

**ITRC PFAS Introductory Training**  
**Questions & Answers: [January 28, 2025 Course Offering](https://pfas-1.itrcweb.org/)**  
**Sponsored by: Interstate Technology and Regulatory Council**

*This question-and-answer file is a reference of the questions asked during the live training course held on January 28, 2025 and archived on the Clu-In website. Additional details have not been provided to these answers. Additional information is available in the PFAS Technical and Regulatory Guidance (<https://pfas-1.itrcweb.org/>).*

**What makes PFAS a good fire retardant?**

**Answer:** PFAS are attracted to the water/air interface. This creates a barrier to oxygen transfer to the fire, smothering it.

**It was mentioned that there are alternatives being produced that are shorter chained. Is this to evade regulation, and are they as detrimental to the environment?**

**Answer:** Alternative PFAS are used to achieve the same benefits, without the known problems. But, sometimes, these alternatives have their own issues. Some have more of a negative impact on human health or the environment than others, and research is ongoing to characterize these alternatives better.

**Is the contamination of drinking water mostly from run off / contamination from other sources? Or is it from coatings on pipes or pipe sealers?**

**Answer:** The four main sources of PFAS to the environment are industrial releases, AFFF releases, and releases from wastewater treatment plants and landfills. While coating and pipe sealers may contain small amounts of PFAS, they have not been identified as major sources.

**Can you please describe what is considered the primary manufacturing source of PFAS?**

**Answer:** That is where the PFAS chemicals are initially produced, as compared to other industries that use the PFAS products produced elsewhere.

**Can precursors be considered a Contaminant of Emerging Concern (CEC) or does that just depend on the situation?**

**Answer:** In a general sense, precursors can be considered as a CEC. CEC is a broad term, with different definitions depending on who is doing the defining. Some definitions just name certain chemicals, and that usually is a short list of PFAS, generally PFAAs, but maybe a few precursors.

**Do you have a source you can share for the determination that the military designated AFFF for use on all liquid fueled fires in the 1960s?**

**Answer:** For specific resources on this topic, you may reference Sections 2 and 3 of the PFAS Technical and Regulatory Guidance (<https://pfas-1.itrcweb.org/>).

**Do PFAS form micelles in the environment?**

**Answer:** PFAS do form supramolecular structures like micelles, hemi-micelles, and bilayers, similar to other surfactants. It is possible under the right conditions. Micelle behavior in the environment is still an area of research for PFAS. Behavior of PFAS in the environment will be discussed more in the fate and transport section of this presentation and additional detail is included in Section 5 (5.2.2.2) of the PFAS Technical and Regulatory Guidance (<https://pfas-1.itrcweb.org/>).

**If the C-F bond is too strong to break, how do these substances really break, how do they really move out of products and release into environment?**

**Answer:** The PFAS moves out of products as the full PFAS chemical structure! It is the PFAS molecule that is very stable because of those C-F bonds. They generally do not have natural mechanisms to break them down in the environment and need special treatment conditions.

**Any published research on the mechanisms of sorption and desorption of PFAS on different soil types and how that affects their transport?**

**Answer:** Behavior of PFAS in the environment will be discussed more in the fate and transport section of this presentation and additional detail is included in Section 5 of the PFAS Technical and Regulatory Guidance (<https://pfas-1.itrcweb.org/>). The tech reg includes links to a very large list of resources, including peer-reviewed literature.

**I've heard of PFAS being present in pesticides and some fertilizers and I am wondering what types are present and what that may entail about farmland and runoff? Also, are there any studies being conducted on plants sprayed with pesticides containing these PFAS chemicals and the amount therefore consumed by individuals eating sprayed produce?**

**Answer:** PFAS has been found in HDPE containers that are used to store and transport pesticides. PFAS has also been found in some pesticides. See Table 2-7 in the Technical and Regulatory Guidance Document: [https://pfas-1.itrcweb.org/2-5-pfas-uses/#table\\_2\\_7](https://pfas-1.itrcweb.org/2-5-pfas-uses/#table_2_7).

**Can you please tell me how the PFAS precursors influence effects or implications to the environment?**

**Answer:** The release of PFAS precursors to the environment means that there is a reservoir of chemicals that can transform to the longer chain PFAAs in the future. They also could have their own level of toxicity.

**2% of 18%, or 2% of the total concentrate?**

**Answer:** 2% of 18%

**What has been the driving factor for why AFFFs evolved over time? Is that related to health or environmental concerns, ingredients available, improvement in efficiency as firefighting foams, etc.?**

**Answer:** There are many reasons the formulations have changed over time. The transition across the industry from C8 legacy foams to C6 modern foams was due only to environmental concern. Other formulations over time were related to a multitude of other factors from efficacy, need, etc.

