

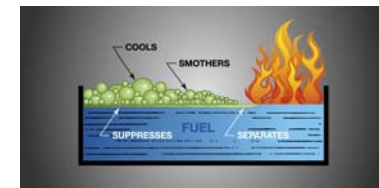
PFAS  
Problems and Concerns for  
Drinking Water

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# Introduction to PFAS



For Leather



## PFAS - Per- and Polyfluoroalkyl Substances

- 4000+ synthetic organic compounds used since 1940s that contain multiple Fluorine (F) atoms
- 2 most studied PFAS are **Perfluorooctanoic Acid (PFOA)** and **Perfluorooctane Sulfonate (PFOS)**

## Wide range of industrial applications:

- Polymers and coatings (Scotchgard®, Teflon®, Gore-Tex®, Stainmaster®)
- Fire-fighting foams (AFFF - Aqueous Film Forming Foam)
- Metal plating, cosmetics, food packaging, electronic and semiconductor applications, oil/mining production,

**Found globally, even in remote places – transport in air and biota**



# PFAS Challenges

## **Chemical Properties for Environmental and Health Impacts**

- **High mobility – water soluble**
- **Potential for bioaccumulation**
- **Resistant to degradation**
- **Bind to proteins in our blood and remain in circulation**
- **Reabsorbed by the kidney; resulting in long half-lives and difficulties in the interpretation of data from studies with animals that have more rapid clearance rates**
- **We are dealing with historical releases involving decades of human exposure over multiple generations and life stages**

# What is a Part Per Trillion

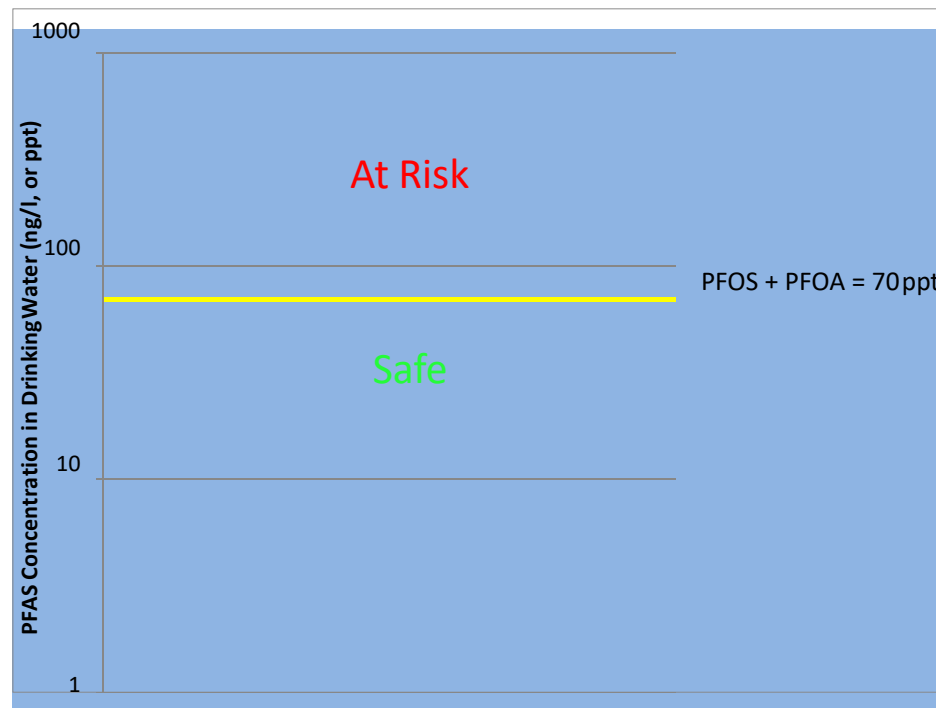
- **PFAS concentrations are reported in concentrations of “parts per trillion”, or “ppt”.**
- **One part per trillion is equivalent to one nanogram per liter of water. A nanogram is a unit of measurement that is equal to one billionth of a gram.**
- **One way to visualize this amount is that a dollar bill weighs about 1 gram. To get 1 nanogram, the dollar bill would be cut into 1,000 pieces. Take one of those pieces and cut it into another 1,000 equal pieces. Then take one of those pieces and cut it into another 1,000 pieces. Each piece in this group will be a billionth of the original dollar and will weigh approximately 1 nanogram. Other ways to conceptualize one ppt are one second in 32,000 years or one grain of sand in an Olympic-size swimming pool.**

