

Appendix E: Research Methodology

The use of AFFF containing PFAS was studied in *ACRP Research Report 173: Use and Potential Impacts of AFFF Containing PFAS at Airports*. That report provides a substantial amount of information regarding the responsible management of AFFF containing PFAS. It also provides guidance and tools airports can use to assess their institutional risks from AFFF PFAS exposure, such as the Managing AFFF and PFAS at Airports (MAPA) tool. Although *ACRP Research Report 173* is a resource, PFAS issues have evolved since the report was published in early 2017.

In response to the aviation industry's need for updated information since *ACRP Research Report 173* was published, two ACRP project teams were tasked to address emerging PFAS research and developments as they pertain to airports. The teams for *ACRP Research Report 255: PFAS Source Differentiation Guide for Airports* (ACRP Project 02-91) and the current report, *ACRP Research Report 262: PFAS Management at Airports: A Guide* (ACRP Project 02-93) worked within similar subject matter areas but with different approaches to resolving PFAS-related airport issues.

Understanding Aviation Industry Needs

Although *ACRP Research Report 173* is a resource, many changes have occurred regarding PFAS issues since its publication in early 2017. Progress has been made in the interim regarding the following PFAS topics relevant to airport operators:

- Chemistry, fate, and transport in the environment;
- Effects on human health;
- Sources of exposure to the environment;
- Alternatives to fluorinated AFFF;
- Methods for remediation and removal from environmental media, materials, and equipment;
- Disposal technologies; and,
- Persistence in the environment.

Finally, some states have been developing regulations and guidance ahead of federal agencies, creating a patchwork of regulations and guidance across the country.

ACRP Project 02-93

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Goals and Objectives for this Guide

The following focus areas have been identified by ACRP as needs for further research to support the aviation industry and are addressed in *ACRP Research Report 262*:

- The characteristics and processes governing PFAS movement and behavior in environmental media;
- Guidance on how to evaluate environmental fate and transport under airport relevant scenarios;
- An overview of the advancements in analytical and fingerprinting techniques and practical guidance on how to use these techniques for source evaluation; Pathways for human and receptor exposure;
- Information on the current PFAS regulatory environment, including a timeline of regulatory changes and guidance on anticipated regulations;
- Guidance on how to handle equipment with exposure to PFAS compounds, including AFFF and other products in an aviation setting;
- New remediation methods and technologies developed;
- AFFF considerations for daily operations and procedures, and planning for future developments and construction;
- Methods of effective communication to the public and community stakeholders regarding the state of AFFF management at airports;
- Information about potential financial and operational risks related to PFAS exposure, risk mitigation measures, techniques for risk avoidance in future operations; and
- Financial vehicles or mechanisms available to support risk mitigation.

The purpose of this work effort is to develop a guide that addresses the topics and aviation industry needs summarized in the list above. Overall, this guide provides research-supported considerations for choosing and implementing appropriate management techniques.

Research Methodology

The research process began with an in-depth analysis of *ACRP Research Report 173*, then researched the scientific, technological, and regulatory developments since its publication. From there, the guide was developed based on peer-reviewed research, references to regulatory materials, and synopses of relevant changes in technology, engineering controls, and planning strategies as of June 2022. Many airports have already invested resources or hired consultants to complete background research into PFAS. The research team communicated with these organizations to request literature review references, vendors and products considered, and other information salient to this research. If a practice was already implemented or a study completed, the team solicited thoughts and opinions on the efforts. The team substantiated shared information with other documented sources before inclusion in the guide. This research approach was further augmented by engaging aviation professional organizations and attending professional conferences, webinars, seminars, and training courses.

Review of *ACRP Research Report 173* and Prior Publications

The research team reviewed *ACRP Research Report 173* and noted which elements were still relevant and which were outdated or needed to be expanded in light of research results. The guide does not

recapitulate what was previously addressed in the *ACRP Research Report 173* beyond where needed for context, but this project supplements with new information about technologies for:

- Fluorine-Free AFFF alternatives;
- Remediation and containment for soils and groundwater;
- Disposal methods and options for airports;
- Environmental fate and transport evaluations under airport relevant scenarios;
- Forensic differentiation of PFAS; and
- Laboratory analytical methods.

