Conductance	µS/cm	1600	N/A	31 - 218	146	Substances that form ions when in water
Sulfate	ppm	500	N/A	1 - 30	16	Runoff / leaching from natural deposits
Total Dissolved Solids	ppm	1000	N/A	<20 - 95	63	Runoff / leaching from natural deposits
Turbidity	NTU	5	N/A	ND - 0.5	0.2	Soil runoff

LEAD AND COPPER (9)	UNIT	AL	PHG	RANGE	90TH PERCENTILE	MAJOR SOURCES IN DRINKING WATER
Copper	ppb	1300	300	<1 - 84	37	Internal corrosion of household water plumbing systems
Lead	ppb	15	0.2	<1 - 10.3	4.8	Internal corrosion of household water plumbing systems

OTHER WATER QUALITY PARAMETERS	UNIT	ORL	RANGE	AVERAGE
Alkalinity (as $CaCO_3$)	ppm	N/A	7 - 112	39
Boron	ppb	1000 (NL)	ND-123	ND
Bromide	ppb	N/A	<5 - 19	8
Calcium (as Ca)	ppm	N/A	2 - 18	10
Chlorate (10)	ppb	800 (NL)	47 - 250	143
Hardness (as $CaCO_3$)	ppm	N/A	8 - 76	44
Magnesium	ppm	N/A	0.2 - 6	3.6
pH	-	N/A	8.8 - 9.8	9.4
Phosphate (Ortho)	ppm	N/A	<0.03 - 0.11	0.04
Potassium	ppm	N/A	0.2 - 1	0.6
Silica	ppm	N/A	5.1 - 5.7	5.3
Sodium	ppm	N/A	2.6 - 17	11
Strontium	ppb	N/A	13 - 204	95

KEY

< / ≤	=	less than / less than or equal to
AL	=	Action Level
Max	=	Maximum
Min	=	Minimum
N/A	=	Not Available
ND	=	Non-Detect
NL	=	Notification Level
NoP	=	Number of Coliform-Positive Sample
NTU	=	Nephelometric Turbidity Unit
ORL	=	Other Regulatory Level
ppb	=	part per billion
ppm	=	part per million
µS/cm	=	microSiemens / centimeter

FOOTNOTES: (1) These are monthly average turbidity values measured every 4 hours daily. **(2)** There is no turbidity MCL for filtered water. The limits are based on the TT requirements for filtration systems. **(3)** This is the highest locational running annual average value. **(4)** Total organic carbon is a precursor for disinfection byproduct formation. The TT requirement applies to the filtered water from the SVWTP only. **(5)** In May 2015, the SWRCB-DDW recommended an optimal fluoride level of 0.7 ppm be maintained in the treated water. In 2016, the range and average of the fluoride levels were 0.5 ppm - 0.8 ppm and 0.6 ppm, respectively. **(6)** The natural fluoride level in the Hetch Hetchy source was ND. Elevated fluoride levels in the SVWTP and HTWTP raw water are attributed to the transfer of fluoridated Hetch Hetchy water into the local reservoirs. **(7)** This is the highest running annual average value. **(8)** Aluminum also has a primary MCL of 1,000 ppb. **(9)** The most recent Lead and Copper Rule monitoring was in August 2015. None of the 59 site samples collected at consumer taps had concentrations above the corresponding ALs. **(10)** The detected chlorate in the treated water is a degradation product of sodium hypochlorite, which we use for water disinfection. **Note:** The different water sources blended at different ratios throughout the year have resulted in varying water quality. Additional water quality data may be obtained by calling our Water Quality Division toll-free number at (877) 737-8297.

San Francisco Water Power Sewer
Services of the San Francisco Public Utilities Commission

FROM OUR SYSTEM TO YOURS
2016 ANNUAL WATER QUALITY REPORT

San Francisco Public Utilities Commission

Every day we deliver high-quality drinking water from the Hetch Hetchy Regional Water System to 2.6 million people in San Francisco, Alameda, Santa Clara and San Mateo counties.

We generate clean, reliable hydroelectricity that powers 100% of San Francisco's vital services, including police and fire stations, street lights, MUNI, SF General Hospital and more.

Unregulated Contaminant Monitoring Rule
In 2013, we conducted monitoring as required by the USEPA's third Unregulated Contaminant Monitoring Rule (UCMR3), and the monitoring results are accessible at ***sfwater.org/quality/2013***. Visit the USEPA website for information about UCMR3.

For more information about this report, contact Michele Liapes at **415-554-3211** or email **Mliapes@sfwater.org**.

Water quality policies are decided at Commission hearings, held the second and fourth Tuesdays of each month at 1:30 pm in San Francisco City Hall, Room 400.

Our Drinking Water Sources and Treatment

Our major water source originates from spring snowmelt flowing down the Tuolumne River to storage in Hetch Hetchy Reservoir. Our well protected Sierra water source is exempt from filtration requirements by the United States Environmental Protection Agency (USEPA) and State Water Resources Control Board's Division of Drinking Water (SWRCB-DDW). Water from the Hetch Hetchy Reservoir receives the following treatments to meet appropriate drinking water standards: disinfection by ultraviolet light and chlorine, corrosion control by adjustment of the water pH value, fluoridation for dental health protection, and chloramination for maintaining disinfectant residual and minimizing disinfection byproduct formation.

Hetch Hetchy water is supplemented with surface water from two local watersheds. Rainfall and runoff from the 35,000-acre Alameda Watershed in Alameda and Santa Clara counties are collected in the Calaveras and San Antonio reservoirs, and delivered to the Sunol Valley Water Treatment Plant (SVWTP). Rainfall and runoff from the 23,000-acre Peninsula Watershed in San Mateo County are stored in the Crystal Springs, San Andreas and Pilarcitos reservoirs, and are delivered to the Harry Tracy Water Treatment Plant. In addition to these local sources, the SWRCB-DDW approved our use of Upcountry Non-Hetch Hetchy Sources (UNHHS), which consist of surface water in Lake Eleanor, Lake Cherry and the associated creeks all conveyed via the Lower Cherry Aqueduct, Early Intake Reservoir and Tuolumne River as an additional drinking water source. The UNHHS water will be treated at the SVWTP prior to service to customers. In 2016 the SFPUC did not use UNHHS. Water at the two local treatment plants is subject to filtration, disinfection, fluoridation, and pH adjustment for corrosion control optimization.

Protecting Our Watersheds

We conduct watershed sanitary surveys for the Hetch Hetchy source annually and local water sources every five years. The last local sanitary survey was done in 2016. We conducted a special watershed sanitary survey for the UNHHS in 2015 as part of our drought response plan efforts. These surveys evaluate the sanitary condition, water quality, potential contamination sources and the results of watershed management activities, and were completed with support from partner agencies including National Park Service and US Forest Service.

These surveys identified wildlife, stock, and human activities as potential contamination sources. Contact the San Francisco District Office of SWRCB-DDW at 510-620-3474 for review of these reports.

Water Quality

We regularly collect and test water samples from reservoirs and designated sampling points throughout the system to ensure the water delivered to you meets or exceeds federal and state drinking water standards. In 2016, we conducted more than 94,360 drinking water tests in the transmission and distribution systems. This is in addition to the extensive treatment process control monitoring performed by our certified operators and online instruments.

Drinking water, including bottled water, may reasonably be expected to contain at least small amounts of some contaminants. The presence of contaminants does not necessarily indicate that water poses a health risk. In order to ensure that tap water is safe to drink, the USEPA and SWRCB-DDW prescribe regulations that limit the amount of certain contaminants in water provided by public water systems. The U.S. Food and Drug Administration regulations and California law also establish limits for contaminants in bottled water that provide the same protection for public health.

Special Health Needs

Some people may be more vulnerable to contaminants in drinking water than the general population. Immuno-compromised persons, such as those with cancer undergoing chemotherapy, persons who have undergone organ transplants, people with HIV/AIDS or other immune system disorders, some elderly people and infants, can be particularly at risk from infections.

These people should seek advice about drinking water from their healthcare providers. USEPA/Centers for Disease Control (CDC) guidelines on appropriate means to lessen the risk of infection by *Cryptosporidium* and other microbial contaminants are available from the USEPA's Safe Drinking Water Hotline 800-426-4791 or at **www.epa.gov/ground-water-and-drinking-water/safe-drinking-water-hotline**.

Fluoridation and Dental Fluorosis

Mandated by State law, water fluoridation is a widely accepted practice proven to be safe and effective for preventing and controlling tooth decay. Our fluoride target level in the water is 0.7 milligram per liter, consistent with the May 2015 State regulatory guidance on optimal fluoride level. Infants fed formula mixed with water containing fluoride at this level may still have a chance of developing tiny white lines or streaks in their teeth. These marks are referred to as mild to very mild fluorosis, and are often only visible under a microscope. Even in cases where the marks are visible, they do not pose any health risk. The CDC considers it safe to use optimally fluoridated water for preparing infant formula. To lessen this chance of dental fluorosis, you may choose to use low-fluoride bottled water to prepare infant formula. Nevertheless, children may still develop dental fluorosis due to fluoride intake from other sources such as food, toothpaste and dental products. Contact your healthcare provider or SWRCB-DDW if you have concerns about dental fluorosis. For additional information about fluoridation or oral health, visit the SWRCB-DDW website **www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/Fluoridation.shtml/**, or the CDC website **www.cdc.gov/fluoridation**.

Contaminants and Regulations

The sources of drinking water (both tap water and bottled water) include rivers, lakes, oceans, streams, ponds, reservoirs, springs and wells. As water travels over the surface of the land or through the ground, it dissolves naturally occurring minerals and, in some cases, radioactive material, and can pick up substances resulting from the presence of animals or from human activity. Such substances are called contaminants, and may be present in source water as:

Microbial contaminants, such as viruses and bacteria that may come from sewage treatment plants, septic systems, agricultural livestock operations and wildlife,

Inorganic contaminants, such as salts and metals, that can be naturally occurring or result from urban stormwater runoff, industrial or domestic wastewater discharges, oil and gas production, mining or farming,

Pesticides and herbicides that may come from a variety of sources such as agriculture, urban stormwater runoff and residential uses,

Organic chemical contaminants, including synthetic and volatile organic chemicals, which are by-products of industrial processes and petroleum production, and can also come from gas stations, urban stormwater runoff, agricultural application and septic systems,

Radioactive contaminants, which can be naturally occurring or be the result of oil and gas production and mining activities.

More information about contaminants and potential health effects can be obtained by calling the USEPA's Safe Drinking Water Hotline **800-426-4791**, or at **www.epa.gov/safewater**.

Drinking Water and Lead

Lead in drinking water is primarily from materials and components associated with service lines and home plumbing. There are no known lead service lines in our water distribution system. We are responsible for providing high quality drinking water, but cannot control the variety of materials used in plumbing components. It is possible that lead levels at your home may be higher than at others because of plumbing materials used in your property.

If present, elevated levels of lead can cause serious health problems, especially for pregnant women and young children. Infants and young children are typically more vulnerable to lead in drinking water than the general population. You can minimize the potential for lead exposure, when your water has been sitting for several hours, by flushing your tap for 30 seconds to 2 minutes (or until the water temperature has changed) before using water for drinking or cooking. If you are concerned about lead levels in your water, you may wish to have your water tested. Additional information on lead in drinking water, testing methods, and steps you can take to minimize exposure is available from the USEPA's Safe Drinking Water Hotline 800-426-4791, or at **www.epa.gov/lead**.

We offer the following programs to minimize exposure to lead in water: low-cost water tests for lead ($25 per tap), to request a test call 877-737-8297. Free lead test vouchers for clients enrolled in the Women, Infants and Children (WIC) program.

San Francisco Groundwater Project

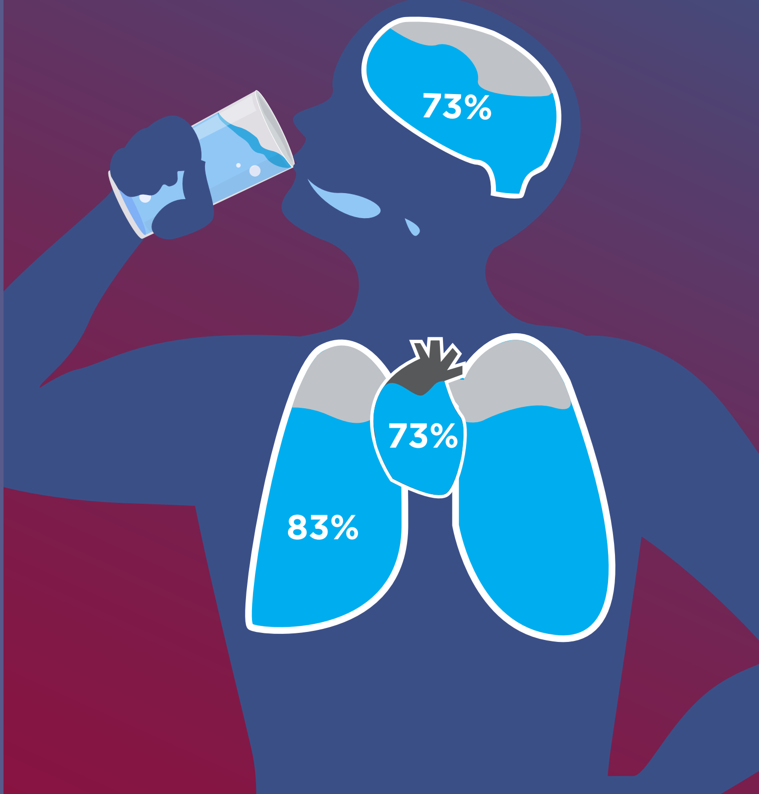
Groundwater — also known as well water — is a renewable source of naturally occurring water that is found in underground reservoirs called aquifers. Aquifers are replenished primarily by rainfall.

In April, 2017, we started pumping groundwater from the Westside Groundwater Basin aquifer that extends to approximately 400 feet below the surface in San Francisco. The groundwater is treated and blended with our regional drinking water supplies before it is delivered to our customers.

For the past decade, we have collected water quality and quantity data from the Westside Basin aquifer. With our extensive testing and data collection we know that after adding groundwater to our regional water supplies, we will continue to provide our customers with high-quality drinking water that meets or exceeds all regulatory health-based and aesthetic standards set by the SWRCB-DDW and the USEPA.

Your Body of Water

Water is of major importance to all living things. Up to 60% of the human adult body is water.



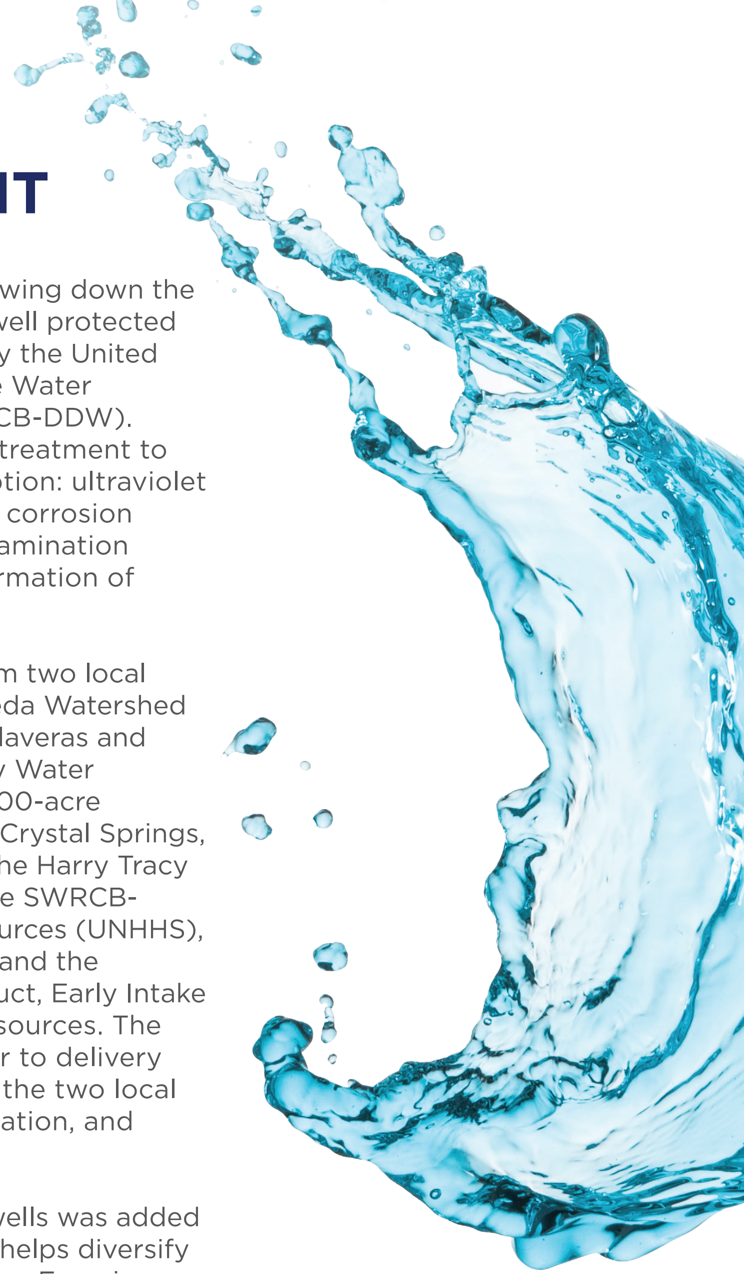
http://www.jbc.org/content/158/3/625.short

San Francisco
Water Power Sewer
Services of the San Francisco Public Utilities Commission

City of San Francisco 2017 Annual

WATER QUALITY REPORT

OUR DRINKING WATER SOURCES AND TREATMENT



Our major water source originates from spring snowmelt flowing down the Tuolumne River to storage in Hetch Hetchy Reservoir. Our well protected Sierra water source is exempt from filtration requirements by the United States Environmental Protection Agency (USEPA) and State Water Resources Control Board Division of Drinking Water (SWRCB-DDW). Water from Hetch Hetchy Reservoir receives the following treatment to meet all appropriate drinking water standards for consumption: ultraviolet light and chlorine disinfection, pH adjustment for optimum corrosion control, fluoridation for dental health protection, and chloramination for maintaining disinfectant residual and minimizing the formation of disinfection byproducts.

Hetch Hetchy water is supplemented with surface water from two local watersheds. Rainfall and runoff from the 35,000-acre Alameda Watershed in Alameda and Santa Clara counties are collected in the Calaveras and San Antonio reservoirs, and are delivered to the Sunol Valley Water Treatment Plant (SVWTP). Rainfall and runoff from the 23,000-acre Peninsula Watershed in San Mateo County are stored in the Crystal Springs, San Andreas and Pilarcitos reservoirs, and are delivered to the Harry Tracy Water Treatment Plant. In addition to these local sources, the SWRCB-DDW approved our use of Upcountry Non-Hetch Hetchy Sources (UNHHS), which consist of surface water in Lake Eleanor, Lake Cherry and the associated creeks all conveyed via the Lower Cherry Aqueduct, Early Intake Reservoir and Tuolumne River as additional drinking water sources. The UNHHS water, if used, would be treated at the SVWTP prior to delivery to customers. We did not use the UNHHS in 2017. Water at the two local treatment plants is subject to filtration, disinfection, fluoridation, and optimum corrosion control by pH adjustment.

Since mid-2017, a small amount of groundwater from local wells was added to our surface water supplies. The use of local groundwater helps diversify our water sources and makes our drinking water supply in San Francisco even more reliable.

Protecting Our Watersheds

We conduct watershed sanitary surveys for the Hetch Hetchy source annually and local water sources as well as UNHHS every five years. The last local sanitary survey was done in 2016. We conducted a special watershed sanitary survey for the UNHHS in 2015 as part of our drought response plan efforts. These surveys evaluate the sanitary condition, water quality, potential contamination sources and the results of watershed management activities, and were completed with support from partner agencies including National Park Service and US Forest Service. These surveys identified wildlife, stock, and human activities as potential contamination sources. You may contact the San Francisco District office of SWRCB-DDW at **510-620-3474** to review these reports.

Water Quality

We regularly collect and test water samples from reservoirs and designated sampling points throughout the system to ensure the water delivered to you meets or exceeds federal and state drinking water standards. In 2017, we conducted more than 101,900 drinking water tests in the transmission and distribution systems. This is in addition to the extensive treatment process control monitoring performed by our certified operators and online instruments.

Drinking water, including bottled water, may reasonably be expected to contain at least small amounts of some contaminants. The presence of contaminants does not necessarily indicate that water poses a health risk. In order to ensure that tap water is safe to drink, the USEPA and SWRCB-DDW prescribe regulations that limit the amount of certain contaminants in water provided by public water systems. The U.S. Food and Drug Administration regulations and California law also establish limits for contaminants in bottled water that provide the same protection for public health.

FLUORIDATION AND DENTAL FLUOROSIS

Mandated by State law, water fluoridation is a widely accepted practice proven to be safe and effective for preventing and controlling tooth decay. Our fluoride target level in the water is 0.7 milligram per liter (mg/L, or part per million, ppm), consistent with the May 2015 State regulatory guidance on optimal fluoride level. Infants fed formula mixed with water containing fluoride at this level may still have a chance of developing tiny white lines or streaks in their teeth. These marks are referred to as mild to very mild fluorosis, and are often only visible under a microscope. Even in cases where the marks are visible, they do not pose any health risk. The Centers for Disease Control (CDC) considers it safe to use optimally fluoridated water for preparing infant formula. To lessen the chance of dental fluorosis, you may choose to use low-fluoride bottled water to prepare infant formula. Nevertheless, children may still develop dental fluorosis due to fluoride intake from other sources such as food, toothpaste and dental products.

Contact your healthcare provider or SWRCB-DDW if you have concerns about dental fluorosis. For additional information about fluoridation or oral health, visit the SWRCB-DDW website at **https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/Fluoridation.html** or the CDC website **www.cdc.gov/fluoridation**.

SPECIAL HEALTH NEEDS

Some people may be more vulnerable to contaminants in drinking water than the general population. Immuno-compromised persons, such as those with cancer undergoing chemotherapy, persons who have undergone organ transplants, people with HIV/AIDS or other immune system disorders, some elderly people and infants, can be particularly at risk from infections.

These people should seek advice about drinking water from their healthcare providers. USEPA/CDC guidelines on appropriate means to lessen the risk of infection by *Cryptosporidium* and other microbial contaminants are available from the USEPA's Safe Drinking Water Hotline **800-426-4791** or at **www.epa.gov/safewater**.

UNREGULATED CONTAMINANT MONITORING RULE

In 2013, we conducted monitoring as required by the USEPA's third Unregulated Contaminant Monitoring Rule (UCMR3), and the monitoring results are accessible at **sfwater.org/quality/2013**. Visit the USEPA website for information about UCMR3.

DRINKING WATER AND LEAD

Lead in drinking water is primarily from materials and components associated with service lines and home plumbing. There are no known lead service lines in our water distribution system. We are responsible for providing high quality drinking water, but cannot control the variety of materials used in plumbing components. It is possible that lead levels at your home in the community may be higher than at others because of plumbing materials used in your property.

If present, elevated levels of lead can cause serious health problems, especially for pregnant women and young children. Infants and young children are typically more vulnerable to lead in drinking water than the general population. You can minimize the potential for lead exposure, when your water has been sitting for several hours, by flushing your tap for 30 seconds to 2 minutes (or until the water temperature has changed) before using water for drinking or cooking. If you are concerned about lead levels in your water, you may wish to have your water tested. Additional information on lead in drinking water, testing methods, and steps you can take to minimize exposure is available from the USEPA's Safe Drinking Water Hotline **800-426-4791**, or at **www.epa.gov/lead**.

In addition to our water source protection efforts, we continue the following programs to minimize customer exposure to lead in water:

- Annual monitoring for lead at transmission's system entry points in 2017 continues to return results of non-detect
- A comprehensive program replacing brass meters with lead-free automated water meters, which has reached 98% completion
- Offering in partnership with the San Francisco Department of Public Health free lead test vouchers for clients enrolled in the Women, Infants and Children (WIC) program
- Offering low-cost water tests for lead for $25 per tap. To request a test, call **877-737-8297**.

San Francisco K-12 Schools Request Assistance for Lead Sampling

In 2017, we completed lead sampling for a total of 109 public and private K-12 schools in San Francisco, which submitted requests for sampling assistance to test lead in their tap water. The lead sampling results of the pubic schools are available at our website **www.sfwater.org/lead**.

CONTAMINANTS AND REGULATIONS

The sources of drinking water (both tap water and bottled water) include rivers, lakes, oceans, streams, ponds, reservoirs, springs and wells. As water travels over the surface of the land or through the ground, it dissolves naturally occurring minerals and, in some cases, radioactive material, and can pick up substances resulting from the presence of animals or from human activity. Such substances are called contaminants, and may be present in source water as:

Microbial contaminants, such as viruses and bacteria that may come from sewage treatment plants, septic systems, agricultural livestock operations and wildlife;

Inorganic contaminants, such as salts and metals, that can be naturally occurring or result from urban stormwater runoff, industrial or domestic wastewater discharges, oil and gas production, mining or farming;

Pesticides and herbicides that may come from a variety of sources such as agriculture, urban stormwater runoff and residential uses;

Organic chemical contaminants, including synthetic and volatile organic chemicals, which are by-products of industrial processes and petroleum production, and can also come from gas stations, urban stormwater runoff, agricultural application and septic systems; and

Radioactive contaminants, which can be naturally occurring or be the result of oil and gas production and mining activities.

More information about contaminants and potential health effects can be obtained by calling the USEPA's Safe Drinking Water Hotline **800-426-4791**, or at **www.epa.gov/safewater.**

DAM SAFETY AND WATER QUALITY

Did you know that our water system includes 18 dams that are regulated by the State Division of Safety of Dams (DSOD)? In fact, 7 of those dams are within the City and County of San Francisco, and you may live near one of them. This year the SFPUC submitted Emergency Action Plans for all 18 of our dams to DSOD. These plans, and the inundation maps they contain, serve as guides and action plans to be used in the unlikely event of a failure, or a partial failure, of one of these dams.

Throughout our service area, many of these dams are in heavily populated areas, and we have taken significant steps to ensure that there is very little risk of failure of any kind. We continue to monitor the dams, using both monitoring equipment such as piezometers, as well as performing regular inspections of all parts of the dams and associated appurtenances. For more information about dam safety we invite you visit DSOD at **water.ca.gov/Programs/All-Programs/Division-of-Safety-of-Dams**.

City of San Francisco - Water Quality Data for 2017

The table below lists all 2017 detected drinking water contaminants and the information about their typical sources. Contaminants below detection limits for reporting purposes are not shown, in accord with regulatory guidance. We hold a SWRCB-DDW monitoring waiver for some contaminants and therefore their monitoring frequencies are less than annual. Visit **sfwater.org/qualitymatters** for a list of all water quality parameters we monitored in raw water and treated water in 2017.

