An Overview of Per- and Polyfluoroalkyl Substances (PFAS)

Everything You Didn't Know You Wanted to Know About PFAS

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Legal Disclaimer

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Where to Start?

- **WHAT** are PFAS
- **WHERE** do PFAS come from
- **WHAT** do they impact
- **HOW** are they regulated
- **WHAT** are remedial options

WHAT ARE PFAS?

- PFAS is an acronym for per- and polyfluoroalkyl substances
- These are **manmade fluorinated chemicals**
- Thousands of PFAS compounds have been identified

- There are a lot of other acronyms that are used
  - **PFC** – perfluorinated compounds (but does not include polyfluorinated substances)
  - **PFASs or PFAS's** – incorrect grammar; PFAS is already plural
  - **PFOS** – specific type of PFAS - perfluorooctane sulfonic acid
  - **PFOA** – specific type of PFAS - perfluorooctanoic acid
  - **AFFF** – specific type of PFAS - aqueous film forming foam
  - **GenX** – replacement PFAS

PFAS in the News

- **Firefighters face lies, 'phony' studies on PFAS exposure** (E&E News Greenwire, February 17, 2021)
- **Hearing to review PFAS risks for service members** (E&E News Daily, February 22, 2021)
- **Illinois EPA Joins Growing List of States Issuing PFAS Health Advisories** (Environmental Law Monitor, Goldberg & Segalla, February 18, 2021)
- **Maine man sues paper mill over PFAS levels in wells** (E&E News Greenwire, March 10, 2021)
- **'Forever chemicals' found in D.C.-area tap water** (E&E News Greenwire, March 10, 2021)

WHERE DO PFAS COME FROM?

- PFAS have been manufactured and used in a variety of industries around the globe, including in the United States since the 1940s

- Some well-known uses of PFAS:
  - 3M – Scotchgard
  - Dupont – Teflon
  - U.S. Navy - Fire-fighting foam for oil-based fires

WHERE DO PFAS COME FROM?

Some less familiar sources:

- **Consumer products** – carpets, leather and apparel, textiles, upholstery, dental floss, rain coats, umbrellas, some cosmetics
- **Paper and cardboard packaging** – plates, popcorn bags, pizza boxes, fast food wrappers, oven-safe papers (muffin cups, parchment)
- **Industrial/household products** – spot cleaners, denture cleaners, dishwashing liquids, floor polish, car care products, non-stick cookware
- Surface coatings, paints, varnishes, and inks
- Plastics, resins and rubbers






- Certain PFAS chemicals are no longer manufactured in the United States as a result of phase outs

HOWEVER

- Although PFOA and PFOS are no longer manufactured in the United States, they are still produced internationally (mainly China, India, Germany, Italy and Russia) and can be imported into the United States in consumer goods such as carpet, leather and apparel, textiles, paper and packaging, coatings, rubber and plastics

The Curious Case of GenX

- GenX is a trade name for a technology developed by DuPont (now Chemours) that is used to make high performance fluoropolymers (e.g., some nonstick coatings) without the use of perfluorooctanoic acid (PFOA)
- GenX was created to replace PFOA coatings in Teflon
- But, GenX chemicals have been found in surface water, groundwater, finished drinking water, rainwater, and air emissions in some areas, such as the Cape Fear River in North Carolina
- GenX is not regulated by federal or state governments
- Are the replacements as bad as the problem? A 2009 consent order between DuPont and EPA headquarters required the company to capture 99% of all air emissions and water discharges of GenX

What makes PFAS different from other contaminants?

1

Do not easily degrade

(commonly known as “forever chemicals”)

2

Accumulate over time

3

Dispersion can be wide and even upgradient of source

What do PFAS impact

Soil/Sediment

- Atmospheric deposition (short and long range) from stack emissions
- Exposure to contaminated media (leachate; biosolids)

Groundwater

- Leaching and percolation
- Due to mobility and persistence, PFAS form larger plumes than other contaminants and have even been found upgradient of source areas

Surface Water

- Low volatility and low sorption coefficients mean that many PFAS remain in solution
- Some partitioning to sediments and uptake to biota possible

What do PFAS impact – Air and Land

AIR

- PFAS can be emitted into the air as vapors or fine particles. PFAS then travels in the atmosphere through adhesion to particulate matter

