

Overview of Per- and Polyfluoroalkyl Substances (PFAS)

September 14, 2021

Purpose and Outline

To provide an overview of PFAS which includes:

- Introduction to PFAS
- Environmental and Human Health Concerns
- Ministry Initiatives and Actions
- Ontario's Drinking Water Advice
- Summary

Key Messages:

- PFAS are “forever chemicals” – persist in the environment and in the human body.
- Actions have been taken to restrict PFAS in Canada and internationally.
- We have developed methods to measure PFAS and have conducted environmental monitoring:
 - Concentrations are generally low in Ontario and are decreasing over time
 - Concentrations are of concern in certain areas of Ontario, such as where fire-fighting foams have been applied
- We are working to understand effects and develop benchmarks to evaluate risks.
- We continue to track science and support efforts to address PFAS issues in Ontario.

Introduction to PFAS

- PFAS are a group of fluorine-containing carbon chemicals known as surfactants, which have lipid and water repellent properties.
- The carbon-fluorine is not a naturally occurring bond and is considered one of the strongest chemical bonds. As such, they are known as “forever chemicals” due to persistence in the environment.
- More than 4000 different PFAS have been available on the global markets since the 1950s. There are no known natural sources.
- Were primarily used in industrial and consumer products: Aqueous Fire Fighting Foam (AFFF), carpets, non-stick cookware, food packaging (Teflon™), paper coatings (foods), stain repellants (ScotchGard™, Stainmaster™).
- Compounds with 6 or more carbon atoms (C6) are generally considered to be “long chain”. The most contentious PFAS are Perfluorooctanesulfonic acid (PFOS) and Perfluorooctanoic acid (PFOA) which have 8 carbon atoms (C8).
- In Canada, PFOS (2006) and PFOA (2012) were declared “toxic” under the *Canadian Environmental Protection Act*, making them subject to a range of risk management measures (RMM) including restrictions / ban on import and use with a few exemptions.
- Production and manufacturing of PFAS have been the main sources of PFAS contamination internationally.
- **Neither PFOS or PFOA was manufactured in Canada.**

