

WATER CONTAMINANTS REGULATED BY THE U.S. ENVIRONMENTAL PROTECTION AGENCY AND THEIR HEALTH EFFECTS

What role does the U.S. Environmental Protection Agency play in drinking water regulation?

The U.S. Environmental Protection Agency (US EPA) plays an important role in protecting human health and the environment. The agency is influential in developing regulations, in the United States, based around health and environmental protection. They also enforce each of the regulations that they have implemented. As of May 2009, the US EPA has put into action almost 90 primary and 15 secondary drinking water regulations. Primary regulations are enforceable standards. On the other hand, secondary regulations are recommendations for drinking water contaminant levels. Secondary regulations are not required to be abided by; these are in place to reduce or eliminate cosmetic and aesthetic effects of drinking water contaminants.

What are water contaminants and where do they come from?

A water contaminant is a substance which is found in water that has the potential to pose a risk to public health at certain levels. Some contaminants occur naturally in the environment and seep into water sources through erosion. Unfortunately, many of the contaminants found in water are a result of human activities. The industrial wastes from factories, refineries, mines and mills all contain harmful substances which can contaminate water sources. Agriculture also plays a part in the contamination of water. Many chemicals used in agriculture can leach into the water system. In terms of microbiological contaminants, many of them are found in human and animal biological waste. For this reason, water sources located too close to agricultural livestock may also become contaminated.

How does the US EPA determine which water contaminants to regulate?

Possible water contaminants are listed by the US EPA on a Contaminant Candidate List (CCL). This list is a requirement of the Safe Drinking Water Act (SDWA), and it is compiled every five years. This list is assembled in a few key steps. A very broad list of possible contaminants is created and then narrowed down based on the probability of occurrence in water, known or

potential health effects, and expert advice. Once created, the CCL is used to determine which contaminants pose a health risk and should become regulated. The SDWA requires that five contaminants are selected from the list to be further analyzed for potential regulation. There are three criteria used by the US EPA to determine if a contaminant should be regulated. First, the contaminant in question may pose a potential health risk. Second, the contaminant has been found in water and is believed to contaminate water at a frequency that poses a danger to public health. Third, regulating the contaminant is believed to provide a reduction in public health risk. Once these three criteria are met, further research on the contaminant can be carried out to determine the maximum contaminant level (MCL) permitted in drinking water. The MCL is the highest concentration of a particular contaminant in drinking water that is not believed to pose a public health risk.

What types of contaminants are regulated?

The primary and secondary regulations cover disinfectants, disinfectant byproducts, inorganic and organic chemicals and microorganisms including bacteria, viruses, and protozoa. These organisms need to be regulated because many of them are known to cause illness, mainly gastrointestinal problems. Disinfectants are commonly used in the treatment process to kill microorganisms that may be present in the water. The levels of these disinfectants in water need to be regulated because they can have harmful effects on human health or go through chemical reactions in the water to create byproducts. These byproducts can be harmful if consumed. Inorganic and organic chemicals must be reduced or eliminated from drinking water as most are unsuitable for human consumption.

Tables of all the contaminants regulated by the US EPA can be found at the end of this fact sheet. This includes both the primary and secondary drinking water regulations. Also listed are the health problems associated with long-term exposure and the source of water contamination. The majority of the data in this table was taken directly from the US EPA website.

What health risks do these contaminants pose?

Different contaminants cause different problems which can be separated into two categories, acute and chronic. Acute health effects are more immediate. These occur within hours or days of ingesting the contaminated water. A certain level of contamination is required to cause acute health effects and this varies depending on the contaminant involved. Although individuals may become ill from acute contamination, most people recover fully. However, people who already have a compromised immune system can become severely ill and, in extreme cases, the illness may result in death.

Chronic health effects are those seen after many years of ingesting contaminated water. Many different water contaminants, consumed over time, can lead to an increased risk of cancer. The types of cancer vary considerably, but most are associated with chemical or radiological contaminants. There are many other severe health problems associated with long-term exposure to water contaminants. Liver and kidney problems are relatively common, along with reproductive difficulties. There are also quite a few contaminants that cause problems with the nervous system. These are just a few examples of health effects associated with water contamination; the tables at the end of this fact sheet show the contaminants and their effects in more detail.

Why are some contaminants regulated by the US EPA, but not Health Canada, and vice versa?

