OFFICE OF ENVIRONMENTAL HEALTH HAZARD ASSESSMENT

GOOD CATCH CALIFORNIA
Your Fish Advisor

Health Advisory and Guidelines for Eating Fish from Lake Temescal (Alameda County)

December 2017

Fish, Ecotoxicology, and Water Section
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LIST OF ACRONYMS AND ABBREVIATIONS

ATL	Advisory Tissue Level
CDFW	California Department of Fish and Wildlife
DDT(s)	dichlorodiphenyltrichloroethane (DDT) and its metabolites dichlorodiphenyldichloroethane (DDD) and dichlorodiphenyldichloroethylene (DDE)
DHA	docosahexaenoic acid
EBRPD	East Bay Regional Park District
EPA	eicosapentaenoic acid
FDA	Food and Drug Administration
Hg	mercury
MDL	method detection limit
MLML	Moss Landing Marine Laboratories
mm	millimeters
OEHHA	Office of Environmental Health Hazard Assessment
PCBs	polychlorinated biphenyls
ppb	parts per billion
RL	reporting limit
RWB2	Regional Water Board 2 (San Francisco Bay)
USDA	United States Department of Agriculture
USDHHS	United States Department of Health and Human Services
US EPA	United States Environmental Protection Agency

PREFACE

The Office of Environmental Health Hazard Assessment (OEHHA), a department in the California Environmental Protection Agency, is responsible for evaluating potential public health risks from chemical contamination of sport fish. This includes issuing fish consumption advisories, when appropriate, for the State of California. OEHHA's authorities to conduct these activities are based on mandates in the:

- California Health and Safety Code
  - Section 59009, to protect public health
  - Section 59011, to advise local health authorities
- California Water Code
  - Section 13177.5, to issue health advisories

The health advisories are published in the California Department of Fish and Wildlife Sport Fishing Regulations in the section on public health advisories.

This report presents guidelines for eating fish from Lake Temescal in Alameda County. The report provides background information and a technical description of how the guidelines were developed. The resulting advice is summarized in the illustrations after the Table of Contents and List of Figures and Tables.

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A GUIDE TO EATING FISH *from* LAKE TEMESCAL

(ALAMEDA COUNTY)

Eat the Good Fish
Eating fish that are low in chemicals may provide health benefits to children and adults.

Avoid the Bad Fish
Eating fish with higher levels of chemicals like mercury or PCBs may cause health problems in children and adults.

Choose the Right Fish
Chemicals may be more harmful to unborn babies and children.

Women (18-45 Years) / Children (1-17 Years)	Women (46+ Years) / Men (18+ Years)
2 TOTAL SERVINGS A WEEK	**7** TOTAL SERVINGS A WEEK
OR	OR
1 TOTAL SERVING A WEEK	**3** TOTAL SERVINGS A WEEK
0 DO NOT EAT	**0** DO NOT EAT

Sunfish Species

Black Bass Species

high in omega-3s

Common Carp

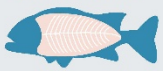
Serving Size
A serving of fish is about the size and thickness of your hand. Give children smaller servings.

For Adults

For Children

California Office of Environmental Health Hazard Assesment
web www.oehha.ca.gov/fish
email fish@oehha.ca.gov
phone (916) 324-7572

Eat only the skinless fillet



Eat only the meat

Some chemicals are higher in the skin, fat, and guts.

