United States
Environmental Protection
Agency

Per- and Polyfluoroalkyl Substances (PFAS) Occurrence and Contaminant Background Support Document for the Final PFAS National Primary Drinking Water Regulation

Office of Water (4607M)
EPA 815-R-24-013
April 2024

Executive Summary

On March 3, 2021 (86 FR 12272; USEPA, 2021a), the United States Environmental Protection Agency (EPA) announced its decision to regulate perfluorooctane sulfonic acid (PFOS) and perfluorooctanoic acid (PFOA) under the Safe Drinking Water Act (SDWA). Subsequently, on March 14, 2023, the EPA announced its preliminary decision to regulate four additional per- and polyfluoroalkyl substance (PFAS) compounds including Hexafluoropropylene Oxide Dimer Acid (HFPO-DA) and its ammonium salt (also known as "GenX Chemicals"), perfluorobutane sulfonic acid (PFBS), perfluorohexane sulfonic acid (PFHxS), and perfluorononanoic acid (PFNA), and also proposed Maximum Contaminant Level Goals (MCLGs) and National Primary Drinking Water Regulations (NPDWRs) for PFOA and PFOS and an MCLG and NPDWR through a Hazard Index (HI) approach for the four additional PFAS (USEPA, 2023a). The EPA is finalizing determinations to individually regulate PFHxS, PFNA, and HFPO-DA, as well as finalizing a determination to regulate any combination of these three PFAS and PFBS in mixtures. Concurrently, the agency is finalizing MCLGs and NPDWRs for PFOA, PFOS, PFNA, PFHxS, and HFPO-DA and an HI MCLG and NPDWR for mixtures containing two or more of PFNA, PFHxS, HFPO-DA, and PFBS. The final determination to individually regulate PFNA, PFHxS, and HFPO-DA is based on the finding that these three contaminants meet the SDWA criteria for regulating a contaminant: 1) the contaminant may have an adverse effect on the health of persons, 2) the contaminant is known to occur or there is a substantial likelihood that the contaminant will occur in public water systems (PWSs) with a frequency and at levels of public health concern, and 3) in the sole judgment of the Administrator, regulation of such contaminant presents a meaningful opportunity for health risk reduction for persons served by PWSs. The final determination to regulate mixtures containing two or more of PFHxS, PFNA, HFPO-DA, and PFBS under an HI approach is similarly based on these three SDWA criteria when considering these four contaminants in mixtures, particularly their dose additive adverse health effects, substantial likelihood of co-occurrence, and meaningful opportunity to reduce health effects of these mixtures. Regarding the individual regulation of PFBS, the EPA is deferring the final individual regulatory determination for PFBS to further evaluate the three regulatory determination criteria previously described under SDWA and consequently is not promulgating an individual NPDWR or MCLG for PFBS in this action.

The EPA reviewed the available peer-reviewed science and supporting studies, as well as finished drinking water data, to evaluate the occurrence of PFOA, PFOS, HFPO-DA, PFHxS, and PFNA and the co-occurrence of these five PFAS and PFBS. To inform analyses and characterize the individual frequency and levels of PFOA, PFOS, HFPO-DA, PFHxS, and PFNA occurrence and frequency and levels of co-occurrence for PFOA, PFOS, HFPO-DA, PFHxS, PFNA, and PFBS, the EPA relied on multiple data sources including the third Unregulated Contaminant Monitoring Rule 3 (UCMR 3) and available state monitoring data. The EPA also incorporated both the UCMR 3 and applicable state data into a Bayesian hierarchical model which further supported occurrence exposure estimates for modeled PFAS. These data together demonstrate individual occurrence of PFOA, PFOS, HFPO-DA, PFHxS, and PFNA and co-occurrence of these five compounds and PFBS in multiple geographic locations.

Occurrence analyses based on the UCMR 3 and state data identify individual reported detections of PFOA, PFOS, HFPO-DA, PFHxS, and/or PFNA located in 43 states, tribes, and territories. Under the UCMR 3, reported detections of PFOA and PFOS above their UCMR 3 minimum reporting levels (MRLs) were found in 117 (2.38 percent) and 95 (1.93 percent) PWSs, serving approximate populations of 7.6 million and 10.4 million people, respectively. These reported detections are all above the EPA's final Maximum

Contaminant Levels (MCLs) of 4.0 parts per trillion (ppt). Reported detections of PFHxS and PFNA above their UCMR 3 MRLs were found in 55 and 14 PWSs, serving approximate populations of 5.7 million and 526,000 people, respectively. All of these detections exceed their final MCLs of 10 ppt each. The available state monitoring data showed that in 32 states there are approximately 1,900 PWSs serving a total population of more than 26 million people that have at least one result exceeding the final PFOA MCL and approximately 1,600 PWSs serving a total population of nearly 24 million people that have at least one result exceeding the final PFOS MCL. The available state monitoring data for PFHxS showed there are approximately 184 PWSs serving a total population of more than 4.3 million people in 21 states that have at least one result exceeding the final MCL. For PFNA, the available state monitoring data showed there are approximately 52 PWSs serving a total population of more than 177,000 people in 12 states that have at least one result exceeding the final MCL, and for HFPO-DA the available state monitoring data showed that in 5 states there are approximately 13 PWSs serving a total population of more than 227,000 people that have at least one result exceeding the final MCL. Related to the HI MCL, state monitoring data demonstrated that in 21 states there are at least 211 systems serving a population of approximately 4.7 million people that exceed the final HI MCL of 1 (unitless) for mixtures containing two or more of PFHxS, PFNA, HFPO-DA, and PFBS. Further, from the Bayesian hierarchical occurrence model developed to explore national occurrence for PFOA, PFOS, and PFHxS, thousands of PWSs serving populations of tens of millions of people are estimated to have mean concentrations over the final MCLs for PFOA and PFOS. Hundreds of systems serving millions of people are anticipated to have system-level mean concentrations over the individual MCL for PFHxS.

Contents

Exhibits

Abbreviations

ADEQ	Arizona Department of Environmental Quality
ADPH	Alabama Department of Public Health
AF	Amorphous Fluoropolymer
ATSDR	Agency for Toxic Substances and Disease Registry
BF	Biodegrades Fast
BFA	Biodegrades Fast with Acclimation
BS	Biodegrades Slowly
BSA	Biodegrades Slowly with Acclimation
BST	Biodegrades Sometimes/Recalcitrant
CAS	Chemical Abstracts Service
CBI	Confidential Business Information
CCL	Contaminant Candidate List
CCL 3	Third Contaminant Candidate List
CCL 4	Fourth Contaminant Candidate List
CDPHE	Colorado Department of Public Health and Environment
CDR	Chemical Data Reporting
CEC	Cation Exchange Capacity
CI	Confidence Interval
CWS	Community Water System
DL	Detection Limit
DoD	Department of Defense
DWTP	Drinking Water Treatment Plants
eCDF	Empirical Cumulative Distribution Function
EPA	Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
EPISuite™	Estimation Programs Interface Suite™
ESP	Exchangeable Sodium Percentage
FEP	Fluorinated Ethylene Propylene
FRN	Federal Register Notice
FUDS	Formerly Used Defense Site
GA EPD	Georgia Environmental Protection Division
GAC	Granular Activated Carbon
GWUDI	Ground water Under the Direct Influence of Surface Water
HBWC	Health Based Water Concentration
HFPO-DA	Hexafluoropropylene Oxide Dimer Acid
HI	Hazard Index
HQ	Hazard Quotient
HRL	Health Reference Level
HRRCA	Health Risk Reduction and Cost Analysis
HSDB	Hazardous Substances Data Bank
IDEM	Indiana Department of Environmental Management
Iowa DNR	Iowa Department of Natural Resources
ITRC	Interstate Technology & Regulatory Council
IUR	Inventory Update Reporting
K_d	Soil Sorption Coefficient
K_H	Henry's Law Constant

K_{oc}	Organic Carbon Partitioning Coefficient
K_{ow}	Octanol-Water Partitioning Coefficient
LC/MS/MS	Liquid Chromatography/Tandem Mass Spectrometry
LCMRL	Lowest Concentration Minimum Reporting Level
Maine CDC	Maine Center for Disease Control and Prevention
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
MDE	Maryland Department of Environment
MDH	Minnesota Department of Health
Michigan EGLE	Michigan Department of Environment, Great Lakes, and Energy
Missouri DNR	Missouri Department of Natural Resources
MRL	Minimum Reporting Level
NAWQA	National Water-Quality Assessment
NCBI	National Center for Biotechnology Information
NCDEQ	North Carolina Department of Environmental Quality
NDAA	National Defense Authorization Act
NDDEQ	North Dakota Department of Environmental Quality
NHANES	National Health and Nutrition Examination Survey
NMED	New Mexico Environment Department
NPDWR	National Primary Drinking Water Regulation
NTNCWS	Non-Transient Non-Community Water System
NWIS	National Water Information System
OHA	Oregon Health Authority
PFA	Perfluoroalkoxy
PFAA	Perfluorinated Alkyl Acid
PFAS	Per- and Polyfluoroalkyl Substances
PFBS	Perfluorobutane Sulfonic Acid
PFC	Perfluorinated Compound
PFCA	Perfluoroalkyl Carboxylate
PFHpA	Perfluoroheptanoic Acid
PFHxA	Perfluorohexanoic Acid
PFHxS	Perfluorohexane Sulfonic Acid
PFNA	Perfluorononanoic Acid
PFOA	Perfluorooctanoic Acid
PFOS	Perfluorooctane Sulfonic Acid
PFSA	Perfluoroalkyl Sulfonate
pKa	Acid Dissociation Constant
POP	Persistent Organic Pollutants
PPM	Parts Per Million
PPMV	Parts Per Million by Volume
PPT	Parts Per Trillion
PQL	Practical Quantitation Level
PTFE	Polytetrafluoroethylene
PWS	Public Water System
PWSID	Public Water System Identification Number
QA	Quality Assurance
RSD	Relative Standard Deviation
SDWA	Safe Drinking Water Act

SDWIS	Safe Drinking Water Information System
SNUR	Significant New Use Rule
STEWARDS	Sustaining the Earth's Watersheds-Agricultural Research Data System
STORET	Storage and Retrieval Data System
TOC	Total Organic Carbon
TRI	Toxics Release Inventory
TSCA	Toxic Substances Control Act
UCMR	Unregulated Contaminant Monitoring Rule
UCMR 1	First Unregulated Contaminant Monitoring Rule
UCMR 2	Second Unregulated Contaminant Monitoring Rule
UCMR 3	Third Unregulated Contaminant Monitoring Rule
UCMR 5	Fifth Unregulated Contaminant Monitoring Rule
USDA	United States Department of Agriculture
USGS	United States Geological Survey
USNLM	United States National Library of Medicine
Virginia ODW	Virginia Office of Drinking Water
WQP	Water Quality Portal
WQX	Water Quality Exchange
WTP	Water Treatment Plant

1 Introduction

This document describes technical and background information on production and use, environmental fate and transport, and in particular, the data and analyses used by the United States Environmental Protection Agency (EPA) to develop national estimates of the individual occurrence of perfluorooctanoic acid (PFOA), perfluorooctane sulfonic acid (PFOS), hexafluoropropylene oxide dimer acid (HFPO-DA) and its ammonium salt, perfluorohexane sulfonic acid (PFHxS), and perfluorononanoic acid (PFNA) and co-occurrence of these five per- and polyfluoroalkyl substances (PFAS) and perfluorobutane sulfonic acid (PFBS) in public drinking water systems (PWSs). Further, this information supports both the final determination to individually regulate HFPO-DA, PFHxS, and PFNA and the final determination to regulate any mixture combination of these three PFAS and PFBS in drinking water, along with the proposed National Primary Drinking Water Regulations (NPDWRs) for PFOA, PFOS, HFPO-DA, PFHxS, and PFNA and the Hazard Index (HI) NPDWR for HFPO-DA, PFHxS, PFNA, and PFBS. Additional supplemental PFOA, PFOS, PFHxS, PFNA, HFPO-DA, and PFBS occurrence background information and data were also reviewed. The information, data, and analyses described in this report are organized into 8 chapters with a brief description of each chapter presented below.

- **Chapter 1: Introduction** provides an overview of the rulemaking process for PFAS in the context of public drinking water.

- **Chapter 2: Data Sources** provides a general overview of the sources of data that the EPA used to evaluate PFAS.

- **Chapter 3: PFOA** provides information on PFOA's chemical and physical properties, sources of PFOA, environmental fate, drinking water and ambient water occurrence data, and laboratory analytical methods.

- **Chapter 4: PFOS** provides information on PFOS's chemical and physical properties, sources of PFOS, environmental fate, drinking water and ambient water occurrence data, and laboratory analytical methods.

- **Chapter 5: PFHxS** provides information on PFHxS's chemical and physical properties, sources, of PFHxS environmental fate, drinking water and ambient water occurrence data, and laboratory analytical methods.

- **Chapter 6: PFNA** provides information on PFNA's chemical and physical properties, sources of PFNA, environmental fate, drinking water and ambient water occurrence data, and laboratory analytical methods.

- **Chapter 7: HFPO-DA** provides information on HFPO-DA's chemical and physical properties, sources of HFPO-DA, environmental fate, drinking water and ambient water occurrence data, and laboratory analytical methods.

- **Chapter 8: Hazard Index MCL Analyses** presents the occurrence analysis relative to the HI NPDWR for the regulation of PFHxS, PFNA, HFPO-DA, and PFBS when co-occurring in mixture combinations.

- **Chapter 9: Co-Occurrence Analyses** presents the co-occurrence analysis of PFAS data in the third Unregulated Contaminant Monitoring Rule (UCMR 3) as well as in non-targeted supplemental state datasets.

- **Chapter 10: Model Estimates and Extrapolation** presents the national occurrence estimates of four PFAS derived from a Bayesian hierarchical model developed to estimate national occurrence.

- **Chapter 11: UCMR 5 Results** presents the preliminary sampling results from the fifth Unregulated Contaminant Monitoring Rule (UCMR 5) as of February 2024.

- **Chapter 12: References** is a list of the cited and supporting scientific literature used in development of the document.

- **Appendix A: PFBS** provides information on PFBS's chemical and physical properties, sources of PFBS, environmental fate, drinking water and ambient water occurrence data, and laboratory analytical methods.

1.1 SDWA Statutory Requirements and Rulemaking Process for PFAS in Drinking Water

Under the Safe Drinking Water Act (SDWA), the EPA has the authority to set enforceable NPDWRs for drinking water contaminants and require monitoring of PWSs. On March 3, 2021 (86 FR 12272; USEPA, 2021a), the EPA published Regulatory Determinations for Contaminants on the Fourth Contaminant Candidate List (CCL 4) which included a final determination to regulate PFOA and PFOS in drinking water. Following that final determination and concurrent with proposing the NPDWRs for PFOA and PFOS, the EPA made a preliminary determination to regulate PFHxS, PFNA, HFPO-DA, and PFBS and proposed an NPDWR for these four PFAS compounds through an HI approach (USEPA, 2023a).

On March 10, 2020, the EPA announced and requested public comment on the preliminary regulatory determinations for eight CCL 4 contaminants, including a preliminary determination to regulate PFOS and PFOA in drinking water (USEPA, 2020a). On March 3, 2021, the EPA announced a final determination to regulate PFOS and PFOA, marking the beginning of the drinking water regulation development process for these two PFAS (USEPA, 2021a).

Concurrent with proposing the NPDWR for PFOA and PFOS, the EPA announced and requested public comment on a preliminary determination to regulate PFHxS, PFNA, HFPO-DA, and PFBS and a proposed NPDWR and Maximum Contaminant Level Goals (MCLGs) through an HI approach for these four compounds. The EPA's final decision to regulate PFOA and PFOS and preliminary decision to regulate PFHxS, PFNA, HFPO-DA, and PFBS was based on its finding that these contaminants meet the SDWA's three criteria for regulating a contaminant: 1) the contaminant may have an adverse effect on the health of persons, 2) the contaminant is known to occur or there is a substantial likelihood that the contaminant will occur in PWSs with a frequency and at levels of public health protection, and 3) in the sole judgement of the Administrator, regulation of such contaminant presents a meaningful opportunity for health risk reduction for persons served by PWSs. The proposal to regulate these contaminants included non-enforceable MCLGs and enforceable Maximum Contaminant Level (MCL) standards.