Health Canada's guidelines vary slightly from that of the US EPA. There can be many reasons for this discrepancy. First and foremost, some contaminants are only found in certain regions. If there is little risk of water being contaminated with a particular substance, there is no need to regulate it. Some contaminants are not given a numerical guideline by Health Canada because the levels normally found in Canadian water are much lower than they believe would be necessary to cause health problems. In some cases there may not yet be sufficient research on a contaminant to support the implementation of a guideline. Health Canada follows similar criteria to the US EPA and once adequate research is done, a Canadian Guideline will be put in place if necessary. It is also important to note that some contaminants regulated by Health Canada are not regulated by the US EPA. The same reasons apply to this situation. Note that contaminants have regulations in the U.S. and guidelines in Canada. This means that the limits are not legally enforceable in Canada. For more information, please read the fact sheet: [What is the Purpose of Drinking Water Quality Guidelines/Regulations?](#)

Regulated Contaminants

Microorganisms

Contaminant	Maximum Contaminant Level Goal (MCLG) (mg/L)	Maximum Contaminant Level (MCL) (mg/L) or Treatment Technology (TT) (use the best possible treatment technique, taking cost into consideration)	Potential Health Effects from Long-Term Exposure Above the MCL (unless specified as short-term)	Sources of Contaminant in Drinking Water
Cryptosporidium	zero	TT	Gastrointestinal illness (e.g., diarrhea, vomiting, cramps)	Human and animal fecal waste
Giardia lamblia	zero	TT	Gastrointestinal illness (e.g., diarrhea, vomiting, cramps)	Human and animal fecal waste
Heterotrophic plate count	N/A	TT	HPC has no health effects; it is an analytic method used to measure the variety of bacteria that are common in water. The lower the concentration of bacteria in drinking water, the better maintained the water system is.	HPC measures a range of bacteria that are naturally present in the environment
Legionella	zero	TT	Legionnaire's Disease, a type of pneumonia	Found naturally in water; multiplies in heating systems
Total Coliforms (including fecal coliform and E. Coli)	zero	5.0%	Not a health threat in itself; it is used to indicate whether other potentially harmful bacteria may be present	Coliforms are naturally present in the environment; as well as feces; fecal coliforms and E. coli only come from human and animal fecal waste.
Turbidity	N/A	TT	Turbidity is a measure of the cloudiness of water. It is used to indicate water	Soil runoff

			quality and filtration effectiveness (e.g., whether disease-causing organisms are present). Higher turbidity levels are often associated with higher levels of disease-causing microorganisms such as viruses, parasites and some bacteria. These organisms can cause symptoms such as nausea, cramps, diarrhea, and associated headaches.	
Viruses (enteric)	zero	TT	Gastrointestinal illness (e.g., diarrhea, vomiting, cramps)	Human and animal fecal waste

Disinfection Byproducts

Contaminant	Maximum Contaminant Level Goal (MCLG) (mg/L)	Maximum Contaminant Level (MCL) (mg/L) or Treatment Technology (TT) (use the best possible treatment technique, taking cost into consideration)	Potential Health Effects from Long-Term Exposure Above the MCL (unless specified as short-term)	Sources of Contaminant in Drinking Water
Bromate	zero	0.010	Increased risk of cancer	Byproduct of drinking water disinfection
Chlorite	0.8	1.0	Anemia; infants & young children: nervous system effects	Byproduct of drinking water disinfection
Haloacetic acids (HAA5)	N/A	0.060	Increased risk of cancer	Byproduct of drinking water disinfection

Total Trihalomethanes (TTHMs)	N/A	0.080	Liver, kidney or central nervous system problems; increased risk of cancer	Byproduct of drinking water disinfection
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Disinfectants

Contaminant	Maximum Residual Disinfectant Level Goal (MRDLG) (mg/L)	Maximum Residual Disinfectant Level (MRDL) (mg/L)	Potential Health Effects from Long-Term Exposure Above the MCL (unless specified as short-term)	Sources of Contaminant in Drinking Water
Chloramines (as Cl ₂)	4	4.0	Eye/nose irritation; stomach discomfort, anemia	Water additive used to control microbes
Chlorine (as Cl ₂)	4	4.0	Eye/nose irritation; stomach discomfort	Water additive used to control microbes
Chlorine dioxide (as ClO ₂)	0.8	0.8	Anemia; infants & young children: nervous system effects	Water additive used to control microbes