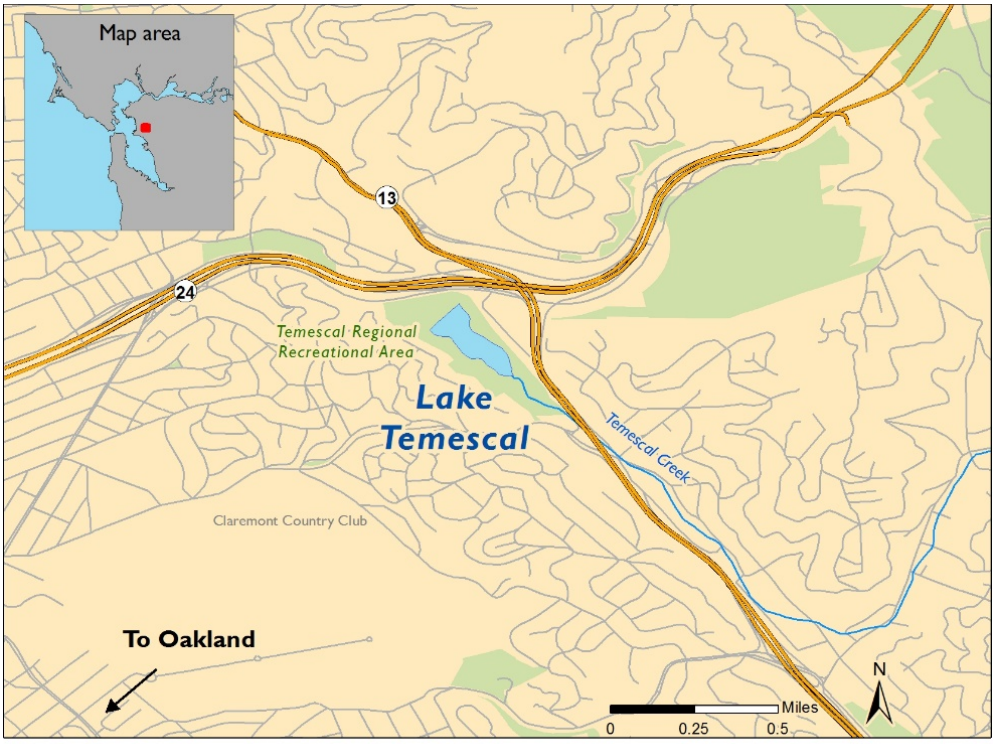
INTRODUCTION

This report presents a guideline for eating fish from Lake Temescal (Figure 1) in Alameda County. Lake Temescal is located in northeastern Oakland, California, near the intersection of Highways 24 and 13.

LOCATION

Lake Temescal was formed by the contruction of a dam on Temescal Creek in 1868[1]. The lake was created to serve as a reservoir for drinking water for the East Bay area. In 1936, the lake was opened to the public for recreational use[2]. The East Bay Regional Park District (EBRPD) manages the Temescal Regional Recreation Area, which includes Lake Temescal. EBRPD, in cooperation with the California Department of Fish and Wildlife (CDFW), plants Rainbow Trout from fall through spring, and Channel Catfish in summer.

FIGURE 1. LOCATION OF LAKE TEMESCAL



[1] Information regarding Lake Temescal was obtained from Bay Nature Magazine. Online at: https://baynature.org/article/what-flows-beneath-the-temescal/

[2] Information regarding Lake Temescal was obtained from the East Bay Regional Park District. Online at: http://www.ebparks.org/parks/temescal

APPROACH USED

The Office of Environmental Health Hazard Assessment (OEHHA) used the results from the monitoring study described in this report to develop the Lake Temescal Advisory. OEHHA uses the following general process in developing consumption advice for sport fish:

1) Evaluation of all fish contaminant data available from a water body and selection of appropriate data that meet data quality criteria and sampling plan guidelines.
2) Determination of fish species for which adequate data are available to issue fish consumption advice.
3) Calculation of an appropriate measure of central tendency (often a weighted arithmetic mean[3]) and other descriptive statistics of the contaminant data, as appropriate, for a chemical of potential concern for the selected fish species.
4) Comparison of the chemical concentrations with the OEHHA Advisory Tissue Levels (ATLs) for each chemical of potential concern.
5) Development of final advice based on a thorough review of the data and best professional judgment relating to the benefits and risks of consuming a particular fish species.