LAND

- Firefighting foam (AFFF) – impacts airports, fire training facilities, railyards and oil refineries
- Consumer goods in landfills
- Industrial facilities where PFAS is used as part of manufacturing of other products – Wolverine boots (used Scotchgard to make their boots stain and water-repellant)

PFAS impacts from industrial sites

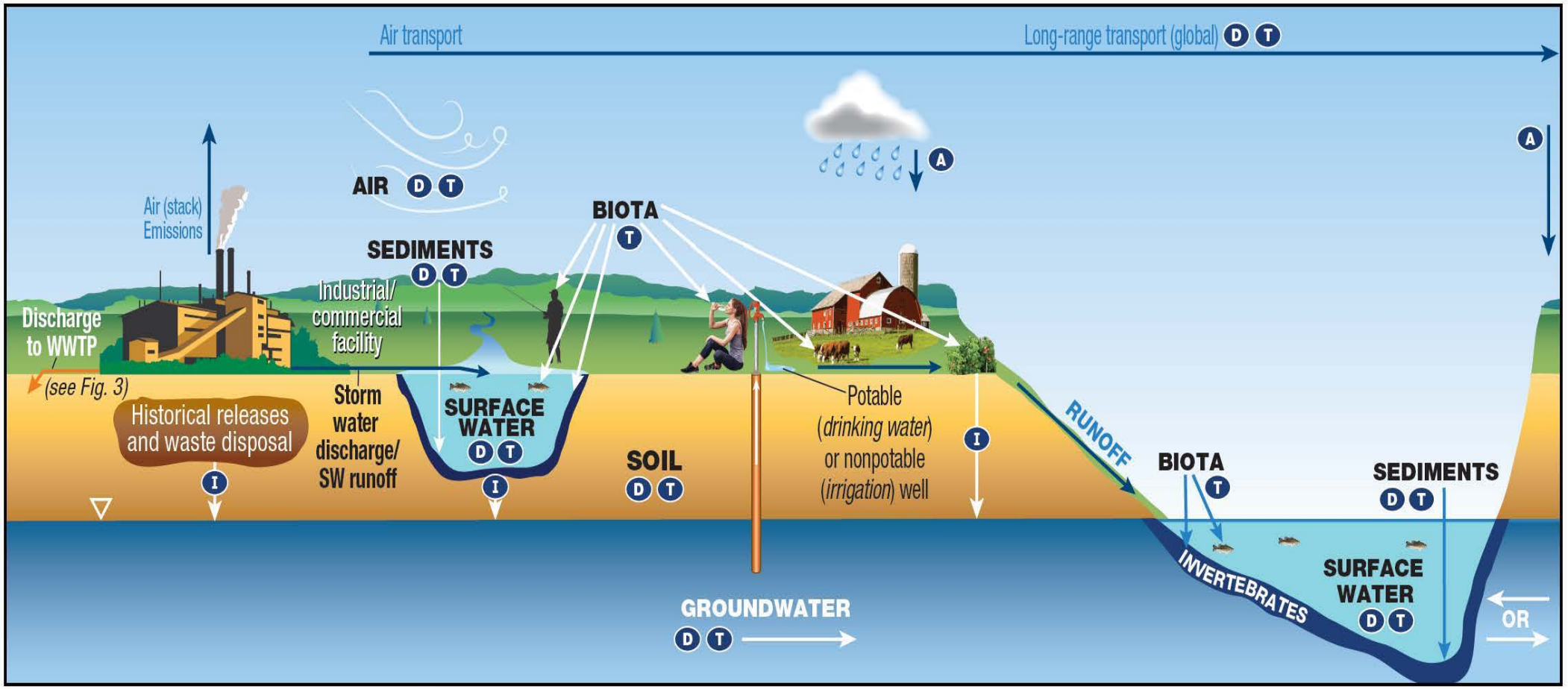


Figure 2. Conceptual site model for industrial sites.