**Can PFSA's be produced by telomerization? or only by ECF?**

**Answer:** See Section 2.2.4.1 of the PFAS-1 Tech Reg document: Fluorotelomer substances are polyfluoroalkyl substances produced by the fluorotelomerization process. As shown in Figure 2-11, the transformation of fluorotelomer-based substances is a potential source of PFCAs in the environment, but not PFSAs (Buck et al. 2011).

**How "easy" is it for the PFAS molecules to break away from other molecules to become mobile.**

**Answer:** There are a few factors. If part of a polymer, the breakdown/release of mobile PFAS can be slow. When considering release to soils, PFAS can sorb and desorb fairly easily. Precursors tend to be more "sticky" in soils, PFAAs are more mobile.

**Will there be any information discussed on in situ thermal desorption of PFAS in soil or steam injection to break apart PFAS in soils?**

**Answer:** Those particular approaches are not addressed in today's training but there is more info available in Section 12 of the PFAS Technical and Regulatory Guidance (<https://pfas-1.itrcweb.org/>).

**Landfill being a source of PFAS contamination, why is it being recommended as a treatment option?**

**Answer:** Some landfills have appropriate liners and other management that reduce the potential for release. It is the older, unlined landfills that would be a concern about releases to the environment.

**So as far I understand, after the 2010s the use of PFOS in AFFFs has been completely restricted. However, can we say that the fluorotelomers that are used for the AFFF in present times has the potential to degrade into PFOAs? Therefore, PFOAs being more PFAS of interest in AFFF than PFOS now?**

**Answer:** Yes- modern fluorotelomer foams that are currently being sold do not intentionally contain PFOA. They can have trace, unintentionally added PFOA. They do contain PFCA precursors that can transform to other short chain PFCAs such as PFHxA, PFPeA and 5:3 FtA.

**What type of PFAS is present in refineries? What about petrochemicals?**

**Answer:** PFAS associated with refineries are generally those that originate with the use of AFFF, so the chemical make-up would depend on the type of AFFF used. There may be other sources on site, but those could vary widely. PFAS can be found in product evaporation-loss layers in storage tanks, and acid-resistant pipe coatings. [https://www.waterboards.ca.gov/pfas/docs/order\\_wq2021-0006-dwq\\_pfas.pdf](https://www.waterboards.ca.gov/pfas/docs/order_wq2021-0006-dwq_pfas.pdf)

**What advancements are being made in the development of PFAS-specific sorbents for groundwater treatment?**

**Answer:** Refer to Section 12 of the PFAS Technical and Regulatory Guidance (<https://pfas-1.itrcweb.org/>) for more information.

**Any understanding yet on the biosolids to agricultural land vector? A lot of states allow for this use of sludges. If biosolids to landfills is a known issue, I have to think that this is/will be a big deal.**

**Answer:** This topic is an active area of study. EPA just released the "Draft Sewage Sludge Risk Assessment for Perfluorooctanoic Acid (PFOA) and Perfluoro octane Sulfonic Acid (PFOS)." (<https://www.epa.gov/biosolids/draft-sewage-sludge-risk-assessment-perfluorooctanoic-acid-pfoa-and-perfluorooctane> ) Additionally ITRC is currently developing additional information and guidance on PFAS and biosolids.

**For testing soils or ground water for contamination, is fluoride a good general indicator of PFAS chemicals being present? Or should they be tested individually?**

**Answer:** Fluoride detection limits are generally not low enough for useful direct comparison. They would need to be tested separately. Also, PFAS is considered organofluorine, which under total fluorine analysis is indistinguishable from inorganic fluorine which may confound results. There are also a number of different technologies being developed and validated for field screening of Total PFAS or individual compounds. Not commercially available for the most part yet but should be fully validated within the next few years.

**Can you explain or give an example how PFOA might be unintentionally added?**

**Answer:** Sure. Unintentional additions may occur in many ways. Some examples 1) The PFAS-free formulation may have been manufactured at a location that historically manufactured PFAS-containing products. Because of the recalcitrance of PFAS, they tend to stick around, and cross-contamination may have occurred. 2) The product may have been cross-contaminated by PFAS contained in the packaging that held the product (we saw this a few years back with pesticides---the pesticides did not contain PFAS but the totes that were used to hold the pesticides did and that PFAS leached into the pesticides), 3) Unintended addition of PFAS from contaminated process water during the manufacturing process.

**Related to air-drying of the PFAS contaminated soil in the lab for soil characterization. Is it safe to dry the soil on the open counter in the lab? I'm worried about the transport of PFAS from soil to air.**

**Answer:** We do not cover that in the PFAS-1 document, however we are working on new content this year, and this may be covered then.