# Is a Part Per Trillion Significant?

- For most chemicals, a ppt is not significant.
- **For chemicals that bioaccumulate, yes.** Mercury and PCBs are present in ppt concentrations in water and they accumulate in fish to the extent that we have consumption advisories.
- **For chemicals that affect the endocrine system, yes.**
- The normal range for parathyroid hormone in blood is 10 – 65 ppt. The normal range for triiodothyronine (T3) (free) is 2.4-4.2 ppt. The normal range for Corticotropin (ACTH) Pituitary hormone 10-60 ppt
- **Remember PFAS compounds accumulate 10-100x in blood from drinking water exposure due to lack of excretion**

# What Level of PFAS in Drinking Water is Safe?

- U.S. EPA
  - January 2009
    - PFOA = 400 ppt
    - PFOS = 200 ppt
  - Early 2016
    - PFOA = 100 ppt
  - – May 2016
    - PFOA + PFOS = 70 ppt
- New Jersey
  - 2009
    - PFOA = 40 ppt
  - 2016 and 2018
    - PFOA = 14 ppt
    - PFOS = 13 ppt
- Vermont
  - March 2016
    - Total PFAS 8 compounds = 20 ppt

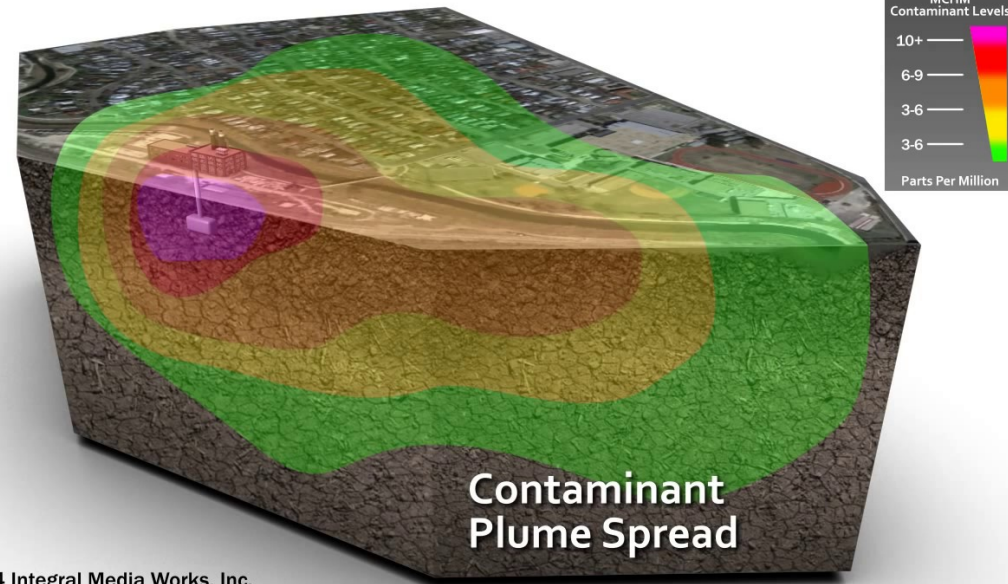
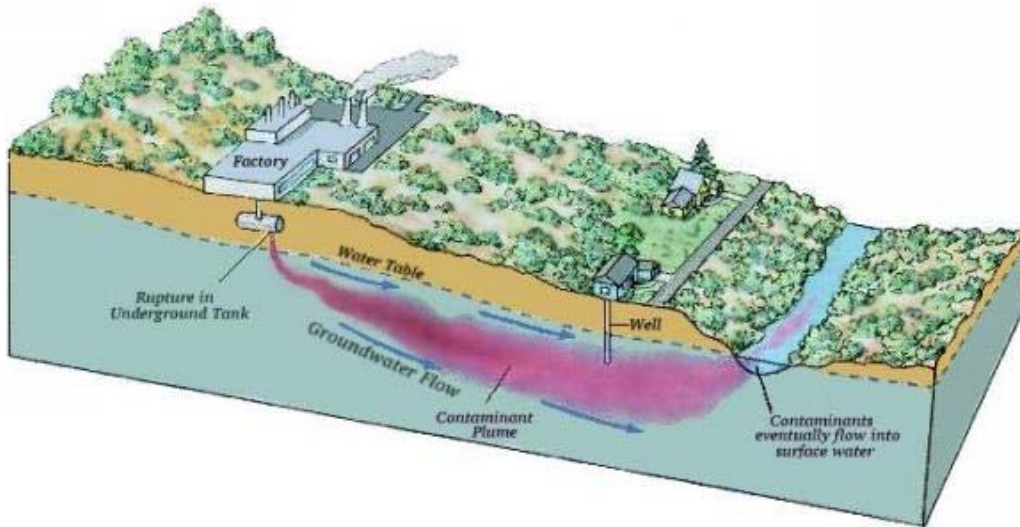