PFAS impacts from landfills and waste water treatment plants

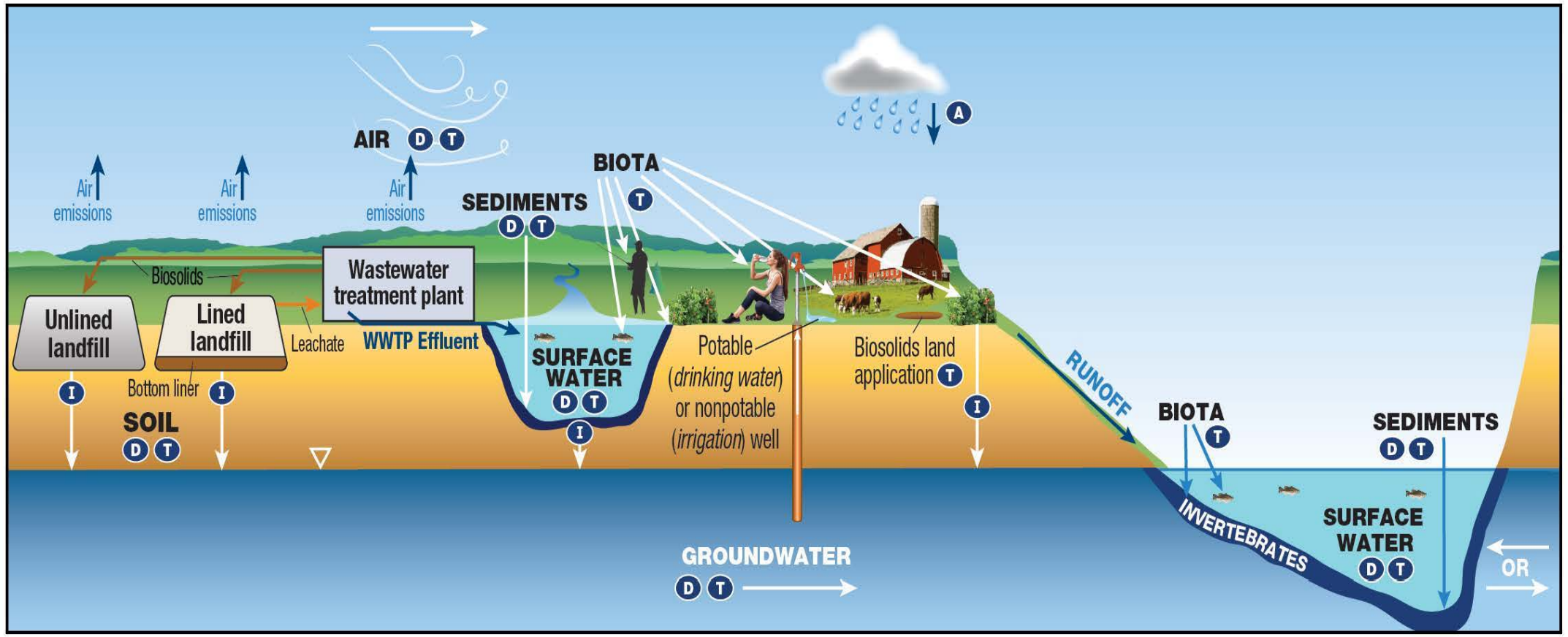


Figure 3. Conceptual site model for landfills and WWTPs.

What do PFAS impact - Water

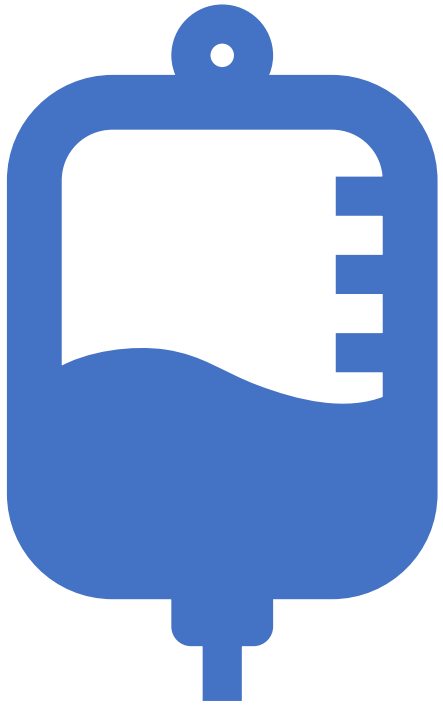
Wastewater Treatment Plants & Drinking Water

- Wastewater containing PFAS contamination from industrial sources
- Leachate containing PFAS contamination from landfills
- Wastewater treatment plant does not treat for PFAS contamination, so the contaminants pass through and get discharged through the wastewater outfalls – impacts to NPDES permitting (**Minnesota case against 3M**)
- Biosolids – USEPA states that more than half of the sludge produced in the U.S. is applied to land as biosolids