The EPA is finalizing determinations to individually regulate HFPO-DA, PFHxS, and PFNA and finalizing a determination to regulate any combination of these three PFAS and PFBS in mixtures. The EPA's final decision to regulate these compounds is based on the same findings as the preliminary determination that they individually and/or as part of a mixture meet the SDWA's three criteria for regulating a contaminant. Concurrent with this final determination, the EPA is finalizing individual NPDWRs for PFOA, PFOS, HFPO-DA, PFHxS, and PFNA and an NPDWR through an HI for mixtures containing two or more of HFPO-DA, PFHxS, PFNA, and PFBS. See Section IV of the final rule Federal Register Notice (FRN) for further discussion about the final MCLGs and Section V of the FRN for further discussion of the final MCLs (USEPA, 2024a).

In accordance with Section 1412(b)(3)(c) of SDWA, the EPA has prepared a Health Risk Reduction and Cost Analysis (HRRCA) of the final MCLs and proposed alternative MCLs. The EPA has assessed the quantifiable and non-quantifiable costs that are likely to occur as a result of compliance with the MCLs. These costs could be new treatment processes as well as incremental monitoring and administrative costs. The EPA also provides an estimate of the health risk reduction benefits likely to occur as a result of the treatment to comply with each PFAS concentration level assessed. For further discussion, see the Economic Analysis of the Final NPDWR for PFAS (USEPA, 2024b).

2 Data Sources

This chapter provides a general overview of the sources of data that the EPA used to evaluate PFAS. The outline of this chapter mirrors the organization of the contaminant-specific chapters that follow. Section 2.1 identifies the sources used to gather contaminant background information and chemical and physical properties. Section 2.2 describes information sources used to characterize contaminant production, use, and release. Section 2.3 describes how environmental fate and transport were evaluated and what information sources were used. Section 2.4 describes the primary and supplemental sources of ambient and drinking water occurrence information used to evaluate contaminant occurrence and exposure and provides information about occurrence data handling. Section 2.5 presents information on evaluation of analytical methods.

2.1 Contaminant Background, Chemical, and Physical Properties

The EPA consulted a number of standard sources to gather information on contaminant background and properties. These sources include the National Center for Biotechnology Information's (NCBI) PubChem database, which houses and displays information from a variety of formerly independent sources such as the U.S. National Library of Medicine's (USNLM) Hazardous Substances Data Bank (HSDB) and USNLM's ChemIDPlus database, plus Toxicity Profiles from the U.S. Agency for Toxic Substances and Disease Registry (ATSDR), and standard chemistry reference books. To fill some information gaps, primary literature was consulted as well, with preference given to peer-reviewed sources.

2.2 Contaminant Production, Use, and Release

Quantitative data on natural and anthropogenic sources, including data on production, use, and industrial releases, were obtained from specific primary sources and data compilations. These data are described below.

2.2.1 Inventory Update Reporting (IUR) and Chemical Data Reporting (CDR) Program

The Toxic Substances Control Act (TSCA) requires the EPA to compile, keep current, and publish a Chemical Substance Inventory, a list of chemical substances that are manufactured (including imported) or processed in the United States. Initially published in 1979, the TSCA Inventory currently lists more than 86,000 chemicals (USEPA, 2022a). Modifications of the IUR rule in 2003 and 2005 expanded the type of chemicals to include inorganic chemical substances, expanded the type of data reported, raised the production volume threshold that triggers reporting from 10,000 pounds to 25,000 pounds, and made certain further adjustments. In 2011, the agency issued the Chemical Data Reporting (CDR) Rule which replaced the IUR Rule and established a somewhat modified program, including annual data gathering and periodic reporting. CDR makes use of a two-tiered system of reporting thresholds, with 25,000 pounds the threshold for most chemical substances and 2,500 pounds the threshold for others (USEPA, 2020b). In 2020, the EPA issued an update to the CDR program revising the definition of a small manufacturer. This revision may impact the reporting requirements of some PFAS manufacturers (USEPA, 2020c).

The EPA makes certain non-confidential information available to the public. This includes aggregated national total annual production volumes for chemicals based on reports filed. As a result of the changes in reporting thresholds and other program modifications, the results from 2006 onward might not be directly comparable to results from earlier years.

In making total annual national production volumes for chemicals available to the public, the agency assigned production volumes to bins. Eight production and importation volume ranges were used under IUR. The ranges used for 2006 data differ slightly from those used for earlier years. Under CDR the number of bins was expanded from 8 to 29. Exhibit 2-1 shows the production and importation volume categories used for 1986-2002 data, 2006 data, and more recent data.

If no reports were filed for a chemical in a particular year, the EPA indicated that the chemical had "no reports" in the summary of IUR/CDR data presented in this document. If production quantities were withheld from publication by the EPA so as not to compromise companies' confidential business information (CBI), the quantities are flagged as "withheld."

Exhibit 2-1: Chemical Volume Production (Including Importation) Ranges Used in IUR and CDR Reporting

1986 - 2002	2006	Post-2006[1]
10,000 pounds - 500,000 pounds	<500,000 pounds	<25,000
>500,000 - 1 million pounds	500,000 to <1 million pounds	25,000 to 100,000
>1 million - 10 million pounds	1 million to <10 million pounds	100,000 to 500,000
>10 million - 50 million pounds	10 million to <50 million pounds	500,000 to 1 million
>50 million - 100 million pounds	50 million to <100 million pounds	1 million to 10 million
>100 million - 500 million pounds	100 million to <500 million	10 million to 50 million
> 500 million - 1 billion pounds	500 million to <1 billion pounds	50 million to 100 million
Over 1 billion pounds	1 billion pounds or greater	100 million to 250 million
		250 million to 500 million
		500 million to 750 million
		750 million to 1 billion
		1 billion to 5 billion

Source: USEPA 2021b
[1]CDR currently uses 29 bins for reporting volumes, including the 12 listed here and an additional 17 bins for production quantities greater than 5 billion pounds.

Several factors should be considered when interpreting production ranges assigned to chemicals. Site-specific production volumes less than 10,000 pounds (25,000 pounds from 2006 on) were not reported and thus are not included in the totals. Production volume ranges for reporting changed in 2006 and changed again in 2012. Furthermore, the data provide a snapshot of annual production (including importation) only every four years through 2006, and therefore do not capture fluctuation from year to year prior to initiation of the CDR in 2012.

2.2.2 Toxics Release Inventory (TRI)

The EPA established the Toxics Release Inventory (TRI) in 1987 in response to Section 313 of the Emergency Planning and Community Right-to-Know Act (EPCRA). EPCRA section 313 requires facilities to report to both the EPA and states annual information on toxic chemical releases and other waste management from facilities that meet reporting criteria. EPCRA section 313 also requires the EPA to make this information available to the public through a computer database. The database is accessible through the EPA's TRI Explorer. In 1990 Congress passed the Pollution Prevention Act, which required that additional data on waste management and source reduction activities be reported under TRI. The

TRI database details not only the types and quantities of toxic chemicals released to the air, water, and land by facilities, but also provides information on the quantities of chemicals sent to other facilities for further management (USEPA, 2022b; USEPA, 2003).

Facilities are required to report releases and other waste management activities related to TRI chemicals if they manufacture, process, or otherwise use more than established threshold quantities of these chemicals. Currently, for most chemicals, reporting of releases is required if 25,000 pounds or more of the chemical are manufactured or processed at a facility, or if 10,000 pounds or more are used at the facility. Note that a lower reporting threshold applies to some TRI chemicals, including a threshold of 100 pounds which applies to PFAS (USEPA, 2022b).

TRI data are particularly useful for tracking trends in chemical releases and other waste management practices. When using the data this way, consider only data that were reported under consistent TRI reporting requirements. Using comparable data will better ensure that any changes in the data over time are driven by actual changes in the use, release or other management of a chemical, and are not simply due to modifications in reporting requirements. For example, the TRI Program has evolved as the EPA extended reporting requirements to additional industry sectors, added or deleted chemicals from the TRI list, and raised or lowered chemical activity reporting thresholds. These changes can influence release and waste management quantities for a given year and may impact multi-year trend analyses or year-to-year comparisons of TRI data. Further, changes in the TRI "reporting universe" may impact multi-year trend analyses or year-to-year comparisons of TRI data. The "reporting universe" can vary year-to-year because facilities may not be required to submit TRI forms for the same chemicals each year and in some years, may not meet the TRI reporting criteria at all. Changes in facility operations, production volume, and type of chemicals used, for example, can influence whether a facility meets the reporting criteria in a given year (USEPA, 2022b).

Additionally, TRI data users should be aware of the scope of PFAS data available in the TRI database. Section 7321 of the National Defense Authorization Act for Fiscal Year 2020 (NDAA) immediately added 172 PFAS to the list of chemicals covered by the TRI list (effective with Reporting Year 2020) and provided a framework for additional PFAS to be added to TRI on an annual basis (USEPA, 2022c).

2.3 Environmental Fate and Transport

In the Environmental Fate section of each chapter, the initial discussion is focused on available data in the literature regarding persistence and mobility. HSDB/PubChem is typically used as the primary source. Other sources consulted include ATSDR Toxicological Profiles, Interstate Technology & Regulatory Council (ITRC) documents, and journal articles. Important parameters include the organic carbon partitioning coefficient (K_{oc}), the octanol-water partitioning coefficient (expressed as log K_{ow}), the Henry's Law Constant (K_H), water solubility, vapor pressure, and half-life. Note that property data are typically provided for the acid form of the various PFAS; however, in cases where salts are common, some properties for the salt form(s) are presented and labeled as such. Certain properties can vary substantially for the acid and salt forms of a given PFAS. For example, the water solubility of PFOS (acid form) and the potassium salt of PFOS may vary by approximately five orders of magnitude.

Li et al. (2018) indicated that because PFAS exhibit both hydrophilic and hydrophobic properties, organic carbon may not be the only factor that dictates the degree to which they sorb to soil. In addition to organic carbon content, the authors found that pH and clay content may also be important factors that affect sorption. The degree to which these factors contribute to sorption varies among the various PFAS.

In particular, log K_{ow} values for PFAS may be difficult to determine and/or have limited relevance regarding environmental partitioning. Prevedouros et al. (2006) reported that PFOA formed multiple layers in octanol and water, thus rendering the log K_{ow} value as questionable/uncertain.

Following this discussion of available data, qualitative conclusions about persistence and mobility are drawn, as applicable, using K_{oc}, log K_{ow}, K_H, water solubility, and suitable half-lives in the context of the persistence/mobility evaluation protocol. This protocol was originally developed and used during the third Contaminant Candidate List (CCL 3)[1] to informally rank chemical contaminants' likely mobility (understood as their tendency to partition to water rather than other media) and persistence as "high," "moderate," or "low" based on physical and chemical properties (see USEPA, 2021b and USEPA, 2009). Use of the protocol helps to ensure that generalizations about the persistence and mobility of compounds are made using standardized scales. Below is a more detailed explanation of how qualitative conclusions about persistence and mobility are drawn using the protocol.

Persistence

Persistence refers to the length of time a contaminant remains in the environment, or in a particular medium like soil or water, when introduced. There are two primary mechanisms of degradation that are of greatest importance: biodegradation and hydrolysis. Of primary importance is degradation in water. However, since release of contaminants to soil can result in migration to surface water and/or ground water (and some contaminants, such as pesticides, are designed to be applied to crops and/or soil), biodegradation in soil is also of importance. Chemical reactivity with soil organic matter may also be important; however, data for this process are not common in sources such as HSDB.

Although other processes can result in either degradation of a contaminant (i.e., photolysis) or contaminant loss from an environmental system (i.e., volatilization), they are of lesser importance in the context of drinking water. Photolysis can occur in surface water but not in ground water; therefore, photolytic degradation may not be applicable to all sources of drinking water. Volatilization from soil or water to the atmosphere is a loss mechanism; however, it is not a destructive loss mechanism. Thus, contaminants that volatilize can be re-introduced to a given environmental medium through atmospheric deposition. Volatilization also does not occur in surface water and in ground water by identical mechanisms or at identical rates. Values for photolysis and/or volatilization half-life are presented when available in HSDB; however, only biodegradation, hydrolysis, and soil reactivity half-lives are assigned a qualitative conclusion for persistence by processing them through the persistence/mobility ranking protocol.

Exhibit 2-2 summarizes the Persistence Scale in the form of derived numerical time scales, qualitative biodegradation codes and their corresponding qualitative textual descriptions (used for the CCL 3 and CCL 4 process which included PFOS and PFOA), and qualitative conclusions for persistence.

[1] See Exhibit A.8 from https://www.epa.gov/sites/default/files/2014-05/documents/ccl3_pccltoccl_08-31-09_508.pdf

Exhibit 2-2: Persistence Scale

A: Numerical Time Scale for Use when Interpreting Literature Values (for half-life)	B: Qualitative Code from CCL 3 Modeling Using BIODEG	C: Qualitative Conclusion for Persistence
Hours-2 days	BF (Biodegrades fast)	Low persistence
>2 days-14 days	BFA (Biodegrades fast with acclimation[1])	Low persistence
>14 days-30 days	BS (Biodegrades slowly)	Moderate persistence
>30 days-59 days	BSA (Biodegrades slowly with acclimation[1])	Moderate persistence
≥60 days	BST (Biodegrades sometimes/recalcitrant)	High persistence

Source: Adapted from USEPA, 2009

[1] The term "acclimation" typically means that a contaminant does not begin to biodegrade until the requisite microorganisms have become acclimated to the metabolism of a particular contaminant under a given set of environmental conditions. Here, "acclimation" is used in a less specific manner (i.e., "Biodegrades fast with acclimation" is a designation to indicate that biodegradation is not as rapid as "Biodegrades fast" but not as slow as "Biodegrades slowly" and "Biodegrades slowly with acclimation" is a designation to indicate that biodegradation is not as rapid as "Biodegrades slowly" but not as slow as "Biodegrades sometimes/recalcitrant").

The output of the persistence evaluation is shown in Column C. The preferred input is measured or modeled half-lives from the literature (especially HSDB), evaluated against the categories in Column A. The numerical time scale in Column A is applicable to a range of degradation processes, including biodegradation, hydrolysis, and soil reactivity. If no numerical values for degradation half-life that are broadly applicable to potential drinking water resources are available from HSDB and other sources in the literature, the next preferred input to the persistence evaluation is a qualitative biodegradation code (corresponding to one of the codes in Column B), as derived by modeling performed during the development of CCL 3 using the EPA's BIODEG model.

If no qualitative biodegradation code from CCL 3 modeling is available, the BIOWIN module of the EPA's Estimation Program Interface (EPI Suite™; USEPA, 2012a) is used to provide a qualitative estimate of persistence. The BIOWIN (v4.10) module of EPI Suite™ uses several models to predict biodegradation, including complete degradation to a primary metabolite and complete degradation to carbon dioxide and water. Although these predictions are not half-lives and therefore cannot be directly compared to the categories for half-lives in the Persistence Scale, an inference regarding persistence can often be made from the BIOWIN data relative to the protocol's duration ranges for low, medium/moderate, and high persistence.

