Per- and Polyfluoroalkyl Substances (PFAS) Fact Sheet

Introduction

To educate stakeholders on problems and solutions and to empower stakeholders in the planning and management of their water infrastructure, Louis Berger, a member of Jersey Water Works, has developed this fact sheet on per- and polyfluroalkyl substances (PFAS), contaminants of emerging concern. The Jersey Water Works Education and Outreach committee and the New Jersey Department of Environmental Protection (DEP) also played important roles in the development of this resource.

This fact sheet provides an introduction to PFAS chemicals, their uses, potential risks, major sources in the environment, occurrence in New Jersey's public water systems, regulatory developments, remediation information, and links to additional resources. It was published in March 2019.

What should I know about PFAS?

- PFAS are a diverse group of synthetic chemicals, considered useful in some manufacturing applications because they are resistant to heat, water, and oil. See the family tree diagram.[1]
- Certain PFAS are environmentally mobile, accumulate through the food chain, and are not known to degrade in the environment.
- Exposure to certain PFAS through consumer products, contaminated drinking water, food, soil, or other media can lead to adverse human health effects.
- PFAS are not removed from water by boiling.
- Certain PFAS are found in the blood of virtually all U.S. residents. This widespread exposure is believed to arise primarily from diet and consumer products.
- When drinking water is contaminated with even relatively low concentrations of PFAS, drinking water exposure can overwhelm general exposures from diet and consumer products.[2]
- PFOA and PFOS have been the most extensively produced and studied of these chemicals. Both are very persistent in the environment and in the human body.
- Use of PFOA and PFOS has been phased out voluntarily in the U.S. by major manufacturers due to concerns about their accumulation in the human body. However, past contamination, particularly in groundwater, will persist indefinitely. Additionally, importing products made with PFAS is still allowed.

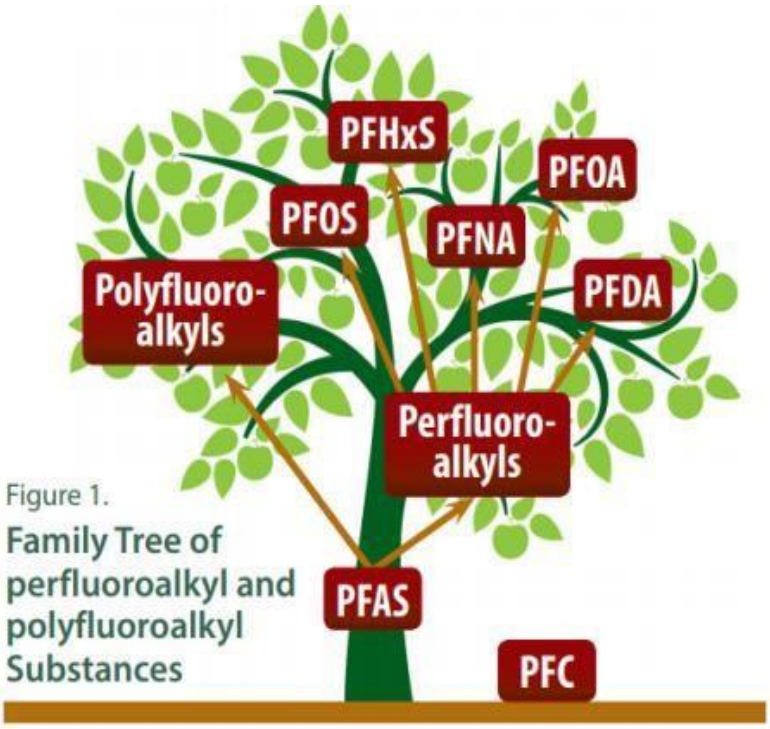


Figure 1. Family Tree of perfluoroalkyl and polyfluoroalkyl Substances

Where are PFAS used or applied?