The ATLs (discussed further in a subsequent section of this report) are chemical levels in fish tissue that are considered acceptable, based on chemical toxicity, for a range of consumption rates. Development of the ATLs also included consideration of health benefits associated with including fish in the diet (OEHHA, 2008). The ATLs should not be interpreted as static “bright lines,” but one component of a complex process of data evaluation and interpretation used by OEHHA in the assessment and communication of the benefits and risks of consuming sport fish.

CHEMICALS OF POTENTIAL CONCERN

Certain chemicals are considered to be of potential concern for people who eat fish because of their toxicity and their ability to accumulate in fish tissue. The majority of fish consumption advisories in California are issued because of mercury (Hg), followed by polychlorinated biphenyls (PCBs) and, in a few cases, selenium (Se) or some legacy pesticides (pesticides that are no longer used but remain in the environment).

Mercury is a natural element found in some rock and soil. Human activities, such as burning coal and the historic use of mercury to mine gold, also add mercury to the environment. If mercury enters waterways, it can be converted to a more toxic form

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[3] Means are an arithmetic average of individual values and/or a weighted average of composites. A weighted average of composites is calculated by multiplying the chemical concentration in each composite by the number of fish in that composite for each species. Products are then summed and divided by the total number of fish in all composites for that species, combined.

known as methylmercury – which can pass into and build up in fish. High levels of methylmercury can harm the brain, especially in fetuses and children.

PCBs are industrial chemicals previously used in electrical transformers, plastics, and lubricating oils, often as flame retardants or electrical insulators. Their use was banned in the 1970s, but they persist in the environment because they do not break down easily and can accumulate in fish. Depending on the exposure level, PCBs may cause cancer or other health effects, including neurotoxicity, in humans.

Detailed discussion of the toxicity of these chemicals and references are presented in "Development of Fish Contaminant Goals and Advisory Tissue Levels for Common Contaminants in California Sport Fish: Chlordane, DDTs, dieldrin, methylmercury, PCBs, selenium, and toxaphene" (OEHHA, 2008).

All fish species collected from Lake Temescal and used in advisory development were analyzed for mercury (as a measure of methylmercury). Common Carp were additionally analyzed for PCBs. Mercury and PCB levels were sufficiently high to impact consumption advice.

DATA SOURCE

The guidelines for eating fish from Lake Temescal are based on the chemicals detected in the fish collected for the monitoring study described below. This study met OEHHA's data quality criteria, including adequate documentation of sample collection, fish preparation method (e.g., skinning or filleting), chemical analyses, quality assurance, and sufficiently low detection limits. "Sample," as used in this report, refers to an individual fish or a composite of multiple fish for which contaminant data was reported. "Sampling" or "sampled" refers to the act of collecting fish for chemical analysis.

REGIONAL WATER QUALITY CONTROL BOARD, SAN FRANCISCO BAY (RWB2), EAST BAY REGIONAL PARK DISTRICT (EBRPD) FISH BIOACCUMULATION STUDY, 2013

The RWB2 staff, in cooperation with the EBRPD, collected Common Carp, Green Sunfish, and Largemouth Bass from Lake Temescal in 2013 to analyze for mercury levels. This is part of an ongoing monitoring effort for lakes throughout the EBRPD (RWQCB, 2013).

FISH SAMPLED FROM LAKE TEMESCAL

The fish sampling data used in this advisory were retrieved from the California Environmental Data Exchange Network (CEDEN), the state's repository for environmental data. Samples were excluded when the fish were not legal size to take or did not meet OEHHA's criteria for minimum "edible" size based on species size at maturity, and professional judgment (as described in OEHHA, 2005). A summary of all fish species evaluated for this advisory is shown in Table 1, including the name of the

species, number of samples collected, total number of fish, project name, year sampled, and contaminants analyzed.

