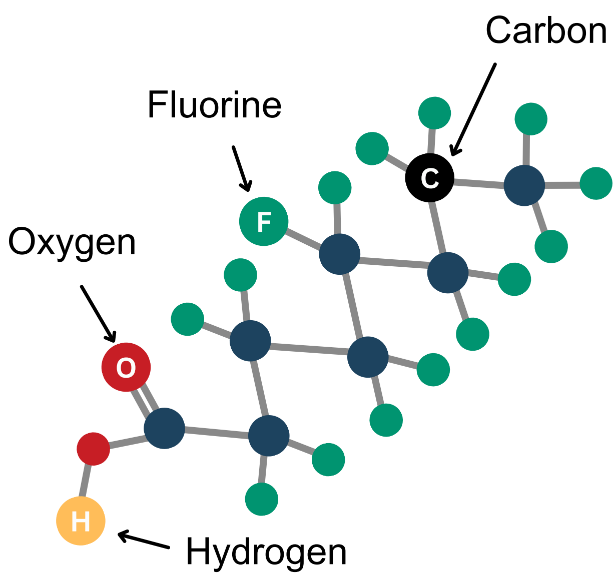
PFAS in Canada

Conservation Council of New Brunswick

Over 47 thousand synthetic chemicals are classified as **PFAS (per- and polyfluorylalkyl substances)**. Due to their surfactant, non-stick, stain-repellent properties, they are widely used in consumer products and industrial applications. These qualities make them useful in textiles (e.g. clothing), personal care products (e.g. cosmetics), food packaging, and firefighting foams.

Do PFAS pose a health risk to humans?

As persistent compounds, PFAS are difficult to break down in our bodies and the environment. This is due to the PFAS' multiple strong Carbon-Fluorine bonds, making the compound highly durable.



Perfluorooctanoic Acid (PFOA), shown above, is one example of a PFAS chemical. The multiple fluorine atoms on a carbon chain are key characteristic of PFAS chemicals.

PFAS have been detected in more than 98% of the US population's blood serum and can be transferred through the placenta to the fetus or ingested via human breastmilk.

PFAS exposure has been linked to both short- and long-term health effects. For example, an epidemiological study found children whose maternal pregnancy serum contained PFOS resulted in decreased antibody concentration after diphtheria and tetanus vaccines.

This is not an isolated incident. In animal (and some human) models, PFAS have been correlated with immunosuppression (Catelan et al. 2021; Granum et al. 2012; Zhang et al. 2023), increased severity of liver disease, decreased maternal health, and even cancer. Health effects of PFAS exposure is an ongoing field of research.

PFAS and the environment

The PFAS chemical family contains a variety of structures and properties that influence their behavior in the environment. **Precursor PFAS** are able to break down in the environment into smaller, more enduring PFAS structures.

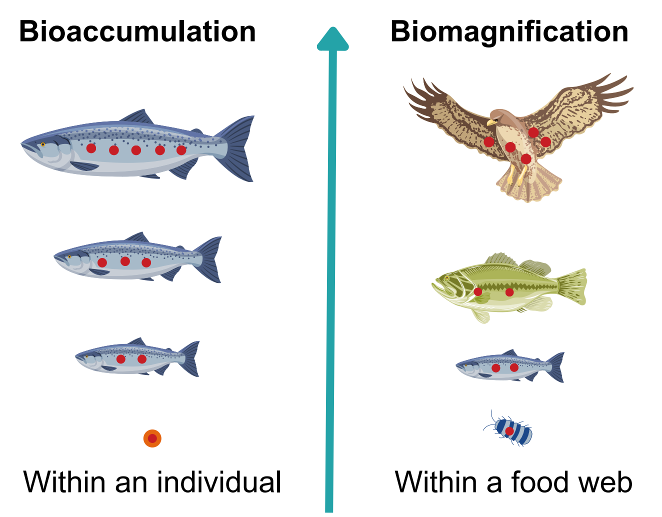
Different PFAS compounds have varying chain lengths. **Short-chain PFAS** are more mobile and easily dispersed in the environment (due to smaller size and hydrophilicity), while **long-chain PFAS** have a greater ability to accumulate and persist in humans and animals (due to higher hydrophobicity)(Li, F., Duan, J., Tian, S., Ji, H., Zhu, Y., Wei, Z., & Zhao, D. (2020). This includes PFAS found in human wastes, fertilizers, and firefighting foams, all of which can leach into soil and water supplies.