The following are some of the major product applications of PFAS in use today within the manufacturing industry:

- Textiles and leather with a coating to repel water, oil, and stains; e.g., protective clothing and outerwear, umbrellas, tents, sails, architectural materials, carpets, and upholstery
- Paper products with surface coatings to repel grease and moisture; e.g., pizza boxes, fast food wrappers, microwave popcorn bags, baking papers, pet food bags
- Metal plating and etching with corrosion prevention, mechanical wear reduction, and aesthetic enhancement
- Wire manufacturing with coating and insulation
- Industrial plastics, resins, and molds
- Firefighting foam (referred to as aqueous film forming foam, or AFFF)

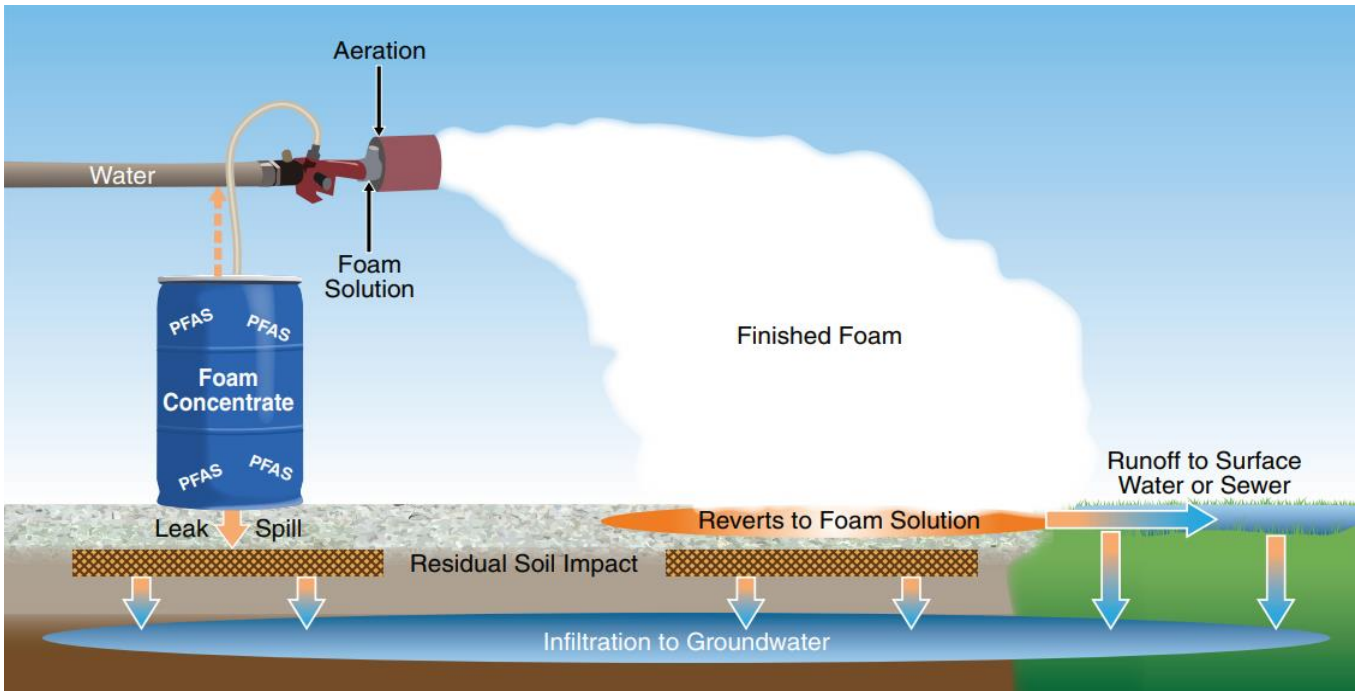
How do PFAS get into drinking water and other environmental media?

Drinking water can be a source of exposure in communities where these chemicals have contaminated water supplies. Such contamination is typically associated with a specific facility; for example:

- A facility where PFAS were produced, used to manufacture other products, or discharged as waste into soil, water, or air.
- An agricultural site using applications of nutrient-rich organic materials, or byproducts resulting from the treatment of domestic sewage in a wastewater treatment facility.
- A location where AFFF is discharged for firefighting or firefighter training, such as an oil refinery, airfield, or military base. The graphic below illustrates how AFFF can contaminate drinking water supplies.[3]