Environmental & Human Health Risks

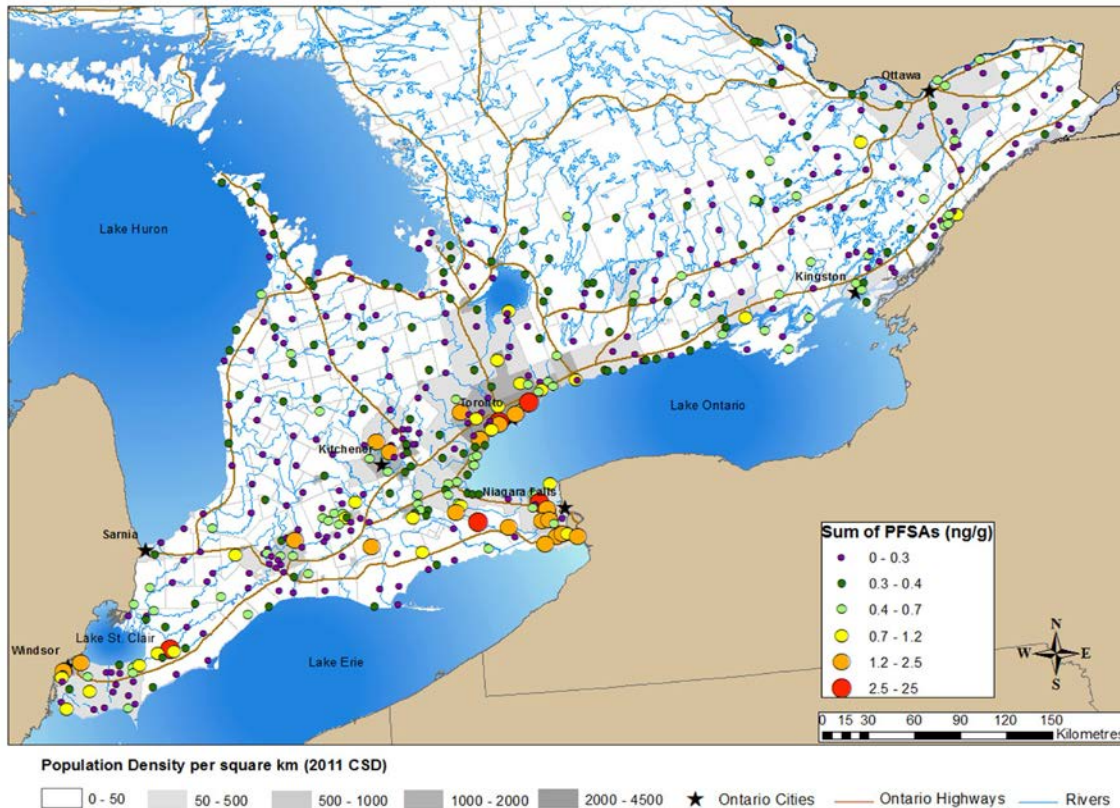
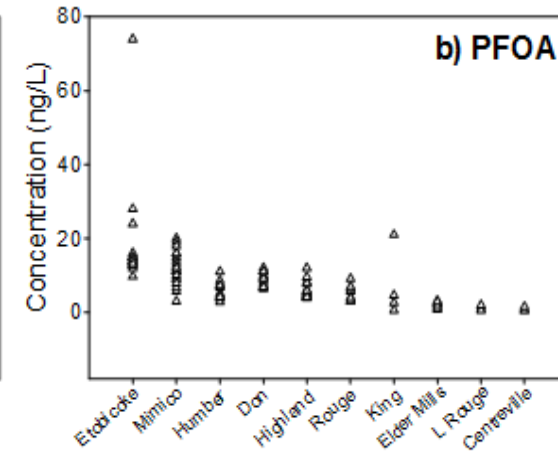
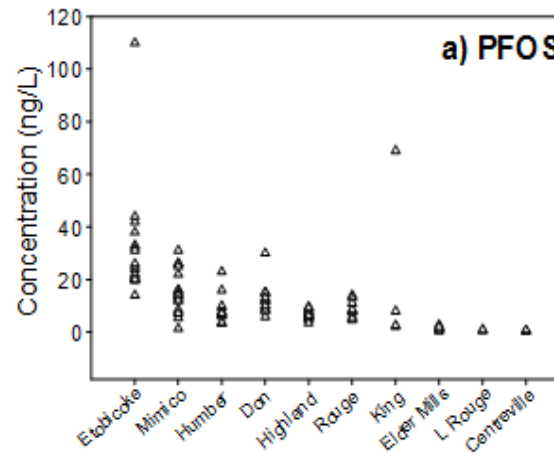
- Most PFAS are persistent, bioaccumulative and toxic (PBT) and may biomagnify through the food chain (severity related to chain length).
- PFOS has a half-life in humans of approximately four years, and up to 1,000 years in the environment.
- PFAS are ubiquitous in the aquatic environment and in humans (blood).
- They bind to proteins in the blood, influencing hormone feedback systems, causing a multitude of toxicological effects (e.g., thyroid disease, liver damage, kidney cancer).
- PFAS can reach the environment through every lifecycle step including manufacturing, industrial use, consumer products, service life and disposal.
- Exposure can occur from:
 - Dust & air - consumer products (e.g., textiles, furniture, polishing and cleaning agents) deposition from industrial emissions (long range transport);
 - Food – packaging;
 - Soils & Plants – aerial deposition, pesticides and biosolids
 - Water – industrial effluents, wastewater treatment plants, spills
- Elevated concentrations in the Ontario environment have primarily been associated with the use of PFAS-containing fire-fighting foams.

MECP Ambient Monitoring

- The ministry has been monitoring PFAS in fish, sediment, surface water, ground water and drinking water since the early 2000s.
- Great Lakes Nearshore Monitoring and Assessment
 - Streams and Sediment (in partnership with Ontario Geological Service (OGS))
 - Great Lake surface water (Ontario, Erie, Superior) in 2006 and 20018-19
- Fish Monitoring
 - Fish contaminant monitoring
- Drinking Water Surveillance Program
 - Special studies have been conducted (2006 and 2012-2016) and (2017 - 2018)

2008 Streams and Sediment

- PFAS decreases from highly urbanized areas (Mimico) to rural areas (Centreville) (before RMM).
- Etobicoke creek levels due to 2002 fire at Toronto Airport
- All data below the PFOS Federal Environmental Quality Guideline (FEQG) of 6800 ng/L.