Inorganic Chemicals

Contaminant	Maximum Contaminant Level Goal (MCLG) (mg/L)	Maximum Contaminant Level (MCL) (mg/L) or Treatment Technology (TT) (use the best possible treatment technique, taking cost into consideration)	Potential Health Effects from Long-Term Exposure Above the MCL (unless specified as short-term)	Sources of Contaminant in Drinking Water
Antimony	0.006	0.006	Increase in blood cholesterol; decrease in blood sugar	Discharge from petroleum refineries; fire retardants; ceramics; electronics; solder

Arsenic	0	0.010	Skin damage or problems with circulatory systems, and may have increased risk of getting cancer	Erosion of natural deposits; runoff from orchards, runoff from glass & electronics production wastes
Asbestos (fiber > 10 micrometers)	7 million fibers per liter	7 MFL	Increased risk of developing benign intestinal polyps	Decay of asbestos cement in water mains; erosion of natural deposits
Barium	2	2	Increase in blood pressure	Discharge of drilling wastes; discharge from metal refineries; erosion of natural deposits
Beryllium	0.004	0.004	Intestinal lesions	Discharge from metal refineries and coal-burning factories; discharge from electrical, aerospace, and defense industries
Cadmium	0.005	0.005	Kidney damage	Corrosion of galvanized pipes; erosion of natural deposits; discharge from metal refineries; runoff from waste batteries and paints
Chromium (total)	0.1	0.1	Allergic dermatitis	Discharge from steel and pulp mills; erosion of natural deposits
Copper	1.3	TT; Action Level = 1.3	Short term exposure: Gastrointestinal distress Long term exposure: Liver or kidney damage People with Wilson's Disease should consult their personal doctor if the amount of copper in	Corrosion of household plumbing systems; erosion of natural deposits

			their water exceeds the action level	
Cyanide (as free cyanide)	0.2	0.2	Nerve damage or thyroid problems	Discharge from steel/metal factories; discharge from plastic and fertilizer factories
Fluoride	4.0	4.0	Bone disease (pain and tenderness of the bones); Children may get mottled teeth	Water additive which promotes strong teeth; erosion of natural deposits; discharge from fertilizer and aluminum factories
Lead	zero	TT; Action Level = 0.015	Infants and children: Delays in physical or mental development; children could show slight deficits in attention span and learning abilities Adults: Kidney problems; high blood pressure	Corrosion of household plumbing systems; erosion of natural deposits
Mercury (inorganic)	0.002	0.002	Kidney damage	Erosion of natural deposits; discharge from refineries and factories; runoff from landfills and croplands
Nitrate (measured as Nitrogen)	10	10	Infants below the age of six months who drink water containing nitrate in excess of the MCL could become seriously ill and, if untreated, may die. Symptoms include shortness of breath and blue-baby syndrome.	Runoff from fertilizer use; leaching from septic tanks, sewage; erosion of natural deposits
Nitrite (measured as Nitrogen)	1	1	Infants below the age of six months who drink water containing nitrite in excess of the MCL could become seriously ill and,	Runoff from fertilizer use; leaching from septic tanks, sewage; erosion of natural

			if untreated, may die. Symptoms include shortness of breath and blue-baby syndrome.	deposits
Selenium	0.05	0.05	Hair or fingernail loss; numbness in fingers or toes; circulatory problems	Discharge from petroleum refineries; erosion of natural deposits; discharge from mines
Thallium	0.0005	0.002	Hair loss; changes in blood; kidney, intestine, or liver problems	Leaching from ore-processing sites; discharge from electronics, glass, and drug factories

Organic Chemicals

Contaminant	Maximum Contaminant Level Goal (MCLG) (mg/L)	Maximum Contaminant Level (MCL) (mg/L) or Treatment Technology (TT) (use the best possible treatment technique, taking cost into consideration)	Potential Health Effects from Long-Term Exposure Above the MCL (unless specified as short-term)	Sources of Contaminant in Drinking Water
Acrylamide	zero	TT	Nervous system or blood problems; increased risk of cancer	Added to water during sewage/wastewater treatment
Alachlor	zero	0.002	Eye, liver, kidney or spleen problems; anemia; increased risk of cancer	Runoff from herbicide used on row crops
Atrazine	0.003	0.003	Cardiovascular system or reproductive problems	Runoff from herbicide used on row crops
Benzene	zero	0.005	Anemia; decrease in blood platelets; increased risk of cancer	Discharge from factories; leaching from gas storage tanks and landfills
Benzo(a)pyrene	zero	0.0002	Reproductive difficulties;	Leaching from