Wildlife and PFAS

PFAS health effects are an ongoing field of research, but preliminary studies have found PFAS to have potential effects on wildlife. Amphibians are especially sensitive to contaminants, with one **study finding** PFOS, PFOA, PFHxS, and 6:2 FTS concentrations reduce body mass in salamanders, frogs, and toads. Mixing these compounds sometimes produce a cumulative effect, exaggerating their effects more than each compound individually.

Some PFAS have been **found to build up in organisms and accumulate** in food chains due to their persistence. Since apex predators are at the top of the food chain, they have more PFAS-related health effects as they ingest all the PFAS in prey from lower trophic levels (ex. bobcats, Canada lynx, and black bears).

Humans may accumulate PFAS too. Eel, fish, and livestock in certain high PFAS areas have been found to have high PFAS levels, which may build up in humans (**Drew et al. 2021**; **Smithwick et al. 2009**). Daily/weekly limits for consumption of certain species may have potential for investigation and should be **communicated to the public**.



Legacy PFAS

"Legacy" PFAS usually refers to well-studied long-chain PFAS compounds that have regulations in many countries, including Canada.

"Emerging" PFAS are shorter-chain and ether-based PFAS compounds that are less understood and detectible, but continue to replace legacy PFAS as bans are put in place.

Current detection methods limit our ability to detect and measure levels of most PFAS chemicals, especially short-chain PFAS and other emerging PFAS. Thus, concentration levels are often underestimated, as are the potential risks.

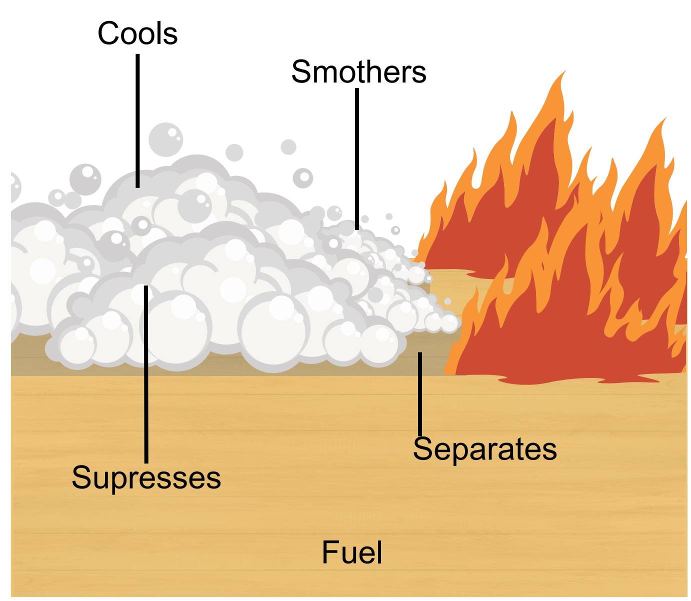
PFAS can be further **break down to terminal PFAS**, which can be extremely persistent in the environment and in our bodies.

Firefighters & PFAS

Firefighters are exposed to PFAS through firefighting foam, which work by forming a film to cut off a fire's oxygen supply. The only class of firefighting foam that contains PFAS is Class B, used only for fuel fires. Class A foams, used for structural and wildfires, **do not contain PFAS**.

Due to the frequent and close-range exposure to class B foams, firefighters generally have higher PFAS concentrations than the average population (Laitinen et al. 2014; Nilsson et al. 2022).

How AFF Works



PFAS Regulations in Canada

PFOS, PFOA, long-chain PFCAs, their salts, and their precursors are **prohibited in Canada**.