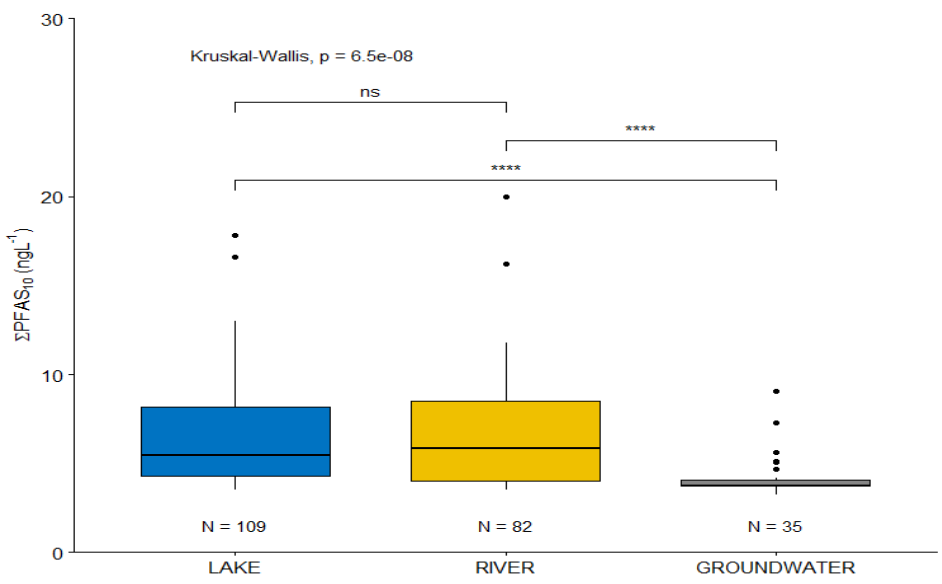
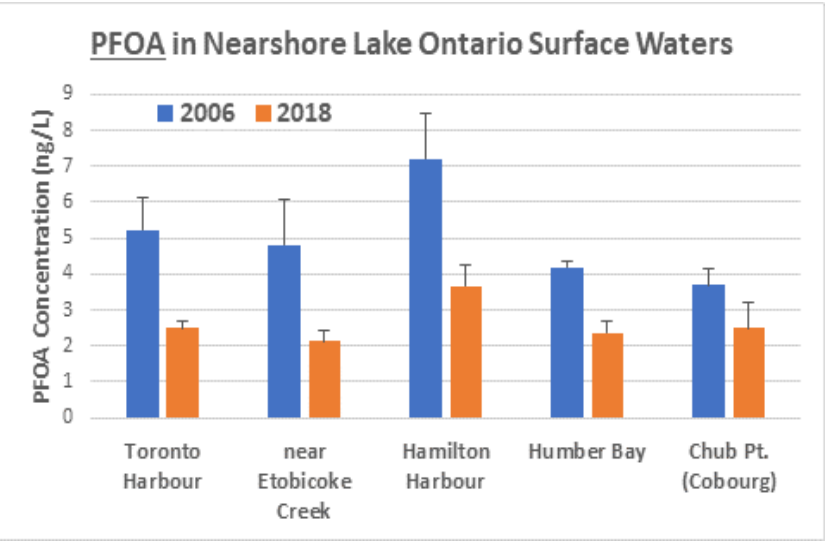
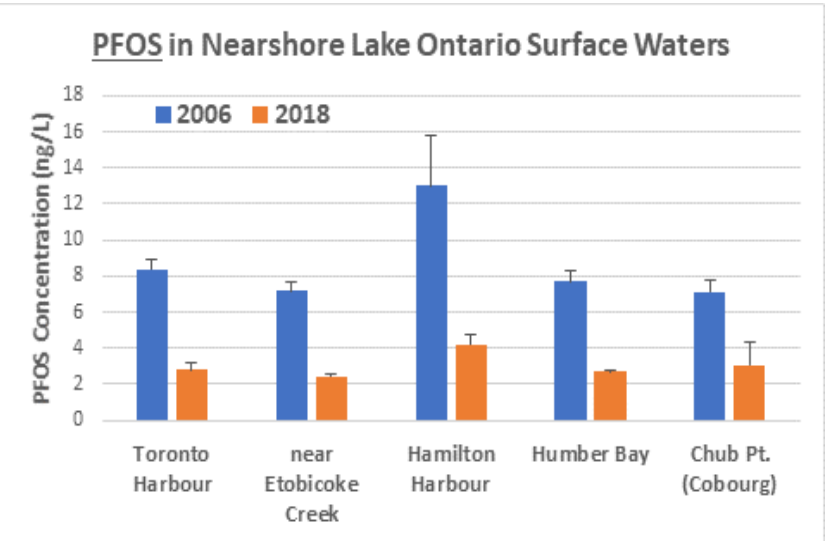