**Landfills nowadays have liner systems as barriers preventing leaching, not sure how these liners react or are stable to PFAS chemicals - are they compromised?**

**Answer:** Recently, EPA updated their "Interim Guidance on the Destruction and Disposal of PFAS and Materials Containing PFAS" (<https://www.epa.gov/pfas/interim-guidance-destruction-and-disposal-pfas-and-materials-containing-pfas>) which includes considerations for identifying preferred landfill disposal alternatives.

**Are the risks from these compounds more associated with the fluorine chains or the carboxyl's and/or sulfonates?**

**Answer:** We are not covering human health effects in this training, but we have a beyond the basics training on 3/25 for human and eco effects: <https://www.clu-in.org/conf/itrc/PFAS-BTB-HH/>.

**Can microbes break down the carbon-carbon bond in PFAA tails so that the tails become shorter over time?**

**Answer:** Yes, that is possible, for precursors, under the right conditions. Precursors may transform into PFAAs through this transformation.

**Are there any known environmental sources of PFAS compounds or are they only known to occur through chemical synthesis?**

**Answer:** All PFAS are of anthropogenic origin. There are no natural sources of the PFAS that concern us today.

**How is PFAS distributed in surface water when it is present? For example, does it tend to clump together or concentrate at the sediment level or at the surface of the water body or is it uniformly distributed throughout the water body?**

**Answer:** Although PFAS are highly soluble in water, their structure causes them to collect at the air-water interface. See Section 5.2.2 of the Technical and Regulatory Guidance Document. [https://pfas-1.itrcweb.org/5-environmental-fate-and-transport-processes/#5\\_2](https://pfas-1.itrcweb.org/5-environmental-fate-and-transport-processes/#5_2). Also, Section 5.3.4 has some additional details on the topic. [https://pfas-1.itrcweb.org/5-environmental-fate-and-transport-processes/#5\\_3](https://pfas-1.itrcweb.org/5-environmental-fate-and-transport-processes/#5_3).

**From Sludge (containing PFAS) to Biosolids/Biochar for agriculture and or Biogas production. The Sludge is subjected to a refining process that includes introduction of high pressure and temperature. Is it possible that these processes help to completely destroy those PFAS or degrade it to a nontoxic compound?**

**Answer:** This topic is an active area of study. EPA just released the "Draft Sewage Sludge Risk Assessment for Perfluorooctanoic Acid (PFOA) and Perfluorooctane Sulfonic Acid (PFOS)." (<https://www.epa.gov/biosolids/draft-sewage-sludge-risk-assessment-perfluorooctanoic-acid-pfoa-and-perfluorooctane>) Additionally ITRC is currently developing additional information and guidance on PFAS and biosolids.

**What could be the most important variables to be considered for modelling the degradation of PFAS in a Drinking/wastewater network system (i.e., in the drinking water pipes and Sewer network)?**

**Answer:** First, it is useful to consider the processes occurring in drinking and wastewater treatment as "removal" or "transformation" rather than degradation. There are many chemical and physical processes that could play a role and create that level of sensitivity that affects your model results. The levels and types of PFAS present are key considerations as well as how these PFAS would partition or transform with your chosen treatment. Those key considerations could include hydraulic residence times, DO concentration, and influent precursor concentration.

**I'm curious about PFAS in dry cleaning. Do you know of resources on which PFAS compounds may have been used in that industry (and to what extent it was common)?**

**Answer:** PFAS related to dry cleaning is often due to the release of PFAS from materials treated to be water resistant or the like. However, it is found in a dry-cleaning agent known as Pure Dry (R) which was a replacement for Perc (Table 2-6 in the Tech Reg).

**What are the current regulatory limits for military installations?**

**Answer:** Overall standards would be the same as for other facilities, as contained in Section 8 of the guidance document.

**The PFAAs are stable though and their tails don't become shorter over time due to microbial degradation?**

**Answer:** Correct

**Are you aware of any good studies about PNAS and biofilms, benthic Cyanobacteria mats, or harmful algae blooms.**

**Answer:** From Section 17.3.1.4 Surface Water (PFAS-1 Tech Reg Doc): Biofilms on surface water are known to accumulate PFAS (Munoz, G., L. C. Fechner, E. Geneste, P. Pardon, H. Budzinski, and P. Labadie. 2018. "Spatio-temporal dynamics of per and polyfluoroalkyl substances (PFAS) and transfer to periphytic biofilm in an urban river: case-study on the river Seine." Environmental Science and Pollution Research 25 (24):23574-23582), as do other organic-/protein-rich particles in aquatic systems (Ahrens and Bundschuh 2014).

