PFAS Decontamination, F3 Transition, and Environmental Guidance for ARFF Vehicles and Fixed Fire Suppression Systems

Lisa Kammer
Zoom Nguyen

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1.0 Executive Summary and Key Takeaways

- **FAA authorized AFFF-to-F3 transition is underway and federally funded***: The Federal Aviation Administration (FAA) has approved fluorine-free foam (F3) for Part 139 compliance, and $350 million in cost reimbursement is available through FY2028 under the PFAS Replacement Program for Airports – retroactive through September 12, 2023. Eligible costs include foam acquisition, aqueous film-forming foam (AFFF) disposal, equipment cleaning or replacement, and aircraft rescue and firefighting (ARFF) vehicle replacement. The window to act and recover costs is open now. (*Subject to federal appropriations.)
- **Cleaning per- and polyfluoroalkyl substances (PFAS) out of firefighting equipment is harder than it sounds**: After years of use, PFAS build up in persistent layers on the interior surfaces of foam tanks, piping, and suppression system components. Simply flushing with water does not remove it, and PFAS levels often rebound after an initial rinse. Published research shows that heated, high-solvency cleaning agents achieve 10- to 20-fold greater PFAS removal compared to water alone. Effective decontamination requires a structured, science-based process with sampling before and after cleaning to verify results.
- **Airlines and private tenants may face legal liability that public airports do not**: In 2024, the U.S. Environmental Protection Agency (EPA) classified two of the most common PFAS (perfluorooctanoic acid [PFOA] and perfluorooctanesulfonic acid [PFOS]) as hazardous substances under federal Superfund law. This designation carries strict and retroactive liability, meaning parties can be held responsible for contamination caused by past activities, even if those activities were legal at the time. EPA has stated that it does not intend to pursue publicly owned airports and local fire departments, but that protection does not explicitly extend to private airline tenants, fixed base operators (FBOs), or other commercial operators that have owned or operated AFFF-containing fire suppression systems.
- **Historical AFFF use may have contaminated soil and groundwater**: Routine activities (i.e., system testing, accidental activation, maintenance, or emergency response) result in AFFF discharges that may have impacted soils, stormwater infrastructure, surface water, drinking water, and groundwater. Where historical use or releases are known or suspected, a phased investigation is recommended to determine risk pathways and whether contamination exceeds federal or state cleanup thresholds.
- **Proactive investigation and remediation are the strongest risk management strategies**: Voluntary action, including proactive decontamination, environmental investigation, and, where needed, remediation and cleanup, reduces long-term liability exposure, supports regulatory compliance, and demonstrates responsible stewardship under EPA's enforcement framework.

This guidance presents Weston's recommended approach for achieving defensible, science-backed results across both firefighting vehicles and fixed fire suppression systems.

2.0 Purpose and Intended Audience

This document has been prepared for airport leadership, airline tenants, FBOs, ARFF operations staff, and environmental compliance staff. Specifically, it provides background information on the transition from PFAS-containing AFFF to F3, the challenges of removing residual PFAS contamination from both ARFF vehicles and fixed fire suppression systems, and Weston's recommendations for achieving the best possible results based on the current state of the science. This guidance addresses both mobile ARFF assets and stationary fire suppression infrastructure commonly operated or maintained by airline tenants in airport hangars and car rental agencies.

3.0 Background

Following FAA approval for use of F3 to meet 14 CFR Part 139 firefighting agent requirements, airports and their tenants may begin transitioning ARFF vehicles and fixed fire suppression systems from AFFF to F3 [1]. The FAA Reauthorization Act of 2024 (Section 767) authorized $350 million through the PFAS Replacement Program for Airports to offset transition costs, including equipment replacement, AFFF disposal, and associated cleanup [2]. The AFFF-to-F3 transition requires removal of residual AFFF and associated PFAS-containing residue from foam proportioning systems, as well as demonstration of decontamination effectiveness through analytical results showing non-detect or concentrations as close to non-detect as achievable [3].

Peer-reviewed research including work led by Weston team members has confirmed that PFAS coats internal surfaces in layers after prolonged AFFF exposure [3,4]. Initial cleaning with water rinses often produces a marked reduction in PFAS concentrations, but levels frequently rebound and may exceed pre-cleaning values.

