



## Per- and Polyfluoroalkyl Substances (PFAS) Investigations at KENNEDY SPACE CENTER

This information sheet describes NASA's Kennedy Space Center (KSC) efforts to address per- and polyfluoroalkyl substances (PFAS) at the Center.

### What are PFAS?

PFAS is the umbrella term for thousands of synthetic fluorinated chemicals. PFAS have been widely used because they repel water, stains, and oil. Many consumer products contain PFAS such as some non-stick cookware, outdoor clothing, paper packaging for food, fabrics, and carpets. They have been used in manufacturing and are contained in a substance called aqueous film-forming firefighting foam (AFFF) used at military bases and airfields.

PFAS are not naturally occurring. They have been manufactured, used, and disposed of for decades. The characteristics that make PFAS compounds effective for so many uses also prevents them from breaking down in the environment. These substances may remain in air, soil, surface water, and groundwater and they can be transported distances from the source.

### Why is NASA Investigating PFAS?

The City of Cocoa supplies drinking water used at KSC and meets all safe drinking water standards. Groundwater beneath KSC is not used for drinking water purposes.

NASA is proactively conducting investigations into past uses and potential exposures of PFAS at all NASA sites guided by federal and state health and environmental agencies. The United States Environmental Protection Agency (EPA) refers to PFAS as emerging contaminants, and in 2016, the agency established non-regulatory lifetime Health Advisories (HA) for two PFAS compounds that have been more widely studied. Several states have established regulatory limits for PFAS exposure, and federal regulatory actions are anticipated.

Currently there is no federal drinking water standard nor are there cleanup standards issued for PFAS. These chemicals have been detected in water bodies that may cause ecological or human health effects (see health effects), and they are typically not regulated under current environmental laws. In 2012, the EPA included two of the most studied PFAS compounds - perfluorooctane sulfonate (PFOS) and perfluorooctanoic acids (PFOA) – on the list of contaminants to sample for in public water systems that serve greater than 10,000 residents and at federal facilities that may have used PFAS-containing fire-fighting foam (AFFF). The Florida Department of Environmental Protection (FDEP) Division of Waste Management is reviewing and providing input on KSC efforts to assess historic and current use of PFAS-containing materials.

AFFF was introduced at KSC during initiation of the KSC Shuttle Program. The KSC fire department changed to a different AFFF formulation and retrofitted its fleet of trucks with AFFF collection and recycling equipment. The investigation underway at KSC is evaluating sources of PFAS-containing materials that may have been released in the past to the environment.

### Investigation Activities at KSC

**NASA KSC is committed to protecting human health and the environment in all its activities and has conducted investigations to:**

**Understand**  
the nature and extent of PFAS at KSC

**Develop**  
a model of how PFAS may be moving in the environment

**Identify**  
potential exposure pathways, and

**Take steps**  
to implement environmental cleanups where needed

NASA's initial investigations in 2018 and 2019 were conducted in targeted locations including a fire training area, fire stations, suspected AFFF use areas, sewage treatment plants and sludge disposal areas, and landfills. These investigations have continued through 2021 and looked at up to 18 PFAS where analytical methods were available and approved.

## Sources of PFAS Exposure

Drinking water is considered a primary source of exposure to PFAS. There have been reports of up to 49 states having some PFAS in drinking water systems. Occupational exposure is highest for workers involved in PFAS manufacturing and for those with possible exposure from use of AFFF. Other potential sources of exposure include ingesting contaminated soil or inhaling dust; eating food grown in contaminated soil or fish from contaminated water; or through transfer from cookware and some food packaging and processing.

## Human Health Effects

Research on health effects has been primarily focused on animals exposed to high doses of one or more PFAS and have shown changes in liver, thyroid, and pancreatic function, as well as some changes in hormone levels. ATSDR's 2021 Final PFAS Toxicology Profile summarized the available information on animal and human health effects of PFAS and established Minimal Risk Levels (MRL) that indicate potential health impacts occur at lower concentrations than EPA's Health Advisory. For more information see ATSDR's May 2021 Final Toxicology Profile for PFAS at <https://www.atsdr.cdc.gov/toxprofiledocs/>.

NASA collected 1,194 groundwater samples at direct push locations and monitoring wells and an on-site supply well; and 217 soil samples, 238 surface water samples, 100 sediment samples, and 10 pore water samples.

NASA is using provisional FDEP groundwater and soil screening and cleanup target levels (developed by the University of Florida) to determine the need and locations for additional investigation. FDEP is using provisional surface water screening levels for the protection of human health and for aquatic receptors (plants, finfish, and shellfish). It is important to note that groundwater beneath KSC is not an exposure pathway for KSC workers and contractors.