DETECTED CONTAMINANTS	UNIT	MCL	PHG OR (MCLG)	RANGE OR LEVEL FOUND	AVERAGE OR [MAX]	MAJOR SOURCES IN DRINKING WATER
TURBIDITY						
Unfiltered Hetch Hetchy Water	NTU	5	N/A	0.3 - 1.1 [1]	[2.7]	Soil runoff
Filtered Water from Sunol Valley Water Treatment Plant (SVWTP)	NTU	1 [2]	N/A	-	[1]	Soil runoff
	-	Min 95% of samples ≤0.3 NTU [2]	N/A	99% - 100%	-	Soil runoff
Filtered Water from Harry Tracy Water Treatment Plant (HTWTP)	NTU	1 [2]	N/A	-	[0.1]	Soil runoff
	-	Min 95% of samples ≤0.3 NTU [2]	N/A	100%	-	Soil runoff
DISINFECTION BYPRODUCTS AND PRECURSOR						
Total Trihalomethanes	ppb	80	N/A	18 - 55	[49] [3]	Byproduct of drinking water disinfection
Haloacetic Acids	ppb	60	N/A	7 - 47	[42] [3]	Byproduct of drinking water disinfection
Total Organic Carbon [4]	ppm	TT	N/A	1.0 - 3.7	2.4	Various natural and man-made sources
MICROBIOLOGICAL						
Total Coliform	-	NoP ≤5.0% of monthly samples	(0)	-	[0.3%]	Naturally present in the environment
Giardia lamblia	cyst/L	TT	(0)	0 - 0.22	0.05	Naturally present in the environment
INORGANICS						
Fluoride (source water) [5]	ppm	2.0	1	ND - 0.6	0.2 [6]	Erosion of natural deposits; water additive to promote strong teeth
Chloramine (as chlorine)	ppm	MRDL = 4.0	MRDLG = 4	0.1 - 3	[2.3] [7]	Drinking water disinfectant added for treatment

CONSTITUENTS WITH SECONDARY STANDARDS	UNIT	SMCL	PHG	RANGE	AVERAGE	MAJOR SOURCES OF CONTAMINANT
Aluminum [8]	ppb	200	600	ND - 99	ND	Erosion of natural deposits; some surface water treatment residue
Chloride	ppm	500	N/A	<3 - 17	9.0	Runoff / leaching from natural deposits
Color	unit	15	N/A	<5 -13	<5	Naturally-occurring organic materials
Specific Conductance	μS/cm	1600	N/A	29 - 256	168	Substances that form ions when in water
Sulfate	ppm	500	N/A	0.9 - 34	17	Runoff / leaching from natural deposits
Total Dissolved Solids	ppm	1000	N/A	<20 - 122	76	Runoff / leaching from natural deposits
Turbidity	NTU	5	N/A	0.1 - 1	0.4	Soil runoff

LEAD AND COPPER [9]	UNIT	AL	PHG	RANGE	90TH PERCENTILE	MAJOR SOURCES IN DRINKING WATER
Copper	ppb	1300	300	<1 - 84	37	Internal corrosion of household water plumbing systems
Lead	ppb	15	0.2	<1 - 10.3	4.8	Internal corrosion of household water plumbing systems

OTHER WATER QUALITY PARAMETERS	UNIT	ORL	RANGE	AVERAGE
Alkalinity (as $CaCO_3$)	ppm	N/A	6 - 131	52
Boron	ppb	1000 (NL)	ND - 203	ND
Bromide	ppb	N/A	<5 - 30	13
Calcium (as Ca)	ppm	N/A	2 - 31	16
Chlorate [10]	ppb	800 (NL)	51 - 180	86
Hardness (as $CaCO_3$)	ppm	N/A	7 - 82	51
Magnesium	ppm	N/A	0.2 - 11	6.2
pH	-	N/A	8.6 - 9.8	9.3
Potassium	ppm	N/A	0.2 - 2	1.0
Silica	ppm	N/A	4.6 - 12	7.6
Sodium	ppm	N/A	2.3 - 31	18
Strontium	ppb	N/A	12 - 234	111

KEY

- **< / ≤** = less than / less than or equal to
- **AL** = Action Level
- **Max** = Maximum
- **Min** = Minimum
- **N/A** = Not Available
- **ND** = Non-Detect
- **NL** = Notification Level
- **NoP** = Number of Coliform-Positive Sample
- **NTU** = Nephelometric Turbidity Unit
- **ORL** = Other Regulatory Level
- **ppb** = part per billion
- **ppm** = part per million
- **μS/cm** = microSiemens / centimeter

Boron Detection Above Notification Level in Source Water

In 2017, boron was detected at a level of 1.74 ppm in the raw water stored in one of our approved sources, Pond F3 East, in Alameda Watershed. Although the detected value is above the California Notification Level of 1 ppm for source water, the corresponding treated water boron level from the SVWTP was only 0.2 ppm.

KEY WATER QUALITY TERMS

The following are definitions of key terms referring to standards and goals of water quality noted on the data table.

Public Health Goal (PHG): The level of a contaminant in drinking water below which there is no known or expected risk to health. PHGs are set by the California Environmental Protection Agency.

Maximum Contaminant Level Goal (MCLG): The level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs are set by the USEPA.

Maximum Contaminant Level (MCL): The highest level of a contaminant that is allowed in drinking water. Primary MCLs are set as close to the PHGs or MCLGs as is economically and technologically feasible. Secondary MCLs (SMCLs) are set to protect the odor, taste, and appearance of drinking water.

Maximum Residual Disinfectant Level (MRDL): The highest level of a disinfectant allowed in drinking water. There is convincing evidence that addition of a disinfectant is necessary for control of microbial contaminants.

Maximum Residual Disinfectant Level Goal (MRDLG): The level of a drinking water disinfectant below which there is no known or expected risk to health. MRDLGs do not reflect the benefits of the use of disinfectants to control microbial contaminants.

Primary Drinking Water Standard (PDWS): MCLs and MRDLs for contaminants that affect health along with their monitoring and reporting requirements, and water treatment requirements.

Regulatory Action Level: The concentration of a contaminant which, if exceeded, triggers treatment or other requirements that a water system must follow.

Treatment Technique (TT): A required process intended to reduce the level of a contaminant in drinking water.

Turbidity: A water clarity indicator that measures cloudiness of the water, and is also used to indicate the effectiveness of the filtration system. High turbidity can hinder the effectiveness of disinfectants.

Cryptosporidium is a parasitic microbe found in most surface water. We regularly test for this waterborne pathogen, and found it at very low levels in source water and treated water in 2017. However, current test methods approved by the USEPA do not distinguish between dead organisms and those capable of causing disease. Ingestion of *Cryptosporidium* may produce symptoms of nausea, abdominal cramps, diarrhea, and associated headaches. *Cryptosporidium* must be ingested to cause disease, and it may be spread through means other than drinking water.

WATER QUALITY TABLE FOOTNOTES:
(1) These are monthly average turbidity values measured every 4 hours daily. **(2)** There is no turbidity MCL for filtered water. The limits are based on the TT requirements for filtration systems. **(3)** This is the highest locational running annual average value. **(4)** Total organic carbon is a precursor for disinfection byproduct formation. The TT requirement applies to the filtered water from the SVWTP only. **(5)** In May 2015, the SWRCB-DDW recommended an optimal fluoride level of 0.7 ppm be maintained in the treated water. In 2017, the range and average of the fluoride levels were 0.5 ppm - 0.9 ppm and 0.7 ppm, respectively. **(6)** The natural fluoride level in the Hetch Hetchy source was ND. Elevated fluoride levels in the SVWTP and HTWTP raw water are attributed to the transfer of fluoridated Hetch Hetchy water into the local reservoirs. **(7)** This is the highest running annual average value. **(8)** Aluminum also has a primary MCL of 1,000 ppb. **(9)** The most recent Lead and Copper Rule monitoring was in August 2015. None of the 59 site samples collected at consumer taps had concentration above the corresponding ALs. **(10)** The detected chlorate in the treated water is a degradation product of sodium hypochlorite, which we use for water disinfection.

Note: The different water sources blended at different ratios throughout the year have resulted in varying water quality. Additional water quality data may be obtained by calling our Water Quality Division toll-free number at (877) 737-8297.

This report contains important information about your drinking water. Translate it, or speak with someone who understands it.

Este informe contiene información muy importante sobre su agua potable. Tradúzcalo o hable con alguien que lo entienda bien.

Mahalaga ang impormasyong ito. Mangyaring ipasalin ito.

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San Francisco Water Power Sewer

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San Francisco Water Power Sewer
Services of the San Francisco Public Utilities Commission

City of San Francisco 2018 Annual

WATER QUALITY REPORT

OUR DRINKING WATER SOURCES AND TREATMENT

Our major water source originates from spring snowmelt flowing down the Tuolumne River to storage in Hetch Hetchy Reservoir. Our well protected Sierra water source is exempt from filtration requirements by the United States Environmental Protection Agency (USEPA) and State Water Resources Control Board's Division of Drinking Water (SWRCB-DDW). Water from Hetch Hetchy Reservoir receives the following treatment to meet the appropriate drinking water standards for consumption: ultraviolet light and chlorine disinfection, pH adjustment for optimum corrosion control, fluoridation for dental health protection, and chloramination for maintaining disinfectant residual and minimizing the formation of regulated disinfection byproducts.

Hetch Hetchy water is supplemented with surface water from local watersheds, upcountry non-Hetch Hetchy sources (UNHHS), and groundwater. Rainfall and runoff from the 35,000-acre Alameda Watershed in Alameda and Santa Clara counties are collected in Calaveras Reservoir and San Antonio Reservoir, and delivered to the Sunol Valley Water Treatment Plant (SVWTP). Rainfall and runoff from the 23,000-acre Peninsula Watershed in San Mateo County are stored in Crystal Springs Reservoir, San Andreas Reservoir and Pilarcitos Reservoir, and are delivered to the Harry Tracy Water Treatment Plant. In 2018, the UNHHS was not used. Water at the two treatment plants is subject to filtration, disinfection, fluoridation, optimum corrosion control, and taste and odor removal.

A small amount of groundwater from four local wells was intermittently added to our surface water supplies in 2018. The use of local groundwater helps diversify our water sources and makes our drinking water supply in San Francisco even more reliable.

Protecting Our Watersheds

We conduct watershed sanitary surveys for the Hetch Hetchy source annually and local water sources as well as UNHHS every five years. The latest local sanitary survey was completed in 2016 for the period of 2011-2015. The last watershed sanitary survey for UNHHS was conducted in 2015 as part of our drought response plan efforts. All these surveys were completed with support from partner agencies including National Park Service and US Forest Service. These surveys evaluate the sanitary conditions, water quality, results of watershed management activities, and identify potential contamination sources that may affect the watersheds. Wildlife, stock, and human activities continue to be the potential contamination sources. To review the reports, contact the San Francisco District office of SWRCB-DDW at **(510) 620-3474**.

Water Quality

We regularly collect and test water samples from reservoirs and designated sampling points throughout the system to ensure the water delivered to you meets or exceeds federal and state drinking water standards. In 2018, we conducted more than 106,620 drinking water tests in the source, transmission, and distribution system. This is in addition to the extensive treatment process control monitoring performed by our certified operators and online instruments.

Drinking water, including bottled water, may reasonably be expected to contain at least small amounts of some contaminants. The presence of contaminants does not necessarily indicate that water poses a health risk. In order to ensure that tap water is safe to drink, the USEPA and SWRCB-DDW prescribe regulations that limit the amount of certain contaminants in water provided by public water systems. The U.S. Food and Drug Administration regulations and California law also establish limits for contaminants in bottled water that provide the same protection for public health.

Fluoridation and Dental Fluorosis

Mandated by State law, water fluoridation is a widely accepted practice proven to be safe and effective for preventing and controlling tooth decay. Our fluoride target level in the water is 0.7 milligram per liter (mg/L, or part per million, ppm), consistent with the May 2015 State regulatory guidance on optimal fluoride level. Infants fed formula mixed with water containing fluoride at this level may still have a chance of developing tiny white lines or streaks in their teeth. These marks are referred to as mild to very mild fluorosis, and are often only visible under a microscope. Even in cases where the marks are visible, they do not pose any health risk. The Centers of Disease Control (CDC) considers it safe to use optimally fluoridated water for preparing infant formula. To lessen this chance of dental fluorosis, you may choose to use low-fluoride bottled water to prepare infant formula. Nevertheless, children may still develop dental fluorosis due to fluoride intake from other sources such as food, toothpaste and dental products.

Contact your healthcare provider or SWRCB-DDW if you have concerns about dental fluorosis. For additional information about fluoridation or oral health, visit the SWRCB-DDW website **waterboards.ca.gov/drinking_water/certlic/drinkingwater/Fluoridation.shtml**, the CDC website **cdc.gov/fluoridation**, or our website **sfwater.org/fluoride**.

Special Health Needs

Some people may be more vulnerable to contaminants in drinking water than the general population. Immuno-compromised persons, such as those with cancer undergoing chemotherapy, persons who have undergone organ transplants, people with HIV/AIDS or other immune system disorders, some elderly people and infants, can be particularly at risk from infections.

These people should seek advice about drinking water from their healthcare providers. US EPA/CDC guidelines on appropriate means to lessen the risk of infection by *Cryptosporidium* and other microbial contaminants are available from the US EPA's Safe Drinking Water Hotline (800) 426-4791 or at **epa.gov/safewater.**

Unregulated Contaminant Monitoring Rule

In 2018, we conducted four-quarter monitoring of 30 contaminants that currently have neither federal nor California health based drinking water standards. The monitoring, as required by the USEPA's fourth Unregulated Contaminant Monitoring Rule (UCMR4), targets 10 cyanotoxins, 2 metals, 9 pesticides, 3 alcohols, 3 synthetic organic contaminants, and 3 groups of haloacetic acids in the distribution system. A summary of monitoring results is available on the **sfwater.org** website. Visit the **epa.gov/dwucmr** website for information about UCMR4.

Drinking Water and Lead

Lead in drinking water is primarily from materials and components associated with service lines and home plumbing. Lead is not found in our surface waters, and we have removed all known lead service lines from our system. We are responsible for providing high-quality drinking water, but cannot control the variety of materials used in plumbing components. It is possible that lead levels at your home may be higher than at others because of plumbing materials used in your property.

If present, elevated levels of lead can cause serious health problems, especially for pregnant women and young children. Infants and young children are typically more vulnerable to lead in drinking water than the general population. You can minimize the potential for lead exposure, when your water has been sitting for several hours, by flushing your tap for 30 seconds to 2 minutes (or until the water temperature has changed) before using water for drinking or cooking. If you are concerned about lead levels in your water, you may wish to have your water tested. Additional information on lead in drinking water, testing methods, and steps you can take to minimize exposure is available from the USEPA's Safe Drinking Water Hotline (800) 426-4791, or at **epa.gov/lead**.

In addition to our water source protection, we continue the following efforts to minimize customer exposure to lead in water:

- Annual monitoring for lead at transmission's system entry points in 2018 continues to return results of non-detect.
- Completed initial 4-quarter monitoring of groundwater sources (no detection of lead).
- Lead and Copper Rule (LCR) - Sampling for lead at a required number of customer taps every three years in compliance with the USEPA LCR. The State Water Resources Control Board-Division of Drinking Water uses the results to determine if additional studies or treatment is necessary.
- Offering in partnership with the San Francisco Department of Public Health free lead test vouchers for clients enrolled in the Women, Infants and Children (WIC) program. Offering low-cost water tests for lead for $25 per tap. To request a test, call **311** or visit our website **sfwater.org/leadtest** for an application form.
- Replacement of brass meters with lead-free automated water meters (more than 98% complete).

In 2018, we completed an inventory of lead user service lines (LUSL) in our distribution system, as directed by SWRCB-DDW under Senate Bill 427. LUSL is defined as any water service line made of lead or any water service line that includes a lead component. Based on the report to the SWRCB-DDW, there were no lead pipelines identified. However, we estimated that the distribution system may have a total of 10,912 service lines made of unknown material and 4,988 galvanized steel service lines, of which 4,524 may contain short (2 to 3 feet) sections of lead connectors between the customer service line and the water meter. Our ongoing policy is to remove and replace any LUSL promptly if it is discovered during pipeline repair and/or maintenance. By July 1, 2020, we will submit to SWRCB-DDW a timeline for replacement of the service lines of which the material content cannot be determined.

Lead Testing of Drinking Water in Schools

In 2017, SWRCB-DDW directed all permitted water systems in California to provide lead monitoring assistance to schools that request it in writing. As of today, we assisted 198 public and private K-12 schools in monitoring of lead in their tap water. School monitoring data can be found at **sfwater.org/lead**. Although this mandatory requirement on helping schools in lead monitoring will expire in November 2019, we are working on a voluntary, recurring program to provide continued support to local schools in addressing lead in their tap water.

Contaminants and Regulations

Generally, the sources of drinking water (both tap water and bottled water) include rivers, lakes, oceans, streams, ponds, reservoirs, springs and wells. As water travels over the surface of the land or through the ground, it dissolves naturally occurring minerals and, in some cases, radioactive material, and can pick up substances resulting from the presence of animals or from human activity. Such substances are called contaminants, and may be present in source water as:

Microbial contaminants, such as viruses and bacteria that may come from sewage treatment plants, septic systems, agricultural livestock operations and wildlife,

Inorganic contaminants, such as salts and metals, that can be naturally occurring or result from urban stormwater runoff, industrial or domestic wastewater discharges, oil and gas production, mining or farming,

Pesticides and herbicides that may come from a variety of sources such as agriculture, urban stormwater runoff and residential uses,

Organic chemical contaminants, including synthetic and volatile organic chemicals, which are by-products of industrial processes and petroleum production, and can also come from gas stations, urban stormwater runoff, agricultural application and septic systems,

Radioactive contaminants, which can be naturally occurring or be the result of oil and gas production and mining activities.

More information about contaminants and potential health effects can be obtained by calling the USEPA's Safe Drinking Water Hotline **(800) 426-4791**, or at **epa.gov/safewater**.

Taste and Odor Treatment at SVWTP

In response to an increase in the magnitude and frequency of algal blooms in Calaveras Reservoir and San Antonio Reservoir, a taste and odor (T&O) control program was initiated for the Sunol Valley Water Treatment Plant (SVWTP). The program is intended to address seasonal taste and odor resulting from algal blooms in the reservoirs. The first component of the program is a Powdered Activated Carbon (PAC) treatment facility for the SVWTP. PAC will be used to mitigate the occurrence of taste and odor compounds. The secondary benefits of using carbon include a reduction in disinfection by-products and color. The second component of the program is an ozonation facility, currently in design.

San Francisco Water System-Water Quality Data for 2018

The table below lists all 2018 detected drinking water contaminants and the information about their typical sources. Contaminants below detection limits for reporting are not shown, in accord with regulatory guidance. We hold a SWRCB-DDW monitoring waiver for some contaminants in our surface water supply and therefore their monitoring frequencies are less than annual. For definitions of the key water quality terms used in this table, please see the end of this report. Visit **sfwater.org/qualitymatters** for a list of all water quality parameters we monitored in raw water and treated water in 2018.

DETECTED CONTAMINANTS	UNIT	MCL	PHG OR (MCLG)	RANGE OR LEVEL FOUND	AVERAGE OR [MAX]	MAJOR SOURCES IN DRINKING WATER
TURBIDITY						
Unfiltered Hetch Hetchy Water	NTU	5	N/A	0.3 - 0.8 (1)	[1.8]	Soil runoff
Filtered Water from Sunol Valley Water Treatment Plant (SVWTP)	NTU	1 (2)	N/A	-	[1]	Soil runoff
	-	Min 95% of samples ≤0.3 NTU (2)	N/A	99.96% - 100%	-	Soil runoff
Filtered Water from Harry Tracy Water Treatment Plant (HTWTP)	NTU	1 (2)	N/A	-	[0.07]	Soil runoff
	-	Min 95% of samples ≤0.3 NTU (2)	N/A	100%	-	Soil runoff
DISINFECTION BY-PRODUCTS AND PRECURSOR						
Total Trihalomethanes	ppb	80	N/A	21 - 71	[49] (3)	By-product of drinking water disinfection
Haloacetic Acids	ppb	60	N/A	14 - 52	[42] (3)	By-product of drinking water disinfection
Total Organic Carbon (4)	ppm	TT	N/A	1.2 - 2.9	2.2	Various natural and man-made sources
MICROBIOLOGICAL						
Total Coliform	-	NoP ≤5.0% of monthly samples	(0)	-	[0.60%]	Naturally present in the environment
Giardia lamblia	cyst/L	TT	(0)	0 - 0.24	0.03	Naturally present in the environment
INORGANICS						
Fluoride (source water) (5)	ppm	2.0	1	ND - 0.7	0.3 (6)	Erosion of natural deposits; water additive to promote strong teeth
Chloramine (as chlorine)	ppm	MRDL = 4.0	MRDLG = 4	0.2 - 3.4	[2.4] (7)	Drinking water disinfectant added for treatment
CONSTITUENTS WITH SECONDARY STANDARDS	**UNIT**	**SMCL**	**PHG**	**RANGE**	**AVERAGE**	**MAJOR SOURCES OF CONTAMINANT**
Chloride	ppm	500	N/A	<3 - 17	8.9	Runoff / leaching from natural deposits
Color	unit	15	N/A	<5 -7	<5	Naturally-occurring organic materials
Specific Conductance	μS/cm	1600	N/A	29 - 221	154	Substances that form ions when in water
Sulfate	ppm	500	N/A	0.9 - 29	16	Runoff / leaching from natural deposits
Total Dissolved Solids	ppm	1000	N/A	<20 - 144	82	Runoff / leaching from natural deposits
Turbidity	NTU	5	N/A	ND - 0.3	0.1	Soil runoff
LEAD AND COPPER (8)	**UNIT**	**AL**	**PHG**	**RANGE**	**90TH PERCENTILE**	**MAJOR SOURCES IN DRINKING WATER**
Copper	ppb	1300	300	7.7 - 103	64	Internal corrosion of household water plumbing systems
Lead	ppb	15	0.2	<1 - 90	6	Internal corrosion of household water plumbing systems

OTHER WATER QUALITY PARAMETERS	UNIT	ORL	RANGE	AVERAGE
Alkalinity (as $CaCO_3$)	ppm	N/A	<3 - 132	51
Boron	ppb	1000 (NL)	ND - 104	ND
Bromide	ppb	N/A	<5 - 27	7
Calcium (as Ca)	ppm	N/A	2.9 - 18	11
Chlorate (9)	ppb	800 (NL)	42 - 230	124
Chromium (VI) (10)	ppb	NA	0.031 - 0.1	0.068
Hardness (as $CaCO_3$)	ppm	N/A	15 - 68	47
Magnesium	ppm	N/A	<0.2 - 6.2	4.0
pH	-	N/A	7.8 - 9.9	9.4
Potassium	ppm	N/A	0.2 - 1.0	0.6
Silica	ppm	N/A	2.8 - 7.1	5.0
Sodium	ppm	N/A	2.3 - 20	14
Strontium	ppb	N/A	12 - 199	99

KEY

- < / ≤ = less than / less than or equal to
- AL = Action Level
- Max = Maximum
- Min = Minimum
- N/A = Not Available
- ND = Non-Detect
- NL = Notification Level
- NoP = Number of Coliform-Positive Sample
- NTU = Nephelometric Turbidity Unit
- ORL = Other Regulatory Level
- ppb = part per billion
- ppm = part per million
- μS/cm = microSiemens per centimeter
- pCi/L = picocuries per liter

FOOTNOTES ON SAN FRANCISCO WATER SYSTEM WATER QUALITY DATA:
(1) These are monthly average turbidity values measured every 4 hours daily. **(2)** There is no turbidity MCL for filtered water. The limits are based on the TT requirements for filtration systems. **(3)** This is the highest locational running annual average value. **(4)** Total organic carbon is a precursor for disinfection byproduct formation. The TT requirement applies to the filtered water from the SVWTP only. **(5)** In May 2015, the SWRCB-DDW recommended an optimal fluoride level of 0.7 ppm be maintained in the treated water. In 2018, the range and average of the fluoride levels were 0.6 ppm - 1.0 ppm and 0.7 ppm, respectively. **(6)** The natural fluoride level in the Hetch Hetchy source was ND. Elevated fluoride levels in the raw water at SVWTP and HTWTP are attributed to the transfer of fluoridated Hetch Hetchy water into the local reservoirs. **(7)** This is the highest running annual average value. **(8)** The most recent Lead and Copper Rule monitoring at consumer taps was in August 2018. Two of the 90 site samples collected at consumer taps had lead concentrations above the AL. **(9)** The detected chlorate in the treated water is a degradation product of sodium hypochlorite, which we use for water disinfection. **(10)** Chromium (VI) has a PHG of 0.02 ppb but no MCL. The previous MCL of 10 ppb was withdrawn by the SWRCB-DDW on September 11, 2017. Currently, the SWRCB-DDW regulates all chromium through a MCL of 50 ppb for Total Chromium, which was not detected in our water in 2018.

Note: The different water sources blended at different ratios throughout the year have resulted in varying water quality. Additional water quality data may be obtained by calling our Water Quality Division toll-free number at (877) 737-8297.

San Francisco Local Groundwater-Water Quality Data for Year 2018

	DETECTED CONTAMINANTS	UNIT	MCL	PHG	RANGE FOUND	AVERAGE	MAJOR SOURCES IN DRINKING WATER
Treated Water (Sunset Reservoir)	**INORGANICS**						
	Chromium (VI)	ppb	N/A [1]	0.02	0.035 - 0.92	0.23	Leaching from natural deposits; commercial and industrial waste discharges, e.g., electroplating.
	Nitrate (as nitrogen)	ppm	10	10	ND - 0.44	0.12	Landscape fertilizers and leaked wastewater.

	DETECTED CONTAMINANTS	UNIT	MCL	PHG	RANGE FOUND	AVERAGE	MAJOR SOURCES IN DRINKING WATER
Raw Water [2] (San Francisco Local Groundwater Wells)	**INORGANICS**						
	Chromium (VI)	ppb	N/A[1]	0.02	6.1 - 25.1	17.4	Leaching from natural deposits; commercial and industrial waste discharges, e.g., electroplating.
	Fluoride	ppm	2	1	ND - 0.1	ND	Leaching from natural deposits.
	Nitrate (as nitrogen)	ppm	10	10	4.6 - 11.5	8.0	Landscape fertilizers and leaked wastewater.
	VOLATILE ORGANICS						
	Carbon tetrachloride [3]	ppb	0.5	0.1	ND - 0.83	ND [3]	Commercial and industrial solvent used in dry cleaning prior to 1960.
	Tetrachloroethylene [4]	ppb	5	0.06	ND - 1.6	1.4 [4]	Commercial and industrial solvent used in dry cleaning prior to 2010, and as a metal degreaser in auto shops and metalworking industries.
	OTHER WATER QUALITY PARAMETERS[5]	**UNIT**	**ORL**		**RANGE FOUND**	**AVERAGE**	
	Bromide	ppb	N/A		188 - 220	202	
	Radon	pCi/L	N/A		150- 310	208	

FOOTNOTES:
(1) Four quarters of initial monitoring in 2018 confirmed that the results of total chromium for these wells were ND. **(2)** The concentration ranges and averages of these contaminants are indicative of the raw groundwater quality prior to treatment. They are not representative of water in the reservoirs and distribution system. **(3)** This contaminant was detected slightly above the MCL at South Sunset Well only. The average is based on the monitoring results from South Sunset Well. **(4)** This contaminant was detected only at Golden Gate Park Central Well. The average is based on the monitoring results from Golden Gate Park Central Well. **(5)** These are non-regulated constituents that we voluntarily monitored as part of our ongoing evaluation of local groundwater quality. Due to the small volumetric contribution of groundwater to Sunset Reservoir, the levels of these constituents are negligible in the treated water from the reservoir.

Carbon Tetrachloride and Tetrachloroethylene Detections in Groundwater Sources

In 2018, we detected carbon tetrachloride at levels above the California MCL in groundwater at South Sunset Well (SSW) and tetrachloroethylene at levels below the MCL in groundwater at Golden Gate Park Central Well (GGP Central Well). However, water from SSW was blended with treated water in Sunset Reservoir and the contaminant was not detected in the blend water that was served to the system. Upon confirmed detection, the use of SSW was discontinued. Groundwater from GGP Central Well was used solely for irrigation of grass fields inside the park.