Fixed fire suppression systems present distinct decontamination challenges compared to ARFF vehicles. These systems contain extensive stainless steel and carbon steel piping networks, bladder tanks, valves, and distribution headers that have been exposed to AFFF over decades of service. Small-diameter pipes common in fixed fire suppression systems are often the primary challenge with limitations to access, flush, and verify effective decontamination. Studies conducted on hangar suppression system piping confirm that a triple-rinse protocol with water does not completely remove PFAS contamination and that PFAS release behavior varies between pipe types within the system [5].

In both vehicle and fixed firefighting systems, the most effective approach available combines a biodegradable, high-solvency cleaning solution with mild heating and surface agitation; pre- and post-cleaning sampling ensures a high level of confidence in decontamination effectiveness. This approach can achieve 10- to 20-fold greater PFAS removal compared to ambient-temperature water rinses [4]. Even with optimized cleaning, residual fluorine persists on pipe surfaces, leaving a risk of PFAS rebound into F3 [4,6].

FAA PFAS Replacement Program

Cost reimbursement funding authorized* under Section 767 of the FAA Reauthorization Act of 2024 (Pub. L. 118-63) is available through FY2028 and retroactive to September 12, 2023.

Reimburses sponsors of eligible airports for costs already incurred for:

- Initial acquisition of MILSPEC F3 foams (for twice the quantity required for all ARFF equipment);
- Disposal of PFAS-containing firefighting foams (AFFF);
- Cleaning or disposal of existing equipment or components to facilitate transition to F3; and
- Acquisition or replacement of any equipment necessary for the F3 transition.

Additionally, $30M is earmarked specifically for Index A airports to replace ARFF vehicles that can only operate with AFFF. 14 CFR Part 139-certified airports can receive $2M grants to fund transition.

*Subject to federal appropriations.

4.0 Regulatory Context for Airlines and Airport Tenants

On April 19, 2024, EPA designated PFOA and PFOS as hazardous substances under Section 102(a) of CERCLA (89 FR 32532), effective July 8, 2024 [7]. This designation carries strict, joint and several, and retroactive liability for owners and operators of facilities where releases have occurred. Airlines and other airport tenants who own or operate fire suppression systems and have stored, used, or released AFFF may qualify as potentially responsible parties (PRPs) under CERCLA Section 107(a). Reportable releases of PFOA or PFOS exceeding one pound within a 24-hour period must be reported to the National Response Center under CERCLA Section 103 and Emergency Planning and Community Right-to-Know Act (EPCRA) Section 304.

EPA's PFAS Enforcement Discretion and Settlement Policy (April 19, 2024) states that the agency does not intend to pursue publicly owned airports and local fire departments where equitable factors do not support seeking response actions or costs [8]. However, this discretion does not explicitly extend to private airline tenants, FBOs, or other commercial operators. Airlines that have maintained or operated AFFF-containing fixed suppression systems in leased hangars should assess their potential liability exposure and evaluate whether proactive investigation and remediation may reduce long-term risk.

5.0 Recommended ARFF Vehicle Decontamination Process

5.1 AFFF Removal and Disposal

Prior to decontamination, residual AFFF in ARFF vehicles is removed. This material, along with any existing AFFF stockpiles, should be disposed of through applicable state-sponsored takeback programs when available. If such programs are not accessible, AFFF must be managed and disposed of in accordance with all applicable regulations and consistent with EPA's Interim Guidance on the Destruction and Disposal of PFAS and Materials Containing PFAS [9].

5.2 Pre- and Post-Decontamination Sampling

Following AFFF removal, baseline sampling is performed to establish the nature and extent of PFAS present inside the foam tank. Surface PFAS analysis is performed on the wall of the foam tank using a surface swab protocol. Sequential swabs using acidified and basified methanol are collected and submitted to an off-site laboratory. This technique has been shown to capture more than 90% of the organic fluorine present on the wall of a PFAS-impacted suppression system and is a better indicator of performance than analyzing aqueous samples alone. Following the last rinse cycle, post-decontamination surface swab PFAS samples are collected using the same procedures.