TABLE 1. FISH SAMPLES EVALUATED FOR THE LAKE TEMESCAL ADVISORY

Common Name	Scientific Name	Number of Samples	Total Number of Fish	Project	Year Collected	Contaminants Analyzed
Common Carp	*Cyprinus carpio*	1	5	RWB2 EBRPD	2013	Hg, PCBs
Green Sunfish	*Lepomis cyanellus*	3	15	RWB2 EBRPD	2013	Hg
Largemouth Bass	*Micropterus salmoides*	11	11	RWB2 EBRPD	2013	Hg

CHEMICAL CONCENTRATIONS

As shown in Table 1, all samples were analyzed for mercury, and Common Carp were further analyzed for PCBs. All fish samples were prepared as skinless fillets and were analyzed as individual fish or composites.

Composites were prepared from equal amounts of tissue from several similarly sized individual fish of a species. Ideally, for composite samples, the total length of the smallest fish in a composite sample is at least 75% of the length of the largest fish in the sample (US EPA, 2000a). All composite samples from Lake Temescal met this requirement.

For this advisory, OEHHA used the weighted (by the number of individual fish) arithmetic mean (average) of the chemical concentrations (in wet weight) for each fish species to estimate average human exposure.

MERCURY

Samples were analyzed for total mercury, as either individual fish or composite samples, using a direct mercury analyzer (DMA) at the CDFW Moss Landing Marine Laboratories (MLML). The DMA method utilizes thermal decomposition and atomic absorption. OEHHA assumed all mercury detected was methylmercury, which is the most common form found in fish and is also the more toxic form (Bloom, 1992). Table 2 shows the averages and ranges for total length[4], as well as mercury concentrations in

[4] Total length is the maximum length of the fish, measured from the tip of the closed mouth to the tip of the pinched tail fin.

each fish species. The DMA method detection limit (MDL)[5] and the reporting limit (RL)[6] for total mercury were reported at 4 and 12 parts per billion (ppb), respectively.

PCBs

Common Carp were analyzed for PCBs using gas chromatography at the CDFW Water Pollution Control Laboratory. For PCBs, each of the concentrations presented was the sum of the detected parent compound, congeners, or metabolites, where applicable. Since the MDLs or RLs were relatively low (≤ 1 ppb), individual congeners or metabolites with concentrations reported as non-detects were assumed to be zero. This is a standard method of handling non-detect values for PCBs and other chemicals with multiple congeners or metabolites in a given sample when detection levels are adequate (US EPA, 2000a). Table 2 shows the averages and ranges for total length[7], as well as PCB concentrations in Common Carp.

TABLE 2. MERCURY AND PCB CONCENTRATIONS IN FISH FROM LAKE TEMESCAL

Species from Lake Temescal	Number of Samples	Total Number of Fish	Mean* Total Length (mm)	Range of Total Lengths** (mm)	Mercury (ppb)	
					Mean*	Range**
Common Carp	1	5	693	642 – 753	118	n/a
Green Sunfish	3	15	150	109 – 203	78	78 - 78
Largemouth Bass	11	11	351	306 – 408	160	89 - 279
Species from Lake Temescal	Number of Samples	Total Number of Fish	Mean* Total Length (mm)	Range of Total Lengths** (mm)	PCBs (ppb)	
					Mean*	Range**
Common Carp	1	5	693	642 – 753	155	n/a

*Means are an arithmetic average of individual values and/or a weighted average of composites.
**Range of individuals and/or range of the composites.
n/a = not applicable due to a single sample

[5] The MDL is the lowest quantity of a chemical that can be distinguished (as greater than zero) in a sample.
[6] The RL is the lowest quantity of a chemical that can be accurately quantified in a sample.
[7] Total length is the maximum length of the fish, measured from the tip of the closed mouth to the tip of the pinched tail fin.