What do PFAS impact

REASONS FOR CONCERN:

- PFAS in drinking water elevates PFAS in blood
- **Little data for health effects of PFAS other than PFOA and PFOS**
- PFOA and PFOS have been linked to cancer, ulcerative colitis, thyroid disease, high cholesterol, high blood pressure during pregnancy, fetal and neonatal developmental effects, and accelerated puberty.
- Evidence of both PFOA and PFOS affecting immune systems, including reduced disease resistance and tumors in rats [National Toxicology Program 2016 and USEPA 2016e]
- The International Agency for Research on Cancer concluded that PFOA is “possibly carcinogenic” to humans (Group 2B)”
- USEPA concluded that there is suggestive evidence of carcinogenic potential for both PFOA and PFOS in humans [USEPA 2016].

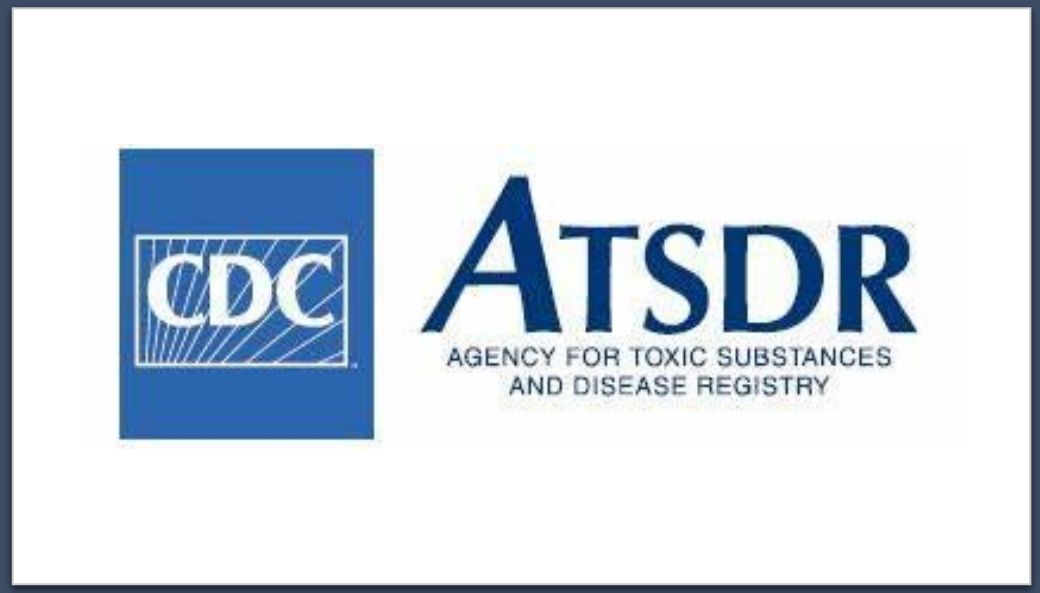


Bioaccumulation

- Long chain PFAS are difficult to be broken down by animal metabolism and therefore removal occurs slowly
- They accumulate in the blood, organ, and muscle tissues
- Concentration levels tend to be higher as trophic levels increase

What do PFAS impact –

- Long-term ingestion of low levels of PFAS - Nature of bioaccumulation through ingestion of contaminated fish and drinking water, atmospheric exposures to air and soil.
- PFAS stay in the human body for long periods of time. As a result, as people get exposed to PFAS from different sources over time, the level of PFAS in their bodies may increase to the point where they suffer from adverse health effects.
- There is evidence that exposure to PFAS can lead to adverse health outcomes in humans. Studies indicate that PFOA and PFOS can cause reproductive and developmental, liver and kidney, and immunological effects in laboratory animals. Both chemicals have caused tumors in animal studies. The most consistent findings from human epidemiology studies are increased cholesterol levels among exposed populations, with more limited findings related to:
  - infant birth weights;
  - effects on the immune system;
  - cancer (for PFOA); and
  - thyroid hormone disruption (for PFOS)



Statement on Potential Intersection between PFAS Exposure and COVID-19:

CDC/ATSDR recognizes that exposure to high levels of PFAS may impact the immune system. There is evidence from human and animal studies that PFAS exposure may reduce antibody responses to vaccines (Grandjean et al., 2017, Looker et al., 2014), **and may reduce infectious disease resistance** (NTP, 2016). Because COVID-19 is a new public health concern, there is still much we don't know. More research is needed to understand how PFAS exposure may affect illness from COVID-19.