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San Francisco Water Power Sewer

Services of the San Francisco Public Utilities Commission

P.O. Box 7369
San Francisco, CA 94120-7369

For more information about this report, contact Suzanne Gautier at **(415) 554-3204** or email **sgautier@sfwater.org**. Water quality policies are decided at Commission hearings, held the second and fourth Tuesdays of each month at 1:30 pm in San Francisco City Hall, Room 400.

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KEY WATER QUALITY TERMS

The following are definitions of key terms referring to standards and goals of water quality noted on the data table.

Public Health Goal (PHG): The level of a contaminant in drinking water below which there is no known or expected risk to health. PHGs are set by the California Environmental Protection Agency.

Maximum Contaminant Level Goal (MCLG): The level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs are set by the USEPA.

Maximum Contaminant Level (MCL): The highest level of a contaminant that is allowed in drinking water. Primary MCLs are set as close to the PHGs or MCLGs as is economically and technologically feasible. Secondary MCLs (SMCLs) are set to protect the odor, taste, and appearance of drinking water.

Maximum Residual Disinfectant Level (MRDL): The highest level of a disinfectant allowed in drinking water. There is convincing evidence that addition of a disinfectant is necessary for control of microbial contaminants.

Maximum Residual Disinfectant Level Goal (MRDLG): The level of a drinking water disinfectant below which there is no known or expected risk to health. MRDLGs do not reflect the benefits of the use of disinfectants to control microbial contaminants.

Primary Drinking Water Standard (PDWS): MCLs and MRDLs for contaminants that affect health along with their monitoring and reporting requirements, and water treatment requirements.

Regulatory Action Level: The concentration of a contaminant which, if exceeded, triggers treatment or other requirements that a water system must follow.

Treatment Technique (TT): A required process intended to reduce the level of a contaminant in drinking water.

Turbidity: A water clarity indicator that measures cloudiness of the water, and is also used to indicate the effectiveness of the filtration system. High turbidity can hinder the effectiveness of disinfectants.

Cryptosporidium is a parasitic microbe found in most surface water. We regularly test for this waterborne pathogen, and found it at very low levels in source water and treated water in 2018. However, current test methods approved by the USEPA do not distinguish between dead organisms and those capable of causing disease. Ingestion of *Cryptosporidium* may produce symptoms of nausea, abdominal cramps, diarrhea, and associated headaches. *Cryptosporidium* must be ingested to cause disease, and it may be spread through means other than drinking water.

Attachment F

BAT and Treatment Cost Estimate of Arsenic for SFWS Source at SVWTP

Attachment F. BAT and Treatment Cost Estimate of Arsenic for SFWS Source at SVWTP

Purpose

This Technical Memorandum (TM) discusses a preliminary cost estimate of the best available technology (BAT) for potentially reducing arsenic concentrations in water to the California Public Health Goal (PHG) level. The cost estimate is provided in support of the 2019 PHG Report for the San Francisco Water System (SFWS).

Introduction

The United States Environmental Protection Agency (USEPA) and the California State Water Resources Control Board, Division of Drinking Water (SWRCB-DDW) promulgate Maximum Contaminant Levels (MCLs), which are legally enforceable drinking water standards. These agencies also adopt the best known, commercially available and economically feasible technologies to reduce contaminant levels to the MCLs. These technologies are prescribed as BATs and are intended to assist public water systems in achieving MCL compliance. For the purpose of this TM, technologies for attaining MCLs are referred to as $BATs_{(M)}$. Full-scale utility applications of such technologies have been implemented nationwide, and the associated treatment costs are available.

PHGs, set by the California Office of Health Hazard Assessment, are often much lower than MCLs, so it is not always possible to determine from available information what treatment, if any, could reduce contaminant levels to the PHGs. Hence, cost estimates for these treatment technologies could be highly uncertain. In this TM, BATs to reduce contaminant levels to PHGs are termed $BATs_{(P)}$.

The Association of California Water Agencies (ACWA) publishes guidelines suggesting how to complete PHG Reports and handle the difficult task of estimating costs of reducing contaminant levels to PHGs. Therefore, ACWA's guidelines have been considered to prepare this cost estimate.

Cost Estimate for the BAT to Reduce Arsenic

Detection of Arsenic in the San Francisco Water System

Between 2016 and 2018, arsenic was detected at a range of 2.08 ppb – 2.30 ppb in raw water samples at the Calaveras reservoir.

Best Available Technologies for Removal of Arsenic

The USEPA has identified seven $BATs_{(M)}$ in the final Arsenic Rule. These $BATs_{(M)}$ are for arsenic-V [As(V)]. Pre-oxidation may be required to convert arsenic-III [As(III)] to As(V). The $BATs_{(M)}$ to achieve levels below the MCL and the maximum percent of arsenic removal that can be reasonably obtained from these technologies are summarized in Table F-1.

Table F-1. Best Available Technologies for Arsenic Removal[1]

Treatment Technology	Maximum Percent Removal	Estimated Concentration after Treatment (ppb)[(a)]
Ion Exchange	95	0.12
Activated Alumina	90	0.23
Reverse Osmosis	>95	<0.12
Modified Coagulation/Filtration	95	0.12
Modified Lime Softening	80	0.46
Electrodialysis Reversal	85	0.35
Oxidation/Filtration	80	0.46

(a) Assumes pre-treatment concentration is equivalent to the maximum arsenic concentration detected during the 2016 – 2018 reporting period (2.3 ppb).

Based on the $BATs_{(M)}$ recommended by the USEPA, the only $BATs_{(P)}$ potentially capable of possibly reducing arsenic to the PHG is reverse osmosis (RO). Even so, such a reduction might require multiple passes through RO membranes, which vastly increases the footprint and cost of an RO facility and produces a large quantity of waste brine (concentrate) flow that represents a loss of water and a new waste stream to process. Furthermore, pretreatment may be required for arsenic species conversion, as arsenic treatment technologies are most effective for the negatively-charged As(V) species versus the neutral As(III) species.

ACWA provides unit cost (dollars per 1,000 gallons treated) estimates, but these values are based on studies which reduced arsenic to the MCL and not the PHG, which is significantly lower. In addition, the ACWA used the cost information from studies regarding RO treatment of surface water that are relatively outdated (1991 and 1998). As such, cost estimates for RO treatment in this Attachment are derived from a more recent study, the City of San Diego's Advanced Water Purification Facility Demonstration Project[2] (AWP Project).

A spreadsheet model was developed to determine the required size of an RO system theoretically capable of removing arsenic at a concentration of 2.3 ppb (the highest concentration found in the annual raw water at Calaveras Reservoir between 2016 and 2018) to a concentration below the PHG. Since arsenic was found only in the Calaveras Reservoir during the reporting period, only this source of water supply to the SFWS is considered for arsenic removal in this report. The model assumed a design flow based on the maximum Sunol Valley Water Treatment Plant (SVWTP) capacity of 160 MGD.

Detailed water quality-specific removal rates from Toray, an RO membrane manufacturer, were used to determine a salt removal of 95.8% under typical conditions through RO membranes. This removal rate was confirmed by a study documenting a field trial[3]. With this removal rate, the water would need to be re-filtered through additional sets of membranes, or passes, to further lower the arsenic concentration. Assuming the same removal rate and an 85% recovery rate[2] through each pass, it was determined that a two-pass RO system is required to achieve arsenic concentrations below the PHG.

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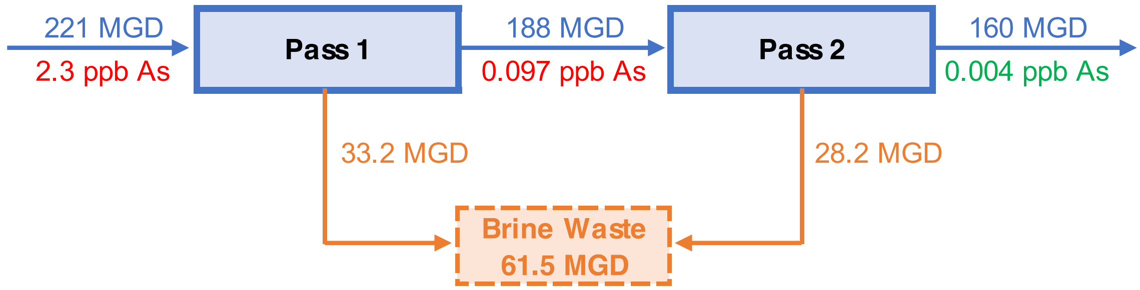
[1] D. Lytle & T. Sorg., *Treatment Options [for Arsenic]*, USEPA Office of Research and Development (Water Supply and Water Resources Division), 2006

[2] City of San Diego, *Advanced Water Purification Facility Study Report*, January 2013

[3] T. Geucke et al., *Desalination*, February 2009

Since RO systems are nominally sized based on the production flowrate, the water flow from each pass of the RO system can be summed to determine the "equivalent size" needed to remove enough arsenic to meet the PHG. Each pass is effectively a separate RO system. Therefore, the equivalent size would be the sum of 221 MGD (first pass production) and 188 MGD (second pass production) for a total of 410 MGD. A conceptual model of the RO treatment system is shown in Figure F-1.

Figure F-1. Conceptual Model of RO Arsenic Treatment for SVWTP



NOTES:

- Arsenic removal through each pass of RO membranes is assumed to be 95.8% from feed to permeate with an 85% flow recovery rate.

Treatment Cost for Removal of Arsenic

To estimate the cost of treating arsenic for the supply to the SFWS, the costs published by the AWP Project were adjusted to account for a higher flow rate and inflation.

Cost adjustment for a higher flow rate

Arsenic was only detected above the PHG at Calaveras Reservoir, so a single system was assumed for this TM. The design flow rate was based on the maximum capacity at SVWTP, even though demand varies. To achieve the 0.004 ppb treatment goal, the effluent of the RO treatment system would need to be equivalent to the full flow at SVWTP.

To account for the size differences between the systems required by the SFPUC, the scale of operations[4] method (also known as the "six-tenths factor") was applied. The scale of operations method is recommended by AACE International as a reliable way of arriving at cost estimates at the predesigned stage, when the analysis involves a large number of variables. The method involves multiplying the known cost by the capacity ratio raised to a capacity factor (between 0.6 and 1). O&M costs were scaled linearly.

The RO treatment system required by the SFPUC is approximately 23 times larger than the full-scale AWP Project (18 MGD capacity). As plant capacity increases to the limits of existing technology, the capacity factor approaches one. Because the capacity ratios are sufficiently large for the RO treatment facility, a capacity factor of 1 was used to calculate capital costs.

Cost adjustment for inflation

The AWP Project published costs in 2012 dollars. Costs were revised to reflect 2019 dollar values, by Gordian Group's RSMeans® Construction Cost Indexes. The adjustment factor of 1.17 was derived from the ratio of the 2019 index/2012 index.

[4] AACE® International Recommended Practice No. 59R-10

Table F-2. Arsenic Treatment Costs Using RO System for SVWTP

Capital Cost ($mil)	$862
Annual O&M Cost ($mil/year)	$65
20-year Annualized Capital and O&M Costs ($mil/year)	$149

The 20-year annualized capital and O&M cost for the RO treatment system was estimated at $149 million.

Other factors would increase the cost of reducing arsenic to the PHG, such as:

- land acquisition
- environmental permitting
- excess capacity for redundancy
- potential raw and product water pumping and storage
- disposal of brine
- evaluating and implementing pretreatment for species conversion
- conducting a comprehensive pilot test to optimize treatment
- interest
- future inflation

Another unknown cost factor that is not considered is the loss of revenue from the brine waste. The RO system has the potential of wasting 61.5 MGD of surface water.

Furthermore, since the proposed arsenic treatment technology has not been implemented at the scale required for the SFWS, it is not certain that the technology would successfully treat arsenic to the PHG of 0.004 ppb.

Because arsenic has been detected in only a single source water (Calaveras Reservoir) and is less than one-quarter of the SWRCB-DDW's MCL, the high costs associated with treating arsenic to the PHG do not appear to be warranted. In addition, East Bay reservoirs, such as Calaveras Reservoir, are usually blended with Hetch Hetchy water, which did not detect arsenic during the reporting period. After blending, arsenic is likely non-detect in the Easy Bay blend.

Attachment G

BAT and Treatment Cost Estimate for Removal of Hexavalent Chromium for SFWS

Attachment G. BAT and Treatment Cost Estimate for Removal of Hexavalent Chromium for SFWS

Purpose

This Technical Memorandum (TM) discusses a cost estimate of the best available technology (BAT) for reducing Cr(VI) concentrations in water to the California Public Health Goal (PHG) level. The cost estimate is provided in support of the 2019 PHG Report for the San Francisco Water System (SFWS).

Definition of Best Available Technology

The United States Environmental Protection Agency (USEPA) and the California State Water Resources Control Board, Division of Drinking Water (SWRCB-DDW) promulgate Maximum Contaminant Levels (MCLs), which are legally enforceable drinking water standards.

USEPA and SWRCB-DDW also adopt the best known, commercially available and economically feasible technologies to reduce contaminant levels to the MCLs. These technologies are prescribed as BATs and are intended for public water systems to attain MCL compliance. For the purpose of this TM, technologies for attaining MCLs are referred to as $BATs_{(M)}$. Some full-scale utility applications of such technologies have been implemented nationwide, and the associated treatment costs are available.

PHGs, set by the California Office of Health Hazard Assessment, are often much lower than MCLs, so it is not always possible to determine from available information what treatment, if any, could reduce contaminant levels to the PHGs. Hence, cost estimates for these treatment technologies could be highly uncertain. In this TM, BATs to reduce contaminant levels to PHGs are termed $BATs_{(P)}$.

The Association of California Water Agencies (ACWA) publishes guidelines suggesting how to complete PHG Reports and handle the difficult task of estimating costs of reducing contaminant levels to PHGs. Therefore, ACWA's guidelines have been used to prepare this cost estimate.

Cost Estimate for the BAT to Reduce Hexavalent Chromium

Detection of Hexavalent Chromium in the San Francisco Water System

The SFPUC detected Cr(VI) in the SFWS reservoirs in 2017 and 2018, when monitoring of treated water for Cr(VI) and nitrate began with the initiation of the San Francisco Groundwater Project (SFGW). Cr(VI) was regularly detected at low levels below the former DLR of 1 ppb. The highest concentration detected was 0.925 ppb, below both the SWRCB-DDW's previous MCL (10 ppb) and DLR but above the PHG of 0.02 ppb.

Cr(VI) was also detected in treated surface water effluent and raw surface water during the annual monitoring in 2016, 2017, and 2018 using the latest detection limit of 0.02 ppb. The contaminant was detected in all treated surface water samples (at concentrations between 0.023 ppb and 0.190 ppb) and in raw surface water samples (at concentrations between <0.02 ppb and 0.21 ppb). However, all detected concentrations were well below the SWRCB-DDW's previous MCL and DLR.

Table G-1. Maximum Cr(VI) Levels Detected at Compliance Monitoring Locations

Compliance Location	Sample Type	Maximum Level Detected (ppb)
Sunset Reservoir (North) outlet	Treated	0.925
Sunset Reservoir (South) outlet	Treated	0.577
Sutro Reservoir outlet	Treated	0.529
HTWTP	Treated	0.190
SVWTP	Treated	0.130
Alameda East	Treated	0.039
Crystal Springs Pipeline #2	Treated	0.034
San Andreas Reservoir	Raw	0.210
Lower Crystal Springs Reservoir	Raw	0.200
Pond F2	Raw	0.160
Pond F3E	Raw	0.120
San Antonio Reservoir	Raw	0.120
Calaveras Reservoir	Raw	0.096
Pilarcitos Reservoir	Raw	0.087
Lake Lloyd (Cherry Lake) Reservoir	Raw	0.025

Best Available Technologies for Removal of Hexavalent Chromium

Most drinking water contaminants have federally and state-approved $BATs_{(M)}$, as well as successful full-scale utility applications for MCL compliance. Although the previous Cr(VI) MCL was withdrawn by the SWRCB-DDW in 2017, the agency is in the process of developing a new MCL. The SFPUC continues to use 10 ppb as a water quality goal. Although the state had previously identified three $BATs_{(M)}$ for treating Cr(VI) to meet the withdrawn MCL, few full-scale applications have been implemented to demonstrate the cost and effectiveness of the technologies.

However, ACWA provides unit costs (dollars per 1,000 gallons treated) for Cr(VI) treatment technologies that are primarily derived from the Hexavalent Chromium Removal Research Project[1] managed by the City of Glendale, California, and referred to herein as the Glendale Project. The Glendale Project identified leading treatment technologies for reducing Cr(VI) in drinking water to the MCL.

The Glendale Project sought to identify technologies capable of reducing Cr(VI) to a range of possible MCLs, from 1 ppb to 25 ppb. It tested influent Cr(VI) concentrations between 10 ppb and 80 ppb. The

[1] Participants and financial partners of the Glendale Project included the City of Glendale; Los Angeles Department of Water and Power; Water Research Foundation; City of Burbank; City of San Fernando; National Water Research Institute; USEPA; ACWA; California Department of Public Health (now SWRCB-DDW); local industry; US Bureau of Reclamation; Metropolitan Water District of Southern California; California Water Service Company; North American Hoganas; Arcadis; Hazen and Sawyer; DOW Chemical; California Water Service Agencies; San Fernando Valley Industry; Evoqua/Siemans; and Aqua Nano.

Glendale Project did not intend to identify technologies to reduce influent concentrations already below 10 ppb, nor did it intend to identify technologies that could reduce levels to the current PHG (0.02 ppb).

The Glendale Project consisted of three phases: bench-scale, pilot, and demonstration testing. Various technologies were screened at the bench-scale level, including anion exchange, sorption, membrane treatment by nanofiltration and reverse osmosis (RO), and coagulation. Among these technologies, seven variations were selected for further study at the pilot level, based on treatment capability and cost-effectiveness. While membrane treatment by nanofiltration and RO were effective at Cr(VI) treatment, the associated considerable loss of water precluded it from larger-scale studies. Therefore, RO is not considered for Cr(VI) treatment, even though it is considered for the treatment of arsenic and Gross Alpha Particle Activity in the 2019 PHG Report.

Based on the first two phases of the Glendale Project, two treatment technologies were identified as leading candidates for Cr(VI) reduction and tested at the demonstration-level: reduction/coagulation/filtration (RCF) and anion exchange. Subsequently, additional pilot testing identified the effectiveness of different anion exchange resins: both weak base anion exchange (WBA) and strong base anion exchange (SBA) resins. Table G-2 presents the ranges of influent and effluent concentrations for each treatment technology that was tested during phase III of the Glendale Project.

Table G-2. Phase III Test Results for Leading Cr(VI) Treatment Technologies of Glendale Project

Treatment Technology	Technological Variation	Test Type	Influent Concentration Range (ppb)	Effluent Concentration Range (ppb)
RCF	Granular media filtration	Demonstration	75 – 80	<0.02 – 4.35
		Demonstration	10 – 15	0.05 – 0.13
	Microfiltration	Demonstration	15	<0.02 – 0.037
	Enhanced*	Demonstration	>20	2.3 – 2.7
WBA	Resin: DOW Amberlite PWA7	Demonstration	25 – 45	<0.02
	Resin: Purolite S106	Pilot	20 – 30	<0.02 – 10
	Resin: ResinTech SIR-700	Pilot	20 – 30	<0.02 – 12
SBA	Resin: Purolite A6006/9149	Pilot	28	<0.02
		Pilot	9.8	<0.02

*Enhanced RCF included a variety of cost-reducing optimizations, iron dose, contact time, and pumping mechanisms.

WBA technology using Amberlite PWA7 resin and SBA technology using Purolite A6006/9149 resin were capable of consistently reducing Cr(VI) concentrations to less than 0.02 ppb during demonstration testing.

The Glendale Project estimated the costs for both WBA and SBA to reduce Cr(VI) below the MCL; however, it did not publish enough information about SBA to estimate the cost of Cr(VI) treatment to the PHG level. Therefore, the cost estimate in this TM is based on the use of WBA with Amberlite PWA7 resin.

WBA resin is reusable but has a limited lifespan. The lifespan is the time during which the resin is adequately effective in reducing the concentration of the target contaminant to the treatment goal. Resin lifespan depends on the target treatment goal, as well as the influent concentration of the contaminant. The Glendale Project determined Amberlite PWA7 lifespans for different treatment goals (Table G-3) using an influent concentration of around 75 ppb. The Glendale Project did not quantify the impact of influent concentration on resin life.

Table G-3. WBA Amberlite PWA7 Resin Lifespans for Different Cr(VI) Treatment Goals

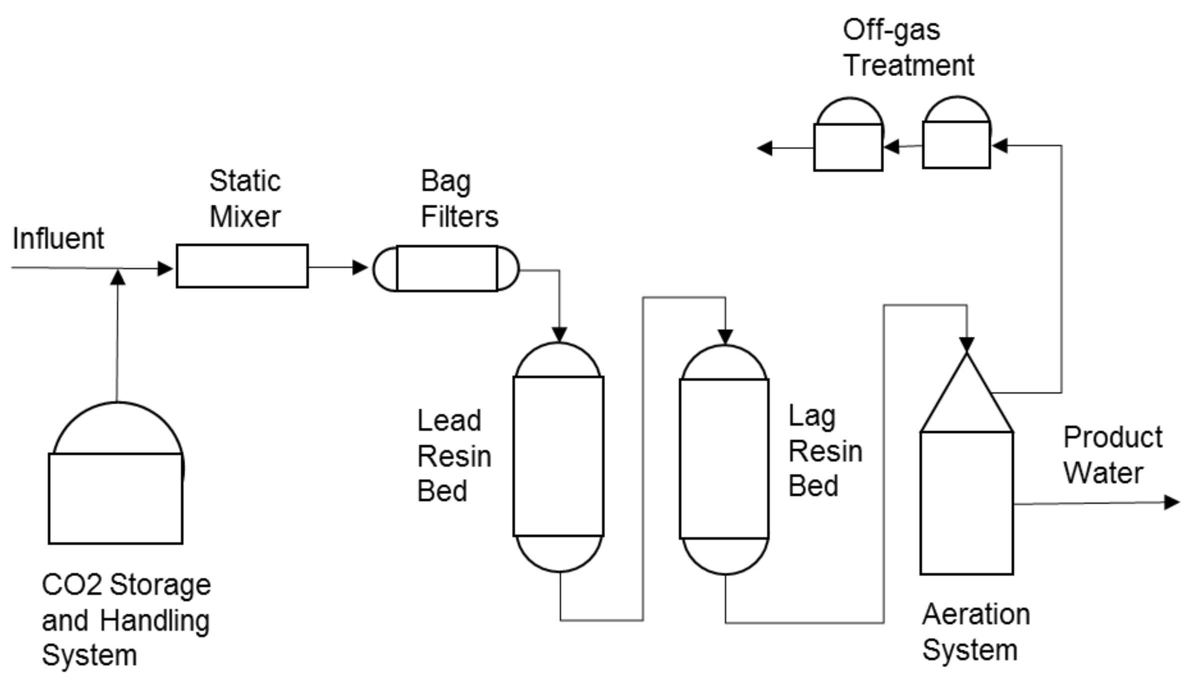
Influent Cr(VI) Concentration (ppb)	Cr(VI) Treatment Goal (ppb)	Resin Lifespan (Days)
75	0.02	105
	1	274
	2	312
	5	360

WBA requires a pH of approximately 6.0 to effectively reduce Cr(VI) concentrations to less than 0.02 ppb. If the pH is higher, Cr(VI) reduction is not as effective. The pH at SFWS entry points is maintained between 8.2 and 9.9 for corrosion control, and the pH of raw groundwater varied between 7.0 and 8.5. Therefore, adjusting the pH before and after the WBA process would be required.

Treatment Cost for Removal of Hexavalent Chromium

The Glendale Project provides cost estimates for treatment using the WBA Amberlite PWA7 resin for systems sized from 10 to 2,000 gallons per minute (gpm). The costs include a carbon dioxide feed system to lower influent pH; bag filters for removing particles; lead and lag pressure vessels containing resin beds for ion exchange; aeration and off-gas treatment for post-treatment pH adjustment; and operation and maintenance (O&M), including resin replacement and disposal. A conceptual model of the WBA system is shown in Figure G-1.

Figure G-1. Conceptual Model of Weak Base Anion Exchange Cr(VI) Treatment



To estimate the cost of treating Cr(VI) in the SFWS, the costs published by the Glendale Project for a 2,000-gpm system were adjusted to account for a lower effluent goal, a higher flow rate, and inflation. However we have no information about the effects on cost if the influent Cr(VI) concentrations were reduced from 75 ppb (in Glendale Project) to 0.925 ppb (the maximum concentration detected in the reporting period.

Cost adjustment for a lower effluent goal

The Glendale Project assumed a resin lifespan corresponding to a treatment goal of 1 ppb. For a 2,000 gpm system and a 1 ppb treatment goal, annual O&M costs would be $1.6 million, with $0.9 million of the total O&M costs attributed to resin replacement. The lifespan of resin used to treat Cr(VI) to the PHG level would be around one third that for the 1 ppb treatment goal. Therefore, resin replacement and disposal costs from the Glendale Project were increased linearly (by a factor of approximately 3) to account for the more frequent resin changeouts. The O&M cost for a 2,000 gpm system and a 0.02 ppb treatment goal are estimated at $3.1 million. Capital costs were not affected by treatment goal.

Cost adjustment for a higher flow rate

Since Cr(VI) was detected above the PHG at multiple compliance monitoring locations, five separate systems were assumed for this TM. The design flow rates were based on the maximum capacities at each location. To achieve the 0.02 ppb treatment goal, the full flow at each treatment facility would need to be treated.

To account for the size differences between the systems required by the SFPUC, the scale of operations[2] method (also known as the "six-tenths factor") was applied. The scale of operations method is recommended by AACE International as a reliable way of arriving at cost estimates at the predesigned stage, when the analysis involves a large number of variables. The method involves multiplying the known cost by the capacity ratio raised to a capacity factor (between 0.6 and 1). O&M costs were scaled linearly.

The system required for the Lake Merced Well is approximately half the size of the 2,000-gpm Glendale Project system, and the system required for the Golden Gate Park/Sunset (GGP/SS) Well Field is approximately one-and-a-half the size. Therefore, a capacity factor of 0.6 was assumed for the SFGW facilities.

The three BAT treatment facilities required for the three separate surface water sources are 50 to 100 times larger than the 2,000-gpm Glendale Project system. As plant capacity increases to the limits of existing technology, the capacity factor approaches one. Because the capacity ratios are sufficiently large for the surface water treatment facilities, a capacity factor of 1 was used to calculate capital costs for these three surface water treatment systems required for the SFPUC.

Cost adjustment for inflation

The Glendale Project published costs in 2012 dollars. Costs were adjusted to reflect 2019 dollar values, by Gordian Group's RSMeans® Construction Cost Indexes. The adjustment factor of 1.17 was derived from the ratio of the 2019 index/2012 index.