However, **Health Canada states** that emerging PFAS compounds, intended to replace prohibited ones, may have unknown environmental and human health effects.

Drinking Water and PFAS

Canada does not regularly monitor PFAS levels in water treatment plants, so data is scarce. Currently, there is little information available about PFAS levels in well water in Canada.

Canada has **Maximum Acceptable Concentrations (MAC)** for PFAS in drinking water (Health Canada 2023). Below the MAC, health effects are not expected to occur.

The **MAC values** only consider PFOA (200ng/L), PFOS (600ng/L), and 9 other PFAS compounds (20-30,000ng/L).

These MACs, however, are much higher than the U.S. Environmental Protection Agency's (EPA) most recent advisory limits for PFOA and PFOS (0.02-0.004ng/L).

Canada's latest proposal for PFAS limits in drinking water have guidelines of 30ng/L for approximately 29 PFAS compounds. This proposal has not been finalized and it is unclear whether it will be enforced.

A recent study by **Munoz et al.** measured concentrations of 42 PFAS compounds in 376 municipalities in Quebec. They found more than 99% of tap water samples contain PFAS, predominantly PFOA and PFOS. The median concentrations of PFOS and PFOA were 0.15ng/L and 0.27ng/L, which are both below Health Canada's MAC for drinking water.

However, **23 other PFAS** were detected in some samples, some of which are not present in drinking water guidelines.

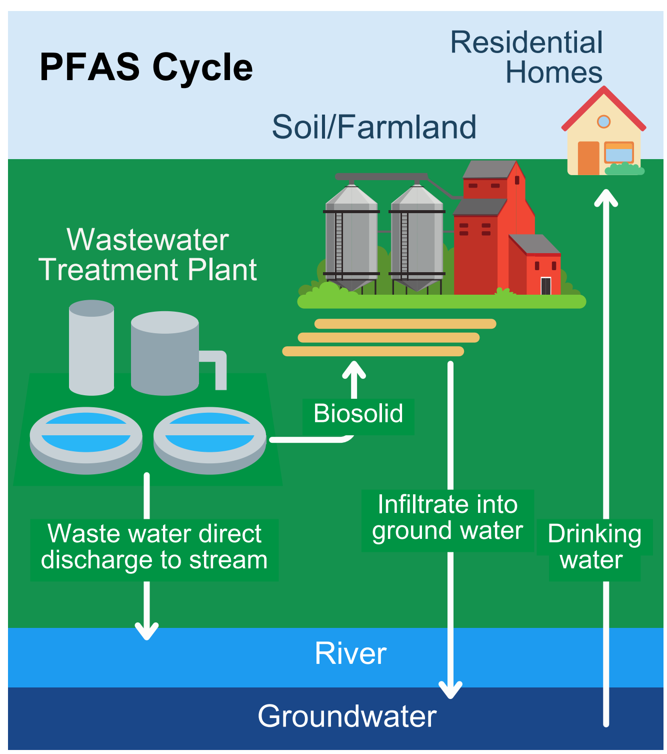
Biosolids and PFAS

Biosolids are organic products from wastewater treatment plants. Biosolids are currently used in Canada to restore vegetative cover and other agricultural applications.

Biosolids are not regulated federally but are managed at the provincial level.

In New Brunswick, there are **maximum acceptable concentrations** for heavy metals and pathogens, but not PFAS.

In Maine, the use of biosolids as agricultural products was banned as of 2022 due to worries over PFAS contamination. Concern was raised due to the **high PFAS concentrations** found in produce grown on biosolid-containing agricultural land and the high level of PFAS found in groundwater under agricultural land where biosolids had been spread.



The lack of data makes it difficult to make decisions about the risk of PFAS exposure from different sources, such as groundwater or crops. But not all agricultural land is the same. For instance, when groundwater is only 1-2 feet below ground, there is a **high chance of PFAS leeching** in from applied biosolids. However, this is not true for all land.