(PAHs)			increased risk of cancer	linings of water storage tanks and distribution lines
Carbofuran	0.04	0.04	Problems with blood, nervous system, or reproductive system	Leaching of soil fumigant used on rice and alfalfa
Carbon Tetrachloride	zero	0.005	Liver problems; increased risk of cancer	Discharge from chemical plants and other industrial activities
Chlordane	zero	0.002	Liver or nervous system problems; increased risk of cancer	Residue of banned termiticide
Chlorobenzene	0.1	0.1	Liver or kidney problems	Discharge from chemical and agricultural chemical factories
2, 4-D	0.07	0.07	Kidney, liver, or adrenal gland problems	Runoff from herbicide used on row crops
Dalapon	0.2	0.2	Minor kidney changes	Runoff from herbicide used on rights of way
1,2-Dibromo-3-chloropropane (DBCP)	zero	0.0002	Reproductive difficulties; increased risk of cancer	Runoff/leaching from soil fumigant used on soybeans, cotton, pineapples, and orchards
o-Dichlorobenzene	0.6	0.6	Liver, kidney, or circulatory system problems	Discharge from industrial chemical factories
p-Dichlorobenzene	0.075	0.075	Anemia; liver, kidney or spleen damage; changes in blood	Discharge from industrial chemical factories
1,2-Dichloroethane	zero	0.005	Increased risk of cancer	Discharge from industrial chemical factories
1,1-Dichloroethylene	0.007	0.007	Liver problems	Discharge from industrial chemical factories
cis-1,2-dichloroethylene	0.07	0.07	Liver problems	Discharge from industrial chemical factories
trans-1,2-	0.1	0.1	Liver problems	Discharge from

Dichloroethylene				industrial chemical factories
Dichloromethane	zero	0.005	Liver problems; increased risk of cancer	Discharge from drug and chemical factories
1,2-Dichloropropane	zero	0.005	Increased risk of cancer	Discharge from industrial chemical factories
Di(2-ethylhexyl) adipate	0.4	0.4	Weight loss, liver problems, or possible reproductive difficulties.	Discharge from chemical factories
Di(2-ethylhexyl) phthalate	zero	0.006	Reproductive difficulties; liver problems; increased risk of cancer	Discharge from rubber and chemical factories
Dinoseb	0.007	0.007	Reproductive difficulties	Runoff from herbicide used on soybeans and vegetables
Dioxin (2,3,7,8-TCDD)	zero	0.00000003	Reproductive difficulties; increased risk of cancer	Emissions from waste incineration and other combustion; discharge from chemical factories
Diguat	0.02	0.02	Cataracts	Runoff from herbicide use
Endothall	0.1	0.1	Stomach and intestinal problems	Runoff from herbicide use
Endrin	0.002	0.002	Liver problems	Residue of banned insecticide
Epichlorohydrin	zero	TT	Increased cancer risk, and over a long period of time, stomach problems	Discharge from industrial chemical factories; an impurity of some water treatment chemicals
Ethylbenzene	0.7	0.7	Liver or kidney problems	Discharge from petroleum refineries
Ethylene dibromide	zero	0.00005	Problems with liver, stomach, reproductive system, or kidneys; increased risk of cancer	Discharge from petroleum refineries
Glyphosate	0.7	0.7	Kidney problems; reproductive difficulties	Runoff from herbicide use