DEVELOPMENT OF GUIDELINES FOR EATING FISH FROM LAKE TEMESCAL

The OEHHA fish advisory process considers the health benefits of fish consumption as well as the risk from exposure to the chemical contaminants found in fish. Benefits are included in the advisory process because there is considerable evidence and scientific consensus that fish should be part of a healthy, well-balanced diet. Fish contain many nutrients that are important for general health and, in particular, help promote optimal growth and development of babies and young children, and may reduce the incidence of heart disease in adults (FDA/US EPA, 2017; American Heart Association, 2014; OEHHA, 2008; Institute of Medicine, 2007; Kris-Etherton et al., 2002). Fish are a significant source of the specific omega-3 fatty acids, docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA), thought to be associated with these beneficial health effects (USDA/USDHHS, 2015; Weaver et al., 2008).

The 2015-2020 U.S. Dietary Guidelines recommend that 1) the general population "consume eight or more ounces per week (less for young children)" of a variety of seafood[8] "for the total package of nutrients that seafood provides, including its EPA and DHA content" and 2) "women who are pregnant or breastfeeding should consume at least eight and up to twelve ounces of a variety of seafood per week from choices that are lower in methylmercury" (USDA/USDHHS, 2015). The particular fish that people eat is an important factor in determining the net beneficial effects of fish consumption. For example, studies have shown that children of mothers who ate low-mercury fish during pregnancy scored better on cognitive tests compared to children of mothers who did not eat fish or ate high-mercury fish (Oken et al., 2005 and 2008). Accordingly, because of the high mercury content of certain fish species, the Food and Drug Administration (FDA) and the United States Environmental Protection Agency (US EPA) recommend that women who are pregnant (or might become pregnant) or breastfeeding, and young children avoid consuming shark, swordfish, tilefish (Gulf of Mexico), bigeye tuna, marlin, orange roughy, and king mackerel (FDA/US EPA, 2017).

In order to address the potential health concerns associated with exposure to contaminants in sport fish, OEHHA has established ATLs for chemicals that are known to accumulate in the edible tissues of fish. ATLs consider both the toxicity of the chemical and potential benefits of eating fish. OEHHA uses the ATLs to determine the maximum number of servings per week that consumers can eat, for each species and at each location, to limit their exposure to these contaminants. Consumers can use OEHHA's guidance when choosing which fish and how much to eat as part of an overall healthy diet.

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[8] "Marine animals that live in the sea and in freshwater lakes and rivers. Seafood includes fish, such as salmon, tuna, trout, and tilapia, and shellfish, such as shrimp, crab, and oysters" (USDHHS/USDA, 2015).

There are two sets of ATLs for methylmercury in fish because of the age-related toxicity of this chemical (OEHHA, 2008). The fetus and children are more sensitive to the toxic effects of methylmercury. Thus, the ATLs for the sensitive population, including women who might become pregnant (typically 18 to 45 years of age) and children 1-17 years, are lower than those for women 46 years and older, and men 18 years and older. The lower ATL values for the sensitive population provide additional protection to allow for normal growth and development of the brain and nervous system of unborn babies and children. Detailed discussion about the toxicity of common fish contaminants and health benefits of fish consumption, as well as derivation of the ATLs, are provided in "Development of Fish Contaminant Goals and Advisory Tissue Levels for Common Contaminants in California Sport Fish: Chlordane, DDTs, dieldrin, methylmercury, PCBs, selenium, and toxaphene" (OEHHA, 2008) and "Development of Fish Contaminant Goals and Advisory Tissue Levels for Common Contaminants in California Sport Fish: Polybrominated Diphenyl Ethers (PBDEs)" (OEHHA, 2011). A list of the ATLs used in this report is presented in Appendix I.

For each fish species in this advisory, OEHHA compared the mean concentration of mercury, as well as PCBs for Common Carp, detected in the fillet to the corresponding ATLs to establish the maximum number of servings per week that could be consumed (see Appendix I).