Sediment*

- Ambient stream sediments across Ontario had fairly low concentrations of PFAS.
- Higher concentrations observed in urban impact streams.
 - Orange < 2.5 ng/L
 - Red < 25 ng/L

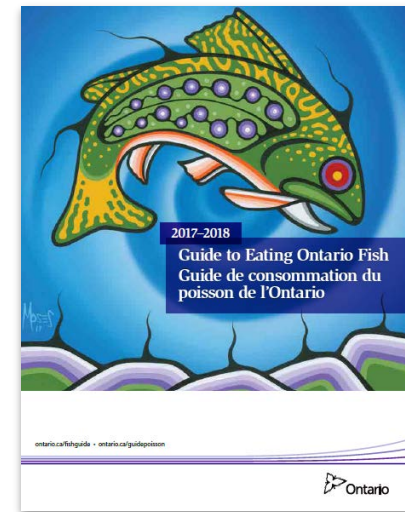
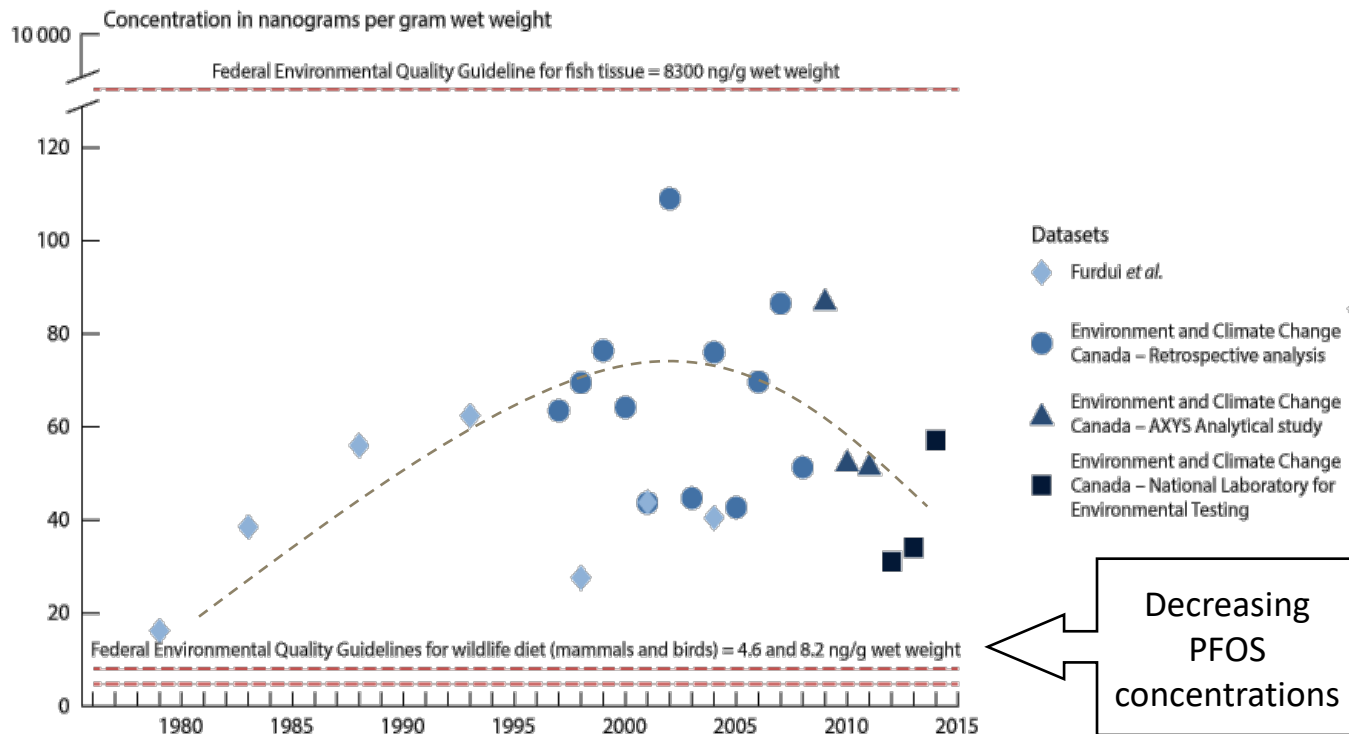
Great Lake and Source Water Monitoring