5.3 Foam Tank Decontamination

Surface agitation is performed using a hot-water pressure washer with a rotating head. Following pressure washing, the water is drained and containerized. A heated cleaning solution with high PFAS solvency is then recirculated throughout the foam tank and ancillary components following the specific connections identified with the airport and ARFF vehicle operators. The solution circulates for approximately 8 hours per cycle, after which a sample is collected. Multiple cycles are performed as necessary based on PFAS analytical results and agreed-upon data quality objectives. Field observations of visible foaming or residues inform the number of cycles. A minimum of three rinse cycles is generally recommended.

5.4 Detachable Components

Prior U.S. Department of Defense (DoD) studies indicate that for detachable components exposed to AFFF, replacement is more economical and effective than decontamination [10]. Our recommendation focuses primarily on the foam tank on the assumption that all other detachable components, including hoses and nozzles, will be replaced.

5.5 Output-Based Foam Testing and Containment

Output-based foam testing (OBFT), an FAA post-decontamination requirement, is an inherently messy process. Because no decontamination procedure achieves 100% PFAS elimination, foam sprayed from a decontaminated ARFF vehicle should be assumed to contain PFAS. We recommend constructing an encapsulated testing area — a temporary, inflatable enclosure within a lined secondary containment area sized to capture all foam discharge. The foam/water mixture is containerized for off-site disposal. Upon completion of OBFT, the testing area is returned to pre-testing conditions.

5.6 Waste Management

All rinsate and spent cleaning solutions must be containerized and disposed of in accordance with applicable federal and state regulations, including CERCLA and Resource Conservation and Recovery Act (RCRA) requirements for PFAS-containing wastes [9]. Similarly, suppression system components removed during AFFF decontamination efforts must be disposed of following applicable laws and regulations.

6.0 Fixed Fire Suppression System Considerations

Fixed systems require a modified approach due to the scale and complexity of piping networks, bladder tanks, and distribution infrastructure. In addition to steps outlined in Section 5.0, key modifications include:

- **System Characterization:** Prior to decontamination, the system should be inventoried to identify pipe materials, lengths, diameters, and configurations. Pipe material, sizing, and surface conditions can influence PFAS sorption and release behavior [4,5] and inform decisions regarding cleaning versus component replacement.
- **Cost-Benefit Analysis and Component Replacement:** A cost-benefit analysis should be performed to evaluate the relative effectiveness, implementability, and lifecycle cost of decontamination versus replacing system components. Small-diameter pipes common in fixed fire suppression systems are often difficult to access, flush, and verify decontamination was effective. In many cases, replacement may be the more cost-effective option. By contrast, decontamination efforts should prioritize reservoir tanks and larger-diameter piping where access, flushing efficiency, and post-cleaning performance evaluation are more feasible and effective.

7.0 Environmental Guidance

Parties responsible for the storage or use of AFFF should assess the potential for PFAS impacts to adjacent environmental media. Historical AFFF discharges, whether associated with system testing, inadvertent activation, maintenance activities, or emergency response, may have resulted in releases to soils, stormwater conveyances, surface water, and underlying groundwater.

COMPOUND	FINAL MCLG	FINAL MCL (enforable levels)
PFOA	Zero	4.0 parts per trillion (ppt)
PFOS	Zero	4.0 ppt
PFHxS	10ppt	10 ppt
PFNA	10ppt	10 ppt
HFPO-DA	10ppt	10 ppt
Mixtures containing two or more PFHxS, PFNA, HFPO-DA, and PFBS	1 (unitless) Hazard Index	

Phase I Environmental Site Assessments conducted for CERCLA liability protection must now identify PFAS as a hazardous substance when evaluating *Recognized Environmental Conditions* [7]. Where historical records or operational knowledge indicate that AFFF releases have occurred, a phased and risk-focused environmental investigation is recommended. This typically includes sampling of environmental media to delineate the nature and extent of PFAS contamination, evaluation of migration pathways including stormwater infrastructure and sanitary sewer connections, and risk assessment. Typically, the most urgent risk scenario is a complete human health consumption pathway through impacted drinking water. EPA's National Primary Drinking Water Regulation established maximum contaminant levels (MCLs) for five PFAS and a Hazard Index for mixtures and are presented in the table above [11].