[2] AACE® International Recommended Practice No. 59R-10

Table G-4. Capacity and Cr(VI) Treatment Costs of Each SFWS Water Source

Source of Water	Maximum Capacity (MGD)	Capital Cost ($mil)	Annual O&M Cost ($mil/year)	20-year Annualized Capital and O&M Costs ($mil/year)
Alameda East*	315	$1,060	$396	$619
Sunol Valley Water Treatment Plant	160	$539	$201	$314
Harry Tracy Water Treatment Plant	180	$606	$226	$354
Lake Merced Well	0.864	$4.71	$1.76	$2.75
Golden Gate Park/Sunset Well Field	3.96	$11.7	$4.38	$6.85
Total		$2,221	$830	$1,967

* Capacity from Tesla Treatment Facility UV disinfection system capacity
MGD = million gallons per day

With an accuracy range of -30% to 50% (the range used in the Glendale Project), the 20-year annualized capital and O&M cost for WBA treatment was estimated at $619 million for Alameda East, $314 million for the Sunol Valley Water Treatment Plant, and $354 million for the Harry Tracy Water Treatment Plant. For all three surface water sites combined, 20-year annualized capital and O&M costs were estimated at $1.29 billion. Because two-thirds of SFPUC surface water is supplied to wholesale agencies, only one third of this cost is assumed to be passed on to SFWS retail customers. The 20-year annualized capital and O&M cost for WBA treatment was estimated at $2.75 million for the Lake Merced Well and $6.85 million the GGP/SS Well Field, for a combined cost at $9.60 million.

Ultimately, the lump sum capital cost for all five treatment facilities is $2.22 billion. The 20-year annualized capital and O&M costs for all five treatment facilities is $1.30 billion. This amount equates to an average water bill increase of 134%, with a maximum increase of up to 178% per year on water bills.[3]

Other factors would increase the cost of reducing Cr(VI) to the PHG, such as land acquisition, environmental permitting, excess capacity for redundancy, potential raw and product water pumping and storage, conducting a comprehensive pilot test to optimize treatment, interest, and future inflation. The cost of adjusting the pH before and after treatment would also be higher for the water supply to the SFWS than estimated by the Glendale Project, because the influent pH assumed by the project is lower than that in the SFWS. Furthermore, since the proposed Cr(VI) treatment technology has not been implemented at the scale required for the SFWS, it is uncertain that the technology would successfully treat Cr(VI) to the PHG of 0.02 ppb.

Because the Cr(VI) concentration in the SFWS is less than one-tenth of the SWRCB-DDW's previous MCL and DLR, the high costs associated with treating Cr(VI) to the PHG do not appear to be warranted.

[3] Water bill increase was calculated from the latest version of SFPUC's water rates model. This model is managed and utilized by the Business Services Bureau (Finance) for calculations and revisions related to water rates.

Attachment H

BAT and Treatment Cost Estimate for Removal of Gross Alpha Particle Activity for SFWS Source

Attachment H. BAT and Treatment Cost Estimate for Removal of Gross Alpha Particle Activity for SFWS Source

Purpose

Although there is no PHG established by the California Office of Health Hazard Assessment for gross alpha particle activity (herein referred to as "Gross Alpha"), the United States Environmental Protection Agency (USEPA) has a Maximum Contaminant Level Goal (MCLG) of zero adopted for this contaminant. This Technical Memorandum (TM) discusses a cost estimate of the best available technology (BAT) for reducing Gross Alpha concentrations in water to a level below the MCLG. The cost estimate is provided in support of the 2019 PHG Report for the San Francisco Water System (SFWS).

Definition of Best Available Technology

The USEPA and the California State Water Resources Control Board, Division of Drinking Water (SWRCB-DDW) promulgate Maximum Contaminant Levels (MCLs), which are legally enforceable drinking water standards. These agencies also adopt the best known, commercially available and economically feasible technologies to reduce contaminant levels to the MCLs. These technologies are prescribed as BATs and are intended for public water systems to attain MCL compliance. For the purpose of this TM, technologies for attaining MCLs are referred to as $\text{BATs}_{\text{(M)}}$. Full-scale utility applications of such technologies have been implemented nationwide, and the associated treatment costs are available.

MCLGs, set by the USEPA, are often much lower than MCLs, so it is not always possible to determine from available information what treatment, if any, could reduce contaminant levels to the MCLGs. Hence, cost estimates for these treatment technologies could be highly uncertain. In this TM, BATs to reduce contaminant levels to MCLGs are termed $\text{BATs}_{\text{(P)}}$.

The Association of California Water Agencies (ACWA) publishes guidelines suggesting how to complete PHG Reports and handle the difficult task of estimating costs of reducing contaminant levels to MCLGs. Therefore, ACWA's guidelines have been considered to prepare this cost estimate.

Cost Estimate for the BAT to Reduce Gross Alpha

Detection of Gross Alpha in the San Francisco Water System

Gross Alpha was not detected in the treated water during the reporting period. However, Gross Alpha was detected at 6.8 pCi/L, which is above the MCLG but below the MCL in one raw water sample collected at Pond F2 in 2016.

Best Available Technologies for Removal of Gross Alpha

The USEPA has identified reverse osmosis as the $\text{BATs}_{\text{(M)}}$ for Gross Alpha treatment to reach the MCL for Gross Alpha. Thus, multiple passes of RO membrane systems would be required to further lower the Gross Alpha level. Such a multiple-pass RO facility would vastly increase the footprint and cost and produce a large quantity of waste brine (concentrate) flow that represents a loss of water and a new waste stream to process.

As a one-pass RO treatment would reduce Gross Alpha to 0.34 pCi/L, which is still above the MCLG of zero and the DLR of 3 pCi/L, a two-pass RO system could theoretically reduce the Gross Alpha concentration by a further 95% to 0.02 pCi/L. However, the remaining Gross Alpha would still be above the MCLG of zero. In fact, achieving an absolute zero concentration of Gross Alpha is not possible. Even with a two-pass RO system, the resulting activity would be significantly below the DLR and thus not detectable. As such, a two-pass RO system has been assumed for purposes of the cost estimate. If more passes were used, the cost would be substantially higher.

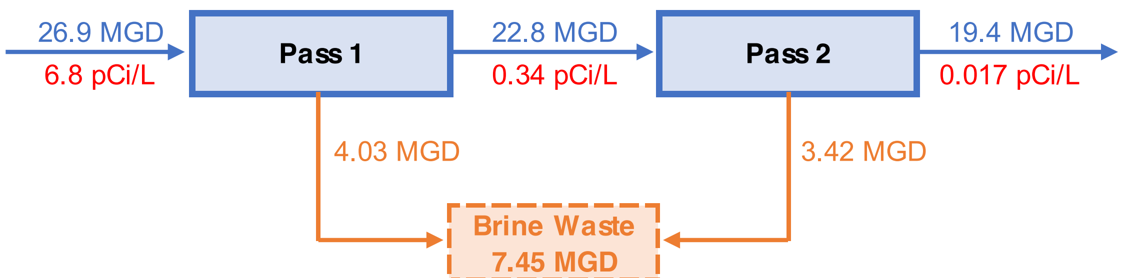
ACWA provides unit cost (dollars per 1,000 gallons treated) estimates for water treatment technologies. However, Pond F2 is currently not in service as no pumps exist yet and it remains disconnected from the San Francisco Regional Water System (SFRWS). Pond F2 was added as a permitted drinking water source to the SFRWS in 2017. Pumps will be installed in the future to divert water from Pond F2 to San Antonio Reservoir or directly to the Sunol Valley Water Treatment Plant (SVWTP).

Therefore, only a rough approximation of costs was prepared in this attachment since pumping capacity for Pond F2 is still in the design phase. Consequently, costs of this Gross Alpha RO treatment system are based on the RO treatment system cost estimate for arsenic (Attachment F).

A spreadsheet model was developed to determine the required size of an RO system theoretically capable of removing Gross Alpha at a concentration of 6.8 pCi/L from the raw surface water at Pond F2 but below the DLR of 3 pCi/L.

For the purpose of this cost estimate, costs were estimated based on the maximum design flow rate for the Pond F2 pumps (19.4 MGD).[1] Gross Alpha would be treated prior to being pumped into the San Antonio Reservoir or to the SVWTP. This cost estimate assumes a 95% removal rate[2] and an 85% recovery rate,[3] with a two-pass RO system. A conceptual model of the RO treatment system is shown in Figure G-1.

Figure H-1. Conceptual Model of RO Treatment of Gross Alpha for Pond F2



Treatment Cost for Removal of Gross Alpha

To estimate the cost of treating Gross Alpha in the water supply to the SFWS, the costs published by San Diego's Advanced Water Purification Project were adjusted to account for a higher flow rate and inflation.

Cost adjustment for a higher flow rate

Gross Alpha was only detected above the MCLG at Pond F2, so a two-pass system was assumed for this TM. To account for the size differences between the systems required by the SFPUC, the scale of operations[4] method (also known as the "six-tenths factor") was applied. The scale of operations method is recommended by AACE International as a reliable way of arriving at cost estimates at the predesigned

[1] Based on the Alameda Creek Recapture Project's design flowrates as of March 2019

[2] Montana, M. *Removal of Radionuclides in Drinking Water by Membrane Treatment Using Ultrafiltration, Reverse Osmosis and Electrodialysis Reversal*. Journal of Environmental Radioactivity Vol. 125, November 2013, Pages86-92.

[3] City of San Diego, *Advanced Water Purification Facility Study Report,* January 2013.

[4]AACE® International Recommended Practice No. 59R-10

stage, when the analysis involves a large number of variables. The method involves multiplying the known cost by the capacity ratio raised to a capacity factor (between 0.6 and 1). O&M costs were scaled linearly.

The RO treatment system for this contaminant is approximately three times larger than the full-scale AWP Project (18 MGD capacity). Therefore, a capacity factor of 0.6 was used to calculate capital costs.

Cost adjustment for inflation

The AWP Project published costs in 2012 dollars. Costs were revised to reflect 2019 dollar values, by Gordian Group's RSMeans® Construction Cost Indexes. The adjustment factor of 1.17 was derived from the ratio of the 2019 index/2012 index.

Table H-1. Gross Alpha Treatment Costs Using RO System for Pond F2

Capital Cost ($mil)	$95.0
Annual O&M Cost ($mil/year)	$7.19
20-year Annualized Capital and O&M Costs ($mil/year)	$16.4

The 20-year annualized capital and O&M cost for the RO treatment system was estimated at $16.4 million.

Other factors would increase the cost of reducing Gross Alpha to the MCLG, such as:

- land acquisition
- environmental permitting
- excess capacity for redundancy
- potential raw and product water pumping and storage
- disposal of brine
- conducting a comprehensive pilot test to optimize treatment
- interest
- future inflation

Another unknown cost factor that is not considered is the loss of revenue from the brine waste. The RO system has the potential of wasting 7.45 MGD of surface water.

Furthermore, since the efficacy of this $BAT_{(P)}$ is only proven at the MCL level. Since the MCLG is set to zero, even RO cannot be guaranteed to be effective. Furthermore, the analytical technology currently prevalent in the industry is not capable of detecting Gross Alpha at extremely low concentrations. In other words, the success of a new RO facility to reduce Gross Alpha to near the MCLG would be impossible to measure.

The likely cause of Gross Alpha in the raw water is the result of the erosion of natural deposits. Because Gross Alpha has been detected in only a single source water (Pond F2) and is less than one-half of the SWRCB-DDW's MCL, the high costs associated with treating Gross Alpha to a non-detectable level do not appear to be warranted.

Attachment I

Two Decades Protecting San Francisco Children from Lead Exposure

TWO DECADES
PROTECTING SAN FRANCISCO CHILDREN FROM LEAD EXPOSURE

August 2015

San Francisco Department of Public Health
Population Health Division
Environmental Health Branch
Children's Environmental Health Promotion Program

POPULATION HEALTH DIVISION
SAN FRANCISCO DEPARTMENT OF PUBLIC HEALTH

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QUICK FACTS

85

Percent of homes in San Francisco built before 1978, the year lead paint was banned from residential use

<6

Age group most at risk for lead poisoning, due to hand-to-mouth exposure pathway

0

Blood lead level (BLL) above which can harm a child's development

(BLL is measured in micrograms per deciliter, mcg/dL or µg/dL)

PREFACE

No matter where children live, learn and play, they all need and deserve healthy environments that promote their optimal development. However, many young children may be exposed to the toxic metal, lead, in the very environments meant to nurture them: homes, yards, child care, schools and public settings.

Lead exposure can cause irreversible harm to children's health, behavior and learning potential. No level of lead in the body is known to be safe. *Any* lead exposure to a fetus or young child creates the risk of causing cognitive and health impacts. The landmark epidemiologic study, "Intellectual impairment in children with blood lead concentrations below 10 mcg per deciliter" published in *The New England Journal of Medicine* in 2003 first established this finding, leading to a major shift in pediatric medical policy and guidance on childhood lead poisoning.

The San Francisco Department of Public Health (DPH) Childhood Lead Prevention Program (CLPP) was launched in February 1993 to protect children from the harmful effects of lead exposure. The work of the CLPP is to eliminate lead paint hazards before children are exposed. This report provides the story of how the CLPP has been effective in achieving that mission and what work remains to be done.

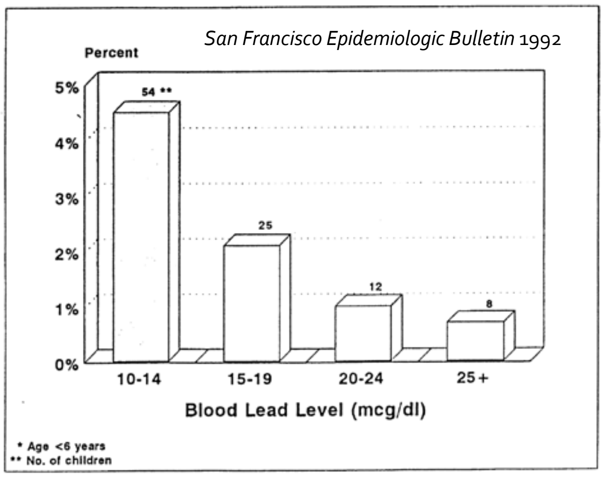
A. Knowledge of Lead Toxicity Since Antiquity

Lead was one of the first metals humans learned to use due to its ease of extraction from the earth, its malleability and its chemical association with silver. Consequently, lead poisoning has been known since antiquity, with the first descriptions of lead toxicity dating back to the second century B.C. The Hellenistic physician Nicander of Colophon identified the acute effects associated with high-dose exposure to be paralysis and saturnine colic.

B. Origins of the Childhood Lead Prevention Program

1st Milestone: Scope of the Problem Becomes Evident

DPH began responding to individual lead poisoning cases in the 1970's and then again, in 1990. That year was the beginning of mandatory laboratory reporting of blood lead levels of 20 micrograms per deciliter (mcg/dL or µg/dL) or greater to the California Department of Public Health (CDPH), who then referred cases to City and County Health Departments for investigation. As a result of those referrals, DPH began an epidemiologic study of how lead poisoning was affecting children in San Francisco: The *San Francisco Epidemiologic Bulletin* published in March/April 1992 provided justification for DPH to conduct community-based lead screening of high risk children, due to the insufficient number receiving blood lead testing through routine health care (see Figure 1). A second *San Francisco Epidemiologic Bulletin* published in January/February 1995 provided a case control study, which demonstrated that children who lived in homes built before 1950 were almost nine times as likely to have a blood lead level greater than or equal to 20 mcg /dL, compared to children who lived in newer homes.



San Francisco Epidemiologic Bulletin 1995

Case Control Study. Results of the case-control study indicated that 97.8 percent (n=89) of the cases (PbB ≥20 ug/dL) lived in houses built before 1950 compared to 83.5 percent (n=152) of the controls (PbB <10 ug/dL). Children who lived in older houses (built before 1950) were almost nine times as likely to have EBL ≥20 ug/dL than children who lived in newer houses (built in or after 1950) {MH age-adjusted OR = 8.7, 95% C.I. (1.90<OR<52.8)].

FIGURE 1 Childhood Lead Poisoning Prevalence by Lead Level, San Francisco, 1991

San Francisco Homes Built Pre-1950

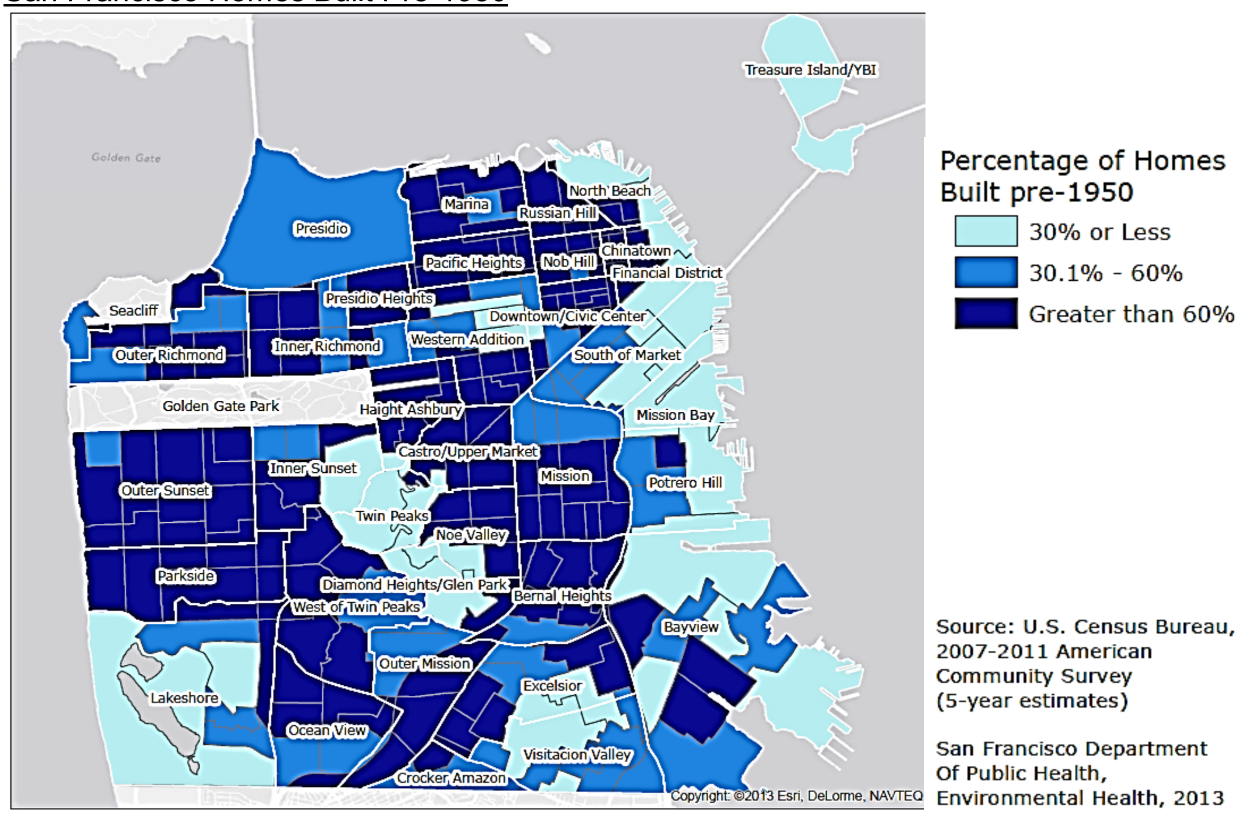


FIGURE 2 San Francisco Homes Built Before 1950

POPULATION HEALTH DIVISION
SAN FRANCISCO DEPARTMENT OF PUBLIC HEALTH

2nd Milestone: Community Coalition Provides Impetus for Local Legislation

The new lead surveillance law also led to renewed community concerns regarding exposure. A community coalition led by the Healthy Children Organizing Project successfully advocated for a December 1992 Ordinance passed by San Francisco's Board of Supervisors. As a result, Article 26 of the San Francisco Health Code was created and a comprehensive lead poisoning prevention program was defined. The Ordinance provided findings that children's lead exposure caused irreversible impacts on learning and development which justified granting authority to the DPH to prevent such exposures through establishing the Director of Health's authority to provide surveillance, medical and environmental response to children's documented lead exposures. Once signed into law, Article 26 required the DPH to develop lead hazard reduction regulations, conduct case management and reporting, educate the community and ensure that children are screened for lead poisoning.

3rd Milestone: The CDPH Funds Local CLPPs Outreach, Screening, Case Response and Surveillance

At the same time, in 1992, the CDPH began to fund local health departments for contractual services that included lead poisoning case identification and direct case management, along with educational outreach to communities, families and health care providers. As the DPH gained local statutory authority to prohibit environmental lead hazard exposure to children, the CLPP developed more programmatic efforts with property owners, tenants, home improvement stores, contractors and construction workers. In 1998, the CLPP broadened its mission and adopted "Children's Environmental Health Promotion Program" as its broader program name, while maintaining the CLPP as a core component.

4th Milestone: The CLPP Gains Regulatory Authority to Prohibit Lead Hazards

In July 1995, the Director of Health gave the CLPP authority to cite public health nuisance code in response to lead hazards identified during child lead poisoning case investigations. In 2001, the Board of Supervisors passed legislation amending the prohibited public health nuisances in the San Francisco Health Code to include "lead hazard", which definitively expanded the CLPP's authority to protect all children less than six years of age from potential lead exposure sources, regardless of blood testing status.

5th Milestone: City and County of San Francisco Participates in Successful CA Multi-Jurisdiction Lawsuit against Lead Paint Manufacturers

Ten California jurisdictions ("The People"), including the City and County of San Francisco, sought a Court Order to abate the alleged public nuisance created by lead paint manufactured or sold by five Defendants in ten California cities and counties. Filed thirteen years ago, the matter proceeded to bench trial in July-August of 2013, in the Superior Court of California and the Court found in favor of the public entities representing the People in those jurisdictions. The Court based the decision solely on the issue of lead paint produced, promoted, sold, and used for interior home use. This decision is now on appeal.

I. PROBLEM STATEMENT

A. Local Risk of Children's Lead Exposure

At least 85 percent of San Francisco housing units were built before lead was banned for use in residential house paints in 1978; (see Figures 3 and 4). The most prevalent source of lead exposure to children in San Francisco is from lead paint hazards that are ubiquitous in this overwhelmingly older housing stock, including residential buildings as well as other sites used for child care and schools. Lead paint hazards in homes and other pre-1978 buildings are defined as those having paint in poor condition, paint dust and debris, paint contaminants deposited in soil, paint on friction and impact surfaces, or paint coatings that were disturbed through repair, renovation and painting surface preparation activities.

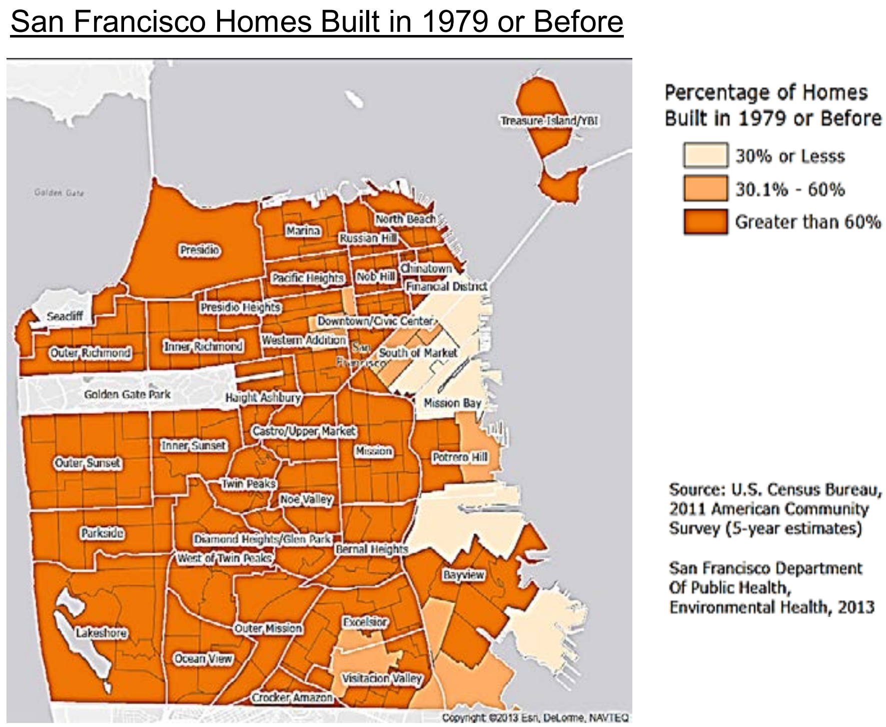
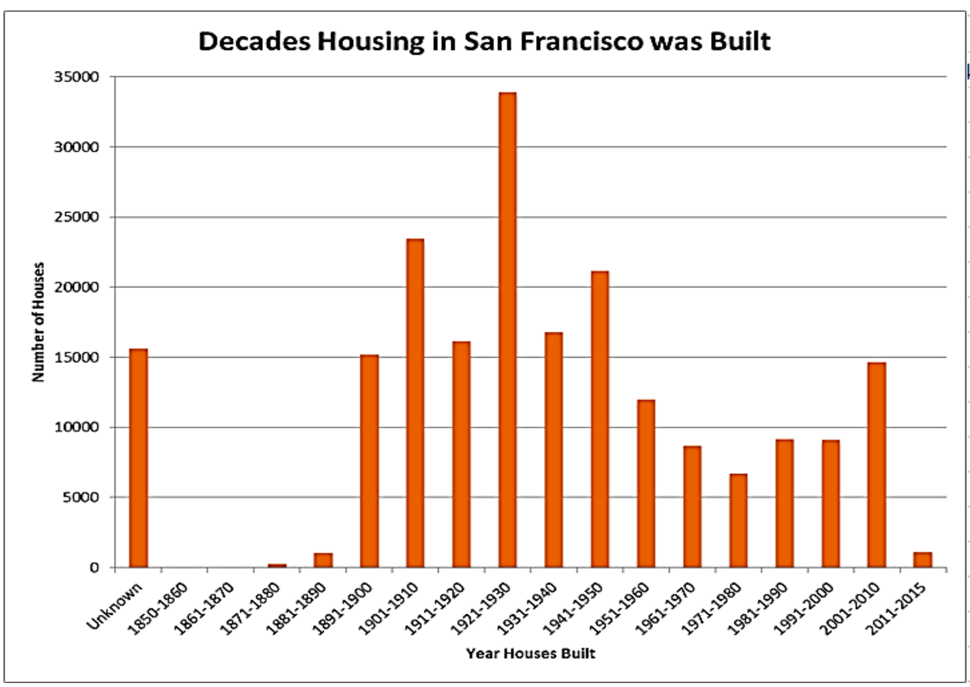


FIGURE 3 San Francisco Homes Built in 1979 or Before



Housing Year	# Houses
Unknown	15625
1850-1860	6
1861-1870	32
1871-1880	285
1881-1890	1093
1891-1900	15217
1901-1910	23478
1911-1920	16170
1921-1930	33907
1931-1940	16821
1941-1950	21198
1951-1960	11996
1961-1970	8694
1971-1980	6740
1981-1990	9180
1991-2000	9104
2001-2010	14687
2011-2015	1121

FIGURE 4 Decades Homes in San Francisco Were Built

B. Local Evidence of Children's Lead Exposure

From 2007-2012, an average of 449 San Francisco children per year were reported as lead-exposed based on their blood lead testing (see Figure 5). Notably, while certain City districts have a greater burden of lead sources based on age of housing, children with lead exposure have been identified in every census tract of San Francisco (see Figure 6). According to the US Centers for Disease Control and Prevention (CDC), children under the age of six are most susceptible to the dangers of lead exposure and lead poisoning, and are often asymptomatic. The only reliable way to verify if a child has been exposed to lead is to have a blood lead test. Although all blood lead testing data is now captured by CDPH, the true incidence of lead exposure in San Francisco children has yet to be measured because children are not universally tested. State regulations apply to all physicians, nurse practitioners, and physician's assistants, and require them to order blood lead testing of:

- All children enrolled in publicly supported programs at both 12 months and 24 months, (examples of publicly supported programs include Medi-Cal, Child Health Disability Prevention Program, Health Families, and Women, Infants and Children Supplemental Nutrition Program);
- All children ages 24 months to 6 years enrolled in publicly supported programs who were not tested previously;
- All children not enrolled in publicly supported programs if the children live in, or spend significant time in, a place built before 1978 that has peeling or chipped paint or that has been recently remodeled, or if there has been a change in circumstances that has put the child at risk of lead exposure. Medical providers must ask parents and guardians questions that identify these risks, and a parent/guardian's "Yes" or "Don't Know" response requires the provider to order lead testing.