Mobility

Mobility refers to how readily a contaminant can partition from one environmental medium to another. In the context of the Contaminant Candidate List (CCL) and Regulatory Determination, it is used specifically to refer to how readily a contaminant partitions to or remains in water. That is, for CCL and in Regulatory Determination, the way that mobility affects concentrations of a contaminant in water is of greatest importance. Exhibit 2-3 summarizes the Mobility Scale for data elements in the form of "bins" that establish cut-offs for low, medium/moderate and high mobility rankings. A low ranking (Column B) minimizes the resulting concentration in water while a high ranking (Column D) maximizes the resulting concentration in water. Thus, those contaminants with a high ranking are of relatively greater concern for their potential to occur in water than those with a low ranking. Note that depending on how a parameter is defined, a large numerical value may result in either a low or a high ranking, as explained in Column E of Exhibit 2-3. Since "mobility" can refer to the tendency to partition both into and out of water, textual descriptions of the results of these rankings are presented not in terms of "high mobility" and "low mobility" but "high likelihood of partitioning to water" and "low likelihood of partitioning to water."

Exhibit 2-3: Mobility Scale

A: Parameter	B: Low Ranking	C: Medium/ Moderate Ranking	D: High Ranking	E: Effect on Water Concentration
Organic Carbon Partitioning Coefficient (K_{oc})	>1,000 mL/g	100-1,000 mL/g	<100 mL/g	Lower values for K_{oc} (Column D) favor dissolution in water over adsorption to soil/sediment
Log Octanol/Water Partitioning Coefficient (log K_{ow})	>4	1-4	<1	Lower values for log K_{ow} (Column D) favor dissolution in water over adsorption to soil/sediment or accumulation in animal lipids
Henry's Law Constant (K_H)	>10^{-3} atm-m^3/mol	10^{-7}-10^{-3} atm-m^3/mol	<10^{-7} atm-m^3/mol	Lower values for K_H (Column D) favor dissolution in water over volatilization to air
Water Solubility	<1 mg/L	1-1,000 mg/L	>1,000 mg/L	Larger values for water solubility (Column D) may favor higher water concentrations unless sorption or volatility are more important

Source: Adapted from USEPA, 2009

K_{oc} is a chemical-specific value that represents the degree to which a chemical sorbs to soil or sediment organic carbon relative to remaining dissolved in water. A related parameter, the soil sorption coefficient or soil distribution coefficient (K_d), modifies K_{oc} to account for the amount of organic carbon that is present in soil or sediment. K_{oc} is used in this document because values for K_{oc} are typically more widely available for most chemicals than are values for K_d and because K_{oc} allows for the comparison of one chemical's sorption potential relative to another chemical's sorption potential without regard to soil type (e.g., a K_d value for chemical A in soil type X cannot be directly compared to a K_d for chemical B in soil type Y). However, researchers have reported that the process of sorption of PFAS may be more complicated than it is for many other chemicals.

Nguyen et al. (2020) indicated that alkyl chain length and charge are two primary attributes that affect PFAS sorption. PFAS with longer alkyl chains (≥C_6) are associated with higher values of logK_d and tend to be sorbed to soil while PFAS with shorter alkyl chains (≤C_5) are associated with lower values of logK_d and tend to remain in the water phase. Various PFAS may exist as anionic, non-ionic or zwitterionic species. The zwitterionic PFAS in the study were observed to have large values for K_d and their sorption was linked to soil cation exchange capacity (CEC), exchangeable sodium percentage (ESP) and pH. Longer chain anionic PFAS were observed to have larger values of K_d than short-chain anionic PFAS and the sorption of both short and long chain anionic PFAS was linked to soil organic carbon content, soil micropore volume and silt-plus-clay content. The sorption of nonionic PFAS did not demonstrate any clear relationship with the soil properties that were evaluated in the study. For all of the PFAS studies, sorption was observed to increase as pH decreased. This was attributed to changes in acid dissociation constant-mediated speciation.

2.4 Contaminant Occurrence

2.4.1 Detection, Quantitation, and Reporting Thresholds

Several types of concentration thresholds are important in the characterization of chemical contaminant occurrence in drinking water. This section clarifies some of the terminology used in this support document.

Typically, an analytical method allows for low-level detection of a contaminant in water at concentrations that cannot be reliably quantified. Thus, there is a distinction between the *detection limit* (or DL, the threshold at or above which the presence or absence of an identified compound can be distinguished with a specified degree of confidence) and a *quantitation limit* or *reporting limit or level* (a somewhat higher threshold, at or above which the concentration of a contaminant can be measured with a specified degree of precision and/or accuracy). Such thresholds can vary from method to method, contaminant to contaminant, laboratory to laboratory, and even from technician to technician, based on method limitations, chemical properties, technician skill, and the quality of analytical instrumentation. Published analytical methods specify the standards of precision and accuracy that define acceptable laboratory performance, and often estimate “normal” or expected DLs. In practice, the limits vary.

The *reporting level* is the threshold at or above which a contaminant’s presence or concentration is officially quantitated. For NPDWR development purposes, the EPA has historically called this threshold the practical quantitation level (PQL). In some of the data sets discussed in this document, the term *reporting limit* may also be used; however, the term reporting level is used in this document for the sake of consistency with the PQL. For the purposes of occurrence data evaluation, the terms “reporting level” and “reporting limit” are considered to be synonymous.

Reporting thresholds may be established by the laboratory or by those who design and carry out a study. The requirements for precision and accuracy that are included in a published analytical method help to dictate where laboratories establish a reporting threshold for a particular analyte. In the case of the EPA’s nation-wide drinking water study, the Unregulated Contaminant Monitoring Rule (UCMR), the selected reporting level is known officially as the minimum reporting level (MRL) and is the minimum quantitation level that the EPA believes can be achieved with specified confidence by a broad spectrum of capable laboratories across the nation.

In the absence of an otherwise established reporting threshold, laboratories generally report results as low as can be reliably measured based on precision and accuracy acceptance criteria and the lowest calibration standard used in the development of their instrument calibration curve, i.e., at the quantitation limit or level.

Knowing the reporting threshold(s) associated with a study or data set can help with interpretation of the results. Also, knowledge of reporting thresholds can help a reader to determine whether data from two studies are directly comparable.

To facilitate interpretation of occurrence results in the contaminant-specific chapters that follow, reporting thresholds are provided whenever they are available. In some cases, reporting thresholds are not known, and this too is documented. In some cases, the lowest reported concentration values can give a rough idea of what the reporting threshold(s) might have been. (Generally, the reporting threshold could not have been higher than the lowest reported concentration. If a sufficiently large number of detections are reported, the lowest reported concentration is likely a good approximation of the reporting level.)

Frequently the word *detection* is used in discussions of contaminant occurrence as shorthand for a sampling result that is equal to or exceeds a given reporting threshold, and *non-detection* for a result that does not equal or exceed the reporting threshold. Thus, even a sample that exhibits a result that exceeds the laboratory DL could, in the context of a particular study or data compilation, be considered a non-detection. For ambient water samples and some state drinking water samples for unregulated contaminants such as those presented within this document, laboratories will often report estimated values that are equal to or greater than the DL but less than the reporting threshold.

2.4.2 Occurrence in Drinking Water

The primary sources of the drinking water occurrence data used to evaluate PFAS occurrence were the UCMR 3 and state monitoring data. The agency also evaluated additional sources of drinking water occurrence information (including information on occurrence in “source” or “untreated” water, e.g., at the wellhead in ground water systems) to augment the primary drinking water occurrence data, to evaluate the likelihood of contaminant occurrence, and/or to more fully characterize a contaminant’s presence in the environment. These data sources are generally narrower in geographic scope than the primary drinking water data sources.

2.4.2.1 Third Unregulated Contaminant Monitoring Rule (UCMR 3) Data

The purpose of the EPA’s unregulated contaminant monitoring program is to collect data on the occurrence of contaminants suspected to be present in drinking water, but that do not have established health-based national standards under SDWA. UCMR 3 monitoring, designed to provide nationally representative contaminant occurrence data, was conducted from 2013 through 2015. UCMR 3 Assessment Monitoring occurrence data are available for six PFAS: PFOS, PFOA, PFBS, PFHxS, PFNA, and perfluoroheptanoic acid (PFHpA). Similar in design to prior rounds of UCMR sampling, UCMR 3 required surface water systems to monitor quarterly and ground water systems to monitor semi-annually to capture seasonal variability. As with first and second rounds of the Unregulated Contaminant Monitoring Rule (UCMR 1 and UCMR 2, respectively), there were multiple tiers of monitoring: Assessment Monitoring for contaminants with commonly used analytical method technologies, Screening Survey monitoring for contaminants that require specialized analytical method technologies not in wide or common use, and pre-screen testing for contaminants that require newer analytical method technologies not in wide or common use. See USEPA (2012b) and USEPA (2019a) for more information on the UCMR 3 study design and data analysis, including a complete list of analytes.

For UCMR 3, all large and very large PWSs (serving between 10,001 and 100,000 people and serving more than 100,000 people, respectively), plus a statistically representative national sample of 800 small PWSs (serving 10,000 people or fewer), were required to conduct Assessment Monitoring during a 12-month period between January 2013 and December 2015. For the individual PFAS contaminants, nearly 37,000 finished water samples were collected from 4,920 PWSs. Analysis of UCMR 3 results is found in the chapters that follow and in *Occurrence Data from the Third Unregulated Contaminant Monitoring Regulation (UCMR 3)* (USEPA, 2019a).

2.4.2.2 State Monitoring Data

The agency supplemented the UCMR 3 data with more recent data collected by states who have made their data publicly available. In general, these more recent state data were collected using newer analytical methods and state results reflect lower reporting and detection limits than those in the UCMR 3. The EPA identified some available state data as part of the preliminary regulatory determination for PFOA and PFOS, and based on public comments received following that preliminary regulatory determination, commenters identified additional state data information and recommended the EPA consider all readily available drinking water sampling conducted by states (USEPA, 2021a). In addition, the EPA gathered updated and new state data as of May 2023 to support the development of the final NPDWR. Exhibit 2-4 discusses state-specific sampling and collection dates for each state. The EPA collected these occurrence data by downloading publicly available monitoring data from state websites. (The EPA notes that one state voluntarily submitted their drinking water data to the EPA.) Drinking water monitoring data for select contaminants were available online from several states, including Alabama, Arizona, California, Colorado, Delaware, Georgia, Idaho, Illinois, Indiana, Iowa, Kentucky, Maine, Massachusetts, Maryland, Michigan, Minnesota, Missouri, New Hampshire, New Jersey, New Mexico, New York, North Carolina, North Dakota, Ohio, Oregon, Pennsylvania, Rhode Island, South Carolina, Tennessee, Vermont, Virginia, West Virginia, and Wisconsin. The available state data are varied in terms of quantity and coverage, and some represent targeted sampling efforts (i.e., monitoring in areas of known or potential PFAS contamination). Thus, the monitoring data from each state may not necessarily be representative of levels found in all PWSs within a state or represent occurrence in other states.

Due to the representative and reporting limitations of some of the available state data (e.g., reporting combined analyte results rather than individual analyte results, very limited available data), the EPA did not utilize all of the data described below in the subsequent occurrence analyses/co-occurrence analyses; specific data analysis criteria (e.g., separation of non-targeted and targeted monitoring results) were applied and are described in the chapters that follow. Furthermore, there were not available data for all six PFAS (PFOA, PFOS, PFHxS, PFNA, HFPO-DA, and PFBS) from all states listed below. See Chapters 3 and 4 of this document for more information on state data collected for PFOA and PFOS, specifically. Please see Chapters 5, 6, and 7 (and Appendix A) of this document for more information on state data collected for PFHxS, PFNA, HFPO-DA, and PFBS. For system-level analyses, inventory information (i.e., source water type and population served information) was obtained from the fourth quarter 2022 report from the Safe Drinking Water Information System / Federal version (SDWIS/Fed) data available online.

Exhibit 2-4: Summary of Available State Reported Monitoring Data

State (Reference)	Date Range	Type of Water Tested	Notes on Overall Coverage	Survey Type
Alabama (ADEM, 2023)	2013 - 2022	Ground Water and Surface Water - Finished Water	The Alabama Department of Public Health (ADPH) instructed water systems to carry out PFAS monitoring at all PWSs not previously sampled during UCMR 3. In 2022, water systems that had not been sampled since UCMR 3 were required to sample between January and June 2022 using current analytical methods . Alabama conducted sampling of 18 PFAS, including PFOS, PFOA, HFPO-DA, PFBS, PFHxS, and PFNA. Data were	Non-Targeted

State (Reference)	Date Range	Type of Water Tested	Notes on Overall Coverage	Survey Type
			downloaded in May 2023 which included monitoring data through August 2022. Only results that are above the reporting limit are posted online; thus, only reported detections were available for use in the occurrence analyses.	
Arizona (ADEQ, 2021; ADEQ, 2023)	2016 - February 2021	Ground Water and Surface Water - Finished Water	The Arizona Department of Environmental Quality (ADEQ) made publicly available PFAS sampling data from systems near the Luke Air Force Base. Finished water data were available from two PWSs. Arizona conducted sampling of two PFAS, PFOS and PFOA.	Targeted
	2018 - 2022	Ground Water and Surface Water - Raw and Finished Water	ADEQ presents a PFAS Interactive Data Map that displays the results of testing conducted by ADEQ since 2018 at PWSs across the state. Data were downloaded in May 2023 which included monitoring data through July 2022. ADEQ (2023) conducted sampling of 18 PFAS, including PFOS, PFOA, HFPO-DA, PFBS, PFHxS, and PFNA.	Targeted
California (CADDW, 2023)	2013 - April 2023	Ground Water and Surface Water - Raw, Finished, and Unknown Water	The EPA reviewed the California PFAS data available online through April 2023. Finished water data were available from approximately 120 PWSs. For analysis purposes, the EPA only included results that were explicitly defined as being from treated water. Sampling in California is ongoing. California conducted sampling of 18 PFAS, including PFOS, PFOA, HFPO-DA, PFBS, PFHxS, and PFNA.	Targeted
Colorado (CDPHE, 2018; CDPHE, 2020)	2013 - 2017	Surface Water (Finished Water) and Drinking Water Distribution Samples	Data available from 28 “drinking water distribution zones” (one or more per PWS) in targeted sampling efforts at a known contaminated aquifer region. Data were collected by El Paso County Public Health, local water districts and utilities, and the Colorado Department of Public Health and Environment (CDPHE). Colorado (2013-2017) conducted sampling of six PFAS, including PFOS, PFOA, PFBS, PFHxS, and PFNA.	Targeted
	2020	Ground Water and Surface Water - Raw and Finished Water	CDPHE offered free testing to PWSs serving communities, schools, and workplaces and also to fire districts with wells. Approximately 50% of PWSs in Colorado participated in the 2020 PFAS sampling project. Data included in this report were collected in March through May of 2020. Colorado (2020) conducted sampling of 18 PFAS, including PFOS, PFOA, HFPO-DA, PFBS, PFHxS, and PFNA.	Non-Targeted
Delaware (DE ODW, 2021)	2019 - 2020	Surface Water - Finished and Unknown Water	Sampling of finished drinking water data between January 2019 and October 2020 from one public water system. Delaware conducted sampling of PFOS and PFOA, the EPA notes that the data no longer appear to be publicly available through the Drinking Water Watch link.	Targeted
Georgia (GA EPD, 2020)	2020	Surface Water - Raw, Finished, and Unknown Water	The EPA and the Georgia Environmental Protection Division (GA EPD) conducted joint sampling of the City of Summerville’s drinking water sources and finished drinking water in January 2020. Georgia conducted sampling of six PFAS, including PFOS, PFOA, PFBS, PFHxS, and PFNA.	Targeted