If investigation results confirm the presence of PFAS above applicable standards, remedial alternatives should be evaluated in accordance with the National Contingency Plan (40 CFR Part 300) or applicable state cleanup programs. Remedial options for PFAS-impacted soil and groundwater may include source removal, soil stabilization, granular activated carbon treatment, ion exchange, or high-pressure oxidation, depending on site-specific conditions. Performance of bench- and pilot-scale testing can optimize remedial efforts. Proactive investigation and, where warranted, voluntary remediation can reduce long-term liability exposure, support regulatory compliance, and demonstrate good faith under EPA's enforcement discretion framework.

8.0 Discretionary Tasks

The following best practices should be considered for inclusion in decontamination projects.

8.1 Foam/Water Tank Hydraulic Connectivity Check

After collecting baseline surface PFAS samples, the ARFF vehicle's foam tank is filled with potable water. Observations are made to check if the foam and water tanks are hydraulically connected. The water tank is then filled, and the vehicle is driven for approximately 30 minutes to ensure mixing. If foaming occurs in the water tank, baseline PFAS samples from both tanks are collected the next day. Water tank samples are sent for rapid PFAS testing to determine if water tanks also require decontamination. In some cases, repairs must be made to the truck prior to decontamination.

8.2 Rebound Testing

At the client's discretion and as practicable, the fire suppression system is filled with potable water or F3 to facilitate long-term rebound testing. Based on prior experience, at least two rebound samples are recommended at approximately 1 and 3 months post-decontamination. Rebound testing timelines can be adjusted to accommodate operational demands.

9.0 References

[1] Federal Aviation Administration. FAA Aircraft Firefighting Foam Transition Plan. Washington, DC: FAA; 2023. Available at: https://www.faa.gov/airports/airport_safety/aircraft_rescue_fire_fighting/f3_transition

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[7] U.S. Environmental Protection Agency. Designation of perfluorooctanoic acid (PFOA) and perfluorooctanesulfonic acid (PFOS) as CERCLA hazardous substances. 89 Fed Reg 39124 (May 8, 2024; effective July 8, 2024).

[8] U.S. Environmental Protection Agency. PFAS Enforcement Discretion and Settlement Policy Under CERCLA. Washington, DC: EPA; April 19, 2024.

[9] U.S. Environmental Protection Agency. Interim Guidance on the Destruction and Disposal of PFAS and Materials Containing PFAS. Washington, DC: EPA; 2026.

[10] Lang J, Anderson J, Healy M. Decision Framework for Methods to Effectively Remove Per- and Polyfluoroalkyl Substances (PFAS) from Fire Suppression Systems. ESTCP Technical Report ER20-5364. Washington, DC: Department of Defense; 2023.

[11] U.S. Environmental Protection Agency. National Primary Drinking Water Regulation for PFAS. 89 Fed Reg 32532 (April 26, 2024; effective June 25, 2024).

ABOUT US

About Weston Solutions, Inc. Weston is an environmental consulting and remediation firm with demonstrated expertise in PFAS decontamination, F3 transition planning, and environmental investigation at airports nationwide. Weston's team includes the authors of peer-reviewed research on PFAS removal from fire suppression systems and has supported airport sponsors in navigating the FAA PFAS Replacement Program reimbursement process, CERCLA compliance, and phased environmental investigation and remediation.

About the Authors

Lisa Kammer, P.G., Vice President and Technical Director of PFAS and Special Programs. Lisa.Kammer@WestonSolutions.com**; 603.656.5457.** Lisa Kammer is a senior environmental professional specializing in PFAS investigation, treatment, and remediation, including AFFF-impacted sites and firefighting system decontamination. She leads national PFAS strategy and has extensive expertise in developing technical standards, regulatory compliance approaches, and implementation frameworks for complex environmental challenges.

Zoom Nguyen, E.I.T., Technical Director of Engineering. Zoom.Nguyen@WestonSolutions.com**; 206.204.5689.** Zoom Nguyen is an environmental engineer with deep expertise in PFAS, recognized for leading bench-, pilot-, and field-scale research on treatment and decontamination technologies. He is a published author on PFAS remediation and decontamination approaches, with hands-on experience translating research findings into practical, cost-effective solutions for mobile and fixed firefighting systems.