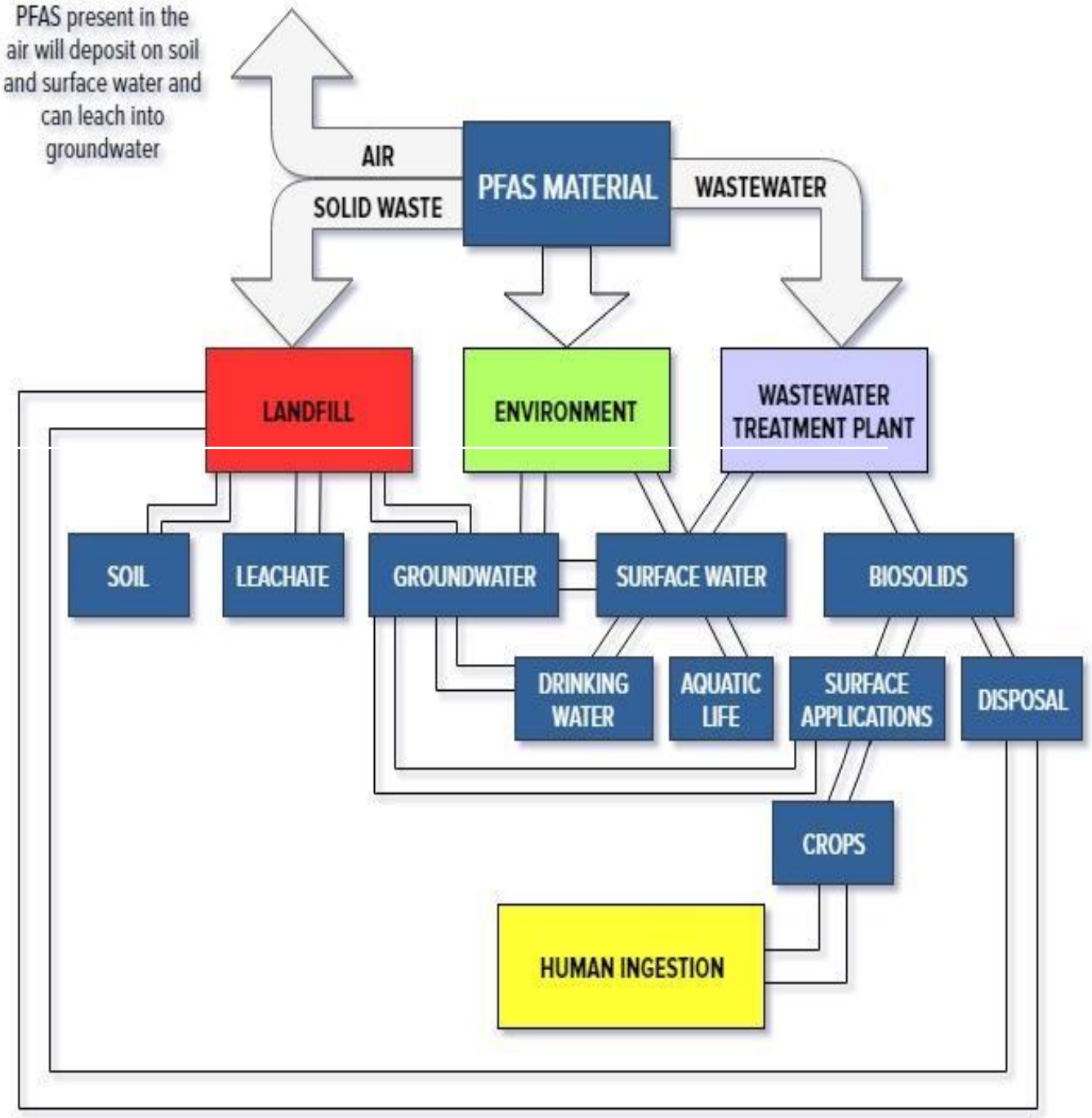
Humans can become exposed to PFAS through food that has become contaminated via:

- Contaminated soil and water used to grow the food.
- Food packaging containing PFAS.
- Equipment that used PFAS during food processing.



Discharge of large amounts of PFAS to air can result in contamination over a large area (up to 20 miles away) due to air deposition. Discharge into a river can result in contamination up to hundreds of miles downstream.

The flow chart below depicts possible pathways PFAS material might take before ending in human ingestion. As environmental sampling for PFAS continues to occur, it is likely that additional sources may emerge.