Heptachlor	zero	0.0004	Liver damage; increased risk of cancer	Residue of banned termiticide
Heptachlor epoxide	zero	0.0002	Liver damage; increased risk of cancer	Breakdown of heptachlor
Hexachlorobenzene	zero	0.001	Liver or kidney problems; reproductive difficulties; increased risk of cancer	Discharge from metal refineries and agricultural chemical factories
Hexachlorocyclopentadiene	0.05	0.05	Kidney or stomach problems	Discharge from chemical factories
Lindane	0.0002	0.0002	Liver or kidney problems	Runoff/leaching from insecticide used on cattle, lumber, gardens
Methoxychlor	0.04	0.04	Reproductive difficulties	Runoff/leaching from insecticide used on fruits, vegetables, alfalfa, livestock
Oxamyl (Vydate)	0.2	0.2	Slight nervous system effects	Runoff/leaching from insecticide used on apples, potatoes, and tomatoes
Polychlorinated biphenyls (PCBs)	zero	0.0005	Skin changes; thymus gland problems; immune deficiencies; reproductive or nervous system difficulties; increased risk of cancer	Runoff from landfills; discharge of waste chemicals
Pentachlorophenol	zero	0.001	Liver or kidney problems; increased cancer risk	Discharge from wood preserving factories
Picloram	0.5	0.5	Liver problems	Herbicide runoff
Simazine	0.004	0.004	Problems with blood	Herbicide runoff
Styrene	0.1	0.1	Liver, kidney, or circulatory system problems	Discharge from rubber and plastic factories; leaching from landfills
Tetrachloroethylene	zero	0.005	Liver problems; increased risk of cancer	Discharge from factories and dry cleaners
Toluene	1	1	Nervous system, kidney, or liver problems	Discharge from petroleum factories

Toxaphene	zero	0.003	Kidney, liver, or thyroid problems; increased risk of cancer	Runoff/leaching from insecticide used on cotton and cattle
2,4,5-TP (Silvex)	0.05	0.05	Liver problems	Residue of banned herbicide
1,2,4-Trichlorobenzene	0.07	0.07	Changes in adrenal glands	Discharge from textile finishing factories
1,1,1-Trichloroethane	0.20	0.2	Liver, nervous system, or circulatory problems	Discharge from metal degreasing sites and other factories
1,1,2-Trichloroethane	0.003	0.005	Liver, kidney, or immune system problems	Discharge from industrial chemical factories
Trichloroethylene	zero	0.005	Liver problems; increased risk of cancer	Discharge from metal degreasing sites and other factories
Vinyl chloride	zero	0.002	Increased risk of cancer	Leaching from PVC pipes; discharge from plastic factories
Xylenes (total)	10	10	Nervous system damage	Discharge from petroleum factories; discharge from chemical factories

Radionuclides

Contaminant	Maximum Contaminant Level Goal (MCLG) (mg/L)	Maximum Contaminant Level (MCL) (mg/L) or Treatment Technology (TT) (use the best possible treatment technique, taking cost into consideration)	Potential Health Effects from Long-Term Exposure Above the MCL (unless specified as short-term)	Sources of Contaminant in Drinking Water
Alpha particles	zero	15 picocuries per Liter (pCi/L)	Increased risk of cancer	Erosion of natural deposits of certain minerals that are radioactive and may emit a form of radiation known as alpha radiation
Beta particles and photon emitters	zero	4 millirems per year	Increased risk of cancer	Decay of natural and man-made deposits of certain minerals that are radioactive and may emit forms of radiation known as photons and beta radiation
Radium 226 and Radium 228 (combined)	zero	5 pCi/L	Increased risk of cancer	Erosion of natural deposits
Uranium	zero	30 ug/L	Increased risk of cancer, kidney toxicity	Erosion of natural deposits

The Safe Drinking Water Foundation has educational programs that can supplement the information found in this fact sheet. Operation Water Drop looks at the chemical contaminants that are found in water; it is designed for a science class. Operation Water Flow looks at how water is used, where it comes from and how much it costs; it has lessons that are designed for Social Studies, Math, Biology, Chemistry and Science classes. Operation Water Spirit presents a First Nations perspective of water and the surrounding issues; it is designed for Native Studies or Social Studies classes. Operation Water Health looks at common health issues surrounding drinking water in Canada and around the world and is designed for a Health, Science and Social Studies collaboration. Operation Water Pollution focuses on how water pollution occurs and how it is cleaned up and has been designed for a Science and Social Studies collaboration. To access more information on these and other educational activities, as well as additional fact

sheets, visit the Safe Drinking Water Foundation website at www.safewater.org.

References

U.S. Environmental Protection Agency, Drinking Water Contaminants
<http://www.epa.gov/safewater/contaminants/index.html>

Health Canada <http://www.hc-sc.gc.ca/index-eng.php>