How are PFAS regulated? FEDERAL

Safe Drinking Water Act (SDWA)

- Under the SDWA, USEPA has the authority to set enforceable Maximum Contaminant Levels (MCLs) for specific chemicals and require testing of public water supplies.
- The SDWA applies to all public water systems in the U.S. but does not apply to private domestic drinking water wells or to water not being used for drinking
- The MCL is the highest level of a contaminant that is allowed in drinking water based on cost benefit analysis and is enforceable.
- **There are currently no Maximum Contaminant Levels (MCLs) established for PFAS chemicals.**

Health Advisories

- In 2016, the U.S. Environmental Protection Agency (USEPA) established drinking water health advisories for two of the most common PFAS compounds: PFOA and PFOS. **The federal health advisories are non-enforceable and nonregulatory**, but rather are intended to provide technical information to states agencies and other public health officials on health effects, analytical methodologies, and treatment technologies associated with drinking water contamination. USEPA's health advisory levels for PFOA and PFOS are set at a level of 70 ppt, or .00007 ppm.
  - Based on analysis of data acquired under the EPA's Unregulated Contaminant Monitoring Rule (UCMR3) program, an **estimated 6 million municipal water users** have drinking water supplied by 66 large U.S. water providers with concentrations of PFOS, PFOA, or both above EPA's 70 ppt health advisory level. The UCMR3 data did NOT include smaller municipalities and private well owners.
- **EPA PFAS Summit (May 2018) and PFAS Action Plan (February 2019)**
  - Maximum Contaminant Level (MCL) to be investigated – would be proposed under Safe Drinking Water Act
  - PFOA and PFOS to be included in the definition of "hazardous substances" under CERCLA (Superfund)
  - Toxicity values for GenX and other PFAS

How are PFAS regulated? FEDERAL

Safe Drinking Water Act (SDWA)

- February 22, 2021:
  - EPA is reproposing the Fifth Unregulated Contaminant Monitoring Rule (UCMR 5) to collect new data on PFAS in drinking water. If promulgated, the Rule will impose data collection obligations on public water systems of a certain size. That data collection, when completed, can serve as part of the underpinning for additional SDWA actions, including adding chemicals to the Contaminant Candidate List and potentially regulating those chemicals under the SDWA
  - EPA plans to move forward with regulating the two most-researched members of the per- and polyfluoroalkyl substances (PFAS) class — PFOA and PFOS — under the SDWA.
- **March 10, 2021**
  - **USEPA concludes that regulating PFOS and PFOA represents a meaningful opportunity to reduce risk to health of sensitive populations, such as infants, children, and pregnant and nursing women.**

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA/Superfund)

- PFAS not currently included in definition of “hazardous substances”
- Contamination could be addressed under CERCLA pollutants or contaminants
- Including PFOA and PFOS in the definition of “hazardous substances” under CERCLA would allow EPA to order cleanup of sites under Sec. 106, and allow CERCLA cost recovery claims under Sec. 107.

How are PFAS regulated? ILLINOIS

- On January 28, 2021, the Illinois EPA announced the issuance of health advisories for four (4) per- and polyfluoroalkyl substances (PFAS) compounds in accordance with the Illinois Part 620 groundwater regulations (35 Ill. Adm. Code Part 620). Health advisories are issued when a chemical substance that is harmful to human health, and for which no numeric groundwater standard exists, is detected and confirmed in a community water supply well (35 Ill. Adm. Code 620.605). The four (4) PFAS compounds for which Illinois health advisories were issued are:
  - PFBS (Perfluorobutanesulfonic Acid) – 140,000 ppt
  - PFHxS (Perfluorohexanesulfonic Acid) – 140 ppt
  - PFHxA (Perfluorohexanoic Acid) – 560,000 ppt
  - PFOA (Perfluorooctanoic Acid) – 2 ppt

  OF NOTE: PFOS (perfluorooctane sulfonate) is not included in this health advisory
- The guidance levels contained in the Illinois health advisories are not enforceable groundwater or drinking water standards; rather, the health advisory guidance levels and other data gathered from the statewide drinking water investigation will be used by Illinois EPA in the development of maximum contaminant levels (MCLs) for PFAS, which are enforceable drinking water standards. In addition, the Illinois health advisory levels can be used to establish groundwater cleanup or action levels (35 Ill. Adm. Code 620.601).

