

North Bay Parry Sound District

Health Unit



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North Bay Parry Sound District Health Unit

Perfluoroalkylated Substances in Water

Medical Officer of Health Report and
Recommendations

FINAL – August 15, 2017

EXECUTIVE SUMMARY

The Department of National Defence (DND) utilized a firefighting foam containing perfluoroalkylated substances (PFAS) at the 22 Wing North Bay facilities for many years. PFAS were detected in nearby private drinking water supplies, Lees Creek which drains into Trout Lake; the municipal drinking water source for the City of North Bay, and in the municipal drinking water system.

PFAS are a group of chemicals that were in widespread use for approximately 60 years starting in the 1940s and 50s. While there are many sources of PFAS in the environment, in this instance, there is an identifiable source. PFAS persist in the environment and the human body for years. Their status as persistent organic pollutants, more than evidence of toxicity, has led to action to end their use and find substitutes. A clear and consistent association between human serum PFAS levels and adverse health effects has not been established. While testing serum levels can confirm exposure and be used for comparison purposes, it does not provide useful information on whether an individual's health has been, or will be, affected by PFAS. One of the PFAS chemicals, perfluorooctanoic acid (PFOA) has been classified by the World Health Organization (WHO) as a possible carcinogen.

At present, there are no formal guidelines or enforceable drinking water standards for PFAS. Health Canada (HC) has proposed drinking water guidelines for PFOA and perfluorooctanesulfonate (PFOS) based on an assessment of risks to health. However, these have not yet been formally adopted through the Federal/Provincial/Territorial committee process. Health Canada has also developed drinking water screening values (DWSV) for nine PFAS, including PFOA and PFOS.

Several water samples from Lees Creek exceeded HC's screening values for PFAS. There is a drinking water advisory for Lees Creek warning the public not to drink the water, and the Ministry of the Environment and Climate Change (MOECC) also has a warning not to eat the fish from Lees Creek due to PFAS levels detected in fish flesh.

As of June 28, 2017, two private drinking water wells in the vicinity of the 22 Wing North Bay have detectable levels of PFAS that exceed HC's DWSV.

SUMMARY OF RECOMMENDATIONS

- First and foremost, the DND remediate the contaminated sites as informed by scientific assessment and per the advice of the MOECC.
- The North Bay Parry Sound District Health Unit (Health Unit) provide homeowners whose drinking water has been tested with advice on the interpretation of water test results for PFAS with respect to the presence of any health risks and need for water treatment that would reduce PFAS levels.
- Explore the most effective and efficient technology capable of eliminating or reducing PFAS to their lowest practical levels at the City of North Bay's Water Treatment Plant. It would be preferable if this technology was also capable of removing organic compounds such as toxins from blue-green algae blooms and reduce chlorinated by-products from disinfection of water with chlorine. This would provide additional protection for consumers of North Bay's municipal drinking water.
- Continued monitoring of drinking water systems (private and municipal) to determine effectiveness of source contamination removal and water treatment devices.
- Regular follow-up communications with stakeholders.

(Full list of recommendations on page 7 of 9).

BACKGROUND

The Health Unit was notified by the DND on December 11, 2016, that PFAS were detected in the City of North Bay, specifically Trout Lake, Lees Creek, North Bay Jack Garland Airport, the Canadian Forces Base (CFB) North Bay, and monitoring wells located near CFB North Bay.¹

The finding of PFAS in drinking water is not uncommon. Results from the US show that drinking water supplies for over 6 million Americans exceed the Environmental Protection Agency's health advisory level. Industrial sites and military fire training sites were associated with the presence of PFAS in water.²

The DND utilized a firefighting foam containing PFAS at the 22 Wing North Bay facilities for many years; its use was discontinued around 1998.¹

In 2012, PFAS were found in the Underground Complex (UGC) at 22 Wing North Bay. Water is collected inside the UGC from a variety of sources; some of it is directed to City services and some is discharged into Lees Creek, which flows into Trout Lake, the source of municipal drinking water.¹

The PFAS were also found in Lees Creek above the UGC discharge point. Therefore, it appears the UGC was not the only contributor of PFAS detected in Lees Creek and the municipal drinking water supply.¹

While detectable levels of PFAS were found, samples from Trout Lake and from the City of North Bay's municipal drinking water were all below HC's DWSVs. At these levels, current scientific evidence indicates that there are no adverse effects on health.³

The levels of PFAS detected in Lees Creek, however, are above HC's screening values. As a result, the Health Unit recommends residents not drink water from the creek.

