

Chlorine and Chlorinated Disinfection By-Products in Drinking Water

Questions and Answers

The Bowen Island Municipality is working with Vancouver Coastal Health to address levels of disinfection by-products (DBP's) in the Cove Bay Water System that are slightly higher than the recommended Health Canada guidelines. This Q&A document addresses the sources and levels of DBP's seen in this water supply and their potential health concerns.

What are chlorinated DBP's?

Chlorinated DBP's are compounds that can form when the chlorine used to disinfect drinking water reacts with naturally occurring organic matter (e.g. decaying leaves and vegetation). Disinfection is an essential component of public drinking water treatment. The health risks associated with disinfection by-products are much less than the risks from consuming water that has not been adequately disinfected. There are many types of chlorinated DBP's. The most common of these are trihalomethane (THM's) and haloacetic acids (HAA's). All chemical disinfectants used in drinking water can be expected to form DBP's, which may affect human health.

Why does chlorine need to be added to my drinking water?

A significant health risk from drinking water supplies is the presence of disease-causing microorganisms. To reduce this risk to an acceptable level a disinfectant, such as chlorine, is added to inactivate microorganisms found in water. Vancouver Coastal Health recommends that drinking water supplies be disinfected, unless specifically exempted. A small amount of chlorine (chlorine residual) is maintained in the distribution system to preserve the microbiological safety of the water throughout the distribution system.

How am I exposed to chlorine DBP's?

Drinking, bathing and showering can expose you to chlorinated DBP's when you either consume or inhale compounds. The additional contributions from showering/bathing were taken into account to ensure the guideline is protective of health from all exposures from drinking water.

What are the Canadian drinking water guidelines for DBP's?

Health Canada has established a guideline for DBP's which are protective of health effects from lifetime exposure. Separate guidelines exist for total THM's and Total HAA's which are expressed as a Maximum Acceptable Concentration (MAC).

The average of four samples taken over a period of one year is used to determine if a water system meets or exceeds the MAC. The Guidelines for Canadian Drinking Water Quality describe the Maximum Acceptable Concentration for THM's to be 100 µg/L (parts per billion) and HAA's to be 80 µg/L (parts per billion).

The Cove Bay Water System has been monitoring the levels of THM's and HAA's in the drinking water supply annually in a number of locations for the past few years. While the sampling plan does not follow the recommended quarterly protocol, individual results in 2016 and 2017 indicate that an annual average of quarterly samples may exceed the guidelines for THM's and HAA's.

Date	Sample Site	THM's in µg/L (ppb)	HAA's in µg/L (ppb)
January 2016	CB1	167	170
January 2016	Hummingbird	211	226
June 2016	Miller	126	101
June 2016	Scarborough	102	603
December 2016	CB1	164	166
December 2016	Melmore	90.1	86.2
June 2017	CB1	134	83.8
June 2017	Hummingbird	141	107
December 2017	Miller	146	173
December 2017	Scarborough	134	184
MAC		100	80

What are the possible health effects from THM's in drinking water?

Some studies suggest a link between reproductive effects and exposure to high levels of THM's. However, an increase in the concentration of THM's could not be linked to an increase in risk, suggesting the need for more research. THM's have been associated with slightly elevated levels of bladder and colon cancer, but no direct link has been determined. Health Canada guidelines are very conservative given the current data. For more detailed information on the possible health effects of THM's please refer to Health Canada's Guideline Technical Document.

What are the possible health effects from HAA's in drinking water?

The only study to look at health effects associated with human exposure to HAA's did not find significant effects. Some animal studies suggest a possible association with liver cancer or possible weight changes in the liver, kidney or testes, but no direct link has been determined in humans. The Health Canada guidelines are very conservative given the current data and more research is needed

For more detailed information on the possible health effects of HAA's please refer to Health Canada's Guideline Technical Document.

What factors determine the levels of chlorinated DBP's in the water supply?

Levels will vary within a single water supply depending on the season, water temperature, amount of natural organic matter in the water, pH amount of chlorine added, time in distribution system, and other factors.

How can chlorinated DBP's be reduced in drinking water supplies?

The best approach is to reduce or prevent their formation. This can be done at the treatment plant through removing the organic matter from the water before chlorine is added, optimizing the disinfection process, using alternative disinfection methods, or by using a different water source. It is critical that any method used to control levels of chlorinated DBP's **must not** reduce the effectiveness of disinfection.

Are there alternatives to chlorination?

Water can be treated with alternative disinfectants however any chemical disinfectant used to treat drinking water may produce by-products. Many alternative disinfectants break down quickly and must be supplemented with a chlorine-based disinfectant in the distribution system. Alternatives include ozone, chlorine dioxide, and chloramines.

What can I do to reduce DBP exposure at home?

There are treatment technologies available that can be used in households in order to reduce exposure to DBP's. Activated Carbon or Reverse Osmosis point-of-use treatment units may be used at the household tap to effectively reduce chlorine and disinfection by-products. Also some pour-through jugs may be able to reduce chlorine and disinfection by-products. Alternatively, a treatment unit for the whole home can be installed instead of point-of-use devices. Be sure to read and follow the manufacturers' instructions on operation and maintenance, and look for products certified to standards developed by the National Sanitation Foundation (NSF) or Canadian Standards Authority (CSA) for drinking water treatment.

What are the next steps?

The Bowen Island Municipality is building a new treatment plant that has filtration which should remove the organic matter and likely reduce the concentration of DBP's.

For further information regarding the operation of the Cove Bay Water System, please contact the Superintendent of Public Works, Bob Robinson.

For further information regarding health implications please contact Vancouver Coastal Health Authority: Medical Health Officer, Dr Mark Lysyshyn or Drinking Water Officer, John Pickles.