How are PFAS regulated?

OTHER STATES

MINNESOTA

- On February 10, 2021, Minnesota announced its “PFAS Blueprint“, a 191 page aggressive plan with its stated goal being to “protect our communities and environment from [PFAS].” The detailed plan sets out a proposal to bolster regulations regarding PFAS through both legislation and agency rulemaking efforts. The PFAS Blueprint lays out ten priority areas of focus for PFAS, and supporting proposed legislative action to accomplish each priority.
- Adopted health based drinking water standards for PFOS (15 ppt) and PFOA (35 ppt) and other PFAS

MICHIGAN – Adopted MCLs for PFOS (16 ppt), PFOA (8 ppt) and other PFAS

How are PFAS regulated?

OTHER STATES

CALIFORNIA

- Adopted drinking water notification levels for PFOS (6.5 ppt) and PFOA (5.1 ppt) AND drinking water response levels for PFOS (40 ppt) and PFOA (10 ppt)
- PFOA and PFOS are included chemicals under Proposition 65 (Prop 65), which requires companies doing business in CA to provide a clear and reasonable warning before exposing anyone to the chemicals.

WASHINGTON STATE

- In March 2021, Washington state announced that, based on the availability of safer alternatives, per- and polyfluoroalkyl substances (PFAS) in four types of food packaging will be banned as of February 2023.
- The Washington Department of Ecology The department determined that PFAS alternatives (shown in parentheses) are available for the following four packaging applications:
  - Wraps and Liners (wax-coated options)
  - Plates (clay-coated and reusable options)
  - Food boats (clay-coated and reusable options)
  - Pizza boxes (uncoated options)

Remedial Strategies

- **Granulated Activated Carbon (GAC)** - Chemicals like PFAS stick to the small pieces of carbon as the water passes through.
- **Nanofiltration and Reverse Osmosis** - A process where water is pushed through a membrane with small pores. The membrane acts like a wall that can stop chemicals and particles from passing into drinking water.
- **Ionic Exchange with resins** - Small beads (called resins) are made of hydrocarbons that work like magnets. The chemicals stick to the beads and are removed as the water passes through.
- **Permeable reactive barriers** - Reactive barriers containing oxygen-releasing compounds
- **Phytoremediation** - Phytoremediation is the direct use of living plants for *in situ* remediation of contaminated soil, sludges, sediments, and shallow groundwater through contaminant removal, degradation, or containment.

ISSUES – cost, many options still require disposal in landfill or incineration, and chosen strategy may not remove all types of PFAS

Destruction

- PFAS are called “forever chemicals” because they don’t break down, and a reliable method of destruction has not been proven
- For obvious reasons, available technologies such as incineration have not been proven effective in destroying PFAS (this is despite USEPA considering incineration as a disposal method until fairly recently)
- "The USEPA is actively researching advanced technologies that destroy PFAS in contained systems, so effectiveness can be verified before the wastes are released into the environment". "We support efforts to safely store wastes until such systems are validated.”
- The Department of Defense, for example, is currently under deadline to dispose of PFAS-laden firefighting foam. But how?

Other Issues: LITIGATION

Litigation

- Major class actions and Attorney General lawsuits filed in multiple states against PFAS manufacturers (mostly 3M and DuPont/Chemours)
- Some municipalities have been brought into litigation as the result of discharges from waste water treatment plants, firefighting facilities and landfills
- Dairies and contaminated milk in New Mexico and Maine (no FDA standards for PFAS in food and beverages)

Wis. city sues foam makers over PFAS pollution [Associated Press, March 5, 2021]

- The city of La Crosse, Wis., filed a lawsuit yesterday against a host of chemical manufacturers that produced firefighting foam linked to groundwater contamination around the city's airport. Tests have revealed at least 40 wells around the airport on French Island are contaminated with man-made chemicals known as PFAS. The chemicals are believed to have originated from firefighting foam used during training and crashes at the airport. The lawsuit alleges the manufacturers knew since the 1960s that per- and polyfluoroalkyl substances, or PFAS, could be released from their foam and seep into groundwater, posing a risk to human health, yet continued to produce and sell it without warning their customers. The defendants include 3M Co., AGC Chemicals Americas and Tyco Fire Products.
- The city is seeking an unspecified amount of damages to cover investigating the extent of the contamination and treating it.