State (Reference)	Date Range	Type of Water Tested	Notes on Overall Coverage	Survey Type
Idaho (Idaho DEQ, 2023)	2016 - April 2023	Ground Water - Finished and Unknown Water	Sampling of finished drinking water data between August 2016 and April 2023 that were available on the state's Drinking Water Watch website. Idaho conducted sampling of 25 PFAS, including PFOS, PFOA, HFPO-DA, PFBS, PFHxS, and PFNA.	Not specified
Illinois (IL EPA, 2023)	2020 - May 2023	Ground Water and Surface Water - Raw and Finished Water	The EPA reviewed statewide finished drinking water data collected between September 2020 and May 2023 that were available on the state's Drinking Water Watch website. Limited PFOA and PFOS data were also available from 2017. Illinois conducted sampling of 20 PFAS, including PFOS, PFOA, HFPO-DA, PFBS, PFHxS, and PFNA. Sampling in Illinois is ongoing.	Non-Targeted
Indiana (IDEM, 2023)	2021 - January 2023	Ground Water and Surface Water - Raw, Finished, and Unknown Water	Beginning in February 2021, the Indiana Department of Environmental Management (IDEM) facilitated PFAS monitoring at all community water systems (CWSs) throughout the state of Indiana. Samples were to be collected at all raw water (i.e., wells and intakes) and finished (after treatment) water points in a CWS's supply to evaluate the statewide occurrence of PFAS compounds in CWS across the state and determine the efficacy of conventional drinking water treatment for PFAS. Indiana conducted sampling of 18 PFAS, including PFOS, PFOA, HFPO-DA, PFBS, PFHxS, and PFNA.	Non-Targeted
Iowa (IA DNR, 2023)	2021 - April 2023	Ground Water and Surface Water - Raw and Finished Water	In January 2020, the Iowa Department of Natural Resources (DNR) developed an Action Plan to protect the health of Iowa residents and the environment from PFAS. Data were downloaded from the PFAS Sampling Interactive Dashboard and Map. Iowa conducted sampling of 30 PFAS, including PFOS, PFOA, HFPO-DA, PFBS, PFHxS, and PFNA.	Targeted
Kentucky (KYDEP, 2019)	2019	Ground Water and Surface Water - Finished Water	Sampling of finished drinking water data between June and October 2019. Under this sampling effort, data are available from 81 community public drinking water treatment plants (DWTPs), representing 74 PWSs, and serving more than 2.4 million people. Kentucky conducted sampling of eight PFAS, including PFOS, PFOA, HFPO-DA, PFBS, PFHxS, and PFNA.	Non-Targeted
Maine (Maine DEP, 2020; Maine DHHS, 2023)	2013 - 2020	Drinking Water - Raw, Finished, and Unknown Water	In March 2019, the Maine PFAS Task Force was created to review the extent of PFAS contamination in Maine. Finished water results collected from 2013 through 2020 have been collected at 23 locations throughout the state. Data may include results from public and private finished drinking water sources. Maine conducted sampling of 35 PFAS, including PFOS, PFOA, HFPO-DA, PFBS, PFHxS, and PFNA. Sampling in Maine is ongoing.	Targeted
	2021 - January 2023	Ground Water and Surface Water - Finished Water	The EPA reviewed the finished water data reported to the Maine Center for Disease Control and Prevention (CDC) Drinking Water Program as compliance samples since June 2021 and processed in the database as of 3/10/2023. Maine conducted sampling of 12 PFAS, including PFOS, PFOA,	Non-Targeted

State (Reference)	Date Range	Type of Water Tested	Notes on Overall Coverage	Survey Type
			HFPO-DA, PFBS, PFHxS, and PFNA. Sampling in Maine is ongoing.	
Maryland (MDE, 2021; MDE, 2022a; MDE, 2022b)	2020 - 2022	Ground Water and Surface Water - Raw and Finished Water	In 2020, Maryland's Department of the Environment (MDE) initiated a project to identify potential sources of PFAS in Maryland and to prioritize water sources for PFAS sampling. The EPA reviewed the finished water results from the first three phases of MDE's Public Water System study for the occurrence of PFAS in state drinking water sources. Under Phase 1 (September 2020 - February 2021), sites were selected for priority sampling based on MDE's evaluation of potential relative risk for PFAS exposure through drinking water. Under Phase 2 (March 2021 - May 2021), MDE conducted sampling at sites that were selected based on their geological setting and proximity to potential sources of PFAS. Under Phase 3 (August 2021- June 2022), MDE tested the remaining CWSs in the state. Maryland conducted sampling of 18 PFAS, including PFOS, PFOA, HFPO-DA, PFBS, PFHxS, and PFNA.	Targeted (Phase 1, Phase 2); Non-Targeted (Phase 3)
Massachusetts (MA EEA, 2023)	2016 - April 2023	Ground Water and Surface Water - Raw and Finished Water	The EPA reviewed the finished water data available online through April 2023. Data were available from approximately 1,300 PWSs. Massachusetts conducted sampling of 18 PFAS, including PFOS, PFOA, HFPO-DA, PFBS, PFHxS, and PFNA. Sampling in Massachusetts is ongoing.	Non-Targeted
Michigan (Michigan EGLE, 2023)	2020 - March 2023	Ground Water and Surface Water -Finished Water	The Michigan Department of Environment, Great Lakes, and Energy (EGLE) developed MCLs for seven PFAS compounds in Michigan, which took effect in August 2020. The EPA reviewed available PFAS finished water compliance monitoring results through March 2023. Michigan conducted sampling of 18 PFAS, including PFOS, PFOA, HFPO-DA, PFBS, PFHxS, and PFNA. Sampling in Michigan is ongoing.	Non-Targeted
Minnesota (MDH, 2023)	2020 - 2023	Ground Water and Surface Water -Finished Water	Through the Statewide PFAS Monitoring Project, the Minnesota Department of Health (MDH) is testing CWSs across the state for PFAS. The EPA reviewed finished water data through MDH's Interactive Dashboard for PFAS Testing in Drinking Water. Minnesota conducted sampling of eight PFAS, including PFOS, PFOA, PFBS, and PFHxS.	Non-Targeted
Missouri (Missouri DNR, 2018; Missouri DNR, 2023)	2016 - 2017	Ground Water and Surface Water - Raw and Finished Water	The Missouri Department of Natural Resources (Missouri DNR) conducted sampling of finished drinking water data between September 2016 and February 2017. Under this sampling effort, 30 finished water samples were collected from 15 PWSs. Missouri conducted sampling of two PFAS, PFOS and PFOA.	Targeted
	2022 - 2023	Ground Water and Surface Water - Raw and Finished Water	The EPA reviewed the finished water data available online from Missouri DNR's "PFAS Viewer Tool" which identifies the location of voluntary sampling for PFAS in public drinking water systems in Missouri. The EPA reviewed finished water data collected from approximately 125 PWSs from 2022 through 2023. Limited data were also available from 2013 through 2017. Missouri conducted sampling of 29 PFAS,	Non-Targeted

State (Reference)	Date Range	Type of Water Tested	Notes on Overall Coverage	Survey Type
			including PFOS, PFOA, HFPO-DA, PFBS, PFHxS, and PFNA..	
New Hampshire (NHDES, 2021)	2016 - May 2021	Ground Water and Surface Water - Raw and Finished Water	The EPA reviewed the New Hampshire PFAS drinking water data available online through May 2021. Finished water data were available from more than 500 PWSs. New Hampshire conducted sampling of 42 PFAS, including PFOS, PFOA, HFPO-DA, PFBS, PFHxS, and PFNA. Sampling in New Hampshire is ongoing.	Non-Targeted
New Jersey (NJDEP, 2023)	2019 - May 2023	Ground Water and Surface Water - Raw, Finished, and Unknown Water	Statewide sampling of finished drinking water data was available from 2019-2023. The EPA reviewed finished water data available online through May 2023 from more than 1,100 PWSs. New Jersey conducted sampling of 14 PFAS, including PFOS, PFOA, PFBS, PFHxS, and PFNA. Sampling in New Jersey is ongoing.	Non-Targeted
New Mexico (NMED, 2019)	2016	Ground Water - Raw and Finished Water	The New Mexico Environment Department (NMED), Department of Health and the U.S. Air Force conducted testing at public drinking water supplies at or around Cannon Air Force Base up to 2019. New Mexico conducted sampling of 21 PFAS, including PFOS, PFOA, PFBS, PFHxS, and PFNA.	Targeted
New York (NYDOH, 2022)	2013 - 2022	Ground Water and Surface Water - Raw, Finished, and Unknown Water	The EPA reviewed finished water data voluntarily provided by the state to the EPA. Data were available from nearly 2,600 PWSs from 2017 through 2022. Limited data were also available from 2013 and 2016. New York conducted sampling of 29 PFAS, including PFOS, PFOA, HFPO-DA, PFBS, PFHxS, and PFNA.	Non-Targeted
North Carolina (NCDEQ, 2021; NCDEQ, 2023)	2017 - 2019	Finished and unknown water	The North Carolina Department of Environmental Quality (NCDEQ) and the NC Department of Health and Human Services investigated the presence of HFPO-DA and other PFAS in the Cape Fear River. Monthly results were collected from five WTPs on the Cape Fear River. Data were available from June 2017 through October 2019. North Carolina conducted sampling of 36 PFAS, including PFOS, PFOA, HFPO-DA, PFBS, PFHxS, and PFNA. Only results above the DL were reported; thus, only reported detections were available for use in the occurrence analyses.	Targeted
	September 2022 - November 2022	Ground Water and Surface Water - Raw, Finished, and Unknown Water	In late 2022, NCDEQ performed three months of sampling at 50 municipal and county water systems identified in the 2019 PFAS Testing Network study with PFOA/PFOS detections above the MRL indicated by the 2022 EPA interim health advisories. Data for three PFAS were included: PFOS, PFOA and HFPO-DA.	Targeted
North Dakota (NDDEQ, 2019; NDDEQ, date unknown; NDDEQ, date unknown)	2018, 2020, 2021	Ground Water and Surface Water - Raw and Finished Water	North Dakota Department of Environmental Quality (NDDEQ) published a 2018, a 2020, and a 2021 survey report of North Dakota Statewide PFAS Presence/Absence results. The first phase of sampling in October of 2018 included raw and finished water from seven drinking WTPs that were chosen based on either the population served or proximity to an industrial site. During the first phase of sampling North Dakota conducted sampling of two	Targeted (2018); Non-Targeted (2020); Non-Targeted (2021)

State (Reference)	Date Range	Type of Water Tested	Notes on Overall Coverage	Survey Type
			PFAS, PFOS and PFOA, The second sampling effort in October of 2020 sought to determine if there was a PFAS presence in a representative portion of the state's public water supply. In 2021, sampling conducted as part of the third phase of the survey focused on drinking water sites not evaluated in the first two surveys. During the second and third phases of sampling, North Dakota conducted sampling of 22 PFAS, including PFOS, PFOA, HFPO-DA, PFBS, PFHxS, and PFNA.	
Ohio (Ohio EPA, 2023)	December 2019 - December 2021	Ground Water and Surface Water - Raw and Finished Water	The Ohio EPA coordinated sampling of raw and finished drinking water from PWSs throughout the state. The EPA reviewed the finished water data available online through December 2021. During this timeframe, data were available from 1,479 PWSs. Ohio conducted sampling of six PFAS, including PFOS, PFOA, HFPO-DA, PFBS, PFHxS, and PFNA.	Non-Targeted
Oregon (OHA-DWS, 2022)	Oct 2021 - Jul 2022	Ground Water and Surface Water -Finished Water	The Oregon Health Authority (OHA) conducted a PFAS drinking water monitoring project in 2021 at PWSs in Oregon identified as at risk due to their proximity to a known or suspected PFAS use or contamination site. The EPA reviewed the finished water data from more than 140 PWSs. Oregon conducted sampling of 24 PFAS, including PFOS, PFOA, HFPO-DA, PFBS, PFHxS, and PFNA.	Targeted
Pennsylvania (PADEP, 2019; PADEP, 2021)	2019 - March 2021	Ground Water and Surface Water -Finished Water	A PFAS Sampling Plan was developed to test PWSs across the state. Finished water data were collected for more than 340 PWSs. Statewide sampling began in June 2019. Pennsylvania conducted sampling from June 2019 through February 2020 of six PFAS, including PFOS, PFOA, PFBS, PFHxS, and PFNA. Sampling was suspended from March 2020 to July 2020 due to COVID-19. Sampling resumed in August 2020 and was completed by the end of March 2021. In 2019, sampling was conducted for 6 PFAS; however, upon monitoring resuming from 2020-2021 sampling was conducted for 18 PFAS. Pennsylvania conducted sampling of 18 PFAS, including PFOS, PFOA, HFPO-DA, PFBS, PFHxS, and PFNA during this timeframe Results for the two rounds of sampling (i.e., pre-2020 and post 2020) are presented separately in the occurrence analyses.	Targeted
South Carolina (SCDHEC, 2020; SCDHEC, 2023)	2017 - March 2023	Ground Water and Surface Water -Raw and Finished Water	The EPA reviewed PFAS sampling results collected by the South Carolina Bureau of Water for community drinking water systems. South Carolina conducted sampling of 18 PFAS, including PFOS, PFOA, HFPO-DA, PFBS, PFHxS, and PFNA. Data were available from 300 PWSs.	Non-Targeted
Tennessee (TDEC, 2023)	2019	Surface Water - Raw and Finished Water	In 2019, Metro Water Services conducted a voluntary sampling of Nashville's drinking water systems for PFAS. Their stated goal was to go above and beyond current federal and state monitoring requirements to understand the potential presence of PFAS in Nashville's drinking water. Sampling data included results for 18 PFAS, including PFOS, PFOA, PFBS, PFHxS, and PFNA.	Non-Targeted

State (Reference)	Date Range	Type of Water Tested	Notes on Overall Coverage	Survey Type
Vermont (VT DEC, 2023)	2019 -April 2023	Ground Water and Surface Water - Raw, Finished, and Unknown Water	The Vermont Water Supply Rule required all CWSs and non-transient non-community water systems (NTNCWSs) to sample for PFAS. The EPA reviewed finished water data available online from July 2019 - April 2023 from approximately 560 PWSs. Vermont conducted sampling of 18 PFAS, including PFOS, PFOA, HFPO-DA, PFBS, PFHxS, and PFNA. Sampling in Vermont is ongoing.	Non-Targeted
Virginia (VDH ODW, 2021)	2021	Ground Water and Surface Water - Raw and Finished Water	The Virginia Department of Health Office of Drinking Water (ODW), in conjunction with the Virginia Per and Poly Fluoroalkyl Substances (VA PFAS) work group, designed the sample study to prioritize sites for measuring PFAS concentrations in drinking water and major sources of water and generate statewide occurrence data. Virginia ODW also selected the 17 largest waterworks in the state, which serve approximately 4.5 million consumers, to participate in the sampling effort. Virginia conducted sampling of nine PFAS, including PFOS, PFOA, HFPO-DA, PFBS, PFHxS, and PFNA.	Targeted / Non-Targeted
West Virginia (WV DHHR. 2023)	2017 - 2019	Ground Water and Surface Water - Raw, Finished, and Unknown Water	The EPA reviewed finished drinking water data collected from 2017-2019 that were available on the state's Drinking Water Viewer website. PFOS and PFOA results were available from one PWS.	Not specified
Wisconsin (WI DNR, 2023)	2022 -April 2023	Ground Water and Surface Water - Raw, Finished, and Unknown Water	The EPA reviewed the finished water data available online from 2022 - 2023. Data were available from nearly 250 PWSs. On Aug. 1, 2022, the state's safe drinking water code ch. NR 809 Wis. Adm. Code was revised to include standards for PFOA and PFOS. Wisconsin conducted sampling of 37 PFAS, including PFOS, PFOA, HFPO-DA, PFBS, PFHxS, and PFNA. Sampling in Wisconsin is ongoing.	Non-Targeted

The EPA notes that additional available state data were reviewed other than what is included in Exhibit 2-4 above, including information from Rhode Island, Alaska and Montana as well as other sampling efforts in Georgia and Michigan. However, those data only either represented the sum of some analytes or the EPA was not able to determine if was representative of finished drinking water data. Additionally, the EPA is aware that since the state data described above and in Exhibit 2-4 were collected, some of these states may have newer data available and additional states have or intend to conduct monitoring of finished drinking water. Any data not listed were also not used within the analyses presented in this document.