SF children <age 21	2007	2008	2009	2010	2011	2012
# Tested	9,794	9,086	9,115	11,138	9,621	9,079
BLL ≥9.5 μg/dL	66	66	35	37	22	25
BLL 4.5- <9.5 μg/dL	528	260	281	1,009	174	189
Total # lead-exposed at current CDC reference level of BLL ≥4.5 μg/dL, with corresponding average = 449/year	594	326	316	1,046	196	214

FIGURE 5 State Health Department Surveillance of Child Lead-Exposure (BLL = Blood lead level);
Source: CDPH Childhood Lead Poisoning Prevention Branch

<u>Annual Rate of Children Aged 0-5 with a Blood Lead Level > 5 µg/dL by Census Tract (2008-2012)</u>

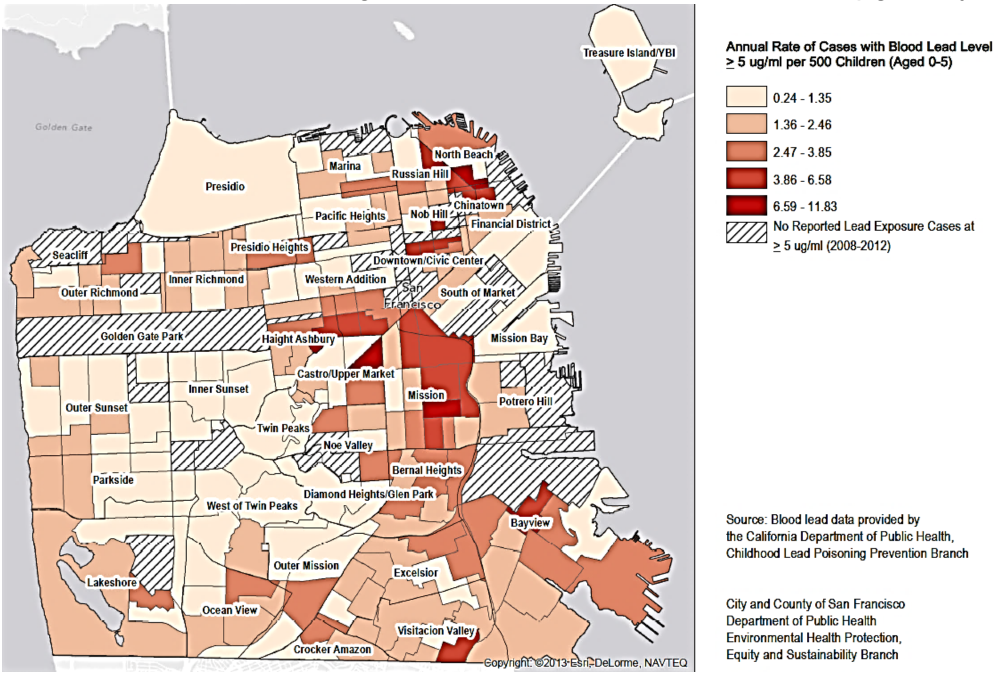


FIGURE 6 Annual Rate of Children Aged 0-5 with a Blood Lead Level Greater or Equal to 5 Micrograms/Deciliter by Census Tract (2008-2012)

C. Lead Exposure Pathways

Organic lead compounds, tetraethyl lead and tetramethyl lead, were once used in the United States as gasoline additives to increase octane rating. However, their use was phased out in the United States in the 1980s, and lead was banned for use in gasoline for motor vehicles beginning January 1, 1996, three years after the inception of the CLPP. Tetraethyl lead is still used in gasoline for off-road vehicles and airplanes. Although all sources of lead are toxic to humans, in San Francisco the CLPP has consistently found that lead paint which has deteriorated or been pulverized into dust and debris, and the subsequent migration of that dust and debris, is of greatest concern as a lead exposure source to children.

When lead-based paint deteriorates, it produces a lead-containing dust which is not always visible. When children touch this dust and put their hands to their mouths, they are poisoning themselves with lead. Young children have an increased risk of poisoning because of:

- Time spent closer to the ground;
- Normal explorative brain development activities for young children such as touching and mouthing surfaces as well as hand-to-mouth contact; and
- Ready absorption of metals perceived as nutrients.

Unfortunately, lead absorption occurs because lead mimics iron and calcium, replacing these essential minerals in children's growing bodies, disrupting the normal functioning of numerous body systems.

Program investigations of the homes of lead-exposed children in San Francisco reveal that these are the environmental lead sources almost universally identified during home inspections:

- Damaged paint conditions in the interior or exterior of the home that result in lead-contaminated dust and debris;

- Renovation and repair practices that create paint dust and debris;
- Friction and impact of door and window surfaces that generate paint dust and debris;
- Lead-contaminated bare soil, found in yards or tracked into the home; and
- Take-home exposure of adults employed in construction-related trades.

Stained glass windows and cabinet doors, where the metal holding the glass pieces together contain elemental lead, a common architectural feature in Victorian and Edwardian buildings. This soft metal source of lead is easily transferred to skin oils on children's hands.

In contrast, very rarely does the CLPP encounter children who have been exposed to or directly ingested lead from a consumer source, even though those consumer sources are frequently covered in mass media. In twenty-two years of following State-defined cases, the CLPP has never identified a lead in water source of exposure.

D. Evidence of Cognitive and Health Impacts from Lead Exposure

Lead is a systemic poison affecting people of all ages. There is no known safe level of lead exposure. Lead exposure in children has been well documented to cause cognitive and health impacts over the life span, and has been associated with neuropsychiatric disorders such as attention deficit hyperactivity disorder (ADHD) and antisocial behavior. One of the most dangerous consequences of lead neurotoxicity for children is interference with brain development, resulting in lower IQ scores, learning disabilities, behavioral health problems, and hearing impairment.

In May 2012, the U.S. Centers for Disease Control (CDC) accepted the recommendation of their Scientific Advisory Panel on Lead and changed their reference value to identify children who have been exposed to lead and who require case management:

- Experts now use a "reference value" of 5 micrograms per deciliter (mcg/dL) to identify children with blood lead levels that warrant attention. This new level is based on the U.S. population of children ages 1-5 years who are in the highest 2.5% of children when tested for lead.

- This reference value is based on the 97.5th percentile of the ongoing National Health and Nutrition Examination Survey (NHANES) blood lead distribution in children. CDC will update the reference value every four years, using the two most recent NHANES surveys.

- Until recently, children were identified as having a blood lead "level of concern" if the test result was 10 or more micrograms per deciliter of lead in blood. CDC no longer uses the term "level of concern" and instead uses the "reference value" to identify children who have been exposed to lead and who require case management.

- In the past, blood lead level tests below 10 micrograms per deciliter of lead in blood may, or may not, have been reported to parents. The new lower reference value means that more children will likely be identified as having lead exposure allowing parents, doctors, public health officials, and communities to take action earlier to prevent children's lead exposure.

The following is taken from the web-posted *CDPH Standard of Care Guidelines on Childhood Lead Poisoning for California Health Care Providers*: http://www.cdph.ca.gov/programs/THE THE CLPPB/Pages/provideroutreach-the THE CLPPb.aspx

> **"No level of lead in the body is known to be safe."**
>
> "Evidence continues to accrue that commonly encountered blood lead concentrations, even those less than 10 mcg/dL, may impair cognition, and there is no threshold yet identified for this effect. Most U.S. children are at sufficient risk that they should have their blood lead concentration measured at least once." (Lead Exposure in Children: Prevention, Detection, and Management, American Academy of Pediatrics Policy Statement, Committee on Environmental Health, *Pediatrics* 2005; 116: 1036-1046)
>
> "Blood lead concentrations, even those below 10 mcg per deciliter, are inversely associated with children's IQ scores at three and five years of age, and associated declines in IQ are greater at these concentrations than at higher concentrations. These findings suggest that more U.S. children may be adversely affected by environmental lead than previously estimated." (Intellectual Impairment in Children with Blood Lead Concentrations below 10 mcg per Deciliter, Richard L. Canfield, Charles R. Henderson, Jr., Deborah A. Cory-Slechta, Christopher Cox, Todd A. Jusko, and Bruce P. Lanphear, *The New England Journal of Medicine* 2003; 348: 1517-1526)
>
> "Evidence from this cohort indicates that children's intellectual functioning at 6 years of age is impaired by blood lead concentrations well below 10 mcg/dL, the Centers for Disease Control and Prevention definition of an elevated blood lead level." (Blood Lead Concentrations < 10 mcg/dL and Child Intelligence at 6 Years of Age, Todd A. Jusko, Charles R. Henderson, Jr., Bruce P. Lanphear, Deborah A. Cory-Slechta, Patrick J. Parsons, and Richard L. Canfield, *Environmental Health Perspective* 2008; 116: 243-248)

In November 2010, the Get the Lead Out Coalition published a document, *Systematic Review of Low Blood Lead Levels and Associations with Cognitive and Neuro-behavioral Outcomes in Children*, summarizing the past two decades of scientific evidence regarding the harm to children from low level lead exposure. The document was created by Amy M. Padula, Ph.D., M.Sc. Post-Doctoral Fellow at the University of California, Berkeley, in collaboration with the Get the Lead out Coalition and funded by the Kresege Foundation.

Key excerpts of this report, found at: http://getleadout.org/parents-pregnant-women-and-kids/ include:

> "It has been well established that high levels of blood lead can result in adverse neuro-cognitive and behavioral consequences in children *(Juberg 1997, Schwartz 1994, Wakefield 2002)*.....In the past 15 years, studies have found cognitive deficits associated with blood lead levels (BLL) below 10 µg/dL. A threshold value below which lead has no apparent adverse developmental effect has not been identified *(Bellinger, 2004)*. It is widely accepted that no "safe" level of lead has yet been established *(WHO, 1995; Wigle & Lanphear, 2005)*."

"This is a summary from a review of scientific literature on the association between low blood lead levels (<10 μg/dL) and: 1) overall cognitive function, 2) Attention Deficit Hyperactivity Disorder (ADHD), 3) anti-social behavior, and 4) other neuro-behavioral effects in children. The researcher selected relevant studies from a PubMed search of articles from 1994 to 2010. The studies included were evaluated on criteria based on methodological design, control of co-variates and relevance to the study question. Of the 157 studies reviewed only 26 were included in the review. The majority of studies were prospective cohort studies, though well-designed cross-sectional case-control and one retrospective cohort were included. Most of these studies focused on children up to 72 months of age and used a variety of cognitive and behavioral assessment tools."

Data Synthesis

"The results from the cohort studies provide sufficient evidence that the associations between BLL in children <72 months and cognitive outcomes are significant, consistent and robust, particularly among those with BLL between 5 and 10 μg/dL. Of the 9 cohort studies all the relationships with cognitive deficits were inversely associated and 8 were statistically significant after adjustment for confounder. In summary adverse outcomes, including reduced IQ and academic deficits are associated with BLL below 10 μg/dL; the association is not linear, the strongest effects are noted at lower levels. Some studies suggest that the rate of decline in performance is greater at levels below 10 than above 10. *(Lanphear, 2000, 2005; Kordas, 2006; Tellez-Rojo, 2006; Hu, 2006; Schnaas, 2006).*

"A large study of children from the National Health and Nutrition Examination Survey found that those in the highest quintile of BLL had more than 4 times the odds of having ADHD compared to the lowest quintile of BLL, even among those <5 μg/dL (*Braun, 2006*)."

"Cohort studies found associations with verbal intelligence *(Walkowiak, 1998)*, inability to sustain attention *(Walkowiak, 1998)*, deficits in reading *(Lanphear, 2000)* arithmetic *(Lanphear, 2000; Kordas, 2006)*, short-term memory *(Lanphear, 2000; Kordas, 2006)*, Peabody Picture Vocabulary Test (PPVT) *(Kordas, 2006)*, cognitive function *(Solon, 2008)* and perceptual scores *(Hubbs-Tait, 2009)*."

Conclusion Summary and Discussion

"The studies presented in this systematic review indicate there is no threshold that can be considered a safe BLL. The 1991 CDC 10 μg/dL BLL guideline was intended to serve as a risk guidance and management tool at the community level. It has commonly—and incorrectly—been considered acceptable for the individual child (*Bellinger, 2004*). Clinicians should attempt to reduce a child's BLL even when it is below 10 μg/dL. The "clinically acceptable" level should be no detectable amount. At this time, most laboratories are able to detect BLL as low as 2 μg/dL."

II. WHAT HAS THE CLPP DONE TO PREVENT LEAD EXPOSURE?

The CLPP uses comprehensive education and outreach, source reduction and regulatory code enforcement strategies to prevent children's exposure to lead hazards in all settings where children under six years old can be exposed. The CLPP has Health Code authority to use these interventions regardless of whether a child's exposure has been documented by blood lead testing.

Under contract to the Childhood Lead Poisoning Prevention Branch (CLPPB) of CDPH, the San Francisco CLPP coordinates lead-related activities of local agencies and organizations, alerts the CLPPB to new sources of lead exposure and barriers in the continuum of care and prevention, and helps develop creative new strategies towards realizing a mutual vision of a healthy lead-safe environment, in which all children can achieve their full potential. Additionally, the CLPP is responsible for case management of children where lead exposure above a certain threshold has already been detected by blood lead testing.

An overview of the CLPP's lead exposure prevention strategies follows.

A. Lead Hazard Prevention Public Awareness and Targeted Outreach

1. Targeted outreach to promote public awareness of childhood lead poisoning, including outreach to parents, child care providers and community-based family-serving agencies

The CLPP's health education team is multilingual, with the capability to provide in-person services in English, Spanish, Cantonese and Mandarin, as well as access to phone-based language interpreters. The CLPP routinely produces all written educational materials in English, Spanish and Chinese, along with Filipino, recently adopted by the City and County of San Francisco as a 4th primary language.

The CLPP uses surveillance data to identify high-risk communities or neighborhoods to focus community education or proactive code enforcement campaigns. The CLPP health educators provide lead hazard prevention and healthy housing presentations to many target audiences: child care providers, parents and family caregivers, school staff, community-based agency staff and clients, pediatric and family health clinics, and food supplement programs. The CLPP health educators provide training via parent education classes and workshops sponsored by community agencies, through community college classes and job development programs, through court-mandated parenting education classes and at health fairs, and via in-home client education.

In addition to interactive presentations, the CLPP health educators create educational print and promotional materials, accept agency referrals for in-home client or patient education, participate in street-level outreach and community health fairs, and work with child-serving professionals to educate about lead hazard prevention. The CLPP team looks for new and creative ways to spread the word about childhood lead hazard prevention to the community, including distributing lead-free promotional items to community members. The CLPP even established a purchasing protocol to prevent vendors from using lead-based inks or materials in purchased promotional materials.

The CLPP media campaigns, such as trilingual MUNI interior bus ads and bilingual cable TV public service announcements promote healthy housing conditions, free of lead hazards, pests and mold.

2013 MUNI bus ad

The CLPP works with DPH Birth Records to provide a trilingual brochure free-of-charge for all new parents in response to all in person or by mail applications for birth certificates. The brochure encourages new parents to use either San Francisco's grant-based remediation services if eligible or the CLPP's lead hazard assessment and code enforcement services.

The CLPP publishes a thematic information bulletin, *The Word on Lead Prevention*, twice a year, widely distributing copies to family and child-serving agencies. The bulletin is designed to engage and inform parents and the public about lead-safe practices, policy updates regarding lead hazards, and the dangers associated with lead exposure. The CLPP also developed a resource-rich website with English, Spanish and Chinese materials on lead poisoning prevention, http://www.sfdph.org/dph/EH/CEHP/Lead/default.asp.

The Word on Lead Prevention

CHILDREN'S ENVIRONMENTAL HEALTH PROMOTION — FALL 2012

Good Nutrition Helps Prevent Lead Poisoning

Making sure children get enough iron, vitamin C, and calcium in their diet can help prevent lead poisoning. Iron is essential for the body; it helps move oxygen through our body and helps us feel energized. If a child has low iron in their body, it can make them feel tired, have low energy, and can eventually cause them to have anemia.

A child with very little iron in their diet will absorb more lead than other children when exposed to lead dust. This is because lead mimics iron in the body and stores itself in the same places where iron is needed—our bones, teeth, bone marrow, liver, brain, and kidneys. When iron can't get to those sites, it prevents the body from functioning normally.

In contrast, children who have enough iron in their diet do not absorb lead as much, because their body has all the iron it needs and will let much of the lead pass through their body without being absorbed.

When giving children iron and calcium, it is best paired with vitamin C; this helps the body absorb and use most of the iron and calcium.

Healthy Food Choices at Farmers Markets

Local farms come together at farmers markets to sell their produce directly to consumers. All produce is purchased directly from the farmers who grow it. They accept Cal Fresh/EBT cards, cash, and major credit cards as forms of payments. Farmers markets are a great place to find produce high in iron, vitamin C and calcium, such as fruits, vegetables, dairy and beans, which help in preventing lead poisoning.

Have you gone to your nearest farmers market yet? If not. Try it! It is a great place to get healthy and nutritious produce for your family. You might be surprised to find live entertainment at some of the farmers markets, which makes buying local pesticide-free produce more enjoyable.

The great news is there are several farmers markets in San Francisco you can go to. Call 311 to find the one nearest you.

Find out if you qualify for Cal Fresh, a supplemental nutrition program, go online at www.benefitscal.org.

This is a great resource for families!

What can you do to be lead-safe when starting a new garden in San Francisco?

It is best to assume the soil next to your home is contaminated with lead. Therefore, we recommend installing a barrier over the existing soil, and creating a raised bed or gardening box over that barrier. Fill the raised bed or gardening box with new clean soil and compost (containing less than 80 parts per million-PPM of lead). Commercially available soil and compost are not guaranteed to have a lead level of less than 80 ppm as current regulations allow up to 300 ppm of lead in products for sale. Therefore, we recommend the following:

1. Buy only California Dept. of Food and Agriculture (CDFA) and/or Organic Materials Review Institute (OMRI) organic certified products.
2. Test new soil to confirm that the lead content is less than 80 ppm.
3. Do not allow children to work or play with soil greater than 80 ppm.
4. Use gloves whenever gardening to limit soil exposure.
5. Wash hands after gardening or any time that your bare hands come in contact with soil or tools.

Please call 311 for any questions regarding lead-free gardening.

All of these activities are quantified in twice-yearly reports to CDPH funders. For example, in the second half of 2014, the CLPP reached 960 people at 4 health fairs, distributing 831 educational materials and presented to 212 child care providers, distributing 428 educational materials. In an additional 30 presentations, 1033 parents and residents received lead education, including distribution of 2054 educational materials. In these settings, 91% of post-tests were answered correctly. In two other literature distribution events, 7518 people received 8211 educational materials.

2. Targeted outreach to gardening supply stores (2014-current)

The CLPP staff supply trilingual brochures and brochure holders to approximately 20 gardening supply stores citywide. The brochure directs readers to its web-posted Lead-Safe Urban Gardening Guidance.
https://www.sfdph.org/dph/EH/CEHP/Lead/InfoGardeners.asp

3. Targeted outreach to construction industry contractors, laborers and do-it-yourself home owners

Audit of home improvement stores for required lead hazard warning signage (1997-current)

Annually, CLPP staff audit approximately 90 home improvement stores citywide, with an emphasis on paint supply and hardware stores. The goal is to ensure this mandated trilingual warning sign is posted, and provide the store management with an adequate supply of the CLPP literature for customers, in the languages most frequently used at that location. This activity reaches those working in the construction and painting trades, as well as many do-it-yourself residents.

4. Targeted outreach to medical providers and clinics

The State contracts with the CLPP to inform medical providers of their legal responsibilities with respect to screening and testing for lead poisoning and of available case management services. The CLPP is also responsible to communicate with medical providers the importance of supplying complete patient information to laboratories when sending samples out for blood lead analysis or when referring children for blood lead analysis.

The CLPP conducts presentations at various hospital Pediatric Grand Rounds and Medical Resident continuing education forums. The CLPP also sends an annual letter updating Pediatric and Family Medical Providers citywide on current issues in lead poisoning prevention and resources for helping patient families access CLPP services and educational materials. See Appendix IV for the CLPP-designed factsheet "*Blood Lead Levels-What Do They Mean?*" intended to help medical providers explain blood lead testing results to patients' families.

The CLPP also wrote to Ob/Gyn medical providers citywide to alert them to CDC's 2010 publication of

Guidelines for the Identification and Management of Lead Exposure in Pregnant and Lactating Women. In 2015, CLPP was asked to prepare this anticipatory guidance for women of child-bearing age.

B. Lead Hazard Code Enforcement and Source Reduction

1. Using SF Health Code authority to order remediation of lead hazards

San Francisco Health Code Article 11, Section 581b defines lead hazards to children less than six years of age as "prohibited public health nuisances", and therefore the Director of Health is granted the authority to issue Notices of Violation for such hazards and to order the property owner to correct the hazard using lead-safe methods. The CLPP uses this authority whenever environmental investigations identify lead hazards, regardless of whether a child at that location has been tested for lead exposure.

Environmental investigators use visual assessment of paint conditions and sample surfaces for dust or yards with bare soil to identify lead hazards in homes. The Code allows the Health Director to presume that all pre-1979 buildings have lead-based paint, adding a year of precaution beyond the 1978 ban on lead paint due to lead paint inventory still being sold. If a property owner wishes to rebut this legal presumption, they must present the CLPP evidence established by a State-certified lead inspector/risk assessor.

During investigations, investigators also educate tenants about the sources and risks associated with lead exposure. From 2008 through 2012, the CLPP conducted over 800 lead investigations and issued over 700 Notices of Violation for lead hazards (see Figure 7). In calendar year 2013, the CLPP inspected 287 homes for lead hazards and issued 187 Notices of Violation based on findings.

<u>Percent of Homes Built Pre-1950 Compared to Number of Lead Hazard Notices of Violation (2008-2012)</u>

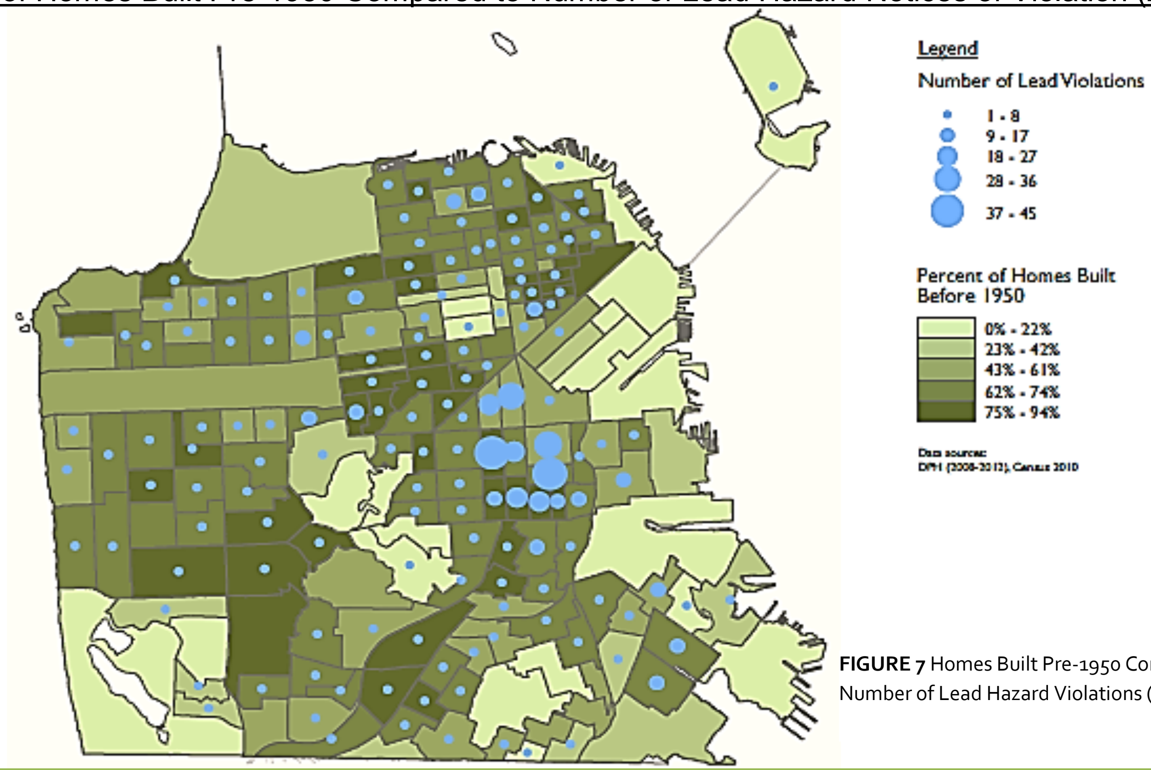


FIGURE 7 Homes Built Pre-1950 Compared to Number of Lead Hazard Violations (2008-2012)

2. Partnering with the DPH Maternal Child Adolescent Health Branch (MCAH) to offer comprehensive healthy housing assessment and code enforcement

The MCAH Branch includes the Nutrition Supplement Program for Women, Infants and Children (WIC), as well as two Public Health Nursing (PHN) field-based programs working with low-income women and their newborn infants. Because the families of these infants and young children often live in housing with the greatest prevalence of housing hazards and deferred maintenance, they may be at risk of lead exposure as well as other code-defined housing habitability issues.

The CLPP provides comprehensive home assessment services to these families, identifying not only lead hazards, but also mold, pest, sanitation, lack of heat and other issues, and issues Notices of Violation to property owners requiring them to eliminate the cited hazards (see Figure 8 for types of hazards). This service allows the CLPP to proactively protect children at risk from lead exposure, and not wait for them to have exposures detected by blood lead testing.

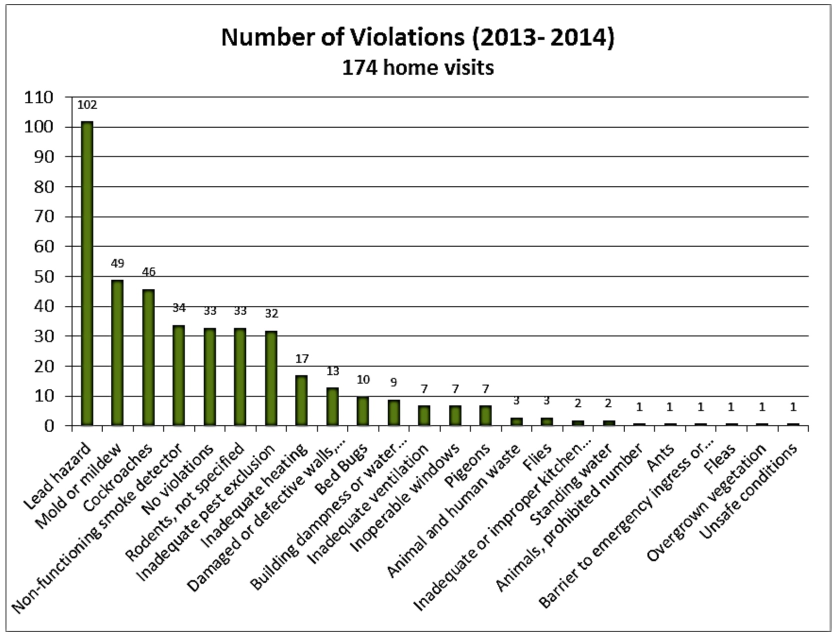


FIGURE 8 Violations from Home Assessments for Wic-Enrolled Families (2013-2014)

3. Partnering with the Mayor's Office of Housing & Community Development (MOHCD) to make effective use of Lead Hazard Remediation Grants

The MOHCD Lead Hazard Control Grant Program provides grants to homeowners to remediate lead hazards on their property. The Lead Program is funded by a periodic federal grant from the U.S. Department of Housing and Urban Development's (HUD). To be eligible for a lead grant, the property owner must apply, and the tenant-occupied household units must meet HUD's Low Income Limit and must have a child under the age of 6 who resides on the property or uses the property on a regular basis. If the property is vacant and is determined eligible, preference must be given to low and moderate income tenant families with children age 6 or younger.