The consumption advice for a fish species is initially based on the chemical with the lowest allowable number of servings per week. Because some chemicals, such as mercury and PCBs, are known to have similar adverse effects, additivity of toxicity is assumed in such cases and may be assessed using multiple chemical exposure methodology (US EPA, 1989 and 2000b). If two or more chemicals with similar adverse effects are present in fish tissue at levels above the corresponding ATL values for daily consumption, multiple chemical exposure methodology is employed. This may result in advising the sensitive population to consume fewer meals per week than would be the case for the presence of one chemical alone, in a similar concentration. Although both mercury and PCBs concentrations were measured in Common Carp, the potential effect of multiple chemical exposures was not assessed because this species exceeded the threshold for no consumption based on PCBs alone. Advice for other species in this advisory was based solely on mercury concentrations.

OEHHA recommends that individuals strive to meet the US Dietary Guidelines seafood consumption recommendations, while also adhering to federal and OEHHA recommendations to limit the consumption of fish with higher contaminant levels. The advice discussed in the following section represents the maximum recommended number of servings per week for different fish species. People should eat no more than the recommended number of servings for each fish species or species group.

OEHHA's advice on consuming a particular fish species can be extended to other closely related fish species[9] known to accumulate similar levels of contaminants.

Consumption advice should not be combined. That is, if a person chooses to eat a fish from the "one-serving-a-week'' category, then they should not eat any other fish from any source (including commercial) until the next week. If a person chooses to eat a fish from the "two-servings-per-week" category, they can combine fish species from that category, or eat one fish from that category and one from a category that recommends more than two-servings-per-week (if available), for a total of two servings in that week. Then they should not eat any other fish from any source (including commercial) until the following week.

CONSUMPTION ADVICE FOR FISH FROM LAKE TEMESCAL

OEHHA's advisory protocol requires at least nine fish of a species to be collected from a water body before an advisory can be developed for the primary contaminant of concern. This is to ensure the sample dataset is representative of the fish species population in the water body. In some cases, an exception is made for species that are commonly caught and consumed from a given water body but where available data may be limited. Advice for Common Carp (n=5) in Lake Temescal was included due to the high level of PCBs. For Lake Temescal, the sample size criterion was met for Green Sunfish and Largemouth Bass. There were not sufficient data to evaluate other species that may be found in this water body.

BLACK BASS SPECIES (LARGEMOUTH BASS)

The mean mercury concentration in Largemouth Bass from Lake Temescal was 160 ppb. Based on the concentration of mercury in these bass, OEHHA recommends a maximum of one serving a week of black bass species for the sensitive population (women 18 to 45 years and children 1 to 17 years), and a maximum of three servings a week for the general population (women 46 years and older, and men 18 years and older). Although a mercury concentration of 160 ppb is the highest value in the four-servings-a-week category for the general population, because of the relatively small size of the sampled bass and the fact that nearly half of the fish fell into a more restrictive meal frequency, OEHHA is recommending a maximum of three servings a week of black bass species for the general population. Mercury generally increases in fish as they grow; therefore, a higher mercury concentration would be expected if larger bass had been included in the analysis. PCBs were not analyzed in Largemouth Bass from Lake Temescal.

OEHHA has evaluated mercury concentrations in black bass species in many water bodies in California and has found a similar range of mercury concentrations when two

[9] Fish species within the same genus are most closely related, and Family is the next level of relationship.

or more of these species were caught from the same water body. Therefore, OEHHA extends the consumption advice for Largemouth Bass to other black bass species, including Redeye, Smallmouth, and Spotted Bass.

Common Carp

The mean mercury and PCB concentrations in Common Carp from Lake Temescal were 118 and 155 ppb, respectively. Based on the concentration of PCBs in these carp, OEHHA recommends no consumption of Common Carp for the sensitive (women 18 to 45 years and children 1 to 17 years) and the general population (women 46 years and older, and men 18 years and older), based on PCBs.