2.4.2.3 Other Data

Department of Defense (DoD) Drinking Water Sampling

In May 2016, the Department of Defense (DoD) took actions to address impacted drinking water and developed strategies to investigate and address DoD releases of PFAS, including testing of PFOS and PFOA at all DoD-owned and operated drinking water systems (DoD, 2020). Additionally, in accordance with Section 345 of the NDAA for Fiscal Year 2022, the DoD was required to provide the final testing results for off-base drinking water located in “covered areas," which are areas in the United States that are adjacent to and down gradient from a military installation, Formerly Used Defense Site (FUDS), or

National Guard facility (DoD, 2023a). The drinking water analytical results from Section 345 Reporting are only for locations outside of the installation boundary. The DoD separately manages and reports on-base drinking water where DoD is the purveyor under SDWA (DoD, 2023b). Currently, DoD uses validated EPA methods 533, 537, 537.1, and 1633 and DoD Quality Systems Manual Table B-15 to test for PFAS in drinking water (DoD, 2023a). The EPA summarized the final testing results for off-base drinking water from samples marked as “post-treatment” (i.e., “finished drinking water” after the filtration system was used and where water is actually being consumed). Note that reported results were based on DLs which varied between both sampling sites and across different PFAS (DoD, 2023a).

2.4.3 Occurrence in Ambient Water

This section describes sources the EPA consulted to evaluate the occurrence of PFAS in U.S. ambient water (e.g., aquifers, rivers, lakes).

2.4.3.1 National Water Information System (NWIS) Data

The National Water Information System (NWIS) is the Nation's principal repository of water resources data collected by the United States Geological Survey (USGS) from more than 1.9 million sites in all 50 states (USGS, 2023). NWIS-Web is the general online interface to the USGS NWIS database. All USGS water quality and flow data are stored in NWIS, including site characteristics, streamflow, groundwater level, precipitation, and chemical analyses of water, sediment, and biological media, though not all parameters are available for every site. NWIS houses the National Water Quality Assessment (NAWQA) data and includes other USGS data from unspecified projects. NWIS contains many more samples at many more sites than the NAWQA Program. Although NWIS is comprised of primarily ambient water data, some finished drinking water data are included as well. The non-NAWQA data housed in NWIS generally involve fewer constituents per sample than the NAWQA data. Unlike the NAWQA data, the non-NAWQA data are a miscellaneous collection, so they are not as well-suited for making temporal and geographic comparisons. NWIS data were downloaded from the Water Quality Portal (WQP) in November 2023 (WQP, 2023).

2.4.3.2 Storage and Retrieval (STORET) Data System / Water Quality Exchange (WQX) / Water Quality Portal Data System (WQP)

The EPA’s Water Quality Exchange (WQX) is the data format and mechanism for publishing monitoring data available through the WQP. In June of 2018, the WQX replaced the Storage and Retrieval Data System (STORET) as the mechanism for data partners to submit water monitoring data to the EPA. The Water Quality Portal is the mechanism for anyone, including the public, to retrieve water monitoring data that were previously in STORET (referred to below as WQP STORET data), as well as the United States Department of Agriculture (USDA) Sustaining the Earth's Watersheds-Agricultural Research Data System (STEWARDS) and USGS NWIS/BioData. The WQP contains raw biological, chemical, and physical data from surface and ground water sampling by federal, state and local agencies, Native American tribes, volunteer groups, academics, and others. The WQP database includes data from monitoring locations in all 50 states as well as multiple territories and jurisdictions of the United States. Most data are from ambient waters, but in some cases finished drinking water data are included as well. Data owners are responsible for providing data of documented quality, so that data users can choose to access only those data collected and analyzed with data quality objectives that meet their study needs. For more general WQX data information, please refer to: https://www.epa.gov/waterdata/water-quality-data-wqx. To retrieve the data via WQP, please refer to: https://www.waterqualitydata.us/portal/.

The WQP STORET data were downloaded from the WQP in November 2023 (WQP, 2023). (STORET data were downloaded from the WQP by selecting the STORET database from the dropdown menu of available data sources.) The EPA reviewed WQP STORET ground water data from wells and springs and surface water data from lakes, rivers, streams, and reservoirs (WQP, 2023).

Limitations of WQP STORET data quality include variations in the extent of national coverage and data completeness from parameter to parameter. Data may have been collected as part of targeted, rather than randomized, monitoring. Furthermore, there are no restrictions on submission of data based on analytical methods or quality assurance (QA) practices.

Since reporting levels vary and are not always provided in the WQP STORET data, it is generally not possible to present a single reporting level or even a range of reporting levels. Instead, the chapters that follow point out the minimum detected concentration. The minimum detected concentration, being equal to or probably no more than a little higher than one reporting level, is probably in or near the range of reporting levels.

2.5 Analytical Methods

The EPA has evaluated the availability of drinking water analytical methods for PFOS, PFOA, PFHxS, PFNA, HFPO-DA, and PFBS. For the purposes of compliance with the PFAS NPDWR, the EPA has currently identified that multiple standardized and validated analytical methods are available, including EPA Methods 533 and 537.1 (Version 2.0).

The EPA notes that laboratories participating in UCMR 3 were required to use EPA Method 537 and were required to report values at or above the EPA-defined MRLs for UCMR 3 PFAS (77 FR 26072; USEPA, 2012b). The MRLs were set based on the capability of multiple laboratories at the time. The EPA Method 537.1 was originally published in November 2018 as Version 1.0 as a more sensitive update to EPA Method 537 (with a slightly expanded target analyte list). Version 2.0 was published in March 2020 and contains minor editorial changes to Version 1.0. Use of EPA Method 537.1 is preferable to use of EPA Method 537 (it may not be feasible to reliably quantitate down to health levels of concern for certain PFAS when using EPA Method 537). For this reason, only EPA methods 533 and 537.1 (Version 2.0) are accepted for use in demonstrating compliance with this final rule.

The following analytical method performance metrics are useful and are typically available for assessing method sensitivity. The Lowest Concentration Minimum Reporting Level (LCMRL) is generally representative of the single EPA laboratory that developed the method, while the MRL is designed to be applied nationally in the context of UCMR monitoring during a specific UCMR cycle for which that MRL was developed. The DL represents the minimum concentration that can be distinguished from a blank sample, i.e., the minimum concentration required to detect the present of an analyte. A quantitation limit represents the minimum concentration at which the measured result can be reported with a desired level of confidence.

- **LCMRL -** The LCMRL is a single-laboratory reporting level for selected EPA analytical methods. It is determined via a statistical model of future analyte recovery using the method, where the future recovery is predicted to fall between 50% to 150% with 99% confidence.

- **MRL -** The MRL is a reporting level used for national application in the EPA's UCMR program. Starting with UCMR 3, the MRL was determined via a statistical model from raw LCMRL study data from multiple laboratories (typically three).
- **DL -** The minimum result which can be reliably discriminated from a blank (for example, statistically determined with a 99% confidence level).
- **Quantitation Limit -** The smallest detectable concentration of analyte greater than the DL where the accuracy (precision & bias) achieves the objectives of the intended purpose.

3 Perfluorooctanoic Acid (PFOA)

This chapter presents information and analysis specific to PFOA, including background information on the contaminant, information on contaminant sources and environmental fate, an analysis of health effects, an analysis of occurrence in ambient and drinking water, and information about the availability of analytical methods and treatment technologies.

3.1 Contaminant Background, Chemical and Physical Properties

Synonyms for PFOA include pentadecafluorooctanoic acid; perfluorocaprylic acid; perfluoroctanoic acid; perfluoroheptanecarboxylic acid; and octanoic acid, pentadecafluoro-, according to the Hazardous Substances Data Bank (NCBI, 2022a).

PFOA is a perfluorinated aliphatic carboxylic acid. It has been used as an emulsifier and surfactant in fluoropolymers (such as in the manufacture of non-stick products like Teflon), fire-fighting foams, cosmetics, greases and lubricants, paints, polishes, and adhesives (NCBI, 2022a). Through the EPA's 2010/2015 PFOA Stewardship Program, a voluntary risk reduction program, eight major chemical manufacturers agreed in 2006 to phase out the use of PFOA and PFOA-related chemicals in their products and as emissions from their facilities by 2015. All participating companies state that they met the PFOA Stewardship Program goals (USEPA, 2022d). PFOA may still be used by other companies not participating in the PFOA Stewardship Program. In addition, PFOA can also be present in imported articles (USEPA, 2017) or may be inadvertently formed as by-products in commercial products (USEPA, 2021c).

The EPA has taken a range of regulatory actions to address PFAS in manufacturing and consumer products. Since 2002, the EPA has finalized a number of TSCA Section 5(a) Significant New Use Rules (SNURs) covering hundreds of existing PFAS no longer in use. These regulatory actions require notice to the EPA, as well as agency review and regulation, as necessary, before manufacture (including import) or processing for significant new uses of these chemicals can begin or resume. The SNURs also apply to imported articles containing certain PFAS, including consumer products such as carpets, furniture, electronics, and household appliances. The EPA also has issued SNURs for dozens of PFAS that have undergone the EPA's new chemicals review prior to commercialization; these actions ensure that any new uses which may present risk concerns but were not part of the EPA new chemicals review, do not commence unless the EPA is notified, conducts a risk review, and regulates as appropriate under TSCA section 5. However, SNURs will not prevent the formation of PFAS by-product formation discussed in the preceding paragraph.

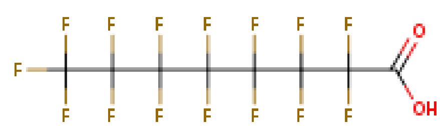
PFOA may also be formed in the environment as a terminal degradation product of commercial PFAS produced by fluorotelomerization and electrochemical fluorination. Perfluorooctane sulfonyl fluoride, 8:2 fluorotelomer alcohols, 8:2 fluorotelomer acrylates, and *N*-alkyl sulfonamido PFAS such as *N*-methyl perfluorooctanesulfonamido ethanol and *N*-ethyl perfluorooctanesulfonamido ethanol are used to produce surfactants and polymers that may degrade to PFOA (ITRC, 2020a; ITRC, 2020b; Buck et al., 2011).

The diagram in Exhibit 3-1 shows the straight-chain chemical structure of PFOA. PFOA and related compounds can exist as either branched-chain or linear-chain isomers depending on their method of manufacture (ATSDR, 2021). Physical and chemical properties and other reference information are listed in Exhibit 3-2 (these properties typically represent mixtures of branched and linear isomers rather than any particular isomer). There is uncertainty as to whether values for certain physical/chemical properties of PFOA can be measured or estimated. For example, NCBI (2022a) reports a value for the log K_{ow} that is estimated using the EPA's Estimation Programs Interface Suite™ (EPISuite™), while ATSDR (2021) and Lange et al. (2006) indicate that log K_{ow} cannot be measured since PFOA is expected to form multiple layers in octanol and water mixtures. While uncharged and very long-chain perfluoroalkyls form layers in water/hydrocarbon mixtures, forms that are charged/ionized at typical environmental pH (such as PFOA) are fairly soluble in water (ATSDR, 2021). Another example of apparent uncertainty is the Henry's Law Constant. NCBI (2022a) presents a value for K_H for PFOA that indicates a very high degree of partitioning from water to air (this value was estimated using EPISuite™), while ATSDR (2021) presents a value that indicates a moderate to nearly high degree of partitioning from water to air.

PFOA is a perfluorinated alkyl acid (PFAA) that exists as its carboxylate anion at typical environmental pH values. Physical and chemical property data for various PFAS often correspond to the protonated acid form of the compound in contrast to the deprotonated anion (ITRC, 2020a). Thus, the available physical and chemical property data for PFOA may not be representative of how PFOA partitions in the environment.

In cases where there are different conclusions in the literature, information describing differences are presented to highlight the uncertainty in this area.

Exhibit 3-1: Chemical Structure of PFOA - Straight-Chain Isomer



Source: NCBI, 2022a

Exhibit 3-2: Physical and Chemical Properties of PFOA

Property	Data
Chemical Abstracts Service (CAS) Registry Number	335-67-1 (NCBI, 2022a)
EPA Pesticide Chemical Code	Not Applicable
Chemical Formula	$C_8HF_{15}O_2$ (NCBI, 2022a)
Molecular Weight	414.069 g/mol (NCBI, 2022a)
Color/Physical State	White to off-white powder (NCBI, 2022a)
Boiling Point	192 deg C (NCBI, 2022a)
Melting Point	54.3 deg C (NCBI, 2022a)
Density	1.792 g/mL at 20 deg C (NCBI, 2022a) 1.8 g/cm^3 at 20 deg C (ITRC, 2021)
Freundlich Adsorption Coefficient	--
Vapor Pressure	0.0316 mm Hg at 19 deg C (NCBI, 2022a) 0.017 mm Hg at 20 deg C (ATSDR, 2021; extrapolated)

Property	Data
K_H	0.362 Pa-m^3/mol (ATSDR, 2021; converts to 3.57E-06 atm-m^3/mol) 0.0908 atm-m^3/mol (NCBI, 2022a; est)[a]
log K_{ow}	4.81 (est) (dimensionless)[b] (NCBI, 2022a) Not applicable (ATSDR, 2021)
K_{oc}	631 ±7.9 L/kg (mean ±1 standard deviation of selected values from Zareitalabad et al., 2013; converted from log K_{oc} to K_{oc})
Acid Dissociation Constant (pK_a)	1.30, 2.80, -0.5-4.2 (NCBI, 2022a) -0.5, 0.5 (ATSDR, 2021)
Solubility in Water	2,290 mg/L at 24 deg C (est); 3,300 mg/L at 25 deg C; 4,340 at 24.1 deg C (NCBI, 2022a) 9,500 mg/L, 3,300 mg/L at 25 deg C (ATSDR, 2021)
Other Solvents	--
Conversion Factors (at 25 deg C, 1 atm)	1 part per million (PPM) = 16.94 mg/m^3; 1 mg/m^3 = 0.059 PPM (ATSDR, 2021)

Note: "--" indicates that no information was found.

[a] These values should not be used to estimate portioning between water and air.

[b] Surfactants are surface acting agents that contain both a hydrophilic part and a hydrophobic part which causes them to accumulate at interfaces hampering the determination of their aqueous concentration. These surfactant properties present difficulties in applying existing methods for the experimental determination of log K_{ow} and produce unreliable results.

3.1.1 Sources and Environmental Fate

3.1.1.1 Production, Use, and Release

Production data for PFOA are available from the EPA's IUR and CDR programs and industrial release data are available from the EPA's TRI, as described below.

Inventory Update Reporting (IUR) / Chemical Data Reporting (CDR) Program

Under the authority of the TSCA, the EPA gathers information on production (including both manufacture and importation) of industrial chemicals. As a compound with a TSCA section 5(a)(2) SNUR, PFOA is among those contaminants to which the 2,500-pound threshold applies. See Chapter 2 for further discussion.

Exhibit 3-3 presents the publicly available information on production of PFOA in the United States from 1986 to 2006 as reported under IUR. Production did not exceed 500,000 pounds in any year with reported data. No data were reported in 1990 (the minimum threshold for reporting chemicals produced was 10,000 pounds or more at a single site).

Exhibit 3-4 presents the publicly available production data for PFOA in the United States from 2011 to 2015 as reported under CDR. (No reports were available for 2016 through 2020.) From 2012 to 2015, PFOA production was less than 1 million pounds. Note that although PFOA are not produced domestically or imported by the companies participating in the 2010/2015 PFOA Stewardship Program, PFOA may still be produced domestically or imported below the CDR reporting thresholds by companies not participating in the PFOA Stewardship Program.