**It appears that the PFAS contamination traces can't be eliminated at the source levels or transition/transportation levels but at receiving source (drinking water) - can the drinking water treatment technologies available today eliminate these chemicals making safe to consume.**

**Answer:** Section 12.2 of the Technical and Regulatory Guidance Document provides details on a number of these technologies, including granular activated carbon and anion exchange. [https://pfas-1.itrcweb.org/5-environmental-fate-and-transport-processes/#5\\_3](https://pfas-1.itrcweb.org/5-environmental-fate-and-transport-processes/#5_3) " There are definitely drinking water treatments that can reduce the level of PFAS to below standards/detection. There is also work that can be done to reduce them from their sources.

**At what surface water depth should PFAS be sampled?**

**Answer:** That depends on the objectives of sampling. We see stratification of PFAS in surface water, with concentrations at the surface often being orders of magnitude higher than concentrations in the water column. Additional information on surface water fate and transport can be found in section 5.3.4.1 and 5.3.4.2, and 10.3.1.2. Surface water sampling is addressed in section 11.1.7.3.

**The fate and transport of PFAS at the soil/water interface and lateral extent was briefly discussed. Is PFAS contamination primarily confined to shallow groundwater or does a typical remedial investigation include a vertical-extent groundwater assessment?**

**Answer:** PFAS can migrate deep within an aquifer, for a variety of reasons, but do not always do so. Investigations should include the vertical extent of PFAS.

**What is the difference between bio transform and biodegrade?**

**Answer:** Biodegrade refers to complete degradation (complete breakdown into CO<sub>2</sub> and F<sup>-</sup>), bio transform refers to the partial transformation of precursors into PFAAs.

**Are there any PFAS that have a tendency to accumulate at the base of an aquifer, or further into an aquifer, rather than at the air-water interface?**

**Answer:** PFAS do not tend to move downward within an aquifer (like DNAPL would) but do move with groundwater, which can distribute PFAS throughout an aquifer. PFAS-1 Section 5.3 provides an overview.



**How readily are airborne PFAS transported to the ground by rain? Is there data for PFAS concentrations in rainfall?**

**Answer:** PFAS released to the atmosphere can migrate and eventually partition to wet deposition or dry deposition. The ITRC PFAS-1 tech reg does contain a great discussion on this in Section 6. There is also data culled from the literature in tables in Section 17 ([https://pfas-1.itrcweb.org/17-additional-information/#17\\_1](https://pfas-1.itrcweb.org/17-additional-information/#17_1)).

**Aside from sampling guidance for quality assurance (e.g., avoid cross-contamination), what safety guidance exists for those who are sampling PFAS in environmental media?**

**Answer:** PFAS compatibility is the primary area where PFAS sampling diverges from conventional sampling. Generally, safety practices for conventional sampling are also adequate for PFAS. One item to note, sometimes site-specific PPE requirements conflict with PFAS sampling best practices (see PFAS-1 section 11.1.2).

**Can PFAS samples be frozen and used later for analysis? Why?**

**Answer:** Yes, according to the recent EPA method (1633), aqueous samples, soil/sediment, biosolids and tissue can all be frozen. Freezing the samples also extends the holding time for specific PFAS compounds.

**Seems like CFCs should have been a clue for our PFAS problems. I must be incorrect because I see no mention of this. How are they significantly related, beyond fluorination?**

**Answer:** CFCs and their replacements are currently a topic of discussion. Stay tuned, as the team is compiling information to answer this question.

**What does "breakthrough" mean in this context?**

**Answer:** Breakthrough refers to detection in the effluent water above the target treatment concentration, which means that the treatment media is "spent" and needs replacement.

**Where do waste products containing concentrated PFAS go? Are there contractors that move those materials to hazardous disposal sites?**

**Answer:** Section 12 of the guidance document covers this topic. There are waste contractors that handle the waste as non-hazardous or hazardous depending on regulatory situation. Additional information is provided in EPA guidance: <https://www.epa.gov/pfas/interim-guidance-destruction-and-disposal-pfas-and-materials-containing-pfas>.



**When incinerating soil impacted with PFAS, are there concerns for air transport of PFAS?**

**Answer:** Incomplete combustion of PFAS compounds could lead to air transport of PFAS. Section 12.4 of the Guidance Document and the 2024 Interim Guidance on the Destruction and Disposal of Perfluoroalkyl and Polyfluoroalkyl Substances and Materials Containing Perfluoroalkyl and Polyfluoroalkyl Substances contain more information on this issue.

**For in situ remediation using colloidal activated carbon, is the hope to just containment rather than treat? If so, do you extract and dispose?**

**Answer:** Containment is the goal, similar to a pump and treat concept. Preventing migration. Details in Section 12