POPULATION HEALTH DIVISION
SAN FRANCISCO DEPARTMENT OF PUBLIC HEALTH

4. Partnering with San Francisco Department of Building Inspection (DBI) to aid DBI's enforcement of lead-safe work practice requirements

Safe work practices are required for paint-disturbing work in pre-1979 buildings. This provision of the San Francisco Building Code, effective January 1998, governs work that disturbs or removes lead-based paint on the exterior of any steel structure or pre-1979 building, and allows the Building Director to presume that all steel structures and pre-1979 buildings have lead-based paint. Property owners must present DBI evidence provided by a State-certified lead inspector/risk assessor if they wish to rebut this legal presumption.

Effective July 4, 2004, SFBC Section 3425 was amended to include safe practices for work that disturbs or removes lead-based paint in the interior of pre-1979 buildings, including child care facilities, hotels and motels, multi-unit housing and other dwellings.

Prior to renovating the interior and/or exterior of a building, the owner or contractor must:

1. Notify affected parties before work begins;
2. Restrict access to the regulated area (except regulated areas that are required for access
3. or egress during the course of the work, see SFBC 3425 Restrict Access for requirements);
4. Use containment and/or barrier systems to prevent migration of lead-based paint chips and dust;
5. Remove all visible lead-based paint chips and dust before completing work or when access to the regulated area is required (see SFBC 3425 Clean Up Standards);
6. Post a "Lead Work In Progress" sign before work begins if containment is needed to prevent lead-based paint from migrating to another property. Remove the sign when work is complete. Where signage is not possible, provide a letter to your neighbors.

In addition, the following work practices are prohibited:

1. Open flame burning or torching;
2. Heat guns without containment and barrier systems, or operating above 1,100 o F or causing the charring of paint;
3. Hydro-blasting or high-pressure washing without containment and barrier systems; and,
4. Dry manual sanding or scraping, machine sanding or grinding, or abrasive blasting or sandblasting without containment and barrier systems or a HEPA vacuum local exhaust tool.

City & County of San Francisco
Department of Building Inspection
1660 Mission Street I San Francisco CA 94103 I www.sfdbi.org

LEAD HAZARD WARNING

Disturbing lead-based paint can be EXTREMLY DANGEROUS to dwelling occupants and visitors, particularly to young children, pregnant women, and pets, and to people performing work on the premises. For interior or exterior paint removal: **Always wet the surface, contain and properly dispose of leaded paint.** If you are unsure whether the paint is leaded, you should test it prior to performing any work. If the paint is found to contain lead, you should consult with an expert about appropriate procedures. Proper containment and 3-day notification is *required* for exterior jobs or more than 10 sq. ft (Sec. 3425 SFBC).

Informational packets are available at (415) 558-6088.

You can contact the San Francisco Childhood Lead Poisoning Prevention Program at (415) 252-3956 for free advice. IF YOU CAUSE LEAD DUST TO BE CREATED, YOU COULD BE LIABLE for any illness caused by the dust.

Housing Inspection Services

Ordinance #446-97
Rev. 9-16-13

C. Advocacy, Policy and Legal Strategies to Reduce Lead Exposure

The CLPP partners with local government and community-based agencies to support and advocate for the development of policy and legislation that helps reduce lead hazards. Additionally, the CLPP works with the San Francisco City Attorney's office to pursue litigation against property owners who have not complied with Notices of Violation.

1. Advocacy for prevention of lead hazards in urban gardens and farms

a. CLPP develops *Lead Hazard Guidance for Urban Gardening* (May 2011)

In 2011, the CLPP identified a significant lead paint hazard on a building adjacent to a recently developed DPH-sponsored community garden, and worked with MOHCD to get the building remediated so that peeling paint would not contaminate the edibles garden being constructed. In our investigations of the homes of lead-exposed children, over 50% of homes having yards with bare soil were found to have code-defined lead in soil hazards (greater or equal to 400 parts per million lead), and over 86% of those yards had lead in soil levels high enough to cause a child's blood lead level to increase by one microgram per deciliter (more details provided below).

As urban gardening became a growing part of San Francisco's local sustainability efforts, the CLPP recognized the need for lead exposure prevention guidance to protect urban gardeners, farmers and school children working on or visiting urban gardens and farms. This led to the CLPP's consultation to several community farms (the Alemany, Hayes Valley and Potrero Hill Texas Street urban farms) to either evaluate their soils and composts or assess prior soil testing results and to advise on safe work practices, particularly for child or school-aged visitors. To guide similar community efforts, the CLPP published a *Lead Hazard Guidance for Urban Gardening* document based on these experiences, which is posted at: https://www.sfdph.org/dph/EH/CEHP/Lead/InfoGardeners.asp

The CLPP collaborates with the City's newly established Urban Gardening Program to prioritize community gardens which could benefit from the CLPP's education and soil sampling consultation. The CLPP urban gardening project goal is to learn from the actual experiences of urban farmers as the basis of developing best practices that prevent lead exposure. The CLPP intentionally avoids using code enforcement authority for this project, instead giving community gardens in San Francisco access to soil testing and guidance on precautions that will prevent lead exposure.

b. Community collaboration to develop Lead-Safe Gardening Best Practices Workshop and Outreach Brochure (September 2012)

Subsequently, the CLPP collaborated with a local community non-profit, Garden for the Environment, in developing and teaching a community-based lead-safe urban gardening workshop, developing a lead-safe urban gardening outreach brochure, and sharing these resources with the regional Get the Lead Out Coalition.

c. CLPP to propose change in the legal definition of "lead-in-soil hazards" (2015)

In 2012, the CLPP modified its Urban Gardening Guidance to provide caution about California's regulatory-allowable level of 300 parts per million (ppm) lead in retail soil and compost products, which is 75% of the bare soil level (400 ppm) that will generate a CLPP Notice of Violation. Clearly, that level is not health protective. The CLPP's more protective guidance is for gardeners to use soil and compost at 80 ppm of lead or less, based on modeling by the CalEPA Occupational and Environmental Health Hazard Assessment program (OEHHA). The OEHHA report indicates that a young child playing daily in bare soil with 80 ppm lead would have a blood lead level increase of 1 μg/dL. As a means of achieving that goal, the CLPP advises the public to only purchase soil and compost products certified by OMRI, the Organic Materials and Research Institute, which requires representative product testing to ensure lead levels of 90 ppm or less. In 2015, the CLPP will advocate for a change in San Francisco Health Code definition of lead in soil hazards.

2. Advocacy with the regional "Get the Lead Out" Coalition

The CLPP is a founding member of the Bay Area regional Get the Lead Out Coalition (GTLO), working since 2010 to protect the public from lead poisoning and to facilitate the pooling of regional CLPP resources for lead exposure prevention. GTLO's website (*getleadout.org*) is a clearinghouse for lead poisoning prevention knowledge and resources, and links to more in-depth information about lead exposure prevention, local groups combatting lead poisoning, and the Bay Area's county-based websites.

GTLO's focus is on vulnerable populations: young children, pregnant women, and workers. GTLO holds special events and campaigns to encourage members of the public and other environmental organizations to join us on specific actions to reduce lead exposures. For example, on behalf of GTLO, San Francisco CLPP hosted two public showings of the documentary film, *MisLead*, during Lead Poisoning Prevention Week in 2013.

3. Litigation by ten California local governments vs. five U.S. lead paint manufacturers

Ten California jurisdictions ("The People"), including the City and County of San Francisco, sought a Court Order to abate the alleged public nuisance created by lead paint manufactured or sold by five Defendants in ten California cities and counties. Filed thirteen years ago, the matter proceeded to bench trial in July-August of 2013, in the Superior Court Of California, County Of Santa Clara, Department 1 (Complex Civil Litigation), the Honorable James P. Kleinberg presiding. San Francisco CLPP's Coordinator spent many hours gathering evidence for legal counsel and was called to testify during the trial.

The Court found in favor of the ten public entities representing the People in those jurisdictions. The Court based the decision solely on the issue of lead paint produced, promoted, sold, and used for interior home use. The Court ruled that Defendants ConAgra, NL, and SW were substantial factors in causing the injury alleged. Defendants ARCO and DuPont were found not liable, and exempted from this ruling.

In January 2014, Judge Kleinberg issued his Final Statement of Decision naming NL, Sherwin Williams, and ConAgra jointly liable to contribute $1.15 billion to an abatement fund, of which up to $80.5 million is allocated to the City and County of San Francisco. The judge ordered the institution of the abatement plan and establishment of the Fund to be administered by the CDPH Childhood Lead Poisoning Prevention Branch (CLPPB), and that the Cities and Counties should apply to the CLPPB for remediation grants.

This decision is currently being appealed by the defendants, so the legal outcomes will not be determined for several years. For further information, see Case No.: 1-00-CV-788657: "The People of the State of California, Plaintiff, vs. Atlantic Richfield Company (Arco), Conagra Grocery Products Company (Conagra), E.I. Du Pont De Nemours and Company (Dupont), NL Industries, Inc. (NL), and The Sherwin-Williams (SW) Company, Defendants and Related Cross-Action."

III. HAVE CLPP'S PREVENTION EFFORTS BEEN EFFECTIVE?

A. Code-Defined Lead Hazard Prohibition Independent of Clinical Status

The CLPP uses the San Francisco Health Code-defined lead hazard prohibition as an effective tool to require that property owners remediate lead hazards in any environment where a child under six spends significant time. The CLPP's policy is that children should not bear the burden of lead hazard detection. By analogy to other environmental health programs, inspectors do not wait for food poisonings or hazardous materials spills to provide environmental regulatory inspections.

The CLPP can enforce this lead hazard prohibition regardless of whether a child's blood has been tested and, if tested, regardless of a child's blood test findings.

B. Lead Abatement Funds for Permanent Removal of Lead Sources

If and when San Francisco's litigation settlement from the lead paint industry defendants becomes available, San Francisco will be able to provide even greater protection for children and benefit for property owners, as there will settlement funds allocated to permanent abatement of lead sources, such as the removal and replacement of lead-painted windows and doors.



C. San Francisco and U.S. Lead-Exposure Finding Has Been Reduced

The lead exposure profile for San Francisco's children has improved over time, similarly to the rest of the country, as airborne and foodborne lead sources decreased in the United States. The Clean Air Act Amendments of 1990 mandated the elimination of lead from all U.S. motor fuel by January 1, 1996. This was the final step in a gradual reduction of lead in gasoline since the early 1970s. "Regular" gasoline typically contained approximately 4.0 grams of lead per gallon; average lead content was reduced to 0.5 gram/gallon in 1985 and still further to 0.1 gram/gallon in 1986. Since 1996, the U.S. population as a whole has not had a "background" source of lead exposure. Therefore, all detected lead exposures indicate that a child has a current exposure pathway to a specific lead source.

D. Reframing the CLPP's Response to Detected Lead Exposures

Even in the context of an overall decrease in lead-exposed children, the CLPP has been effective in reducing the incidence of higher blood lead levels through its policy of responding to all detected lead exposures, initiated in 2005. By responding at the earliest detection of exposure, rather than waiting for a clinically-defined poisoning, the CLPP can identify and order the remediation of environmental lead hazards, thereby preventing ongoing exposure which can lead to higher blood lead levels.

The CLPP has provided justification to local medical providers that the provision of environmental investigation services at the lowest limit of lead exposure detection is an effective measure for the prevention of continued lead exposure to their patients. This policy allows the program to focus on lead exposure prevention versus lead poisoning response.

E. Measurement of Effectiveness

The CLPP measures the effectiveness of this approach by comparing the proportion of higher blood lead levels found earlier in the program, when the CLPP only responded to high CDPH-case defined blood lead levels (≥15 twice or ≥20 µg/dL once) to now, when the CLPP responds to all detected blood lead levels, offering home inspection for lead hazards and subsequent code enforcement (see Figures 9 and 10).

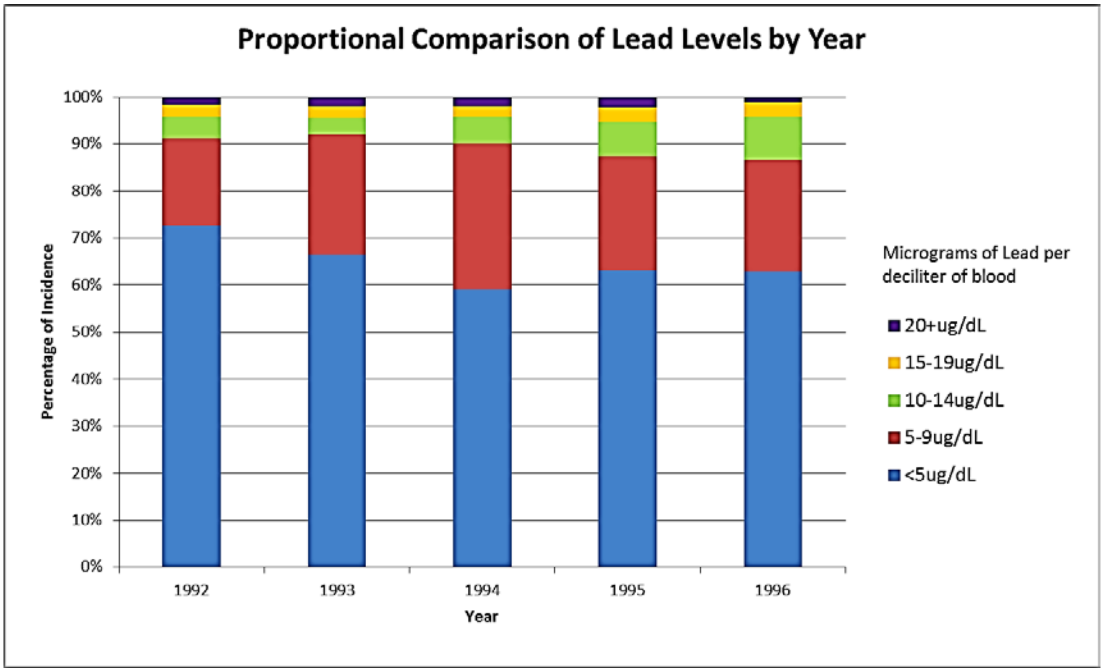


FIGURE 9 Proportional Comparison of Lead Levels by Year (1992-1996)

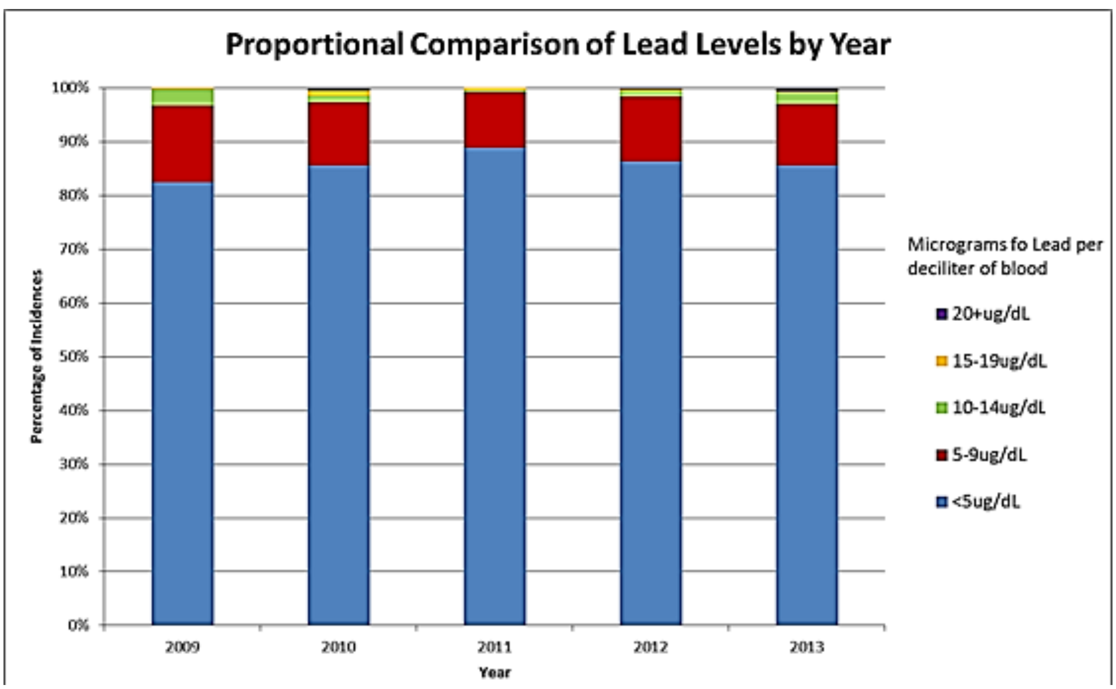
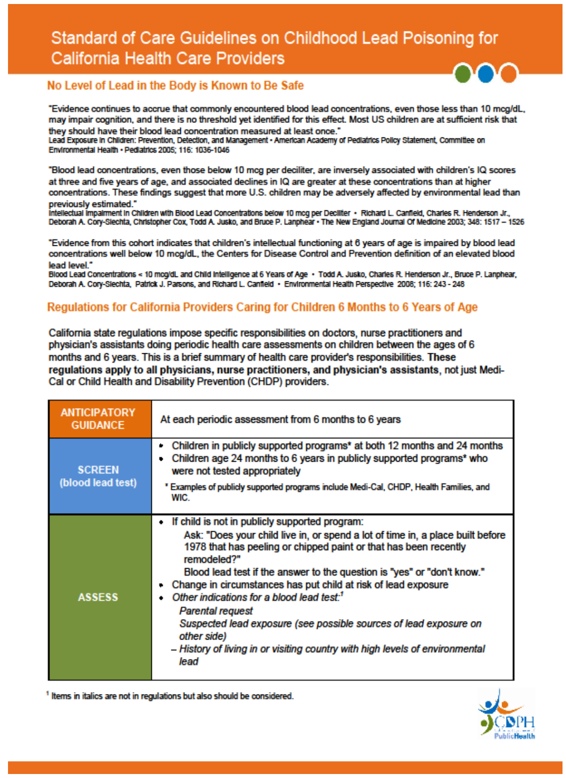


FIGURE 10 Proportional Comparison of Lead Levels by Year (2009-2013)

IV. HOW DOES THE CLPP RESPOND TO LEAD-EXPOSED CHILDREN?

A. CLPP Blood Lead Testing Surveillance and Response

The CLPP receives blood lead testing data from many laboratories serving local hospitals, clinics and medical offices, as well as the California Department of Public Health (CDPH) surveillance system. Program surveillance of blood lead testing allows the CLPP to offer families of children with detectable lead exposure environmental investigation of lead sources in their home or child care setting and at a certain threshold of exposure, also offer nurse case management and nutritionist services. The CLPP offers environmental investigation in response to children with *any level* of lead exposure detected, with the goal of identifying and eliminating lead exposure sources to prevent further exposure from occurring.



Standard of Care Guidelines on Childhood Lead Poisoning for California Health Care Providers

No Level of Lead in the Body is Known to Be Safe

"Evidence continues to accrue that commonly encountered blood lead concentrations, even those less than 10 mcg/dL, may impair cognition, and there is no threshold yet identified for this effect. Most US children are at sufficient risk that they should have their blood lead concentration measured at least once."
Lead Exposure in Children: Prevention, Detection, and Management • American Academy of Pediatrics Policy Statement, Committee on Environmental Health • Pediatrics 2005; 116: 1036-1046

"Blood lead concentrations, even those below 10 mcg per deciliter, are inversely associated with children's IQ scores at three and five years of age, and associated declines in IQ are greater at these concentrations than at higher concentrations. These findings suggest that more U.S. children may be adversely affected by environmental lead than previously estimated."
Intellectual Impairment in Children with Blood Lead Concentrations below 10 mcg per Deciliter • Richard L. Canfield, Charles R. Henderson Jr., Deborah A. Cory-Slechta, Christopher Cox, Todd A. Jusko, and Bruce P. Lanphear • The New England Journal Of Medicine 2003; 348: 1517 – 1526

"Evidence from this cohort indicates that children's intellectual functioning at 6 years of age is impaired by blood lead concentrations well below 10 mcg/dL, the Centers for Disease Control and Prevention definition of an elevated blood lead level."
Blood Lead Concentrations < 10 mcg/dL and Child Intelligence at 6 Years of Age • Todd A. Jusko, Charles R. Henderson Jr., Bruce P. Lanphear, Deborah A. Cory-Slechta, Patrick J. Parsons, and Richard L. Canfield • Environmental Health Perspective 2008; 116: 243 - 248

Regulations for California Providers Caring for Children 6 Months to 6 Years of Age

California state regulations impose specific responsibilities on doctors, nurse practitioners and physician's assistants doing periodic health care assessments on children between the ages of 6 months and 6 years. This is a brief summary of health care provider's responsibilities. **These regulations apply to all physicians, nurse practitioners, and physician's assistants**, not just Medi-Cal or Child Health and Disability Prevention (CHDP) providers.

ANTICIPATORY GUIDANCE	At each periodic assessment from 6 months to 6 years
SCREEN (blood lead test)	• Children in publicly supported programs* at both 12 months and 24 months • Children age 24 months to 6 years in publicly supported programs* who were not tested appropriately * Examples of publicly supported programs include Medi-Cal, CHDP, Health Families, and WIC.
ASSESS	• If child is not in publicly supported program: Ask: "Does your child live in, or spend a lot of time in, a place built before 1978 that has peeling or chipped paint or that has been recently remodeled?" Blood lead test if the answer to the question is "yes" or "don't know." • Change in circumstances has put child at risk of lead exposure • *Other indications for a blood lead test:*[1] *Parental request* *Suspected lead exposure (see possible sources of lead exposure on other side)* – *History of living in or visiting country with high levels of environmental lead*

[1] Items in italics are not in regulations but also should be considered.

B. Anticipatory Guidance and Blood Lead Testing

To aid compliance with state health code requirements for medical providers to conduct anticipatory guidance and order blood lead testing, the clpp conducts outreach and provides tools to ensure that all medical providers:

1. Provide State-mandated Anticipatory Guidance to parents and guardians about the potential for lead exposure to children from 6-72 months of age; and
2. Order State-mandated Blood Lead Testing of all children at one and at two years of age living in San Francisco who meet any of these criteria:
   - Recipients of State-subsidized health care;
   - Live or spend time in housing built before 1978 (85% of SF housing units);
   - Under 72 months old, but were not tested at one and two years of age.

CLPP provides medical settings with this trilingual *Health Hazard Advisory* as a primary prevention tool. Available both as a wall poster and a flyer, the *Health Hazard Advisory* serves as an anticipatory guidance tool informing patient families what lead hazards look like, how the CLPP can help fix these hazards, and why they should have their child tested for lead. Pediatric and family practice clinics and medical offices are encouraged to refer parents and guardians who recognize such lead hazards in their homes for the CLPP's home assessment and code enforcement services.

V. WHAT ARE BARRIERS TO ELIMINATING LEAD EXPOSURES?

A. Overarching Challenges

- The inadequate number of state-certified lead professionals in the San Francisco Bay Area who are qualified to identify and correct lead hazards.
- The inability of government-provided financial incentives to property owners for fixing lead hazards, such as the MOHCD lead hazard remediation grant program, to compete with market forces, due to San Francisco's tight rental market.
- The prevalence of lead poisoned children associated with the percentage of San Francisco housing built prior to 1950 (see Figure 11).

Percent of Homes Built Before 1950 Compared to the Average Annual Rate of BLL Cases per 100 Children Aged 0-5 by Census Tract (2008-2012)

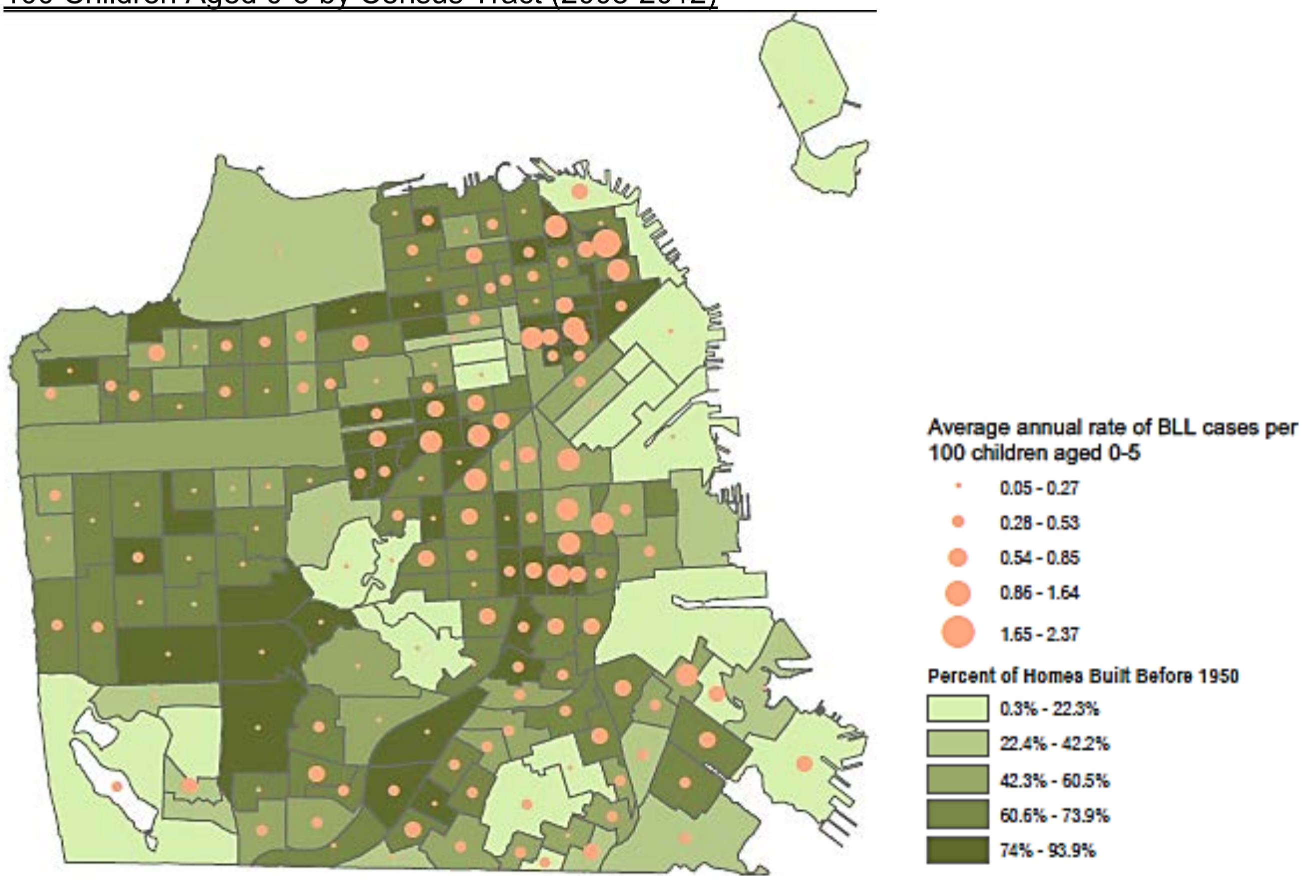


FIGURE 11 Percent of Homes Built Pre-1950 Compared to the Average Annual Rate of BLL Cases ≥ 5ug/dL in Children (0-5) by Census Tract (2008-2012)

- The extreme lack of affordable quality housing makes our 65% rental tenant population fearful of reporting code violations (see Figure 12).