What health effects are associated with PFAS?[4]

According to the United States Environmental Protection Agency (US EPA), PFAS exposure can lead to adverse outcomes in humans. If humans, or animals, ingest PFAS (by eating food or drinking water that contains PFAS), the PFAS are absorbed, and can accumulate in the body. 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 health impacts become evident.

Studies indicate that PFOA and PFOS can have reproductive, developmental, liver, kidney, and immunological effects in laboratory animals. Both sets of chemicals have caused tumors in animals.

The most consistent findings from human epidemiology studies are increased cholesterol levels, liver enzymes and uric acid among exposed populations, with more limited findings related to:

- Decreased infant birth weights;
- Negative effects on the immune system, including decreased response to vaccinations;
- Cancer (for PFOA).

The potential effects on human health of exposure to PFAS continue to be studied.

Monitoring and occurrence in New Jersey public water systems (PWSs)

From 2013 to 2015, US EPA included six PFAS -- PFOS, PFOA, PFNA, PFHxS, PFHpA, and PFBS -- as part of the Third Unregulated Contaminant Monitoring Rule (UCMR 3). UCMR 3 applied to the following systems in New Jersey:

- 165 large PWS;
- 13 of approximately 435 small PWSs;
- 8 of approximately 700 non-transient non-community water systems (NTNCWSs)

New Jersey versus National PFC Detections in UCMR3					
Compound	Reporting Level (ng/L)	New Jersey PWS		National PWS	
		# Detects*	% Detects	# Detects (other than New Jersey)**	% Detects (other than New Jersey)
PFOA (C8)	20	19/175	10.9%	98/4745	2.1%
PFNA (C9)	20	4/175	2.3%	10/4745	0.2%
PFOS (C8-S)	40	6/175	3.4%	89/4745	1.9%
PFHxS (C6-S)	30	2/175	1.1%	53/4745	1.1%
PFBS (C4-S)	90	0/175	0%	8/4745	0.2%
PFHpA (C7)	10	6/175	3.4%	80/4745	1.7%
*New Jersey data as of 10/14/16. **US EPA data posted online as of July 2016.					

A reanalysis of the data using lower reporting levels (similar to those used in the New Jersey data mentioned above) shows that PFAS are very frequently found in PWSs.[5]

Based on data collected by DEP from studies it performed in 2006 and 2009-2010 and additional data submitted by PWSs through 2016, PFOA was found at some level in raw or finished water in about 60 percent of the PWSs tested, and PFOS in about 30 percent. Other PFAS were reported less frequently.