- Grab samples were collected in each year at the Lake Ontario sites, representing urban impacted waters (Toronto / Hamilton area) and a background site (Chub Pt.).
- PFOS and PFOA have declined since RMMs have come into effect.
- Concentrations are relatively uniform across Lake Ontario.
- All samples were well below FEQG of 6800 ng/L.
- Median \sum PFAS 10 for lake, river and ground water are 5.5, 5.9 and 3.85 ng/L respectively.



Fish

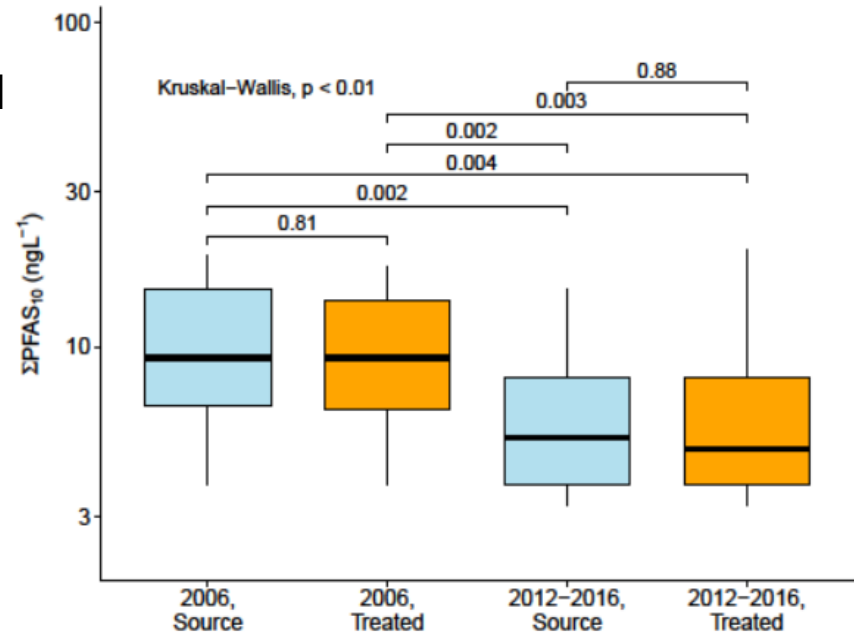
- MECP initiated regular monitoring of forage and large fish in the late 2000s, focusing on potentially impacted sites.
- First fish consumption advisories due to elevated PFOS levels were published in 2011 in the Guide to Eating Ontario Fish.
- In January 2021, the State of Wisconsin updated its rainbow smelt fish consumption advisory in Lake Superior as a result of elevated PFAS levels.
 - MECP is working with the Ministry of Natural Resources and Forestry to collect smelt and further expand the information for this type of fish.