When biosolids are **not used as fertilizer**, they are typically burned (which releases carbon dioxide) or end up in landfills (where water contamination can occur from landfill leachate).

Wastewater Treatment Plants in Canada and PFAS

Since PFAS compounds are widely used in our everyday products, they inevitably end up in wastewater treatment plants.

PFAS are not regularly monitored in Canadian wastewater treatment plants (WWTPs).

For example, **a study from 2020** found a significant concentration of PFAS compounds found in Scotchgard™ fabric protectors in 20 WWTPs in 8 provinces across Canada. Other PFAS compounds were measured as well, but had concentrations thirty times lower.

A **study from 2014** evaluated PFAA concentrations in 20 Canadian wastewater treatment plants. PFOAs were the most common PFAS in wastewater, whereas PFOS dominated in treated biosolids.

PFAS can also be made during the wastewater treatment process. This same study found higher PFAA levels in final effluent compared to raw effluent, which indicates PFAA being manufactured in WWTPs. This may be due to the breakdown of precursor compounds during processing.

PFAS Alternatives

Food Packaging

- Bio-Wax
- Clay-coated
- Bamboo
- Palm Leaf
- Polylactic acid (Compostable plastic made from corn)

Textiles

- Silicones
- Polyurethanes
- Acrylates
- Paraffin waxes
- Patagonia and some companies have found alternatives

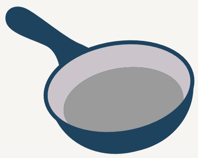
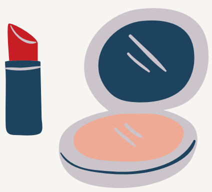
Can we Remove PFAS?

Although expensive, PFAS removal from water and wastewater is possible in several ways:

- Thermal treatment of soil
- Granular Activated carbon (GAC)
- Ion exchange resins
- Osmosis membranes
- High-pressure membranes
- Super-critical fluid oxidation (an emerging water treatment tech)

While there are a variety of methods of removing PFAS, such as those listed above, positive impacts of risk management measures should not be overlooked. Risk management measures include PFAS restrictions. A **study published in 2020** reported a significant decrease in PFAS levels in Great Lakes and wastewater effluent after Canada released PFAS regulations (2012-16 and 2018-19) (Kleywegt et al. 2020), demonstrating the effectiveness of federal regulation of chemicals.

Where can you find PFAS?

	**Nonstick Cookware** Teflon and other nonstick are coated in PTFE (Polytetrafluoroethylene) that can be released into air and food at normal cooking temperatures (Sajid & Ilyas 2017).
	**Firefighting Foams** In Class B foams for liquid fires: Aqueous film-forming foams (AFFFs) to suppress oil fires (Kabore et al. 2022).
	**Personal Care Products** Waterproof cosmetics such as foundations, mascara, and lipstick. Also used in cosmetics to aid in skin absorption to make products look more natural (Whitehead et al. 2021). Floss, nail polish, and some shampoos.
	**Single-use Food Packaging** Fast food packaging, compostable bowls, microwave popcorn bags (Schwartz-Narbonne et al 2023).
	**Waterproofing Agents** Waterproofing sprays (ex, for shoes) (Borg & Ivarsson 2017).
	**Textiles** Water- and stain-resistant fabrics such as rain jackets, outdoor and hiking gear (tents, ropes, boots), clothing, carpeting and upholstery

Established in 1969, the Conservation Council of New Brunswick is the province's leading public advocate for environmental protection. A member of the United Nations' Global 500 Roll of Honour, we work to find practical solutions to help families and citizens, educators, governments and businesses protect the air we breathe, the water we drink, the precious marine ecosystem and the land, including the forests, that support us.

Conservation Council *of* New Brunswick
180 St. John Street
Fredericton New Brunswick
Canada E3B 4A9
T. (506) 458-8747
E. info@conservationcouncil.ca
www.conservationcouncil.ca
/cc_nb /conservationcouncil
/conservationcouncilnb