Exhibit 3-3: IUR Reported Annual Manufacture and Importation of PFOA in the United States, 1986-2006 (pounds)

	Reporting Cycle					
	1986	**1990**	**1994**	**1998**	**2002**	**2006**
Range of Production Volume	10,000 - 500,000	No Reports	10,000 - 500,000	10,000 - 500,000	10,000 - 500,000	< 500,000

Source: USEPA, 2008

Exhibit 3-4: CDR Reported Annual Manufacture and Importation of PFOA in the United States, 2011-2020 (pounds)

	Chemical Inventory Update Reporting Cycle					
	2011	**2012**	**2013**	**2014**	**2015**	**2016 - 2020**
Range of Production / Importation Volume	Withheld	<1,000,000 lbs	<1,000,000 lbs	<1,000,000 lbs	<1,000,000 lbs	No Reports

"Withheld" = results not publicly available due to confidential business information.
Source: USEPA, 2022e

Toxics Release Inventory (TRI)

The EPA established TRI in 1987 in response to section 313 of the EPCRA. EPCRA section 313 requires the reporting of annual information on toxic chemical releases from facilities that meet specific criteria. This reported information is maintained in a database accessible through TRI Explorer (USEPA, 2023b).

Although TRI can provide a general idea of release trends, it has limitations. Not all facilities are required to report all releases. Facilities are required to report releases if they manufacture, process, or otherwise use a listed toxic chemical in quantities above the respective activity threshold. For PFOA, the reporting threshold is 100 pounds manufactured, processed, or otherwise used over the year. It should also be noted that, as of this publication, quantities of PFOA at concentrations under 1.0 percent within mixtures may be exempt from TRI reporting requirements. Reporting requirements have changed over time (e.g., the chemical list has changed), so conclusions about temporal trends should be drawn with caution. TRI data are meant to reflect releases and other waste management activities and should not be used to estimate general public exposure to a chemical (USEPA, 2023b).

TRI data for PFOA are available for 2020 through 2022 (USEPA, 2023b). As shown in Exhibit 3-5, there were about 780 pounds of total on-site disposals and 11,498 pounds of total off-site disposals across all industries in 2020. Reported releases decreased in 2021 but then increased again in 2022 to more than 18,000 pounds of total on- and off-site disposal and other releases. A total of eight facilities from seven states reported releases of PFOA in 2022 (USEPA, 2023b).

Exhibit 3-5: Environmental Releases of PFOA in the United States, 2020-2022

Year	On-Site Releases (in pounds)				Total Off-Site Releases (in pounds)	Total On- and Off-Site Releases (in pounds)
	Air Emissions	Surface Water Discharges	Underground Injection	Releases to Land		
2020	0	9	771	0	11,498	12,278
2021	4	0	288	0	0	292
2022	6	0	249	17,464	549	18,268

Source: USEPA, 2023b

3.1.1.2 Environmental Fate

The primary measures used by the EPA to assess mobility include (where available) K_{oc}, log K_{ow}, K_H, water solubility, and vapor pressure. For PFOA, pK_a is also important.

Based on its vapor pressure, if PFOA is released to the atmosphere it will be present as a vapor. PFOA can react in the atmosphere with photochemically produced hydroxyl radicals. The half-life for the degradation in air of PFOA by photochemically produced hydroxyl radicals is estimated to be 31 days, based on a structure estimation method (NCBI, 2022a). (Note that radical reactions typically proceed more rapidly than chemically or microbially mediated degradation reactions in other environmental media such as water, soil and/or sediment.) PFOA is not expected to undergo direct photolysis (NCBI, 2022a).

Based on findings from laboratory studies, Zareitalabad et al. (2013) calculate an average log K_{oc} of 2.8 ±0.9, equivalent to a K_{oc} of 631 ±7.9 L/kg, which suggests a propensity for PFOA to be mobilized to ground water and surface water rather than to bind to suspended solids or sediments. The authors note that field studies indicate a greater propensity for PFOA to bind to soil and sediment than the lab-derived K_{oc} values would predict.

With a pK_a ranging from -0.5 to 4.2 (NCBI, 2022a), PFOA will exist almost entirely in its anionic form in the environment, which contributes to mobilization in water (NCBI, 2022a; Lange et al., 2006). An estimated Henry's Law Constant of 0.0908 atm-m^3/mol suggests that PFOA may volatilize from moist soil, although the ionic nature of the compound at typical environmental pH may lessen its volatilization. A vapor pressure of 0.0316 mm Hg suggests that PFOA may not volatilize from dry soil (NCBI, 2022a).

PFOA is resistant to hydrolysis, photolysis, and biodegradation (NCBI, 2022a; Lange et al., 2006). Washington et al. (2010) found that PFOA had a modeled disappearance half-life of 1.0 years in sludge-applied soils near Decatur, Alabama. Washington et al. (2010) noted that this disappearance half-life is the time over which PFOA concentration in the surface soil was diminished by half due to *all* environmental processes: those processes could potentially include uptake into plants (c.f. Yoo et al., 2011), erosion, leaching, ingrowth from precursors, and degradation. Washington et al. (2014) posits that among these possible processes, leaching was likely a leading mode of loss. However, the chemical stability of PFOA is much longer than this disappearance half-life. Additionally, labile PFAS precursors commonly present in sludge may degrade in soil settings, leading to ingrowth of recalcitrant PFAS such as PFOS, PFOA and related compounds (Wang et al., 2009; Martin et al., 2010; Washington et al., 2014; Washington et al., 2015).

Under CCL 3, the EPA created scales[2] to informally rank chemical contaminants' likely mobility (understood as their tendency to partition to water rather than other media) and persistence as "high," "moderate," or "low" based on physical and chemical properties (see USEPA, 2021b and USEPA, 2009). For PFOA, a K_H of 0.0908 atm-m^3/mol and a log K_{ow} of 4.81 predict a low likelihood of partitioning to water. A K_{oc} value of 631 ±7.9 L/kg and a second K_H value of 3.57E-06 atm-m^3/mol predict a moderate likelihood of partitioning to water. A water solubility of 2,290 mg/L at 24 degrees C to 9,500 mg/L at 25 degrees C predicts a high likelihood of partitioning to water. A resistance to essentially all forms of degradation other than atmospheric processes predicts high persistence.

3.2 PFOA Occurrence

This section presents data on the occurrence of PFOA in drinking water and ambient water in the United States. The EPA is finalizing an MCLG of 0 parts per trillion (ppt) for PFOA. Under SDWA, the EPA must establish an enforceable MCL, the maximum concentration of a contaminant that is allowed in PWSs, as close to the MCLG as feasible, taking several factors into consideration, including analytical methods capable of measuring the contaminant, available treatment technologies to remove the contaminant, and costs. Based on these factors, the EPA is finalizing an MCL of 4.0 ppt for PFOA. Occurrence data from various sources presented below are analyzed with respect to the MCL and two alternative MCLs for PFOA of 5.0 ppt and 10.0 ppt that the EPA evaluated under its HRRCA for the proposed and final rule. When possible, estimates of the population exposed at concentrations above the MCL and alternative MCLs are presented. Also, when possible, studies that are meant to be representative and studies that are targeted at known or suspected sites of contamination are identified as such.

The drinking water analyses presented in this section were performed for UCMR 3 and select state data sources. In addition, this section presents PFOA findings from occurrence analyses conducted by non-EPA researchers. Chapter 10 describes the Bayesian hierarchical model used to extrapolate PFOA occurrence to the nation and also points the reader to examine Cadwallader et al. (2022) for further details.

For additional background information about data sources used to evaluate occurrence, please refer to Chapter 2.

3.2.1 Occurrence in Drinking Water

Data sources reviewed by the agency for information on PFOA occurrence in drinking water included UCMR 3, state drinking water monitoring programs, and the DoD PFAS drinking water testing, as well as additional studies from the literature.

Note that there may be some overlap, as sources with different purposes and audiences may have reported the same underlying data. UCMR 3 is a nationally representative data source. Other data sources profiled in this section are considered "supplemental" sources. Also note that 29 PFAS, including PFOA, are being monitored for under the fifth round of UCMR (UCMR 5), that data collection effort is occurring from 2023 to 2025. Analysis of partial UCMR 5 results (the first three quarters of data that

2 See Exhibit A.8 here: https://www.epa.gov/sites/default/files/2014-05/documents/ccl3_pccltoccl_08-31-09_508.pdf

were made available as of February 2024) are discussed in section 11 of this document. The EPA notes that the UCMR 3 MRL for PFOA is higher than that utilized within the majority of state monitoring data and for the UCMR 5.

3.2.1.1 UCMR 3 Data

UCMR 3 monitoring, designed to provide nationally representative contaminant occurrence data, was conducted from 2013 through 2015. UCMR 3 Assessment Monitoring occurrence data are available for PFOA from all large and very large public water systems or PWSs (serving between 10,001 and 100,000 people and serving more than 100,000 people, respectively), plus a statistically representative national sample of 800 small PWSs (serving 10,000 people or fewer).[3] Surface water and ground water under the direct influence of surface water (GWUDI) sampling points were monitored four times during the applicable year of monitoring, and ground water sample points were monitored twice during the applicable year of monitoring. See USEPA (2012b) and USEPA (2019a) for more information on the UCMR 3 study design and data analysis.

Exhibit 3-6 through Exhibit 3-8 provide an overview of PFOA occurrence results from the UCMR 3 Assessment Monitoring. Laboratories participating in UCMR 3 were required to report values at or above MRLs defined by the EPA. The UCMR MRLs are not intended to represent the lowest achievable measurement level an individual laboratory may achieve. Rather, the MRLs are established to ensure reliable and consistent results from the array of laboratories needed for a national monitoring program and are set based on the quantitation level capability of multiple commercial laboratories prior to beginning each UCMR round. The MRL used for PFOA in the UCMR 3 survey was 20 ng/L (77 FR 26072; USEPA, 2012b). Exhibit 3-6 presents a sample-level summary of the results. Exhibit 3-7 shows a statistical summary of PFOA concentrations by system size and source water type (including the minimum, 25th percentile, median, 75th percentile, 90th percentile, 99th percentile, and maximum). Exhibit 3-8 shows system-level results for detections greater than or equal to the MRL.

A total of 36,972 finished water samples for PFOA were collected from 4,920 PWSs. PFOA was reported ≥ MRL of 20 ng/L in 1.03 percent of UCMR 3 samples. Reported PFOA concentrations for these results ranged from 20 ng/L (the MRL) to 349 ng/L. Of 4,920 systems, 117 (2.4 percent of systems, serving 3.2 percent of the PWS-served population) reported at least one detection.

Exhibit 3-6: PFOA National Occurrence Measures Based on UCMR 3 Assessment Monitoring Data - Summary of Samples

Source Water Type	Total # of Samples	Samples with Detections ≥ MRL of 20 ng/L	
		Number	Percent
Small Systems (serving ≤ 10,000 people)			
Ground Water	1,853	2	0.11%
Surface Water	1,421	2	0.14%
All Small Systems	**3,274**	**4**	**0.12%**

[3] A total of 799 small systems submitted Assessment Monitoring results.

Source Water Type	Total # of Samples	Samples with Detections ≥ MRL of 20 ng/L	
		Number	**Percent**
Large Systems (serving 10,001 - 100,000 people) -- CENSUS			
Ground Water	11,707	94	0.80%
Surface Water	14,860	198	1.33%
All Large Systems	**26,567**	**292**	**1.10%**
Very Large Systems (serving > 100,000 people) -- CENSUS			
Ground Water	2,020	7	0.35%
Surface Water	5,111	76	1.49%
All Very Large Systems	**7,131**	**83**	**1.16%**
All Systems			
All Water Systems	**36,972**	**379**	**1.03%**

Exhibit 3-7: PFOA Occurrence Data from UCMR 3 Assessment Monitoring - Summary of Reported Concentrations

Source Water Type	Concentration Value of Detections (in ng/L) ≥ MRL of 20 ng/L						
	Minimum	**25th percentile**	**Median**	**75th percentile**	**90th Percentile**	**99th Percentile**	**Maximum**
Small Systems (serving ≤ 10,000 people)							
Ground Water	30	30	30	30	30	30	32
Surface Water	130	150	170	190	200	210	206.05
All Small Systems	**30**	**30**	**80**	**150**	**180**	**200**	**206.05**
Large Systems (serving 10,001 - 100,000 people) -- CENSUS							
Ground Water	20	20	30	40	70	320	338
Surface Water	20	20	30	40	70	290	349
All Large Systems	**20**	**20**	**30**	**40**	**70**	**290**	**349**
Very Large Systems (serving > 100,000 people) -- CENSUS							
Ground Water	21	30	40	50	50	60	65
Surface Water	20	20	30	40	50	140	140
All Very Large Systems	**20**	**20**	**30**	**40**	**50**	**140**	**140**
All Systems							
All Water Systems	**20**	**20**	**30**	**40**	**70**	**290**	**349**

Exhibit 3-8: PFOA National Occurrence Measures Based on UCMR 3 Assessment Monitoring Data - Summary of System and Population Served Data - Reported Detections

Source Water Type	UCMR 3 Samples		Number With At Least One Detection ≥ MRL of 20 ng/L		Percent With At Least One Detection ≥ MRL of 20 ng/L		National Inventory		Percent of National Inventory Included	
	Systems	Population	Systems	Population	Systems	Population	Systems	Population	Systems	Population
Small Systems (serving ≤ 10,000 people)										
Ground Water	527	1,498,845	1	536	0.19%	0.04%	55,700	38,730,597	0.95%	3.87%
Surface Water	272	1,250,215	1	8,323	0.37%	0.67%	9,728	20,007,917	2.80%	6.25%
All Small Systems	**799**	**2,749,060**	**2**	**8,859**	**0.25%**	**0.32%**	**65,428**	**58,738,514**	**1.22%**	**4.68%**
Large Systems (serving 10,001 - 100,000 people) -- CENSUS										
Ground Water	1,453	37,141,418	32	925,684	2.20%	2.49%	1,470	37,540,614	98.84%	98.94%
Surface Water	2,260	69,619,878	62	2,043,795	2.74%	2.94%	2,310	70,791,005	97.84%	98.35%
All Large Systems	**3,713**	**106,761,296**	**94**	**2,969,479**	**2.53%**	**2.78%**	**3,780**	**108,331,619**	**98.23%**	**98.55%**
Very Large Systems (serving > 100,000 people) -- CENSUS										
Ground Water	68	16,355,951	4	603,800	5.88%	3.69%	68	16,355,951	100.00%	100.00%
Surface Water	340	115,158,260	17	4,051,738	5.00%	3.52%	343	120,785,622	99.13%	95.34%
All Very Large Systems	**408**	**131,514,211**	**21**	**4,655,538**	**5.15%**	**3.54%**	**411**	**137,141,573**	**99.27%**	**95.90%**
All Systems										
All Water Systems	**4,920**	**241,024,567**	**117**	**7,633,876**	**2.38%**	**3.17%**	**69,619**	**304,211,706**	**7.07%**	**79.23%**

3.2.1.2 State Monitoring Data

In the development of the proposed and final NPDWR, the agency supplemented its UCMR 3 data with more recent publicly available data collected by states. In general, these more recent state data were collected using newer analytical methods and state results reflect lower reporting and detection limits than those in the UCMR 3. The EPA downloaded publicly available monitoring data for PWSs from state websites through May of 2023. Drinking water occurrence data for PFOA were available from several states, including Alabama, Arizona, California, Colorado, Delaware, Georgia, Idaho, Illinois, Indiana, Iowa, Kentucky, Maine, Maryland, Massachusetts, Michigan, Minnesota, Missouri, New Hampshire, New Jersey, New Mexico, New York, North Carolina, North Dakota, Ohio, Oregon, Pennsylvania, South Carolina, Tennessee, Vermont, Virginia, West Virginia, and Wisconsin. Note that while some states did have available raw water data as indicated in Exhibit 3-9, for the subsequent analyses the EPA only evaluated finished water results.