- ATSDR
  - May 2018
    - PFOA = 21 ppt
    - PFOS = 14 ppt

Population Risk vs Protection of Sensitive Groups

# Groundwater Contamination Basics

- Plume



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<http://geochico.csuchico.edu/mobile/ChicoToxicPlumes/>

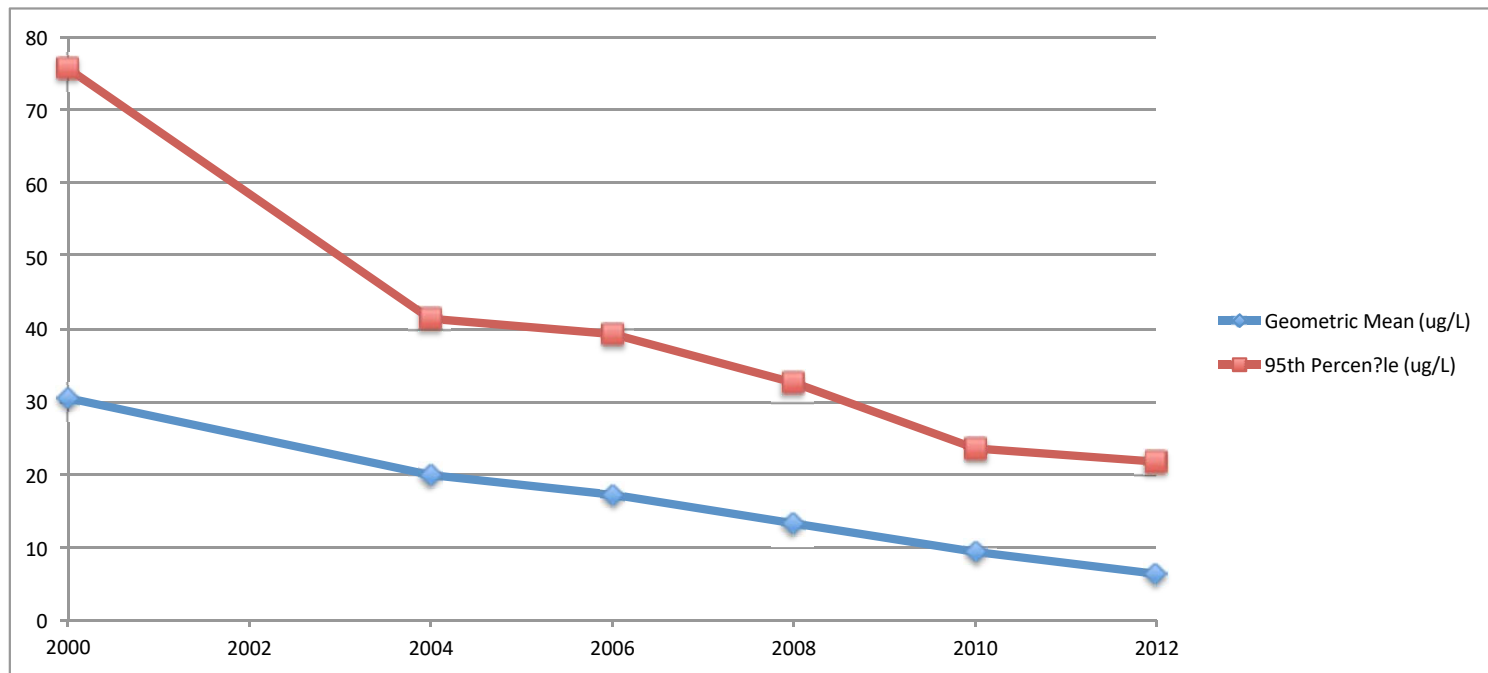
[https://www.youtube.com/watch?v=Tv8imh0\\_bn4](https://www.youtube.com/watch?v=Tv8imh0_bn4)

# **Health Effects in Humans and Animals**

- **No correlation with blood levels, increased frequency of health effects at population level.**
- **Changes in the body's hormones and immune system**
- **Decreased fertility**
- **Immune System Suppression**
- **Increased cholesterol**
- **Increased risk of certain kidney and testicular**
- **Thyroid disease**
- **Pregnancy induced hypertension**