In addition, as per the recent Guide to Eating Ontario Fish (2017-2018) issued by the MOECC, fish caught in Lees Creek should not be consumed.⁴

PERFLUOROALKYLATED SUBSTANCES

Per- and polyfluoroalkylated substances (PFAS) also referred to as perfluoroalkylated compounds (PFCs), are man-made chemicals, the most common and well-studied being perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA).⁵⁻⁸

The chemical structure of PFAS allows them to persist in the environment unchanged and uniquely repel oil, grease, and water.^{5,6} The PFAS have been frequently detected in the environment due to their widespread use as paper and cardboard coatings, adhesives, use in stain-resistant carpet, upholstery and clothing, in non-stick coatings on cookware, cleaning products, personal care products, and cosmetics. They are found in shampoo, dental floss, nail polish, eye makeup, paints, varnishes, and sealants, as well as in aqueous film-forming foam (AFFF) for fire-fighting.^{5,7-10}

For most Canadians, exposure to PFAS including PFOS and PFOA occurs largely through diet and consumer products followed by indoor dust and drinking water.^{9,10} The primary route of exposure may, however, be age- dependent with oral exposure (including hand-to-mouth activity) to consumer

products (e.g. treated fabrics and carpets) as the primary route of exposure for infants, toddlers, and children.^{5,11} Where elevated levels of PFAS are found in drinking water, this may become a significant source of exposure and can appreciably add to a person's total exposure.^{9,10}

Environmental concentrations of PFAS may be higher in areas near facilities that use large amounts of these chemicals, and near locations where fire-fighting foams containing PFAS were used to put out a fire.³ While import and production in North America has ceased, existing stocks are still in use and manufacturing continues in some countries.^{6,8}

PFAS DRINKING WATER STANDARDS

Health Canada Proposed Drinking Water Guidelines

Although Canadian Drinking Water Guidelines have not yet been finalized, Health Canada has proposed drinking water guidelines of 600ng/L for PFOS and 200ng/L for PFOA.^{9,10} The Health Canada values were proposed after a review of human and animal evidence on the adverse effects of PFOA and PFOS.^{9,10}

Health Canada's proposed PFOS guideline is based on a rat study which found harmful effects on the liver; additional support for the value comes from a monkey study that found effects on the thyroid. The guideline value was derived from the animal studies using an uncertainty (or safety) factor of 25 for the rat study and 75 for the monkey study and the assumption that an individual weighing 70 kg consumes 1.5 liters of water daily. A further protective assumption was made by 'allocating' only 20% of the total daily PFOS exposure to drinking water. Health Canada describes their proposed value as sufficiently protective against both cancer and non- cancer effects of PFOS.⁹

Health Canada Drinking Water Screening Values

Drinking Water Screening Values (DWSV) are developed at the request of a federal department or a province or territory when there is a need for a quick response, and there are no existing formal guidelines. Because of the need for a quick response, screening values are a rapid assessment to help an organization identify a level at which no health effects are expected. They are not based on the same extensive research and do not undergo the same internal peer review and public consultation as formal guidelines. However, they are based on similar risk assessment approaches as formal guidelines.³

DWSV are established at a level designed to protect the health of Canadians, including children, based on lifetime exposure to the substance. The DWSV are not a line between 'safe' and 'unsafe' exposure, they incorporate uncertainty or safety factors and are set below the lowest level at which adverse effects on health have been found in human or animal studies.³ The PFAS DWSV are provided in Table 1.

Table 1 HEALTH CANADA’S DRINKING WATER SCREENING VALUES FOR PERFLUOROALKYLATED SUBSTANCES (PFAS)

PFAS NAME	ACRONYM	DRINKING WATER SCREENING VALUE (milligrams/litre) (mg/L)	DRINKING WATER SCREENING VALUE (micrograms/litre) (µg/L)
perfluorooctanoic acid	PFOA	0.0002	0.2
perfluorooctane sulfonate	PFOS	0.0006	0.6
perfluorobutanoate	PFBA	0.03	30
perfluorobutane sulfonate	PFBS	0.015	15
perfluorohexanesulfonate	PFHxS	0.0006	0.6
perfluoropentanoate	PFPeA	0.0002	0.2
perfluorohexanoate	PFHxA	0.0002	0.2
perfluoroheptanoate	PFHpA	0.0002	0.2
perfluorononanoate	PFNA	0.0002	0.2

Health Canada. *Health Canada’s Drinking Water Screening Values for Perfluoroalkylated Substances (PFAS)*.