Exhibit 3-9 provides a summary of the available state reported monitoring data for PFOA, including date range and a description of coverage and representativeness (including whether monitoring was non-targeted or targeted (i.e., monitoring in areas of known or potential PFAS contamination). A description of those studies is also included in Exhibit 3-9. Within state reported data, there may be overlap with UCMR 3 results from 2013 - 2015, though the EPA notes that the large majority of the available state data are from 2019 and later. In addition, the EPA excluded UCMR 3 results from the state data whenever possible. State reporting thresholds are also provided, where available, in Exhibit 3-9. The EPA notes that different states utilized various reporting thresholds when analyzing and presenting their data, and for some states there were no clearly defined thresholds publicly provided; in these cases, minimum detected concentrations reported may be indicative of reporting thresholds used. Further, for some states, the thresholds varied when reporting results for the same analyte, as well as the laboratory analyzing the data. For those states, a range of thresholds is provided. As shown in Exhibit 3-9, some states reported at thresholds and/or presented data at concentrations below the EPA's final MCL and/or PQL for PFOA. However, to present the best available occurrence information, the EPA collected and evaluated the data based on the information as reported directly by the states and when conducting data analyses incorporated individual state-specific reporting thresholds where possible. Additionally, the EPA notes that the majority of the data were analyzed via an EPA-approved drinking water analytical method.

Exhibit 3-9: Summary of Available PFOA State Reported Monitoring Data

State (Reference)	Date Range	Type of Water Tested	Reporting Threshold (ppt)	Notes on Coverage	Survey Type
Alabama (ADEM, 2023)	2013-2022	Ground Water and Surface Water - Finished Water	Not reported	ADPH instructed water systems to carry out PFAS monitoring at all PWSs not previously sampled during UCMR 3. In 2022, water systems that had not been sampled since UCMR 3 were required to sample between January and June 2022 using current analytical methods. Only results that are above the MRL are posted online; thus, only reported detections were available for use in the occurrence analyses.	Non-Targeted
Arizona (ADEQ, 2021; ADEQ, 2023)	2016 - February 2021	Ground Water and Surface Water - Finished Water	Not reported	ADEQ made publicly available PFAS sampling data from systems near the Luke Airforce Base. Finished water data were available from two PWSs.	Targeted
	2018 - June 2021	Ground Water and Surface Water - Raw and Finished Water	1.6 - 2	ADEQ presents a PFAS Interactive Data Map that displays the results of testing conducted by ADEQ since 2018 at PWSs across Arizona.	Targeted
California (CADDW, 2023)	2013 - April 2023	Ground Water and Surface Water - Raw, Finished, and Unknown Water	0.002 - 20	The EPA reviewed the California PFOA data available online through April 2023. Finished water data were available from approximately 120 PWSs. For this analysis, the EPA only included results that were explicitly marked as being from treated water. Sampling in California is ongoing.	Targeted
Colorado (CDPHE, 2018;CDPHE, 2020)	2013 - 2017	Surface Water (Finished Water) and Drinking Water Distribution Samples	2 - 20	Data available from 28 “drinking water distribution zones” (one or more per PWS) in targeted sampling efforts at a known contaminated aquifer region. Data were collected by El Paso County Public Health, local water districts and utilities, and the CDPHE.	Targeted
	2020	Ground Water and Surface Water - Raw and Finished Water	1.6 - 2.4	CDPHE offered free testing to PWSs serving communities, schools, and workplaces and also to fire districts with wells. Approximately 50% of PWSs in Colorado participated in the 2020 PFAS sampling project. Data included in this report were collected in March through May of 2020.	Non-Targeted
Delaware (DE ODW, 2021)	2019 - 2020	Surface Water - Finished and Unknown Water	2	Sampling of finished drinking water data between January 2019 and October 2020 from one public water system. The EPA notes that the data no longer appear to be publicly available through the Drinking Water Watch link.	Targeted

State (Reference)	Date Range	Type of Water Tested	Reporting Threshold (ppt)	Notes on Coverage	Survey Type
Georgia (GA EPD, 2020)	2020	Surface Water - Raw, Finished, and Unknown Water	20	The EPA and the GA EPD conducted joint sampling of the City of Summerville's drinking water sources and finished drinking water in January 2020.	Targeted
Idaho (Idaho DEQ, 2023)	2021- April 2023	Ground Water - Finished and Unknown Water	0.5 - 1	Sampling of finished drinking water data between August 2016 and April 2023 that were available on the state's Drinking Water Watch website.	Not specified
Illinois (IL EPA, 2023)	2020 - May 2023	Ground Water and Surface Water - Raw and Finished Water	1.7 - 8	In 2020, the IL EPA initiated a statewide investigation into the prevalence and occurrence of PFAS in finished drinking water at 1,749 community water supplies across Illinois. The EPA reviewed finished drinking water data collected between September 2020 and May 2023 that were available on the state's Drinking Water Watch website. Limited PFOA data were also available from 2017. Sampling in Illinois is ongoing.	Non-Targeted
Indiana (IDEM, 2023)	2021 - January 2023	Ground Water and Surface Water - Raw, Finished, and Unknown Water	2	Beginning in February 2021, the IDEM facilitated PFAS monitoring at all CWSs throughout the state of Indiana. Samples were to be collected at all raw water (i.e., wells and intakes) and finished (after treatment) water points in a CWS's supply to evaluate the statewide occurrence of PFAS compounds in CWS across the state and determine the efficacy of conventional drinking water treatment for PFAS.	Non-Targeted
Iowa (IA DNR, 2023)	2021 - April 2023	Ground Water and Surface Water - Raw and Finished Water	1.7 - 4	In January 2020, the Iowa DNR developed an Action Plan to protect the health of Iowa residents and the environment from PFAS. Data were downloaded from the PFAS Sampling Interactive Dashboard and Map.	Targeted
Kentucky (KYDEP, 2019)	2019	Ground Water and Surface Water - Finished Water	3.24	Sampling of finished drinking water data between June and October 2019. Under this sampling effort, data are available from 81 community public DWTPs, representing 74 PWSs, and serving more than 2.4 million people.	Non-Targeted
Maine (Maine DEP, 2020; Maine DHHS, 2023)	2013 - 2020	Drinking Water - Raw, Finished, and Unknown Water	1.78 - 20	In March 2019, the Maine PFAS Task Force was created to review the extent of PFAS contamination in Maine. Finished water results collected from 2013 through 2020 have been collected at 23 locations throughout the state. Data may include results from public and private finished drinking water sources. Sampling in Maine is ongoing.	Targeted

State (Reference)	Date Range	Type of Water Tested	Reporting Threshold (ppt)	Notes on Coverage	Survey Type
	2021 - January 2023	Ground Water and Surface Water - Finished Water	2	The EPA reviewed the finished water data reported to the Maine CDC Drinking Water Program as compliance samples since June 2021 and processed in the database as of 3/10/2023. Sampling in Maine is ongoing.	Non-Targeted
Maryland (MDE, 2021; MDE, 2022a; MDE, 2022b)	2020 - 2022	Ground Water and Surface Water - Raw and Finished Water	1	In 2020, MDE initiated a project to identify potential sources of PFAS in Maryland and to prioritize water sources for PFAS sampling. The EPA reviewed the finished water results from the first three phases of MDE's Public Water System study for the occurrence of PFAS in State drinking water sources. Under Phase 1 (September 2020 - February 2021), sites were selected for priority sampling based on MDE's evaluation of potential relative risk for PFAS exposure through drinking water. Under Phase 2 (March 2021 - May 2021), MDE conducted sampling at sites that were selected based on their geological setting and proximity to potential sources of PFAS. Under Phase 3 (August 2021- June 2022), MDE tested the remaining CWSs in the state.	Targeted
Massachusetts (MA EEA, 2023)	2016 - April 2023	Ground Water and Surface Water - Raw and Finished Water	0.56 - 10	EPA reviewed the finished water data available online through April 2023. Data were available from 1,330 PWSs. Sampling in Massachusetts is ongoing.	Targeted
Michigan (Michigan EGLE, 2023)	2020 - March 2023	Ground Water and Surface Water - Finished Water	2	The Michigan EGLE developed MCLs for seven PFAS compounds in Michigan, which took effect in August 2020. The EPA reviewed available finished compliance monitoring results through March 2023. Sampling in Michigan is ongoing.	Non-Targeted
Minnesota (MDH, 2023)	2020 - 2023	Ground Water and Surface Water - Finished Water	Not reported	Through the Statewide PFAS Monitoring Project, MDH is testing CWSs across the state for PFAS. The EPA reviewed finished water data through MDH's Interactive Dashboard for PFAS Testing in Drinking Water.	Non-Targeted
Missouri (Missouri DNR, 2018 Missouri DNR, 2023)	2016 - 2017	Ground Water and Surface Water - Raw and Finished Water	Not reported	The Missouri DNR conducted sampling of finished drinking water data between September 2016 and February 2017. Under this sampling effort, 30 finished water samples were collected from 15 PWSs.	Targeted
	2022 - 2023	Ground Water and Surface Water - Raw and Finished Water	Not reported	The EPA reviewed the finished water data available online from Missouri DNR's "PFAS Viewer Tool" which identifies the location of voluntary sampling for PFAS in public drinking water systems in Missouri. The EPA reviewed finished water data collected from approximately 125 PWSs from 2022 through 2023. Limited data were also available from 2013 through 2017.	Non-Targeted

State (Reference)	Date Range	Type of Water Tested	Reporting Threshold (ppt)	Notes on Coverage	Survey Type
New Hampshire (NHDES, 2021)	2016 - May 2021	Ground Water and Surface Water - Raw and Finished Water	2 - 5	The EPA reviewed the New Hampshire PFOA data available online through May 2021. Finished water data were available from more than 500 PWSs. Sampling in New Hampshire is ongoing.	Non-Targeted
New Jersey (NJDEP, 2023)	2019 - May 2023	Ground Water and Surface Water - Raw, Finished, and Unknown Water	0.17 - 5	Statewide sampling of finished drinking water data was available from 2019-2023. The EPA reviewed data available online through May 2023 from more than 1,100 PWSs. Sampling in New Jersey is ongoing.	Non-Targeted
New Mexico (NMED, 2019)	2016	Ground Water - Raw and Finished Water	Not reported	NMED, Department of Health and the U.S. Air Force conducted testing at public drinking water supplies at or around Cannon Air Force Base up to 2019.	Targeted
New York (NYDOH, 2022)	2017 - 2022	Ground Water and Surface Water - Raw, Finished, and Unknown Water	0.000000001 - 2,020	The EPA reviewed finished water data voluntarily provided by the state to the EPA. Data were available from nearly 2,600 PWSs from 2017 through 2022. Limited data were also available from 2016.	Non-Targeted
North Carolina (NCDEQ, 2021; NCDEQ, 2023)	2017 - 2019	Finished and unknown water	Not reported	NCDEQ and the Department of Health and Human Services investigated the presence of HFPO-DA and other PFAS in the Cape Fear River in June 2017. Monthly results were also collected from five water treatment plants on the Cape Fear River. Data were available from June 2017 through October 2019. Only results above the DL were reported; thus, only reported detections were available for use in the occurrence analyses.	Targeted
	September 2022 - November 2022	Ground Water and Surface Water - Raw, Finished, and Unknown Water	Not reported	In late 2022, NCDEQ performed three months of sampling at 50 municipal and county water systems identified in the 2019 PFAS Testing Network study with PFOA/PFOS detections above the MRL indicated by the 2022 EPA interim health advisories.	Targeted
North Dakota (NDDEQ, 2019; NDDEQ, date unknown; NDDEQ, date unknown)	2018, 2020, 2021	Ground Water and Surface Water - Raw and Finished Water	Not reported	NDDEQ published a 2018 and a 2020 survey report of North Dakota Statewide PFAS Presence/Absence results. The first phase of sampling in October of 2018 included raw and finished water from seven drinking WTPs that were chosen based on either the population served or proximity to an industrial site. The second sampling effort in October of 2020 sought to determine if there was a PFAS presence in a representative portion of the state's public water supply. In 2021, sampling conducted as part of the third phase of the survey focused on drinking water sites not evaluated in the first two surveys.	Targeted (2018); Non-Targeted (2020); Non-Targeted (2021)

State (Reference)	Date Range	Type of Water Tested	Reporting Threshold (ppt)	Notes on Coverage	Survey Type
Ohio (Ohio EPA, 2023)	December 2019 - December 2021	Ground Water and Surface Water - Raw and Finished Water	5	The Ohio EPA coordinated sampling of raw and finished drinking water from PWSs throughout the state. The EPA reviewed the finished water data available online through December 2021. During this timeframe, data were available from 1,479 PWSs.	Non-Targeted
Oregon (OHA-DWS, 2022)	2021 - July 2022	Ground Water and Surface Water - Finished Water	10.1 - 12.4	OHA conducted a PFAS drinking water monitoring project in 2021 at PWSs in Oregon identified as at risk due to their proximity to a known or suspected PFAS use or contamination site. The EPA reviewed the finished water data from more than 140 PWSs.	Targeted
Pennsylvania (PADEP, 2019)	2019	Ground Water and Surface Water - Finished Water	2	A PFAS Sampling Plan was developed to test PWSs across the state. Finished water data were collected for 87 PWSs in 2019.	Targeted
Pennsylvania (PADEP, 2021)	2020 - March 2021	Ground Water and Surface Water - Finished Water	1.7 - 4	Beginning in 2020 and running through March of 2021, finished water data were collected by more than 340 PWSs.	Targeted
South Carolina (SCDHEC, 2020; SCDHEC, 2023)	2017 - March 2023	Ground Water and Surface Water - Raw and Finished Water	2	The EPA reviewed PFAS sampling results collected by the South Carolina Bureau of Water for community drinking water systems. Data were available from 300 PWSs.	Non-Targeted
Tennessee (TDEC, 2023)	2019	Surface Water - Raw and Finished Water	Not reported	In 2019, Metro Water Services conducted a voluntary sampling of Nashville's drinking water systems for PFAS. Their stated goal was to go above and beyond current federal and state monitoring requirements to understand the potential presence of PFAS in Nashville's drinking water.	Non-Targeted
Vermont (VT DEC, 2023)	2019 -April 2023	Ground Water and Surface Water - Finished Water	2	The Vermont Water Supply Rule required all CWSs and NTNCWSs to sample for PFAS. The EPA reviewed finished water data available online from July 2019 - April 2023 from approximately 560 PWSs. Sampling in Vermont is ongoing.	Non-Targeted
Virginia (VDH ODW, 2021)	2021	Ground Water and Surface Water - Raw and Finished Water	3.5	The Virginia ODW, in conjunction with VA PFAS work group, designed the sample study to prioritize sites for measuring PFAS concentrations in drinking water and major sources of water and generate statewide occurrence data.	Targeted / Non-Targeted
West Virginia (WV DHHR. 2023)	2017 - 2019	Ground Water and Surface Water - Raw, Finished, and Unknown Water	Not reported	The EPA reviewed finished drinking water data collected from 2017-2019 that were available on the state's Drinking Water Watch website. PFOS and PFOA results were available from one PWS.	Not specified

State (Reference)	Date Range	Type of Water Tested	Reporting Threshold (ppt)	Notes on Coverage	Survey Type
Wisconsin (WI DNR, 2023)	2022 - April 2023	Ground Water and Surface Water - Raw, Finished, and Unknown Water	Not reported	The EPA reviewed the finished water data available online from 2022 - 2023. Data were available from nearly 250 PWSs. On Aug. 1, 2022, the state's safe drinking water code ch. NR 809 Wis. Adm. Code was revised to include standards for PFOA and PFOS. Sampling in Wisconsin is ongoing.	Non-Targeted

A summary of state reported monitoring data from PWSs for PFOA is presented in Exhibit 3-10 through Exhibit 3-13. As noted above, some of the monitoring data from each state are limited and may not be representative of occurrence in the state. In addition, states have varying reporting thresholds, as described earlier and indicated in the first column of Exhibit 3-10. For states with available reporting thresholds, only detected concentrations greater than the reporting thresholds were counted as detections. For states that did not provide reporting thresholds, the EPA included all detected concentrations reported in the count of detections. Overall, state reported detected concentrations ranged from 0.21 ppt (New Jersey) to 650 ppt (New York). Note that for a small number of systems, population served information could not be identified. These systems were included in the counts and analysis presented in Exhibit 3-12; however, no associated population served was included in the counts and analysis presented in Exhibit 3-13.