Sunfish Species (Green Sunfish)

The mean mercury concentration in Green Sunfish from Lake Temescal was 78 ppb. Based on the concentration of mercury in these sunfish, OEHHA recommends a maximum of two servings a week of sunfish species for the sensitive population (women 18 to 45 years and children 1 to 17 years), and a maximum of seven servings a week for the general population (women 46 years and older, and men 18 years and older).

OEHHA has evaluated mercury concentrations in sunfish species in many water bodies in California and has found a similar range of mercury concentrations when two or more of these species were caught from the same water body. Therefore, OEHHA extends the consumption advice for Green Sunfish to other sunfish species (Bluegill, Redear Sunfish, and Pumpkinseed) to other sunfish species. PCBs were not analyzed in Green Sunfish from Lake Temescal.

RECOMMENDED MAXIMUM NUMBER OF SERVINGS

The recommended maximum numbers of servings per week for fish from Lake Temescal are shown in Table 3.

TABLE 3. RECOMMENDED MAXIMUM NUMBER OF SERVINGS PER WEEK FOR FISH FROM LAKE TEMESCAL

Fish Species	Women 18–45 years and Children 1–17 years	Women 46 years and older and Men 18 years and older
Black Bass species	1	3
Common Carp	0	0
Sunfish species	2	7

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APPENDIX I. ADVISORY TISSUE LEVELS

Advisory Tissue Levels (ATLs) guide the development of advice for people eating sport fish. ATLs are levels of contaminants found in fish that correspond to the maximum numbers of recommended fish servings. OEHHA uses ATLs to provide advice to prevent consumers from being exposed to:

- More than the average daily reference dose[10] for chemicals not known to cause cancer, such as methylmercury, or
- For cancer-causing chemicals, a risk level greater than one additional cancer case in a population of 10,000 people consuming fish at the given consumption rate over a lifetime. This cancer endpoint is the maximum acceptable risk level recommended by the US EPA (2000b) for fish advisories.

For each chemical, ATLs were determined for both cancer and non-cancer risk, if appropriate, for one to seven eight-ounce servings per week. The most health-protective ATLs for each chemical, selected from either cancer or non-cancer based risk, are shown in the table below for zero to seven servings per week. When the guidelines for eating fish from Lake Temescal are followed, exposure to chemicals in fish from Lake Temescal would be at or below the average daily reference dose or the cancer risk probability of one in 10,000.

ADVISORY TISSUE LEVELS FOR SELECTED ANALYTES

Contaminant	Consumption Frequency Categories (8-ounce servings/week)[a] and ATLs (in ppb)							
	7	6	5	4	3	2	1	0
Chlordanes	≤ 80	>80-90	>90-110	>110-140	>140-190	>190-280	>280-560	>560
DDTs	≤ 220	>220-260	>260-310	>310-390	>390-520	>520-1,000	>1,000-2,100	>2,100
Dieldrin	≤ 7	>7-8	>8-9	>9-11	>11-15	>15-23	>23-46	>46
MeHg (Women 18-45 and children 1-17)	≤ 31	>31-36	>36-44	>44-55	>55-70	>70-150	>150-440	>440
MeHg (Women > 45 and men)	≤ 94	>94-109	>109-130	>130-160	>160-220	>220-440	>440-1,310	>1,310
PBDEs	≤ 45	>45-52	>52-63	>63-78	>78-100	>100-210	>210-630	>630
PCBs	≤ 9	>9-10	>10-13	>13-16	>16-21	>21-42	>42-120	>120
Selenium	≤ 1000	>1,000-1200	>1,200-1,400	>1,400-1,800	>1,800-2,500	>2,500-4,900	>4,900-15,000	>15,000
Toxaphene	≤ 87	>87-100	>100-120	>120-150	>150-200	>200-300	>300-610	>610

[a] Serving sizes (prior to cooking, wet weight) are based on an average 160-pound person. Individuals weighing less than 160 pounds should eat proportionately smaller amounts.

[10] The reference dose is an estimate of the maximum daily exposure to a chemical likely to be without significant risk of harmful health effects during a lifetime.