Municipal Drinking Water in Ontario

- Ministry study compared 10 PFAS ($\sum\text{PFAS}_{10}$) at 25 Drinking Water Systems in 2006 and 2012-2016.
- All samples had detectable levels of PFAS.
- Significant decrease in PFAS concentrations can be attributed to implementation of RMM nationally and internationally
- PFOS + PFOA represented 9-66% of the $\sum\text{PFAS}$ in drinking water.
- Median PFOS and PFOA concentrations in drinking water post RMM were 0.98 ng/L and 1.5 ng/L respectively.
- Median $\sum\text{PFAS}_{10}$ = 5.82 ng/L.
- No samples exceeded any jurisdictional advisory levels of PFAS in drinking water.
- **Study concluded that PFAS in municipal drinking water unlikely to be a concern in Ontario unless due to a spill or intentional release (published 2020).**

$\sum\text{PFAS}_{10}$ = PFHpA + PFHxS + PFOS + PFOSA + PFOA + PFDS + PFDA + PFDoDA + PFNA + PFUnA.



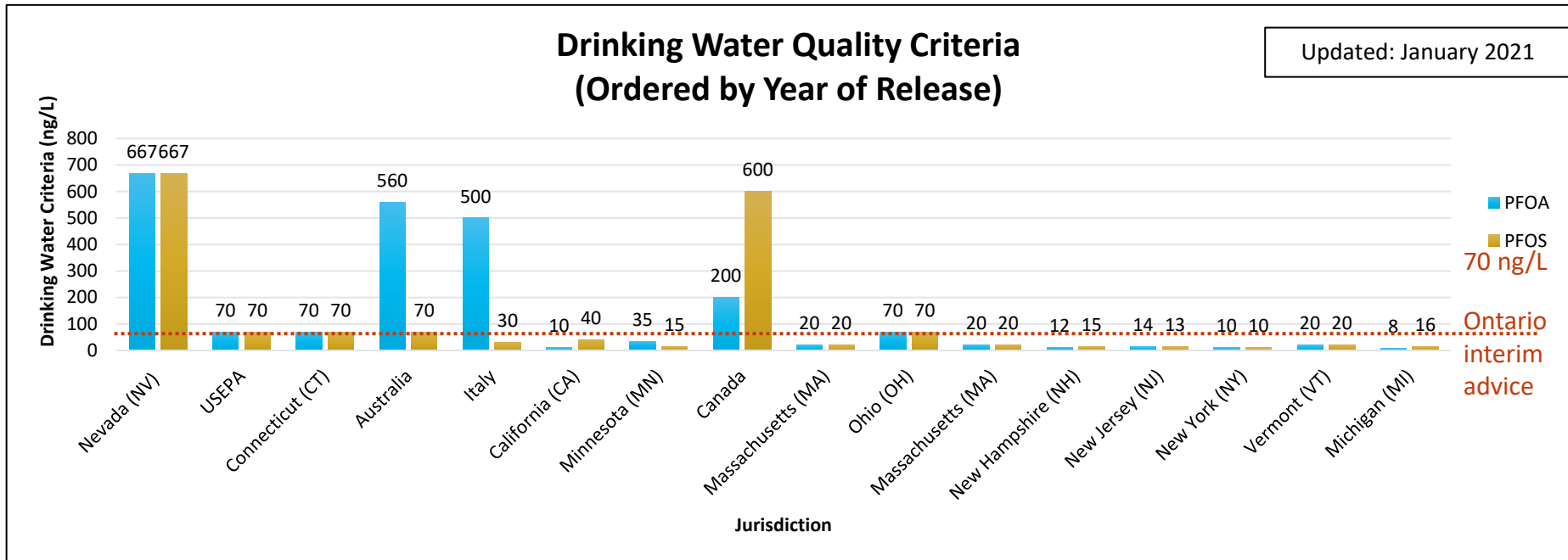
Summary of Monitoring Results

- Since PFAS were never manufactured in Ontario, ambient concentrations are significantly lower than those in other parts of the world (especially the US).
- Generally, ambient water monitoring indicates PFAS levels are not of concern in Ontario;
 - Concentrations < current guidelines and standards (where available)
 - Detections and concentrations of PFOS/PFOA decreasing after implementation of RMM
 - Need to track replacement PFAS and trends moving forward – analytical and monitoring resources
- Past uses of PFOS-based firefighting foam has resulted in high soil and groundwater PFOS concentrations at some Ontario locations.
- Limited information suggests there are still sources of PFAS to municipal sewer systems.
- Due to the persistence of these “forever chemicals” select PFAS continue to be cycled through the environment.