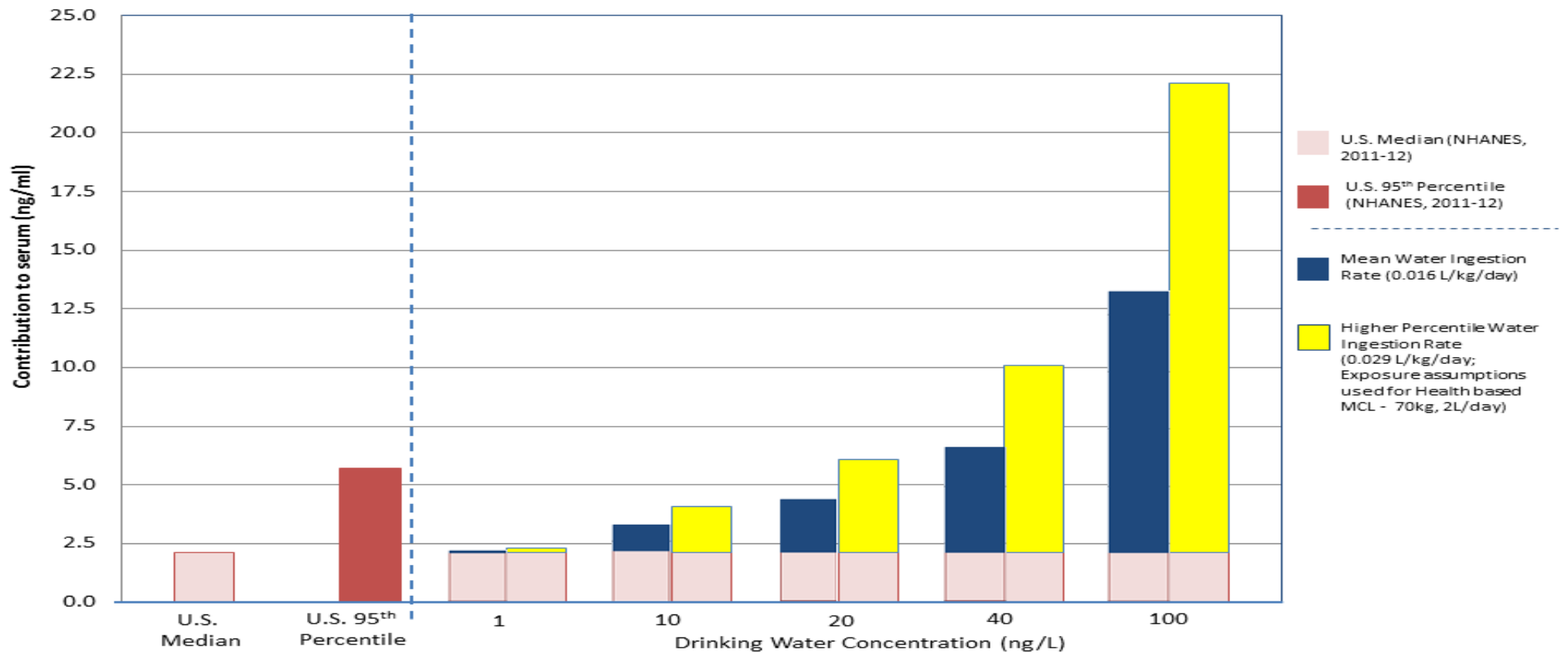
# PFOA in Blood in U.S. Population



U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, Fourth National Report on Human Exposure to Environmental Chemicals, Updated Tables, March 2018, Volume 1.

Current level ~2  $\mu\text{g/L}$  (ppb)

# Increases in Serum Concentrations Predicted from Ongoing Exposure to PFOA in Drinking Water



*Post et al, 2017*

# Home Drinking Water Treatment

- **Granular Activated Carbon Filters**
- [https://www.michigan.gov/documents/deq/deq-dwmad-eh-swpu-FilterFactSheet\\_610096\\_7.pdf](https://www.michigan.gov/documents/deq/deq-dwmad-eh-swpu-FilterFactSheet_610096_7.pdf)
- Aquasana, Culligan, and eSpring have NSF P473 Approved Carbon Filters
- Tap filters for low levels
- Whole House Filters for high levels
- All need testing to verify performance



# **PFAS Challenges**

- **Funding for monitoring and investigation of PFAS contamination and sources**
- **Medical and health research**
- **Community support resources**
- **Need for regulations in the presence of uncertainty**
- **Transparent way to communicate science and uncertainty**