The research effort began by establishing which topics in the guide required more extensive attention based on gaps in current guidance or accessible information, coordination with other aviation industry professionals and airport operators, and the results of an aviation stakeholder survey. With this information, a literature review of advances in PFAS management techniques and technologies was completed using 2017, the year *ACRP Research Report 173* was published, as a baseline.

Advancements in PFAS sampling methods, as well as developments in PFAS source identification, have been made since 2017. More is now known about PFAS behavior in stormwater and possible interactions with stormwater infrastructure such as concrete pipes, oil–water separators, and detention or retention basins. Prior guidance for airports has focused primarily on PFAS sources from AFFF use. However, more information and support were needed to identify additional, offsite PFAS sources, which may be transported onto the airport property. Advances in PFAS remediation technologies, treatment and disposal methods, and novel formulations for fluorine-free AFFF alternatives have been made since 2017 as well.

Finally, industry, regulatory, and academic research into PFAS impacts were progressing in 2017. This research assessed what tools, institutional policies, and recommended methods are available from private sources and public agencies for PFAS management planning, operational resiliency, and risk reduction.

Industry Professional Organization Involvement

Research team members participated in panels with aviation industry professionals and aviation industry groups. These organizations provided many opportunities to learn about the concerns of industry professionals, PFAS management experiences of airport staff, regulatory trends, and government actions. Though these efforts were helpful to supplement the literature review process, anecdotal information was substantiated with thorough research before incorporation into the guide. Practices or techniques discussed were chosen on the basis of the availability and robustness of supporting information. Assertions regarding the possible efficacy of a given practice are informed by peer-reviewed data or information from reputable public sources.

Training Events, Seminars, and Conferences

The research team attended webinars, training events, seminars, and conferences with PFAS industry and aviation industry professionals to learn about what new technologies are available or are in development. The team also attended training provided by state and federal agencies, the U.S. Environmental Protection Agency, the Centers for Disease Control and Prevention, the Strategic Environmental Research and Development Program, and the Environmental Security Technology Certification Program, among others. Research team members attended conferences and workshops hosted by aviation industry professional organizations, such as the American Association of Airport Executives (AAAE), where airport staff and aviation consultants presented their approaches, collected data, and accumulated information in a public or semipublic setting. When appropriate, the research team collaborated with these presenters regarding research guidance and additional information.

Aviation Stakeholder Group Survey

After completing primary research, the project team surveyed an aviation stakeholder group that represented airport staff nationwide from diverse aviation facilities for their input regarding current issues, practices, and challenges with PFAS management at their institutions. The airports represented were inclusive of diverse sizes, climates, and land use settings, and the team solicited feedback from personnel within a variety of aviation roles at these representative airports. Respondent diversity among the participants provided a more comprehensive understanding of PFAS issues at airports, and the survey captured perspectives and input from both persons in high-level administrative positions and individuals more directly involved in day-to-day airport operations.

ACRP 02-91 and ACRP 02-93 Project Coordination

Although the project teams for ACRP 02-91 and ACRP 02-93 both developed reports to assist airports with their AFFF- and PFAS-related issues, the projects had distinct focus areas. ACRP 02-91 addressed previously identified or suspected PFAS sources, with greater emphasis on locating and quantifying a specific, discrete PFAS source area and how to mitigate institutional risks from an insufficient or excessive response.

ACRP Research Report 262, developed by the ACRP 02-93 project team, takes an institutional planning approach, emphasizing modifications to current operational procedures, managerial policies, and public engagement approaches to address PFAS issues. As well as enhancing current operational policies and procedures, this guide includes adaptive planning methods for future regulatory actions and requirements, financial obligations and funding allocations, and promoting public communication and positive engagement. Other areas where the teams for ACRP Projects 02-91 and 02-93 share similarities involve determining current and past AFFF and PFAS exposures, developing an inventory of sources and source areas, and assessing when environmental media sampling may be appropriate.