Available from: <http://s3.documentcloud.org/documents/2756386/Health-Canada-PFAS-Screening-Values-Fact-Sheet.pdf>

United States Environmental Protection Agency

Although there are no current or proposed United States (US) standards for PFAS in drinking water, the US Environmental Protection Agency (EPA) has a health advisory level of 70 ng/L for the sum of PFOS and PFOA in drinking water. The EPA describes this as a level that offers all drinking water consumers a margin of protection against adverse effects from PFOS and PFOA even with lifetime exposure. It is not a regulatory standard. It was established for use by water system operators, state, tribal and local officials so they can take appropriate action to protect consumers.^{12,15}

Ministry of the Environment and Climate Change

For private wells, the MOECC has recently (March 2017) recommended that treatment be considered if the sum total of all PFAS, not just PFOS and PFOA, are above 70 ng/L as these compounds may act similarly in producing health effects.¹³

POTENTIAL HEALTH EFFECTS OF PFAS

Given the widespread use of PFAS for decades and their persistence in the environment, virtually everyone will have detectable concentrations of PFOA and PFOS in their body. Concentrations tend to be a little higher in males than females and are higher in older persons.^{8,14}

Although there are epidemiological studies on occupationally exposed cohorts or populations exposed to contaminated drinking water, no consistent association between serum PFAS levels and adverse health effects (including bladder cancer, prostate cancer, diabetes mellitus, cholesterol levels, and triiodothyronine levels) has been observed.^{7,8,15,16}

PFOA and PFOS are readily absorbed via ingestion and poorly metabolized. The half-life of PFOS in humans is approximately 5.4 -8.5 years and the half-life for PFOA is 3.8 years. Women may eliminate PFOA faster than males.^{8,14}

The Canadian Health Measures Survey (CHMS) collects health and wellness data and biological specimens on a representative sample of Canadians. The CHMS, cycle 1 (2007-2009) measured plasma levels of PFOS and PFOA compounds in 2880 adults (aged 20 to 79 years), and found a geometric mean plasma concentration of 8.85 and 2.52 µg/L, respectively.⁷ In cycle 2 (2009-2011), plasma concentrations of PFOS and PFOA compounds in 1017 adults (aged 20 to 79 years) had decreased to 6.9 and 2.3 µg/L, respectively.¹¹

The World Health Organization (WHO) has classified PFOA as possibly carcinogenic to humans (Group B) due to limited evidence in human and animal studies.¹⁷ A similar assessment is not available for PFOS.

While measurement of plasma PFOS and PFOA can provide information on an individual's level of exposure in comparison to the general Canadian population, there are currently no frameworks for relating plasma concentrations to health risks.

Epidemiological studies have shown associations between exposure to PFAS and health outcomes such as reproductive, developmental, and immunological effects. However, given the lack of any consistent dose response relationship and weaknesses in study design that raise the possibility of factors other than PFAS as the explanation for the associated health effects, these studies cannot be used to derive guidance values.^{7,8,15,16} In animals, non-cancer effects observed include immunological effects, liver effects, effects on the thyroid, and changes in serum lipid levels.⁹

DEPARTMENT OF NATIONAL DEFENCE PRIVATE WATER WELL SAMPLING

A contractor (Stantec) for DND began sampling for PFAS from private water wells in the vicinity of the CFB North Bay/Airport area on April 6, 2017.

Twenty-seven water samples have been analyzed and results reported. PFAS were detected in ten of the twenty-seven sample results at concentrations below HC's DWSVs. The levels of PFAS detected in Trout Lake, and in the City of North Bay Municipal Water are below HC's DWSV. However, the levels of PFAS detected in Lees Creek are above HC's values.

Four PFAS results exceeded 70 ng/L for all PFAS compounds tested. All of the North Bay municipal drinking water samples for PFAS (December 16, 2016) exceed 70 ng/L for total PFAS. Further off-site sampling took place in June. The twenty-seven results so far indicated that PFAS levels in the water of two tested residences exceeded HC's DWSVs. Additional testing is planned.

The MOECC committed to continue monitoring the developments with respect to the understanding of toxicity of PFAS due to exposures via drinking water and will provide additional guidance as deemed necessary.¹³

MEDICAL OFFICER OF HEALTH RECOMMENDATIONS

The Medical Officer of Health's role is to protect the public from exposure to unsafe drinking water. The Health Unit is responsible for the identification, assessment, and management of health hazards with the lead government agencies with primary responsibility for the environmental issue and/or other relevant agencies, experts and interested parties, as applicable, in accordance with the Identification, Investigation and Management of Health Hazards Protocol, 2008 made under the Ontario Public Health Standards (OPHS, 2008).¹⁸

In this instance, collaborative efforts were undertaken with the MOECC, the DND, the City of North Bay, and Public Health Ontario (PHO).