Rent Affordability Gap

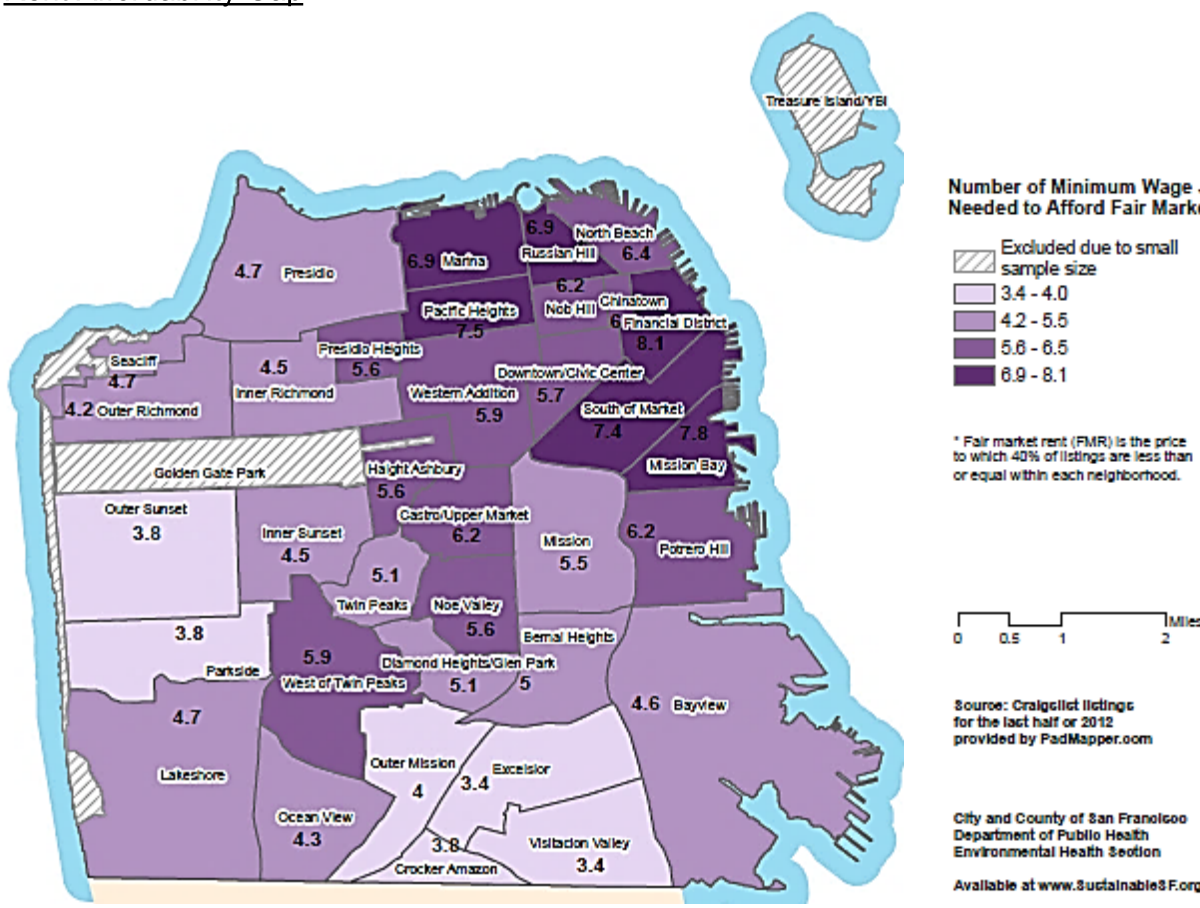


FIGURE 12 Rent Affordability Gap

B. Public Perception Influenced by Media

Lead paint is crushable by thumb pressure and thus able to release milligram-to-gram levels of lead dust into the environment. Lead dust does not biodegrade, but persists in the environment. The enormity of this lead burden to our society is difficult to perceive and acknowledge.

In contrast, the public is subjected to competing mass media messages about the potential for lead exposure from more exotic lead sources (e.g. edible grasshoppers from Mexico) and consumer products (e.g. lipsticks and women's purses), sources not typically available to or ingested by children.

The lead hazard exposures that happen several hundred times a year in San Francisco are not deemed newsworthy. In this environment of 85% older housing, children have a constant potential for exposure to lead from normal hand-to-mouth behavior after touching damaged or disturbed paint, lead-containing dust or soil. These stories are omitted, even when media outlets feature home repair and renovation projects that disturb lead paint and create copious dispersion of lead dust.

C. Consumer Awareness of Lead-Safe Renovations

Despite EPA-required lead training and certification for contractors and renovators being required since 2010, San Francisco's increasingly affluent population is not guaranteed to receive lead-safe specifications from contractors hired to do renovations. Consequently, the CLPP continues to have a growing caseload of children from upper middle class and middle class homes being renovated.

D. Competing Survival Needs of Families

With the high cost of rent in San Francisco, many tenants fear losing the unit in which they are residing. Many tenants have expressed concern that they fear their landlord or master tenant will harass them, evict them or raise the rent if they found out that lead hazard assessment had occurred on their property. Our environmental investigators do their best to alleviate these concerns, informing tenants of their housing rights and connecting them to resources such as the SF Rent Board and tenant advocacy organizations. Nevertheless, tenants still have fears that sometimes make cooperation with the CLPP staff more difficult.

For the majority of the CLPP caseload, an increase in poverty and lack of affordable housing has led to families prioritizing of survival needs. For the vast majority of WIC-enrolled families that voluntarily used the CLPP's comprehensive healthy homes assessment and code enforcement services, their motivation for enlisting our services was the hope that we could provide them healthier housing.

E. Challenges in Policy and Legal Strategies

1. Alignment of City agencies to require lead-safe training of contractors

The CLPP has not been able to align other permit-issuing City agencies to require proof of a permit applicant's federally-required (USEPA) Repair, Renovation and Painting (RRP) training certification as a pre-requisite to obtaining a City permit for activities that would disturb lead-based paint. The San Francisco Department of Building Inspection did not want to take on this policy unless it was specifically written into local law.

2. Insufficient resources to require permanent abatement of lead hazards

In the enforcement of SF Health Code lead hazard prohibition, the CLPP cannot require the permanent abatement of lead hazards such as replacement of lead painted windows, instead allowing for less permanent lead hazard remediation techniques such as paint stabilization. Similarly the USHUD grant funds administered by MOHCD must use a combination of permanent abatement and interim lead hazard remediation measures based on the expenditure cap allowed per housing unit.

In many homes and facilities, such as those maintained by SF Housing Authority or SF Recreation and Park Department, the interim control of lead hazards has not been sustainable, as stabilized paint surfaces will again deteriorate over time. With greater resources, permanent abatement of building components with lead hazards would be a better solution.

3. Outdated lead-in-soil hazard code definition

Our SF Health Code lead in soil hazard definition of 400 parts per million lead is out of date. Current health-based modeling conducted by the Cal/EPA Office of Environmental Health Hazard Assessment demonstrates that 80 parts per million of lead exposure can cause an increase in a child's blood lead level.

F. Challenges Due to Lead Poisoning's Clinical Paradigm

The most significant challenge to primary, secondary and tertiary prevention of lead exposure to children has been the clinical rather than environmental framing of this issue and how it affects children. An environmental framework seeks to reduce risk, even allowing for the Precautionary Principle Policy adopted by San Francisco, which seeks to limit all exposures that may cause harm. While there have been many champions in preventing lead exposure, more than a few medical providers have told the CLPP that they believe we are unnecessarily concerning families by offering home environmental assessments for children who have been detected with low blood lead levels.

During the slow progress of epidemiologic science to prove that any level of lead exposure causes deficits in learning and behavior for children, many, many children had lead exposures that were considered medically acceptable, not causing harm and not warranting "treatment". Chelation therapy is relevant only to significantly higher lead exposures and has its own inherent risks. The only true treatment for lead exposure is removing the lead source, and the only way to find the lead source is by environmental assessment.

G. Challenges in Anticipatory Guidance and Blood Testing

While we have provided the SF medical community with resources for anticipatory guidance, required by state law, we have no way of assessing whether or not anticipatory guidance occurs at ages one and two, and for all children under six who have not yet received a blood lead test. Due to the age of our housing stock, it is probable that all young children in San Francisco reside in, spend time at, receive child care or play in locations that have significant lead sources and potential for lead exposure, and should therefore be offered a lead test.

Anecdotally, the CLPP has been informed by middle class parents with higher education levels that some medical providers have told them that only lower-income families need to be concerned about lead exposure. In the CLPP's experience, it is these more well off and educated parents that have most berated themselves when finding out that their child has been lead exposed. They read the internet, find out that no level of lead is considered harmless, and spend considerable time waiting for lead levels to go down and worrying about their child's future learning impacts.

VI. WHAT MORE CAN CLPP DO TO END CHILDREN'S LEAD EXPOSURE?

A. Advocate for New Affordable Housing for Families with Children

The CLPP Program Manager is participating in the five-year strategic planning effort of the SFDPH Maternal Child Adolescent Health Branch, leading efforts to promote quality affordable housing placements for low-income families with children. Though the Mayor and the City have committed to aggressive development of affordable housing for families, need still greatly outpaces production.

B. Advocate for and Incentivize All Contractors Disturbing Lead Paint to Receive CDPH Lead Certification Training

No State legislative mandate exists at this time, although the Federal mandate requires all contractors disturbing lead paint through renovation, repair or painting work to receive an 8-hour EPA certification training. In San Francisco, we have local Building Code requirements for lead-safe work practices. However, not all contractors and those paying for their services are aware of these requirements. Due to at least fifty thousand San Francisco residential properties having been constructed in the years when lead paint was still widely in use, the need for a contracting work force knowledgeable of lead-safe work practices is enormous, and CDPH certification is the gold standard for that knowledge.

C. Modify the San Francisco Health Code Lead-In-Soil Hazard Definition to be More Protective

The CLPP is committed to changing the SF Health Code definitions of lead hazards, in particular to lower the lead in soil hazard definition to reflect the findings of the child lead exposure modeling study. A revised California Human Health Screening Level for Lead (Review Draft) was made public by the CalEPA Office of Environmental Health Hazard Assessment in May 2009. According to the study, a child's daily hand-to-mouth exposure from playing in bare soil with a lead content of 80 parts per million will cause the child's blood lead levels to rise by 1 microgram per deciliter.

D. Link Lead Hazard Home Assessment to Universal Preschool

As San Francisco commits to providing free universal preschool to all San Francisco children, the CLPP will explore whether this enrollment can be linked to offering or requiring lead hazard home assessments for all participating children citywide.

E. Prepare for Litigation Settlement Implementation

Lead paint industry defendants have appealed the Court decision awarding a litigation settlement to plaintiffs such as the City and County of San Francisco. That Court appeal must be heard and judged, which may take until mid-2017. Assuming the litigation settlement is upheld, it will be distributed via a Request for Proposal process administered by the CDPH Childhood Lead Poisoning Prevention Branch, with designated amounts to be received by each of the ten plaintiff jurisdictions. San Francisco is due to receive $77 million for the permanent abatement of lead hazards in high risk housing to be expended over a mere four-year period. It is urgent that all 10 participating jurisdictions be immediately poised to deliver services authorized by the litigation settlement, involving the following:

- **Proactive Inspection of High-Risk Homes with Young Children**
  San Francisco must continue outreach efforts to identify qualified consultants and offer incentives to those who can become state-certified to conduct proactive lead hazard inspections and assessments that qualify homes for abatement funded by the litigation settlement. Certified Industrial Hygienists were notified of this upcoming opportunity at the December 2014 California Industrial Hygiene Conference.

- **Family and Property Owner Incentives**
  Community-based organizations must be enlisted and incentivized to provide access to families with young children who live in these high-risk homes and to motivate and support rental property owners who currently rent to families to participate in the subsidized abatement program.

- **Workforce Development**
  San Francisco must do outreach and offer incentives to qualified contractors who can become state certified to provide permanent abatement of interior lead hazards, the main activity that will be funded by the litigation settlement. The lead supervisor and worker certifications must be integrated into all City-funded construction job training programs, as there is currently a significant shortage of these personnel.

- **Permanent Abatement of Interior Lead Hazards and Friction Surfaces**
  San Francisco must begin working with local window and door suppliers to anticipate the need for inventory as the replacement of windows and doors is one of the main features funded by the litigation settlement. Furthermore, the CLPP must work with Planning, Building Inspection and the Mayor's Office of Housing and Community Development to ensure that the public encounters a smooth permitting process for this work.

CONCLUSION

All children deserve healthy environments to develop healthy brains and bodies, regardless of the neighborhood they live in and the type of housing their family occupies. In order to protect children from the harmful effects of lead exposure, the CLPP will continue its emphasis on primary prevention of lead exposure through the elimination of lead sources. City policymakers have been extremely helpful in passing legislation that defines the hazards, establishes protocols for ordering the remediation of lead hazards found in the environments where children spend time, and regulating lead-safe work practices on pre-1979 buildings. The future lead paint industry litigation settlement, if sustained in court, will provide the financial resources and infrastructure to permanently remove many interior lead sources.

It is clear that the CLPP has been successful in many areas: Health educators providing multilingual education and outreach have made "lead" a household word in San Francisco. The majority of WIC-enrolled families receiving CLPP services stated they were motivated to request a home assessment due to their concern about their child's risk of exposure to lead. Environmental investigators continue to successfully identify many sources of lead exposure that have resulted in remediation of those lead hazards.

Despite all that the CLPP has accomplished, the pervasiveness of lead hazards in San Francisco's environment and the continuing scientific revelations of lead's ability to damage health and cognition, both demonstrate that there is still work to be done. Given that lead sources exist in 85% of San Francisco homes and that approximately 500-600 children are found to be lead-exposed each year, we need to do more.

APPENDICES

APPENDIX I. San Francisco Health Code Article 26 Comprehensive Environmental Lead Poisoning Prevention Program Mandates

Once signed into law in late 1992, Article 26 required DPH to develop lead hazard reduction regulations, conduct case management and reporting, educate the community and ensure that children are screened for lead poisoning. Other Article 26-mandated activities included:

- Three Advisory Committees: the City Agency Task Force on Lead Issues, the Lead Poisoning Prevention Citizen Advisory Committee, and the Lead Hazard Reduction Citizen Advisory Committee, which met regularly over the first decade of the program.

- The two Citizen Advisory committees were charged with: a) drafting consensus-based legislation to define the scope of DPH regulatory authority, and b) providing oversight to each City and County agency that could potentially control or eliminate lead hazards in its facilities and that could provide lead hazard prevention education to client families with young children.

- The Citizen Advisory Committees successfully became a collaborative effort between community-based organizations, professionals, and several City agencies to prevent children's lead poisoning and provided legislation for Board of Supervisors adoption over a 14-year span, strengthening the City's ability to prevent childhood lead exposure.

- DPH Guidelines, issued in 1995, instructing City agencies how to assess for lead hazards at City-owned or operated sites.

- In a related mandate, Section 1609 provided the opportunity for DPH to issue a Director's Report on the Comprehensive Environmental Lead Poisoning Prevention Program to the San Francisco Board of Supervisors regarding overall progress and the progress of each City agency in addressing lead hazard control of its facilities and lead prevention education with its family clients.

- The Director of Health issued such reports to the Board in 1998 and December 2003, with subsequent hearings at the Board. One of these hearings on the Director's Report resulted in the Director of Health advocating for and the Board of Supervisors establishing an annual $200,000 capital project allocation for proactive lead hazard assessment and control of public facilities in the Recreation and Park Department budget.

- Mandated Public Awareness Strategies:
    - A periodic lead poisoning prevention information bulletin (the *Word on Lead* newsletter);
    - A six-language pre-1978 Lead Hazard Notice in the Tax Collector's billing mandating property owners to warn residents that dwelling units constructed before 1978 may contain lead hazards and providing phone numbers to call for additional information;

  - A trilingual lead hazard warning sign mandated for posting in all retail stores selling home improvement products, which indicates that painting and remodeling can expose one's family to lead, and encourages members of the public to ask for a free pamphlet on lead-based paint hazards. DPH audits home improvement stores for the presence of this posting on a semi-annual basis.

- DPH-designated High Priority Lead Reduction Areas so that City departments could direct their resources for primary prevention services, screening, lead hazard reduction efforts, inspections, loans, loan guarantees or grants to properties in these areas. Prioritization was to be based on factors such as: (1) the number and severity of cases of elevated blood lead level children; (2) the age and condition of dwelling units; (3) the results of any inspections carried out in the homes of children with lead poisoning; (4) income levels; and (5) the historic and current presence of known sources of lead such as highways or industrial facilities. This mandate was the basis for the CLPP's proactive survey of exterior paint conditions in the Mission District from 2010-2011, the neighborhood with the greatest number of lead-poisoned children.

APPENDIX II. Two Decades of CLPP Strategies and Achievements

Since February 1993, over a 22-year period, the Childhood Lead Prevention Program (CLPP) has implemented lead hazard prevention strategies to protect San Francisco's children from lead exposure. The following is a summary of key strategies used throughout the program's history and related achievements.

A. Public Awareness and Targeted Outreach Strategies

Needs Assessment and Program Evaluation to Promote Public Awareness of Lead Poisoning Prevention (1992-1999)

At the outset of this program, from 1992-1996, the CLPP collaborated on a US Centers for Disease Control (CDC) grant with the State CLPPB and Alameda County CLPP, which included an educational campaign with the Safeway grocery chain and mass media coverage of lead issues and local campaigns by English, Spanish and Chinese-language TV, radio and print outlets. Local media coverage included blood lead screening conducted at the Geneva Towers public housing site and door-to-door in the Mission District, the Safeway campaign, lead in construction training, a HEPA vacuum loaner program, focus on lead in mini-blinds, ceramics, public housing and playgrounds, and the general promotion of lead hazard prevention and blood lead testing of children under six years old.

The CDC grant allowed the CLPP to fund two community-based initiatives in San Francisco: 1) The CLPP issued mini-grants to 12 community-based partners in San Francisco, and 2) in 1993, the CLPP conducted door-to-door lead screening outreach in the Mission District, the district with greatest case finding, in an effort to identify young children with lead poisoning and to overcome barriers to blood lead testing. The

CLPP provided home-based and special event blood lead testing for 418 children and provided parents with lead prevention education and referrals to comprehensive health care services for their children. The screening project found 8.5% of screened blood lead levels were >10 µg/dL. It was also found that the greatest occurrence of elevated lead levels was in one year-olds.

In 1995, the CLPP initiated a major marketing campaign on the dangers of lead with a public relations and advertising firm, utilizing commercial tools such as light pole banners, labels on paint cans sold at home improvement stores, and commercial direct mail offers for lead-safe work supplies. The first phase of the campaign involved notifying property owners, managers, and contractors about the upcoming campaign by conducting focus group sessions and workshops, sending out letters and articles, and developing informational materials for landlords, property owners, and supply stores. The second phase involved reaching out to the general public through press conferences, bus advertisements, print materials, and public service announcements on television and radio. The Marketing Campaign successfully increased the general public's awareness of lead poisoning, as indicated by the next year's evaluative survey.

In 1996, the CLPP conducted a survey to determine what Hispanic, African American and Asian/Pacific Islander adults know about child lead poisoning, what preventive actions they have taken and whether those surveyed at family-serving community agency sites offered lead prevention education had a different level of knowledge or prevention practice from respondents surveyed in public locations. Bilingual health educators interviewed a total of 607 adults in English, Spanish or Cantonese, in neighborhoods where children faced increased risks for lead poisoning. Half of the respondents were interviewed in family-serving community agencies where the CLPP provides lead prevention education, and the rest in public places, including street corners, bus stops and laundromats. The majority of respondents (72%) had heard of lead poisoning, with the general public most frequently mentioning television (33%) and newspapers (18%), while community agency respondents mentioned doctors (31%), WIC programs (26%) and television (26%).

Paint was named as a source of lead in the home more frequently than any other source (58%). Lead in water was the next most frequently mentioned source (33%). One significant finding was that individuals within all three groups erroneously believed that lead in water was one of the main sources of lead exposure in San Francisco.

Community agency respondents were more likely than public respondents to have taken steps to prevent lead poisoning such as keeping paint intact (26% vs. 10%) and testing children (28% vs. 7%). The results of the survey assisted in improving the educational component of the CLPP's scope of services.

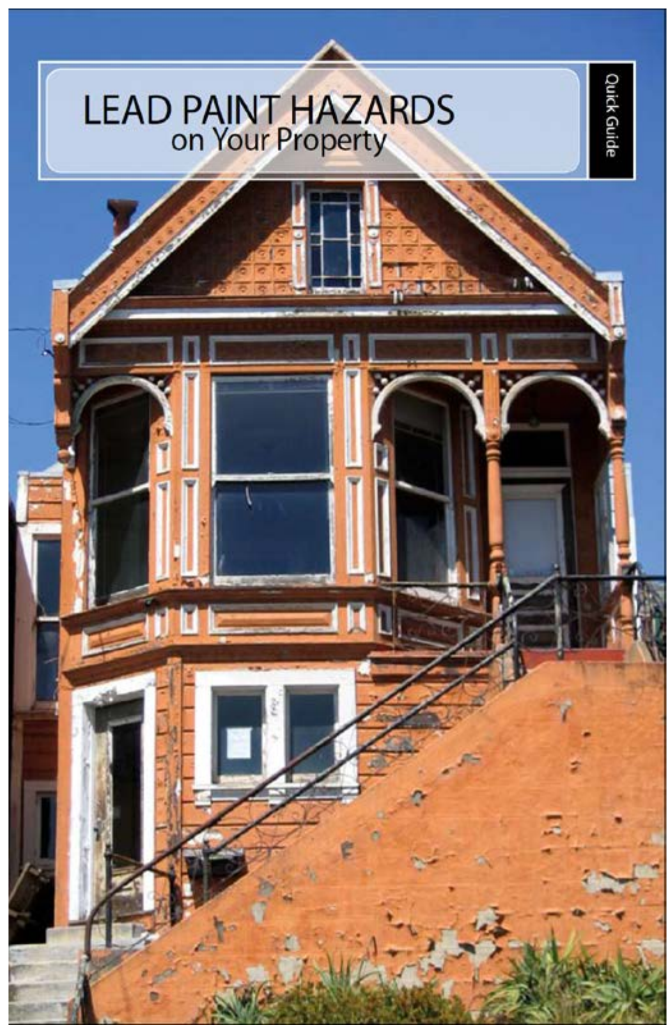
In 1999, the CLPP hired a program evaluator to identify through surveys and interviews where the program was effective or needed increased effort to meet community needs, particularly in the seven zip codes with the highest incidence of reported childhood lead poisoning. The evaluator conducted 597 household phone surveys, which included 210 parents, 414 tenants, 29 rental property owners or managers, and 30 contractors doing business in San Francisco. Among tenants, a significant finding was that most reported not receiving the mandated notification on lead hazards from their landlords (66%). Most of the contractors were aware of the new San Francisco law requiring safe work practices when disturbing lead-based paint, with most construction workers learning about lead-safe work practices through their union. Non-union contractors learned about lead safety through job sites and the newspaper.

Overall, findings from the household survey indicate the majority of the sampled residents, both parents and non-parents, are familiar with the problem of lead poisoning among children (89%), have a basic understanding of how children are exposed to lead, and generally understand that lead poisoning can cause brain damage, learning disorders or affect the nervous system of children (46%). Many had taken precautions to prevent lead exposure in their homes (61% of parents or child caregivers and 27% of non-parents), and tenant respondents overall were willing to ask their landlord to fix a lead problem in their home (83% of parents and 90% of non-parents). Among tenants surveyed, 84% said the city should require landlords to fix lead hazards in rental properties. In this same time period, the Mayor's Office of Housing (MOH) was awarded its first of several grants from USHUD to conduct lead hazard remediation in the homes of children under six, including private housing and family-based child care settings. The CLPP developed both cable TV ads and MUNI bus ads to promote the public's awareness of lead hazards and access to the CLPP and MOHCD services.

Milestones in Promoting Property Owner and Resident Knowledge of Regulatory Requirements (2000-2009)

From 2005 through 2007, the CLPP created the Youth Civic Engagement Project (YCEP), training small groups of high school students to promote healthy neighborhoods in San Francisco. The second cohort of the YCEP created a cable TV public service announcement to promote property owner window replacement in pre-1979 buildings.

In January 2007, the CLPP issued and mailed the *Property Owner Quick Guide: Lead Paint Hazards on Your Property* to the Tax Assessor's entire database of Residential Rental Property Owners. A second mailing provided this same audience access to Spanish and Cantonese language versions of the *Quick Guide*. The CLPP worked with the SF Apartment Association to survey their members on whether they remembered receiving the guide and whether they found it helpful. A nearby jurisdiction on the peninsula asked if they could copy and adapt the guide for property owners in their City. Remaining copies were made available to the public through the SF Public Library.



In 2007, the CLPP staff conducted the Pharmacy Outreach Project to educate residents about the health effects of lead poisoning and the importance of lead screening for young children. The program targeted adults and parents who were customers of retail pharmacies because it was thought that consumers at these locations would be receptive to preventive health information. The program focused on the neighborhoods of Excelsior, Outer Mission, and Bernal Heights, which are at high risk for lead exposure. Those who we spoke with learned about screening resources, services available through the DPH, sources of lead and the risks of lead poisoning.

In 2010, the CLPP helped lead a regional campaign promoting awareness of the new federal Environmental Protection Agency (EPA) Renovation, Repair and Painting Rule (RRP). Effective April 22, 2010, the EPA RRP Rule requires contractor training and certification in specific work practices to prevent lead contamination for any work that disturbs lead-based paint in homes, child care facilities and schools built before 1978. The DPH participated in a multi-county awareness campaign coordinated by the Get the Lead Out Coalition to inform consumers that they should ask to see a contractor's EPA RRP certification before hiring their services. The RRP rule also requires contractors to provide the EPA pamphlet, *Renovate Right*, to homeowners, owners and operators of child care facilities and schools built prior to 1978 and provide information to parents or guardians of children under age six that attend.

The CLPP amplified this outreach locally by placing a three-language insert (English, Chinese and Spanish) into the San Francisco Department of Election's Voter Information Pamphlet. The CLPP also translated the EPA *Renovate Right* pamphlet into Chinese for the benefit of San Francisco's significant Chinese-reading population.

Primary Prevention Outreach Focus (2010-2014)

In 2010, the CLPP established outreach facilitated by the DPH Birth Records office, providing trilingual brochures to each family applying for a San Francisco birth certificate, whether in person or by mail. This outreach method continues currently.

In 2013, the CLPP worked with partner Mayor's Office of Housing and Community Development (MOHCD) to promote the HUD Grant resources to all state-licensed family child care providers in San Francisco, including trilingual presentations via a childcare umbrella agency, the San Francisco Children's Council. In addition, the CLPP and MOHCD reached out to all Section 8 property owners under the oversight of the San Francisco Housing Authority to offer HUD grant services.

In 2013, the CLPP created Chinese-language translations of multiple Federal and State educational materials aimed at training contractors and laborers in the EPA Renovation, Repair and Painting (RRP) Rule, with the aim of assisting MOHCD to conduct Cantonese-language RRP worker trainings.