Other Issues:

TRANSACTIONS

Real estate and asset transactions

Phase I Environmental Site Assessments - history of property all the more important to be able to identify and quantify any potential PFAS contamination risks

Other Issues:

- Exposure to PFAS through required clothing/equipment
  - Firefighters - Although PFOA is no longer used to produce the protective pants and jackets firefighters call turnout gear, manufacturers still use other per- and polyfluoroalkyl substances (PFAS) that pose similar health risks.
  - Members of the Armed Services - PFAS contamination has become a high-profile issue for the Department of Defense due to the widespread presence of the chemicals in and around military sites. Firefighting foam commonly used in those areas contains PFAS.
- PFAS in pesticides - may raise a host of public health concerns including food safety, increased exposure through municipal mosquito spraying

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For more information…

USEPA

- *Per- and Polyfluoroalkyl Substances (PFAS)* -https://www.epa.gov/pfas
- GenX Chemicals Studies - https://www.epa.gov/pfas/genx-chemicals-studies
- PFAS Laws and Regulations - https://www.epa.gov/pfas/pfas-laws-and-regulations

ILLINOIS EPA

- https://www2.illinois.gov/epa/topics/water-quality/pfas/Pages/default.aspx

NORTH CAROLINA DEPARTMENT OF ENVIRONMENTAL QUALITY

- https://deq.nc.gov/news/key-issues/genx-investigation

3M - https://www.3m.com/3M/en_US/pfas-stewardship-us/

Chemours - https://www.chemours.com/en/about-chemours/global-reach/fayetteville-works/fayetteville-works-toxicology

And more information…

INTERSTATE TECHNOLOGY REGULATORY COUNCIL

- History and Use of Per- and Polyfluoroalkyl Substances (PFAS) - https://dnr.wi.gov/topic/brownfields/documents/bsg/ITRCPFAS1809.pdf
- Treatment Technologies and Methods for Per- and Polyfluoroalkyl Substances (PFAS) - https://pfas-dev.itrcweb.org/wp-content/uploads/2020/10/treatment_tech_508_Aug-2020-Final.pdf

MIDWEST ENVIRONMENTAL ADVOCATES

- Issues - https://midwestadvocates.org/issues-actions/issues/detail/pfas
- Conceptual site model for industrial sites - https://midwestadvocates.org/assets/resources/fateandtransportindustrialsites.jpg
- Conceptual site model for landfills and WWTPs – https://midwestadvocates.org/assets/resources/fateandtransportlandfillsandwwtps.jpg

And even more information…

AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY (ATSDR)

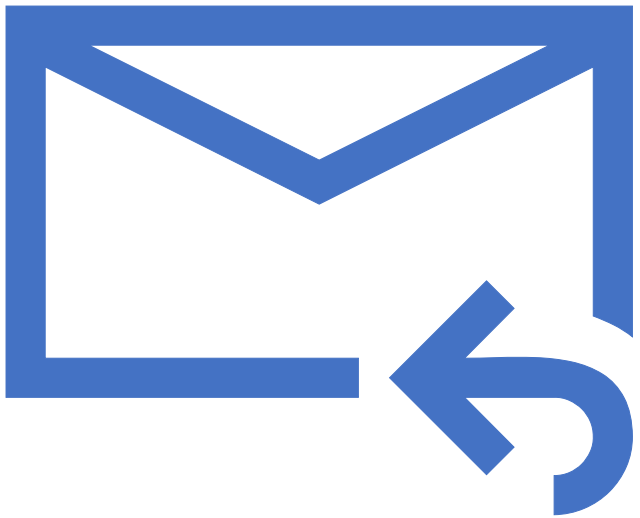
- Per- and Polyfluoroalkyl Substances (PFAS) and Your Health - https://www.atsdr.cdc.gov/pfas/health-effects/

ENVIRONMENTAL LAW NEXT

- State and Federal PFAS Drinking Water Standards by State (updated 01/08/2021) - Freeborn & Peters, LLP - https://www.environmentallawnext.com/wp-content/uploads/sites/11/2020/09/Chart-State-and-Federal-PFAS-Drinking-Water-Standards-1.8.21.pdf

State of Minnesota, City of Lake Elmo and Metropolitan Council v. 3M

- Minnesota District Court (Hennepin County, 4th Judicial District), Civil File No. 27-CV-10-28862



QUESTIONS

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