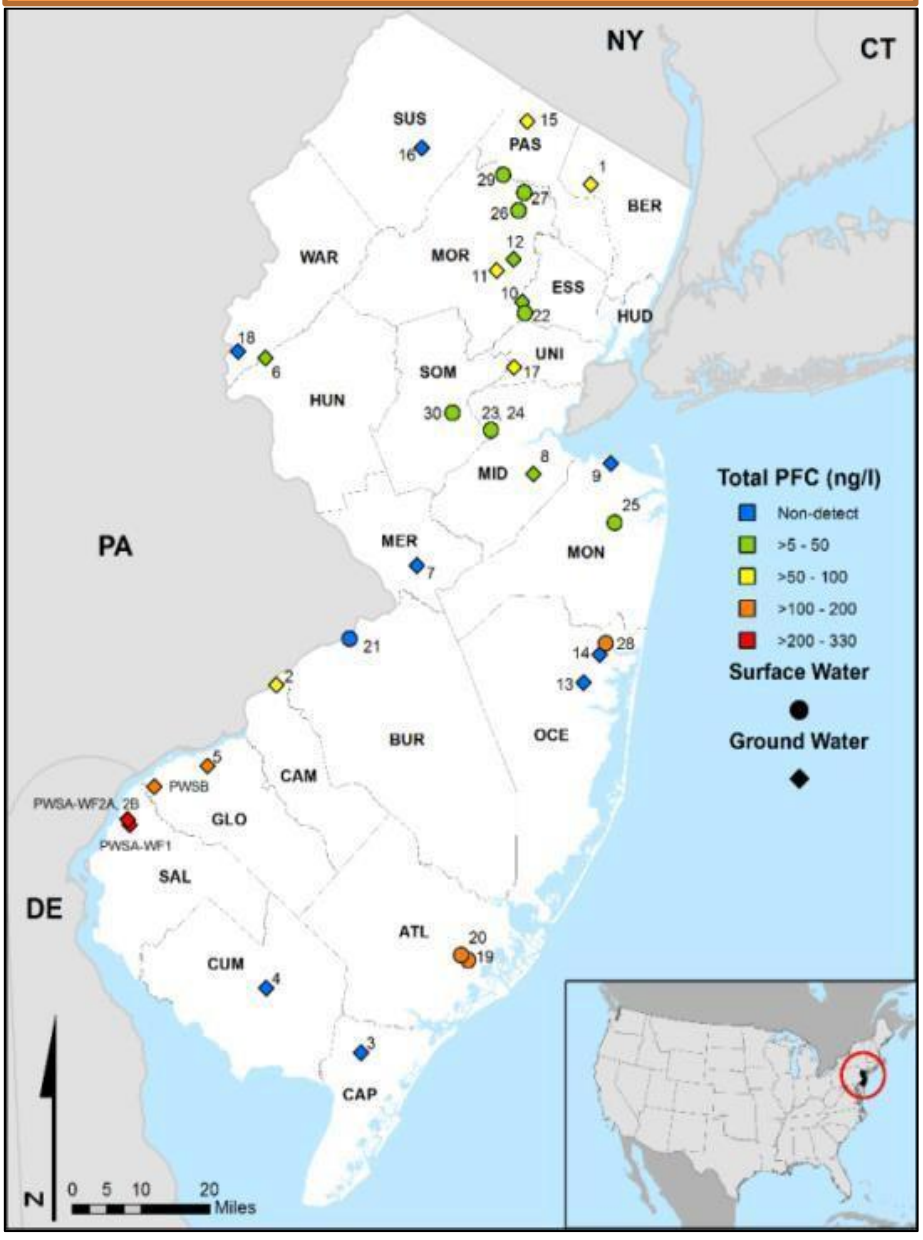
Data through 2018 from approximately 216 of 580 PWSs in New Jersey from the two DEP studies, UCMR3 data from EPA, and other data submitted to DEP found levels above at least one of the New Jersey maximum contaminant levels (MCLs) for PFOA, PFOS, and/or PFNA in 48 of 216 PWSs that had reported data.

Many of these PWSs have taken action to reduce exposure.

The following is a summary of PFAS-related studies and findings conducted by DEP since 2006:

- **2006:** DEP study detected PFOA in 15 of 23, and PFOS in 7 of 23 PWSs above 4 ppt.[6]
- **2009-2010:** DEP studied PFOA, PFOS, and eight other PFAS in 31 PWSs. Results for PFOA and PFOS were similar to the 2006 study, and other PFAS were found less frequently.
- PFOA and PFNA have been detected more frequently in New Jersey than nationally, with most frequent detections in the following counties:
    - PFNA – Gloucester and Camden counties.
    - PFOA – Salem, Ocean, Essex, and Bergen counties.
- The following PFAS source sites in New Jersey have been confirmed:
    - Five industrial sites.
    - Four federal sites where firefighting foam has been applied extensively.

Occurrence of perfluorinated chemicals in raw water from New Jersey PWSs[6]



How are PFAS regulated and monitored in drinking water and ground water in New Jersey?

Below are significant regulatory developments for PFAS at the federal and state levels:

- **2007:** DEP issues chronic drinking water guidance for PFOA of 40 parts per trillion (ppt)
- **July 2015:** New Jersey Drinking Water Quality Institute (DWQI) recommends MCL for PFNA of 13 ppt.
- **May 2016:** US EPA issues a Lifetime Health Advisory for PFOS, PFOA, or the total of both, of 70 ppt in drinking water.
    - New Jersey and other states have developed standards or guidance values for PFAS in drinking water lower than the USEPA Health Advisory.
- **March 2017:** DWQI recommends MCL for PFOA of 14 ppt.
- **October 2017:** DEP issues updated drinking water guidance for PFOA: 14 ppt
- **January 2018:** DEP adds PFNA to Groundwater Quality Standards (GWQS) and New Jersey List of Hazardous Substances at levels above 10 ppt.
- **September 2018:** DEP adopts new MCL and revised GWQS for PFNA: 13 ppt.
- **June 2018:** DWQI recommended the PFOS MCL of 13 ppt.
- **January 2019:**
    - DEP develops draft Interim Ground Water Quality Criteria for PFOA and PFOS: 10 ppt.
    - DEP states that it plans to propose MCLs for PFOA and PFOS in spring 2019.
    - DEP began to get results of PFAS monitoring under the new PFNA MCL.
- **March 2019:** DEP established Interim Specific GWQS of 10 ng/L for PFOA and 10 ng/L for PFOS.
- **April 2019:** DEP to propose rules for PFOA and PFOS, including MCLs, GWQS, and inclusion on the New Jersey List of Hazardous Substances.

The following outlines the regulatory monitoring framework for PFAS chemicals in New Jersey PWSs:

- PFNA monitoring required by DEP at all PWSs and all NTNCWSs; e.g., schools, factories, office buildings, and hospitals that have their own water systems.
    - Monitoring of small (serving a population of 10,000 or fewer) groundwater systems and NTNCWSs begins in 2019.
    - Monitoring of large (serving a population greater than 10,000) groundwater systems and all surface water systems begin in 2020.
- PFNA monitoring is currently not required at transient water systems and private wells.
- PWSs reporting data for PFNA are encouraged to report data for PFOA and PFOS, as submissions may be considered to be "grandfathered data" for reduced future monitoring frequency if MCLs for PFOA and PFOS are adopted.

What remediation technologies exist for affected utilities?

PFAS remediation technologies at contaminated sites exploit chemical and physical properties to immobilize, remove, or destroy the targeted contaminants. Currently, full-scale PFAS treatment in water is limited to absorption, using carbon, mineral media (e.g. clay), or a combination of these. Available drinking water treatment technology can remove PFAS to non-detectable levels, and additional PFAS treatment technologies are being tested.

Where can I find more information?

- **US EPA – Per- and Polyfluoroalkyl Substances (PFAS)**
- **US EPA – Technical Fact Sheet – Perfluorooctane Sulfonate (PFOS) and Perfluorooctanoic Acid (PFOA)**
- **DEP – Contaminants of Emerging Concern (PFAS)**
- **DOH – Drinking Water Facts: Per- and Polyfluoroalkyl Substances (PFAS) in Drinking Water**
- **Interstate Technology and Regulatory Council – PFAS Fact Sheets**
- **DWQI reports supporting MCL recommendations for PFOA, PFOS, and PFNA**
- **DEP Standards Compendium**
- **DEP Rules and Regulations**

About Jersey Water Works

Jersey Water Works is working to transform New Jersey's inadequate water infrastructure through sustainable, cost-effective solutions that provide communities with clean water and waterways; healthier, safer neighborhoods; local jobs; flood and climate resilience; and economic growth. Learn more at **www.JerseyWaterWorks.org**

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[1] The family tree of per- and polyfluoroalkyl substances (PFAS) for environmental health professionals: https://www.atsdr.cdc.gov/pfas/docs/PFAS_FamilyTree_EnvHealthPro-508.pdf

[2] Post GB, Gleason JA, Cooper KR (2017) Key scientific issues in developing drinking water guidelines for perfluoroalkyl acids: Contaminants of emerging concern. PLoS Biol 15(12):e2002855.

[3] https://pfas-1.itrcweb.org/wp-content/uploads/2017/11/pfas_fact_sheet_history_and_use__11_13_17.pdf

[4] U.S. Environmental Protection Agency

[5] https://greensciencepolicy.org/wp-content/uploads/2017/12/Andy_Eaton_UCMR3_PFAS_data.pdf

[6] https://www.nj.gov/dep/dsr/dw/final_pfoa_report.pdf

[6] Post, G.B., Louis, J.B., Lippincott, R.L., and Procopio, N.A. (2013). Occurrence of perfluorinated chemicals in raw water from New Jersey public drinking water systems. Env. Sci. Technol. 47:13266-75.