The Medical Officer of Health recommendations to protect the health of the public are supported by the following knowledge and information:

1. The DND utilized a firefighting foam containing PFAS at the 22 Wing North Bay facility for many years and discontinued its use around 1998.¹
2. In 2012, PFAS were found in the UGC at 22 Wing North Bay. Water is collected inside the UGC from a variety of sources; some of it is directed to City services and some is discharged into Lees Creek, which flows into Trout Lake, the municipal potable water supply.¹
3. PFAS were also found in Lees Creek up gradient of the UGC discharge point. Therefore, the UGC was not the only contributor of PFAS detected in Lees Creek and the municipal drinking water supply.¹
4. Subsequent investigation revealed PFAS contaminated sites at the airport both on DND property and off property, City of North Bay land. The total extent of the groundwater plume is unknown.¹
5. Private water samples tested by DND contractor Stantec in April 2017 indicated 10 of 27 samples contained PFAS. The affected wells were southeast of the airport along Lees Creek down to Trout Lake. The tests northeast of the airport did not detect PFAS.
6. Private water samples tested by DND contractor Stantec in June 2017 indicate 2 of 27 samples contained PFAS that exceeded HC's DWSVs.
7. PFAS were detected in municipal drinking water samples (raw and treated water - 2014 and 2016).
8. The current municipal water treatment plant does not have the capability to reduce or eliminate PFAS from the municipal drinking water system.
9. Various technologies have been studied for removal of PFAS. A fact sheet from the American Water Works Association provides a list of technologies.²¹ Granular activated carbon filters (GAC) have been effective in removing PFAS from large municipal drinking water systems as well as smaller point-of-use systems.^{13, 21} The filters are also effective in the treatment of blue-green algae (BGA) and the reduction of trihalomethanes (THM), a byproduct of chlorine and organic material.^{19,20}
10. Many homeowners on Trout Lake draw their drinking water directly from the lake. No data is available on PFAS levels beyond Delaney Bay where the municipal drinking water intake is located.
11. PFAS are present in water as a result of human activity. They are not naturally occurring. PFAS persist in the environment and the human body for years.^{7,8}
12. While there are multiple sources of PFAS in the environment, in this case, at least one clear source for the PFAS present in water can be identified.^{1, 5,7-10}
13. There is no drinking water standard or formal guideline for PFAS. Those are determined by HC

and the MOECC, not the Medical Officer of Health.³

14. HC has proposed drinking water guidelines for PFOS and PFOA of 600 ng/L and 200 ng/L respectively. These are not enforceable standards until adopted through provincial regulation.³ HC has developed drinking water screening values for nine PFAS, including PFOA and PFOS.
15. The USEPA has set a health advisory level of 70 ng/L for the total PFOS + PFOA in drinking water.¹² This is not an enforceable standard but is intended to guide action by drinking water system operators, state, tribal and local officials with responsibility for drinking water systems.
16. For private wells, the MOECC has recently (March 2017) recommended that treatment be considered if the sum total of all PFAS, not just PFOS and PFOA, are above 70 ng/L as these compounds may act similarly in producing health effects.¹³
17. The available scientific evidence to date is not able to demonstrate a consistent association between serum PFAS levels and adverse health effects.^{7,8,15,16}
18. Absence of formal drinking water guidelines or standards for PFAS and lack of, or incomplete scientific knowledge/consensus regarding health effects and at what levels if indeed they do occur, does not preclude us from taking action in the face of these uncertainties.

RECOMMENDATIONS TO PROTECT THE HEALTH OF THE PUBLIC

1. First and foremost, the DND remediate the contaminated sites as informed by scientific assessment and per the advice of the MOECC.
2. Fully delineate the areal extent of the PFAS groundwater plume and sources of contamination.
3. The North Bay Parry Sound District Health Unit (Health Unit) provide well owners with advice on the interpretation of water test results for PFAS with respect to the presence of any health risks and need for water treatment that would reduce PFAS levels.
4. Explore the most effective and efficient technology capable of eliminating or reducing PFAS to their lowest practical levels at the City of North Bay's Water Treatment Plant. It would be preferable if this technology was also capable of removing organic compounds such as toxins from blue-green algae blooms and reduce chlorinated by-products from disinfection of water with chlorine. This would provide additional protection for consumers of North Bay's municipal drinking water.
5. Continued monitoring of PFAS levels in both homeowners' and municipal drinking water systems on a quarterly basis for the next two years to determine the effectiveness of the source contaminant removal and any installed water treatment devices.
6. Expand the PFAS sampling area to homeowners on Delaney Bay who draw their drinking water directly from the lake. Continue to expand the sampling area depending on the results.
7. That future sampling evaluate whether other chemicals present on DND property have moved off site.
8. All water samples be collected by technically knowledgeable experts to avoid contamination and analyzed by the same accredited laboratory for consistent comparable results.
9. All organizations and individuals (DND, MOECC, City of North Bay, NBPSDHU, PHO, and the public) continue to work collaboratively to address this issue.
10. Evaluate the progress of source contaminant removal and efficacy of water treatment devices on a quarterly basis.
11. Continue to provide and share up-to-date communications/information with organizational partners and the public.

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