In October 2013, the CLPP hosted two showings of the documentary film, *MisLEAD*, for the public and for Northern California-based CLPP programs.

B. Policy and Legislative Strategies for Lead Hazard Source Reduction

Establishing Regulatory Authority to Conduct Environmental Investigation in the Homes of Lead-Poisoned Children (1995)

In 1991, San Francisco DPH began investigating homes of children with BLLs ≥20 μg/dL. Once the CLPP was established, from 1995 the protocol was revised to include environmental investigations for cases persistently ≥15 μg/dL. From January 1992 to December 1995, 154 cases at 125 residences received environmental investigation, which represented 86% of identified cases. Those lost to investigation were usually due to the child moving outside of San Francisco before the investigation could be initiated. Samples were collected from interior and exterior paint, dust, soil and water. Of these samples, 44% of interior paint has hazardous lead levels, 68% of exterior paint, 63% of soil, 36% of dust and 0% of water sampled.

In July 1995, the Director of Health gave the CLPP the authority to cite lead hazards identified during lead poisoning case investigation as public health nuisances. As a result, the CLPP began issuing Notices of Violation (NOV) requiring owners of investigated properties to remediate identified lead hazards and to use prescribed lead-safe work practices. Each case was required to pass the CLPP clearance testing before the owner's obligations were met. The ability to issue NOVs resulted in greater property owner compliance in lead hazard remediation.

In October 1996, the Lead Hazard Reduction Citizen Advisory Committee's draft legislation was passed by the Board of Supervisors, strengthening the Health Director's authority to respond to lead hazards in the homes of lead-poisoned children beyond issuing NOVs. This includes legal penalties for non-compliant owners, authority to order temporary relocation during remediation paid for by the rental property owner, and prohibition of rent increases related to lead hazard remediation.

Data analysis indicated that the CLPP's lead hazard findings included many friction and impact surfaces, namely windows and doors. The replacement of these components became a priority, using the MOHCD HUD grant and other City incentives.

Establishing regulatory authority to prevent lead hazards during the disturbance of lead-based paint (1997&2004)

The greatest number of complaint calls to DPH involved unsafe repair, renovation and paint prepping activities. Furthermore, the CLPP investigations of lead-poisoned children's settings had repeatedly demonstrated how renovation activities have contributed to case children's lead dust exposure. In 1997 and again in 2004, the Board of Supervisors passed legislation proposed by the Lead Hazard Reduction Citizen Advisory Committee, granting the San Francisco Department of Building Inspection (DBI) authority to regulate lead-safe work practices in pre-1979 buildings. The 1997 law concerned only building exteriors and steel structures, while the 2004 amendment expanded lead-safe work practice requirements to residential rental and child care uses. The DBI has the authority to presume the presence of lead-based paint in all pre-1979 buildings. San Francisco was the first California jurisdiction to pass such a law, and it remains in effect despite later state laws intended to mandate lead-safe work practices.

Pilot and policy establishing lead testing of tap water for WIC-enrolled families (1998-1999)

From May 1998-April 1999, the CLPP collaborated with the Public Utilities Commission (PUC) Water Quality Bureau and the DPH Women, Infants and Children (WIC) Supplemental Nutrition Program, to offer free tap water testing for lead to over 5,000 WIC-enrolled families. This offer was accepted by approximately 1,400 WIC-enrolled families, and resulting water tests demonstrated that lead in San Francisco tap water was not of concern. Currently, WIC-enrolled families may still request to have their water lead-tested free of charge, courtesy of PUC Water Department vouchers provided to the WIC program.

Health Code amendment to define lead hazards as a prohibited public health nuisance (2001)

In 2001, Article 11, Section 581b of the San Francisco Health Code was amended to include Lead Hazards as a prohibited public health nuisance, providing the CLPP proactive lead hazard code enforcement authority. This amendment for the first time gave the CLPP authority to issue notices of violation to settings where children under six could be exposed to lead hazards, independent of whether a specific child had been tested for lead exposure. The CLPP has authority to presume the presence of lead-based paint in all pre-1979 buildings, and to define poor paint conditions and lead dust findings as lead hazards in a Notice of Violation. Furthermore, the CLPP orders such lead hazards to only be remediated by State-certified workers and then inspected at completion by State-certified lead risk assessor/inspectors.

Working to remove lead-contaminated candies from retail locations (2005-2008)

In 2005, after Southern California's *Orange County Register* published a series of articles about lead-contamination of Mexican candies, particularly those containing chili powder, the CLPP conducted community surveys of Mission District residents about their consumption of Mexican chili-containing condiments and candies and found such food products were consumed on a regular basis. The CLPP also worked with a community-based organization, La Raza Centro Legal, to survey 414 retail stores with candy or food licenses issued by DPH Environmental Health from March-May of 2005. Survey findings were that 106 of the 414 stores (26%) sold candy that had been identified as potentially containing lead. Survey data within the two zip codes (94110 and 94112) that were likely to have residents consuming chili condiments and candies found that 87 of 172 stores contacted (51%) sold candy that may contain lead.

Following this survey, the CLPP mailed a letter to all vendors in San Francisco with a candy or food license warning them of the identified lead-containing candies and requesting that store owners and managers remove the candies from their shelves and refrain from selling them.

The CLPP made a follow-up survey to determine if vendors had removed these candies in response to our letter warning about the potential hazard of these candies. The follow-up survey indicated that 61 stores removed the candies (a 57 % reduction). In the zip codes of greatest concern (94110 and 94112), 41 stores removed the candies (a 52 % reduction). The CLPP program staff distributed 18,840 posters and flyers describing these candies and explaining the potential hazards that they pose to children. This information was given to schools, childcare providers, dentists, and medical providers.

Subsequently, the State passed regulations requiring the ongoing testing of imported candies, with website and hazard alert disclosure of lead findings. In 2008, in conjunction with a Public Health Trust grant awarded to the Get the Lead Out Coalition, the CLPP worked with La Raza Centro Legal, a San Francisco non-profit community law center, to again visit candy retailers in the districts of greatest concern. In this round of outreach, the goals were to have stores agree to post a bilingual English-Spanish window sticker stating their pledge to only sell lead-free candies.

Retailers were also given tools for identifying which candies had been tested by the State lab and found either lead-free or lead-contaminated. Additionally, a bilingual English-Spanish factsheet was developed to inform the public how to access State candy lead testing data online, and this factsheet was also distributed as part of the grant project.

Incorporating lead hazard inspections into proactive comprehensive healthy home visits for WIC-enrolled families (2008-current)

In 2008, the CLPP initiated a Healthy Homes Environmental Assessment and Education Project offered to approximately 6,000 WIC-enrolled families. This provided a proactive approach to identifying lead and other hazards in the homes of low-income families at greatest risk of environmental health hazards. Through 2010, 64 families received services and 75% of the participating families had a total of 137 hazards identified, including damaged lead paint, pests, mold, water leaks, second-hand smoke migration, clutter, humidity, inoperable windows, bare soil, bird waste, excessive use of insecticide, offensive odors and exposed wiring. All hazards were referred to code enforcement agencies as needed, and the CLPP follow up was conducted to ensure that hazards were corrected.

In the CLPP's published report of findings, the neighborhoods of the assessed homes were also analyzed for healthy community built environment indicators such as overcrowding, outdoor air pollution, access to positive resources such as elementary schools, food markets and parks, as well as access to a negative resource, fast food establishments. The GIS analyses validated the CLPP observations that low-income families are subject to worse neighborhood conditions in addition to worse housing conditions that families of higher income.

For example, as compared to areas outside the WIC recipient neighborhoods, there was an increase of 7.12% of households found living in overcrowded conditions. Also 82% of WIC participants lived in a traffic hazard zone as compared to 68% citywide, providing the WIC population greater exposure to pedestrian injuries, and less healthy air quality and ambient noise conditions.

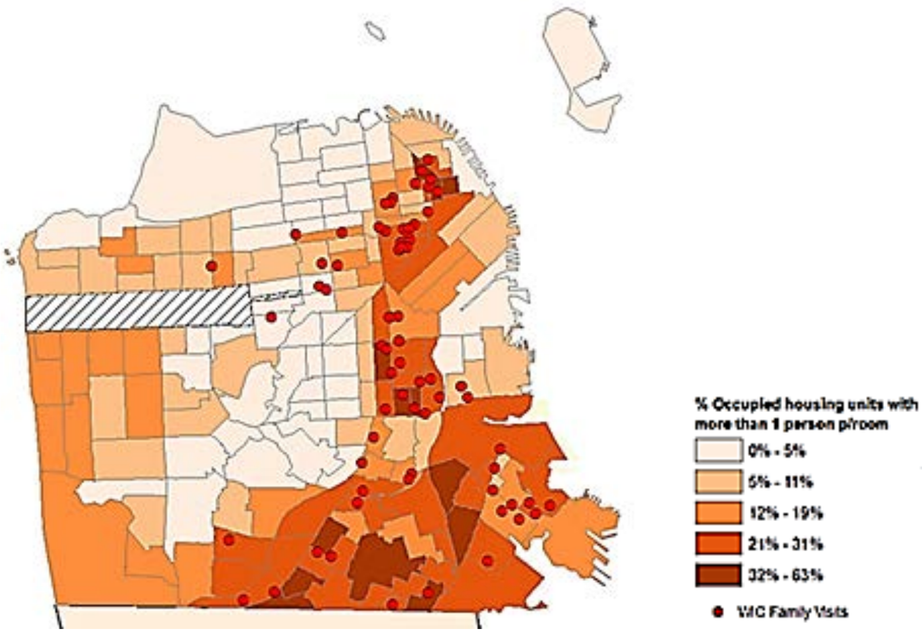


FIGURE 13 Percent of Occupied Housing Units with More Than 1 Person per Room

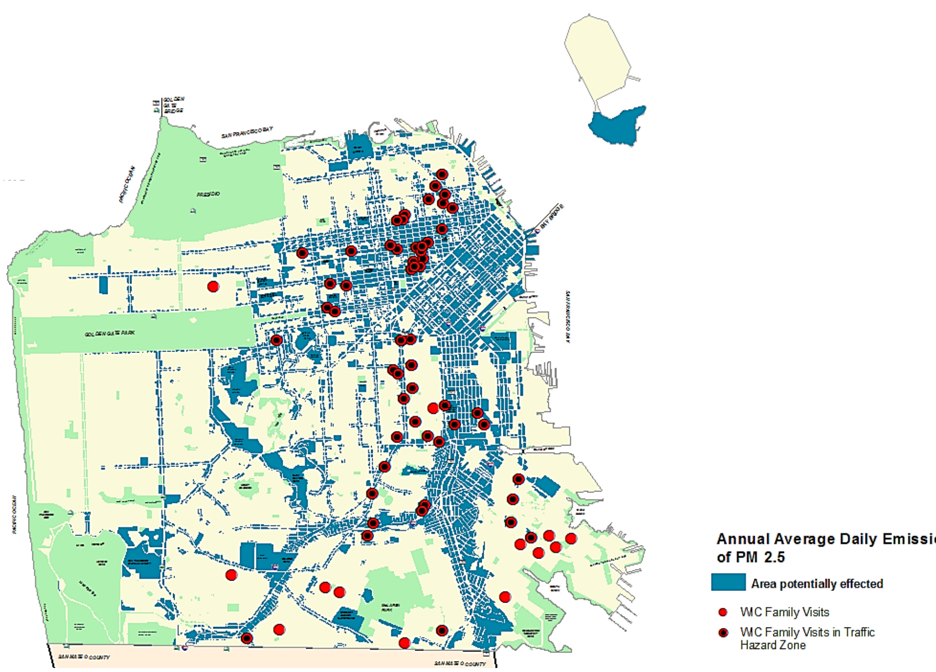


FIGURE 14 Annual Average Daily Emissions of Fine Particulate Matter

Policy established to proactively assess exterior paint conditions in High Priority Lead Reduction Areas (2010-current)

From 2010-2012, the CLPP staff assessed exterior paint conditions in all Mission District census tracts, issuing 96 Notices of Violation for lead hazards. The CLPP implemented the Mission District Project due its standing as the location with the highest rate of lead exposed children, as well as the district's high percentage of multi-unit housing as well as significant child population. More recently, the CLPP staff assessed a North Beach census tract based on the same criteria, resulting in 16 Notices of Violation.

C. Secondary Prevention Strategies

Individual providers educated about lead and direct reporting from blood testing labs established (1994)

The CLPP began educating individual providers about CDC lead screening guidelines and case management policies and procedures. The program specifically targeted pediatricians who treated patients in high risk, low income eligible areas, and who were eligible for MediCal or Child Health & Disability Prevention (CHDP) benefits.

Physician education and outreach project conducted (1995)

The CLPP's Public Health Nurse began systematically visiting every San Francisco CHDP-enrolled medical provider and contacted every major medical group providing pediatric care. The project aimed to discover what amount of screening was being done by physicians, what the opinions of physicians regarding lead screening were, and building a personal relationship between physicians and the CLPP. Furthermore, the project aimed to encourage more effective use of CHDP screening guidelines, improve screening reporting to the CLPP, and ensure physicians were aware of the CLPP case management services. Through this program the CLPP succeeded in increasing screening rates and building a closer personal relationship with physicians in the city.

Evaluation of CLPP environmental investigation data and blood lead surveillance (1991-1997)

The 1998 *SF Childhood Lead Prevention Program Data Evaluation* report presented the findings of a comprehensive analysis of blood lead screening/surveillance and environmental data captured by the Childhood Lead Prevention Program from 1991 to 1997. The purpose of the evaluation was to:

- Fulfill the mandates of the Comprehensive Lead Poisoning Prevention Ordinance (SF Health Code, Article 26, Sections 1620-1622).
- Analyze screening and case finding trends over time.
- Create a report to fulfill data requests.
- Assist with the development of the City's blood lead screening policy.
- Provide evidence of lead-paint hazards in the City.
- Promote policy and legislation that reduce sources of lead hazards.

Environmental Findings:

Between July 1991 and May 2004, more than 2500 environmental samples were collected as part of the SFDPH routine responses to lead complaints and blood lead testing reports. Environmental lead sources identified include: lead-based paint, lead contaminated dust, lead contaminated soil, home remedies, pottery, take home exposure, hobbies/other, and in one sample, lead in water.

A high percentage of homes had at least one interior lead-based paint hazard (54%) and/or an exterior lead-based paint hazard (40%). A lead dust hazard was identified in 29% of the homes investigated. Other hazards identified by percentage of homes include: soil (19%), take home (14%), hobby/other (8%), home remedies (5%) and pottery (3%).

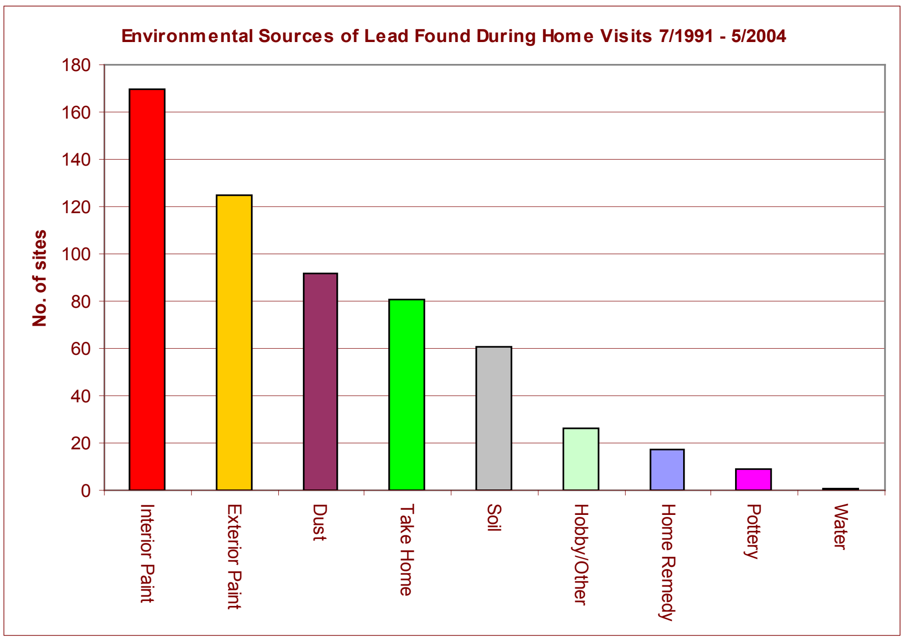


FIGURE 15 Environmental Sources of Lead Home Visits 1991-2004

A particular site may be represented in more than one bar of this graph.
For example, if a site had both a soil hazard and a pottery source it would appear in both the bar for soil and the bar for pottery.

Child Lead Exposure Findings:

Blood lead screening in San Francisco had increased every year since the program's inception, and after witnessing an increase of over 100% in case findings from 1991 to 1995, the number of cases decreased significantly for the first time in 1996. The 1998 CLPP report stated:

"A cursory look at our screening and case finding data might lead people to assume that we are solving the lead poisoning problem and making it go away. However, such an assumption is dangerously misleading, especially here in San Francisco, for the following reasons:"

"The source of the problem still exists, and will always exist, because lead is ubiquitous in the environment. The primary source of lead for children under six years of age is lead-based paint, which can be found in most homes built before 1978. Fully 94% of SF housing was built before 1978, and two-third of the housing

(68%) was built before 1950 when lead-based paint, containing up to 50% lead, was in widespread use. A common misconception is that the removal of lead from household paint and gasoline in the United States has been so successful that lead is no longer a health threat. Once lead is mined and introduced to the surface environment it does not go away. When lead paint deteriorates, peels, or is disturbed, lead dust is produced. Lead-dust hazards are frequently created when homes are repainted, remodeled, or renovated using unsafe work practices, such as dry scraping or sanding of surfaces with lead-based paint. Exterior paint tends to have a much higher lead content than interior paint and is often in worse condition; therefore it poses a greater threat to children than interior paint. For these reasons, lead-based paint, dust, and soil hazards are prevalent in the City due to the age and extreme density of our housing stock."

"Although screening numbers have increased, a significant number of eligible children have not been screened. Screening in San Francisco increased 145% from 1991 to 1996 due to education and outreach efforts by the CLPP to individuals, community-based organizations, and health care providers. Although this increase is significant, there is still a huge gap between the number of children eligible for testing and the number of children screened. Only 5-15% of one and two year olds estimated to be eligible for blood lead testing had test results reported to the CLPP between 1991 and 1996."

Anticipatory Guidance Campaign with Medical Providers (2003)

Anticipatory Guidance promotes parental knowledge of lead as a systemic poison with long-term health consequences, as well as potential lead sources and exposure pathways in their child's environment. The guidance should also stress how oral exploration common to infant and toddler developmental stages may lead to lead exposure. Finally, anticipatory guidance motivates parents to seek lead testing, particularly for their one and two-year-olds, and the Director urged providers to order blood lead testing according to State requirements, emphasizing that because 63% of San Francisco's housing units were built and painted pre-1950 and 91% built and painted pre-1980, when residential lead paint became discontinued, virtually *all* children in SF are at risk of lead exposure.

Because medical providers are an important resource for parents, and often can encourage healthy behaviors back home, the Director of Health assisted the CLPP to conduct an Anticipatory Guidance Campaign during Public Health Week of 2003. In his letter to all San Francisco pediatric and family practice medical providers, the Director summarized recent State law requiring that medical providers give anticipatory guidance on lead poisoning prevention at each periodic assessment from six to 72 months of age. The letter also served to assist medical providers with this requirement, by enclosure of English/Spanish and English/Chinese bilingual posters which can be used in treatment and waiting rooms, as well as other patient education resources.

Lead Care Analyzers distributed to community clinics (2008-2010)

In 2008, the CLPP's public health nurse worked with several community clinics to place Lead Care II Analyzers at their site. As a State-approved portable lab, the Lead Care II allows these clinics to draw finger stick samples that can be analyzed immediately onsite with the Lead Care II and its reagents. These clinics desired that capability to help families who would otherwise have to travel to a remote lab or were unlikely to follow through with the doctor's order to visit the phlebotomy lab. In addition, the Lead Care II finger stick method is more acceptable to those who culturally do not accept venous blood draws as it is perceived as less invasive.

APPENDIX III: Consumer Products with Lead Content

Direct ingestion of lead sources, whether a lead paint chip or a consumer source, may cause a distinctly high blood lead level. An X-ray may be ordered to look for a swallowed object. For blood lead levels detected greater than 45 ug/dL, the child may be referred for chelation therapy by their primary medical provider.

In 2004, a child in Oregon had a BLL of 123 μg/dL after ingesting a necklace with high lead content. The most recent U.S. fatality from acute lead poisoning, in 2006, was that of a Minnesota child who swallowed a heart-shaped metallic charm containing lead; the charm had been attached to a metal bracelet provided as a free gift with the purchase of shoes manufactured by Reebok International Ltd., later recalled from the market by Reebok and the Consumer Product Safety Commission.

Three such websites for consumer product lead alerts include: CDPH Food and Drug Branch Recalls for "Lead in Candy", CDTSC "Lead in Jewelry" Advisory, and US Consumer Product Safety Commission Recalls for "Hazard:Lead".

CLPP's lead source investigations occasionally reveal consumer products with lead content, and CLPP provides educational material highlighting these lead sources:

- The CLPP programs are alerted by State and Federal agencies to the existence of imported lead-contaminated consumer sources such as traditional home remedies, non-Western medicines, cosmetics and spices, and on occasion, these lead sources have been identified in our caseload.
- Another semi-frequent source found by the CLPP investigations has been brass objects and artifacts mouthed by children, where the lead component of brass is leached out by the child's saliva.
- The CLPP has not encountered food cooked in lead-glazed ceramic pots, but once found infant formula stored in a lead-glazed ceramic pot.
- Although the CLPP has found children who ate suspect import candies and chili powders, mouthed lead-leaching soft plastic cables or handled lead-painted toys, none of these sources has been an isolated cause of lead poisoning in our caseload.
- Lead in water has been a non-existent source of lead exposure for our caseload.

- On a single investigation, the CLPP encountered a child whose sole hand-to-mouth exposure came from touching the soft leaded features decorating a glass cabinet, and another single investigation identified a child who had access to touching and mouthing lead bullets.

APPENDIX IV. Medical Management Guidelines

CDPH contracts with the CLPP to provide public health nurse (PHN) case management and registered environmental health specialist (REHS) environmental investigation for blood lead levels (BLL) of 15 ug/dL and above, which is contrary to current US Centers for Disease Control guidance. As stated earlier in this report, systematic review of childhood lead poisoning studies have indicated there is no threshold that can be considered a safe BLL and therefore the clinically acceptable level of lead exposure is "non-detected." At this time, most laboratories have a limit of detection equal to 2 micrograms per deciliter.

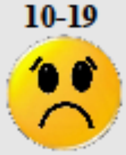
When the CLPP is notified of blood testing results, the Program's follow up response is based on the severity of the blood lead level (BLL), corresponding to State mandated minimum follow up:

- A BLL ≥70µg/dL: An emergency value requiring immediate hospital or emergency room attention. The CLPP contacts the primary care provider (PCP) immediately and the state CLPPB as soon as possible. The CLPP assigns the PHN case manager and REHS environmental investigator to visit the patient's home within 24 hours of referral. Based on the CLPP referral, a Nutritionist consult with the family will follow.
- A BLL 45-69 µg/dL: Requires immediate medical follow up and potential chelation therapy to be ordered by patient's health care provider in consult with the CLPPB-designated SF-based chelation expert. The CLPP contacts the PCP and the CLPPB as soon as possible. The CLPP assigns the PHN case manager and REHS environmental investigator to visit patient's home within 48 hours of referral. Based on the CLPP referral, a Nutritionist consult with the family will follow.
- BLL 20-44 µg/dL: PHN will ensure retesting every month until the child's BLL is ≤20 µg/dL, recommend the child to California Children's Services if he/she has no health insurance or needs chelation therapy. The CLPP assigns the PHN case manager and REHS environmental investigator to visit the patient's home within one week of referral. Based on the CLPP referral, a Nutritionist consult with the family will follow.
- BLL 15-19 µg/dL: The CLPPB designates this response if the BLL is persistent for several months, but the CLPP will assign resources at the first BLL finding in this range. The CLPP assigns the PHN case manager and REHS environmental investigator to visit the patient's home within two weeks of referral. The PHN will ensure the affected child has medical evaluation and management and discuss the option of iron therapy with medical provider. Based on the CLPP referral, a Nutritionist consult with the family will follow.
- BLL 10-14 µg/dL: The CLPP assigns an environmental investigator to visit the patient's home within two weeks of referral. The investigator also provides nutrition counseling.
- BLL 5-9 µg/dL: The child's parents are called by one of our program's environmental investigators to offer the family an environmental inspection to identify lead hazard sources and to order remediation of lead hazards by the property owner.
- BLL 2-4 µg/dL: A letter indicating the child's BLL finding is sent to the child's parents offering the CLPP's environmental investigation to identify lead hazard sources and order their remediation by the property owner. Educational materials in English, Spanish or Chinese are included.

Blood Lead Levels

What Do They Mean?

The blood lead test gives an idea of how much lead your child has been recently exposed to in the environment. Children with lead in their blood may not look or act sick, but learning and behavior problems may show up years later when they go to school.

Blood Lead Test Result in micrograms per deciliter (mcg/dL)	**What Does It Mean?**	**When To Get Another Blood Test?**	**What Can You Do?**
0 	**Your child has no detectable lead in their body.**	Ask your doctor to test your child for lead at 1 & 2 years of age or once before the age of 6.	☐ Avoid sources of lead ☐ Give your child vitamin C, calcium & iron rich food ☐ Wash hands and face before eating ☐ Keep home paint intact and dust free ☐ Use a wet sponge or mop to clean floors and windows
1-4 	**No amount of lead in the body is normal or safe.** Your child has been exposed to small amounts of lead.	Retest if your child's risk of lead exposure changes. For example: If you move to an older home with chipped or peeling paint, if someone in your home works in construction, gardening, etc.	☐ All the above, and... ☐ See back of this form for information on lead hazards around your home (Lead is a Poison) ☐ Find lead hazards in your home ☐ Follow best practices if someone in your household works in construction, landscaping, etc. ☐ Our program will provide information and offer a home visit to help you look for lead hazards around your home ☐ For any questions or concerns please call your home inspectors
5-9 	Your child has been exposed to some amount of lead in their environment.	**6 months** (Call your doctor to have your child tested for lead again)	
10-19 	Your child has been exposed to moderate amounts of lead in their environment.	**3 months** (Call your doctor to have your child tested for lead again)	☐ All the above, and... ☐ At a Blood Lead Level of 15 and above a Public Health Nurse will make a home visit to provide follow-up care
20-44 	Your child has been exposed to large amounts of lead in their environment.	**2-3 months** (Call your doctor to have your child tested for lead again)	☐ All the above, and... ☐ Lead exposures must be identified and reduced. Our Program will test your home for lead hazards
45-69 	Your child has been exposed to very large amounts of lead in their environment.	**As Soon As Possible** (Call your doctor to have your child tested for lead again)	☐ All the above, and... ☐ Your child may require specialized medical treatment in the hospital. Call your doctor ASAP for a confirming blood test and lead poisoning checkup
Above 70 	**Medical Emergency:** Your child has been exposed to dangerously high amounts of lead in their environment.	**Seek IMMEDIATE medical attention**	☐ All the above, and... ☐ Your child requires specialized treatment in the hospital NOW!

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http://www.cdc.gov/nceh/lead/publications/LeadandPregnancy2010.pdf

California Department of Public Health Childhood Lead Poisoning Prevention Branch
http://www.cdph.ca.gov/programs/THE THE CLPPB/Pages/default.aspx

San Francisco Department of Public Health Childhood Lead Prevention Program
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CREDITS

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