### **The City of Cocoa supplies drinking water used at KSC and meets all safe drinking water standards.**

While groundwater beneath KSC is not used for drinking water, NASA is working with FDEP to investigate PFAS and perform potential cleanup where needed at KSC (FDEP requires any contaminated aquifer be returned to a condition that meets drinking water standards).

NASA prepared several reports documenting the investigation activities and results, which identified an additional 33 locations of concern for further investigation. This is an iterative process and NASA continues to gather site data to understand groundwater and surface water interaction and transport/movement at the locations of concern.

## Regulatory Status

As of October 2021, EPA has not established a Maximum Contaminant Level (MCL), or drinking water standard, for PFAS under the Safe Drinking Water Act, nor has the agency established any surface water standards. In 2016, EPA updated the HA for PFOA and PFOS. The HA is a non-enforceable federal limit - an estimate of the daily exposure to the human population that is likely to be without risk or harmful effects over a lifetime. EPA recommends that drinking water systems with PFOA, PFOS, or both, levels above the HA of 70 parts per trillion (ppt) take steps to assess contamination, inform consumers, and limit exposure.

- **In 2018, EPA issued a PFAS Action Plan**

outlining a number of steps the agency is taking to address PFAS, <https://www.epa.gov/newsreleases/aggressively-addressing-pfas-epa>

- **On December 19, 2019, EPA issued Interim Recommendations for Addressing Groundwater Contaminated with PFOA and PFOS,**

which provides cleanup guidance that will be helpful to states and tribes and recommends a 40 ppt screening level for federal cleanup programs.

- **In October 2021, EPA released the agency's PFAS Strategic Roadmap.**

Based on the Roadmap, EPA expects to promulgate a national primary drinking water regulation for PFOA and PFOS by fall of 2023 and publish surface water criteria for PFAS by fall 2024.

<https://www.epa.gov/pfas/pfas-strategic-roadmap-epas-commitments-action-2021-2024>

- **EPA has initiated** the regulatory development process for listing PFOA and PFOS as hazardous substances under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and the Resource Conservation and Recovery Act (RCRA).

In the absence of federal regulations, several states are taking action to address PFAS. Currently, Florida follows EPA's health advisory of 70 ppt in drinking water. In addition, FDEP has calculated Provisional Cleanup Target Levels for groundwater and soil and Provisional Screening Levels for irrigation water and surface water. [https://floridadep.gov/sites/default/files/Draft\\_Dynamic\\_Plan\\_Aug2021\\_0.pdf](https://floridadep.gov/sites/default/files/Draft_Dynamic_Plan_Aug2021_0.pdf).



Using EPA-approved methods, investigators collected and evaluated data for the presence of PFAS.

## Next Steps

NASA will continue to investigate the presence of PFAS and take actions as needed. NASA is using a three-pronged approach to guide further activities: **Identify, Respond, and Prevent.**

### 1. Identify

NASA is committed to conducting further investigations at KSC to understand the nature and extent of PFAS and be responsive to new regulations and requirements. NASA has installed a network of monitoring wells screened at multiple depths to study PFAS levels and interactions between groundwater and surface water, and to define the potential migration in the environment. Although human exposure to PFAS from groundwater is not a concern at KSC, NASA is planning to determine potential impacts to waterways, lagoons, and marine wildlife as well as potential human exposure from consuming locally caught fish and shellfish.

### 2. Respond

NASA is committed to protecting the health of the KSC workforce and nearby communities. Groundwater beneath KSC is not used for drinking water. NASA also sampled water from known non-potable wells. The levels were all below the State's provisional groundwater cleanup levels.

### 3. Prevent

NASA is working to ensure that releases of AFFF containing PFAS have been identified, and NASA has taken steps to prevent any future releases to the environment. The KSC fire department changed to a different AFFF formulation and trucks were retrofitted with AFFF collection and recycling equipment. In the unlikely event that AFFF is released or a spill occurs, KSC will implement environmental cleanups that prevent potential exposures.



All air rescue fire fighting trucks at KSC were retrofitted and equipped to collect and recycle AFFF.

## Keeping People Informed

NASA is committed to communicating about PFAS investigations and we will continue to share information about the progress being made at KSC. Updates like this sheet will be distributed periodically and information will be posted to the NASA Environmental Assurance Branch website at <https://environmental.ksc.nasa.gov/RemediationProgram/PFAS>.

## For More Information Contact

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