Ontario's Drinking Water Advice

Σ PFAS 10	Σ PFAS11 DW advice
PFHpA	Y
PFHxS	Y
	PFHxA
PFOS	Y
PFOSA	Y
PFOA	Y
PFDS	Y
PFDA	Y
PFDoDA	Y
PFNA	Y
PFUnA	Y

- Health Canada published guidelines for two PFAS in 2018: PFOS (600 ng/L) and PFOA (200 ng/L). However, these guidelines are less stringent than those set by other leading jurisdictions.
- The ministry carried out a review of current science and other jurisdictional values to inform the development of interim advice for drinking water systems. This advice is more stringent than Health Canada's guidelines.
 - Ministry's interim advice (Σ PFAS₁₁ < 70 ng/L) is more in line with other jurisdictions. It reflects the achievability of certified treatment technology.
- Note: Jurisdictions may refer to their drinking water quality criteria as standards (regulatory or non-regulatory), Maximum Concentration Limits, action levels, etc.



Ontario's Drinking Water Advice cont'd

- Ministry's interim advice ($\sum\text{PFAS}_{11} < 70 \text{ ng/L}$) is consistent with the current federal "health advisory" used in the United States; however, some states have recently set more stringent drinking water quality criteria.
 - The ministry's rationale document describes the approach in detail and was shared with Ontario Drinking Water Advisory Council in January 2020 and Health Canada on December 11, 2020.
 - The ministry is revising the rationale document in light of Health Canada's comments, and new science that has since developed.
- On April 24, 2021, the federal government posted a notice of intent in the Canada Gazette, Part I to move forward with activities to address the broad class of PFAS, recognizing that the large number of PFAS makes a chemical by chemical approach impractical as well as concerns about newer replacement PFAS. This approach is intended to consider cumulative effects, and to prevent regrettable substitution.
- The federal government also noted an intent to move forward with drinking water guidelines for PFAS as a group. This will likely result in a future replacement of the current guidelines for PFOS and PFOA. The ministry and Health Canada have already discussed opportunities to work together on new guidelines for PFAS as a group.

Ongoing Ministry engagement in working groups

Drinking Water

- Ministry scientists participate in the federal/provincial/territorial processes to develop Canadian Drinking Water Quality Guidelines and will work with Health Canada in the development of new/revised Guidelines, that will focus on PFAS as a group.

Soil and Ground Water

- Canadian Council of Ministers of the Environment (CCME) are in the process of finalizing guidelines for PFOS. Guidelines are voluntary and jurisdictions make their own decisions about whether to adopt or not.

Great Lakes National and Binational Agreements

- PFOS, PFOA and Long-Chain Perfluorinated carboxylic acids are designated Chemicals of Mutual Concern (CMC) under the Great Lakes Water Quality Agreement (Canada & USA).
 - CMCs have strategies developed to reduce exposure.
- These chemicals are Chemicals of Concern under Canada-Ontario Agreement on Great Lakes Water Quality and Ecosystem Health (COA).
 - Annex 2 (Harmful Pollutants) commits the Provincial government to: Identifying and assessing the occurrences, sources, loadings, transport and impacts of Chemicals of Concern.
- The Great Lakes St Lawrence Governors and Premiers have formed a Great Lakes PFAS Task Force to discuss PFAS issues and push for further federal action (US focus).

Summary

- Generally, ambient water monitoring indicates PFAS levels are not of concern in Ontario.
- Past uses of PFOS-based firefighting foam has resulted in high soil and groundwater PFOS concentrations at some Ontario locations.
 - Continued efforts needed to find and address historically contaminated areas.
- Science continues to evolve on effects of PFAS;
 - Efforts needed to track science and consider needs for provincial standards and guidelines;
 - Need to track replacement PFAS and trends moving forward and,
 - Continue identifying and addressing localized PFAS contamination through risk assessment and remediation, if required.