Exhibit 3-10: PFOA State Reported Drinking Water Occurrence Data - Summary of Finished Water Samples

State (Reporting Threshold)	Source Water Type	Total # Samples	All Detections		Detections > 4.0 ppt		Detections > 5.0 ppt		Detections > 10.0 ppt	
			Number	Percent	Number	Percent	Number	Percent	Number	Percent
Alabama[1] (Not reported)	Ground Water	--	32	--	13	--	8	--	4	--
	Surface Water	--	144	--	96	--	91	--	59	--
	Total	**--**	**176**	**--**	**109**	**--**	**99**	**--**	**63**	**--**
Arizona, ADEQ Sampling (1.6 - 2 ppt)	Ground Water	24	18	75.0%	14	58.3%	11	45.8%	6	25.0%
	Surface Water	2	1	50.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**26**	**19**	**73.1%**	**14**	**53.8%**	**11**	**42.3%**	**6**	**23.1%**
Arizona, Luke Air Force Base (Not reported)	Ground Water	263	111	42.2%	70	26.6%	56	21.3%	20	7.6%
	Surface Water	16	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**279**	**111**	**39.8%**	**70**	**25.1%**	**56**	**20.1%**	**20**	**7.2%**
California (0.002 - 20 ppt)	Ground Water	1,899	385	20.3%	170	9.0%	131	6.9%	39	2.1%
	Surface Water	4,138	1,009	24.4%	465	11.2%	377	9.1%	163	3.9%
	Unknown	29	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**6,066**	**1,394**	**23.0%**	**635**	**10.5%**	**508**	**8.4%**	**202**	**3.3%**
Colorado (2013 - 2017) (2 - 20 ppt)	Distribution (Finished)	96	33	34.4%	30	31.3%	30	31.3%	28	29.2%
	Surface Water (Finished)	11	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**107**	**33**	**30.8%**	**30**	**28.0%**	**30**	**28.0%**	**28**	**26.2%**
Colorado (2020) (1.6 - 2.4 ppt)	Ground Water	339	30	8.8%	15	4.4%	11	3.2%	2	0.6%
	Surface Water	244	24	9.8%	5	2.0%	4	1.6%	0	0.0%
	Total	**583**	**54**	**9.3%**	**20**	**3.4%**	**15**	**2.6%**	**2**	**0.3%**
Delaware (2 ppt)	Ground Water	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	34	4	11.8%	1	2.9%	1	2.9%	1	2.9%
	Total	**34**	**4**	**11.8%**	**1**	**2.9%**	**1**	**2.9%**	**1**	**2.9%**
Georgia (20 ppt)	Ground Water	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	2	1	50.0%	1	50.0%	1	50.0%	1	50.0%
	Total	**2**	**1**	**50.0%**	**1**	**50.0%**	**1**	**50.0%**	**1**	**50.0%**

State (Reporting Threshold)	Source Water Type	Total # Samples	All Detections		Detections > 4.0 ppt		Detections > 5.0 ppt		Detections > 10.0 ppt	
			Number	Percent	Number	Percent	Number	Percent	Number	Percent
Idaho (0.5 - 1 ppt)	Ground Water	18	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**18**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**
Illinois (1.7 - 8 ppt)	Ground Water	1,831	187	10.2%	66	3.6%	43	2.3%	27	1.5%
	Surface Water	302	111	36.8%	4	1.3%	0	0.0%	0	0.0%
	Total	**2,133**	**298**	**14.0%**	**70**	**3.3%**	**43**	**2.0%**	**27**	**1.3%**
Indiana (2 ppt)	Ground Water	422	7	1.7%	1	0.2%	1	0.2%	0	0.0%
	Surface Water	59	1	1.7%	0	0.0%	0	0.0%	0	0.0%
	Total	**481**	**8**	**1.7%**	**1**	**0.2%**	**1**	**0.2%**	**0**	**0.0%**
Iowa (1.7 - 4 ppt)	Ground Water	154	42	27.3%	21	13.6%	15	9.7%	4	2.6%
	Surface Water	65	14	21.5%	5	7.7%	4	6.2%	0	0.0%
	Total	**219**	**56**	**25.6%**	**26**	**11.9%**	**19**	**8.7%**	**4**	**1.8%**
Kentucky (3.24 ppt)	Ground Water	33	6	18.2%	3	9.1%	2	6.1%	1	3.0%
	Surface Water	48	18	37.5%	6	12.5%	2	4.2%	0	0.0%
	Total	**81**	**24**	**29.6%**	**9**	**11.1%**	**4**	**4.9%**	**1**	**1.2%**
Maine (PFAS Task Force)[2] (1.78 - 20 ppt)	Ground Water	9	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	3	3	100.0%	0	0.0%	0	0.0%	0	0.0%
	Unknown	75	19	25.3%	16	21.3%	13	17.3%	10	13.3%
	Total	**87**	**22**	**25.3%**	**16**	**18.4%**	**13**	**14.9%**	**10**	**11.5%**
Maine (Compliance) (2 ppt)	Ground Water	646	135	20.9%	74	11.5%	66	10.2%	31	4.8%
	Surface Water	62	7	11.3%	4	6.5%	3	4.8%	1	1.6%
	Total	**708**	**142**	**20.1%**	**78**	**11.0%**	**69**	**9.7%**	**32**	**4.5%**
Maryland (Phase 1) (1 ppt)	Ground Water	70	50	71.4%	18	25.7%	13	18.6%	2	2.9%
	Surface Water	76	50	65.8%	18	23.7%	17	22.4%	8	10.5%
	Total	**146**	**100**	**68.5%**	**36**	**24.7%**	**30**	**20.5%**	**10**	**6.8%**
Maryland (Phase 2) (1 ppt)	Ground Water	9	3	33.3%	1	11.1%	1	11.1%	1	11.1%
	Surface Water	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**9**	**3**	**33.3%**	**1**	**11.1%**	**1**	**11.1%**	**1**	**11.1%**

State (Reporting Threshold)	Source Water Type	Total # Samples	All Detections		Detections > 4.0 ppt		Detections > 5.0 ppt		Detections > 10.0 ppt	
			Number	Percent	Number	Percent	Number	Percent	Number	Percent
Maryland (Phase 3) (1 ppt)	Ground Water	88	20	22.7%	11	12.5%	11	12.5%	10	11.4%
	Surface Water	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**88**	**20**	**22.7%**	**11**	**12.5%**	**11**	**12.5%**	**10**	**11.4%**
Massachusetts (0.56 - 10 ppt)	Ground Water	7,211	3,941	54.7%	2,793	38.7%	2,281	31.6%	557	7.7%
	Surface Water	2,135	1,422	66.6%	905	42.4%	689	32.3%	114	5.3%
	Total	**9,346**	**5,363**	**57.4%**	**3,698**	**39.6%**	**2,970**	**31.8%**	**671**	**7.2%**
Michigan (2 ppt)	Ground Water	10,007	489	4.9%	185	1.8%	139	1.4%	43	0.4%
	Surface Water	519	60	11.6%	0	0.0%	0	0.0%	0	0.0%
	Unknown	164	8	4.9%	1	0.6%	0	0.0%	0	0.0%
	Total	**10,690**	**557**	**5.2%**	**186**	**1.7%**	**139**	**1.3%**	**43**	**0.4%**
Missouri, 2016 - 2017 (Not reported)	Unknown	29	9	31.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**29**	**9**	**31.0%**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**
Missouri, 2022 - 2023 (Not reported)	Ground Water	213	12	5.6%	9	4.2%	7	3.3%	3	1.4%
	Surface Water	26	5	19.2%	0	0.0%	0	0.0%	0	0.0%
	Total	**239**	**17**	**7.1%**	**9**	**3.8%**	**7**	**2.9%**	**3**	**1.3%**
New Hampshire (2 - 5 ppt)	Ground Water	1,656	936	56.5%	632	38.2%	540	32.6%	192	11.6%
	Surface Water	157	73	46.5%	26	16.6%	14	8.9%	1	0.6%
	Unknown	1	1	100.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**1,814**	**1,010**	**55.7%**	**658**	**36.3%**	**554**	**30.5%**	**193**	**10.6%**
New Jersey (0.17 - 5 ppt)	Ground Water	12,713	6,128	48.2%	4,626	36.4%	3,987	31.4%	1,459	11.5%
	Surface Water	3,178	1,923	60.5%	1,545	48.6%	1,339	42.1%	647	20.4%
	Unknown	16	12	75.0%	6	37.5%	5	31.3%	0	0.0%
	Total	**15,907**	**8,063**	**50.7%**	**6,177**	**38.8%**	**5,331**	**33.5%**	**2,106**	**13.2%**
New Mexico (Not reported)	Ground Water	2	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**2**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**
New York	Ground Water	5,515	1,333	24.2%	666	12.1%	538	9.8%	229	4.2%

State (Reporting Threshold)	Source Water Type	Total # Samples	All Detections		Detections > 4.0 ppt		Detections > 5.0 ppt		Detections > 10.0 ppt	
			Number	Percent	Number	Percent	Number	Percent	Number	Percent
(0.000000001 - 2,020 ppt)	Surface Water	1,520	416	27.4%	90	5.9%	61	4.0%	30	2.0%
	Unknown	21	2	9.5%	1	4.8%	1	4.8%	0	0.0%
	Total	**7,056**	**1,751**	**24.8%**	**757**	**10.7%**	**600**	**8.5%**	**259**	**3.7%**
North Carolina, Cape Fear River[1] (Not Reported)	Unknown	--	372	--	353	--	352	--	342	--
	Total	**--**	**372**	**--**	**353**	**--**	**352**	**--**	**342**	**--**
North Carolina, 2022 (Not Reported)	Ground Water	21	6	28.6%	3	14.3%	3	14.3%	0	0.0%
	Surface Water	141	131	92.9%	70	49.6%	52	36.9%	9	6.4%
	Total	**162**	**137**	**84.6%**	**73**	**45.1%**	**55**	**34.0%**	**9**	**5.6%**
North Dakota, 2018 (Not reported)	Ground Water	4	2	50.0%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	3	3	100.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**7**	**5**	**71.4%**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**
North Dakota, 2020 (Not reported)	Ground Water	42	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	9	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**51**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**
North Dakota, 2021 (Not reported)	Ground Water	56	1	1.8%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	7	1	14.3%	0	0.0%	0	0.0%	0	0.0%
	Total	**63**	**2**	**3.2%**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**
Ohio[3] (5 ppt)	Ground Water	1,775	104	5.9%	104	5.9%	104	5.9%	46	2.6%
	Surface Water	170	12	7.1%	12	7.1%	12	7.1%	0	0.0%
	Total	**1,945**	**116**	**6.0%**	**116**	**6.0%**	**116**	**6.0%**	**46**	**2.4%**
Oregon (10.1 - 12.4 ppt)	Ground Water	131	1	0.8%	1	0.8%	1	0.8%	1	0.8%
	Surface Water	29	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**160**	**1**	**0.6%**	**1**	**0.6%**	**1**	**0.6%**	**1**	**0.6%**
Pennsylvania, 2019 (2 ppt)	Ground Water	75	17	22.7%	6	8.0%	3	4.0%	1	1.3%
	Surface Water	21	12	57.1%	6	28.6%	3	14.3%	1	4.8%
	Total	**96**	**29**	**30.2%**	**12**	**12.5%**	**6**	**6.3%**	**2**	**2.1%**
	Ground Water	314	83	26.4%	61	19.4%	42	13.4%	14	4.5%

State (Reporting Threshold)	Source Water Type	Total # Samples	All Detections		Detections > 4.0 ppt		Detections > 5.0 ppt		Detections > 10.0 ppt	
			Number	Percent	Number	Percent	Number	Percent	Number	Percent
Pennsylvania, 2021 (1.7 - 4 ppt)	Surface Water	98	29	29.6%	23	23.5%	18	18.4%	4	4.1%
	Total	**412**	**112**	**27.2%**	**84**	**20.4%**	**60**	**14.6%**	**18**	**4.4%**
South Carolina (2 ppt)	Ground Water	572	53	9.3%	21	3.7%	13	2.3%	4	0.7%
	Surface Water	197	88	44.7%	51	25.9%	33	16.8%	5	2.5%
	Total	**769**	**141**	**18.3%**	**72**	**9.4%**	**46**	**6.0%**	**9**	**1.2%**
Tennessee (Not reported)	Ground Water	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	2	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**2**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**
Vermont (2 ppt)	Ground Water	1,463	224	15.3%	140	9.6%	111	7.6%	36	2.5%
	Surface Water	102	1	1.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**1,565**	**225**	**14.4%**	**140**	**8.9%**	**111**	**7.1%**	**36**	**2.3%**
Virginia (3.5 ppt)	Ground Water	5	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	36	4	11.1%	4	11.1%	2	5.6%	0	0.0%
	Total	**41**	**4**	**9.8%**	**4**	**9.8%**	**2**	**4.9%**	**0**	**0.0%**
West Virginia (Not reported)	Ground Water	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	31	24	77.4%	14	45.2%	12	38.7%	4	12.9%
	Total	**31**	**24**	**77.4%**	**14**	**45.2%**	**12**	**38.7%**	**4**	**12.9%**
Wisconsin (Not reported)	Ground Water	733	136	18.6%	25	3.4%	13	1.8%	0	0.0%
	Surface Water	54	31	57.4%	0	0.0%	0	0.0%	0	0.0%
	Total	**787**	**167**	**21.2%**	**25**	**3.2%**	**13**	**1.7%**	**0**	**0.0%**

[1] Only reported detections were available in this state's dataset.
[2] Reported data from Maine may include results from public and private finished drinking water sources. Based on available state data information, the EPA could not verify public water system identification numbers (PWSIDs) for all included samples.
[3] The reporting threshold for Ohio is 5 ppt; thus, any occurrence estimates relative to the final MCL of 4.0 ppt only include results greater than or equal to 5 ppt.

Exhibit 3-11: PFOA State Reported Drinking Water Occurrence Data - Summary of Detected Concentrations

State (Reporting Threshold)	Source Water Type	Concentration Value of Detections (ppt)				
		Minimum	Median	90th Percentile	99th Percentile	Maximum
Alabama[1] (Not reported)	Ground Water	0.3	3.80	10.9	23.8	26
	Surface Water	0.9	8.55	19.0	32.7	41
	Total	**0.3**	**7.30**	**18.5**	**31.8**	**41**
Arizona, ADEQ Sampling (1.6 - 2 ppt)	Ground Water	1.7	5.75	21.3	24.5	25
	Surface Water	2.8	2.8	2.8	2.8	2.8
	Total	**1.7**	**5.40**	**21.2**	**24.5**	**25**
Arizona, Luke Air Force Base (Not reported)	Ground Water	2.5	5.10	15.0	30.7	33
	Surface Water	--	--	--	--	--
	Total	**2.5**	**5.10**	**15.0**	**30.7**	**33**
California (0.002 - 20 ppt)	Ground Water	1.4	3.60	10.6	28.0	190
	Surface Water	0.9	3.80	17.3	58.0	130
	Unknown	--	--	--	--	--
	Total	**0.9**	**3.70**	**14.0**	**57.1**	**190**
Colorado (2013 - 2017) (2 - 20 ppt)	Distribution (Finished)	2.4	33.0	71.6	86.8	90
	Surface Water (Finished)	--	--	--	--	--
	Total	**2.4**	**33.0**	**71.6**	**86.8**	**90**
Colorado (2020) (1.6 - 2.4 ppt)	Ground Water	1.7	4.00	8.67	11.0	11
	Surface Water	1.9	3.20	6.34	6.75	6.8
	Total	**1.7**	**3.30**	**8.18**	**11.0**	**11**
Delaware	Ground Water	--	--	--	--	--

State (Reporting Threshold)	Source Water Type	Concentration Value of Detections (ppt)				
		Minimum	Median	90th Percentile	99th Percentile	Maximum
(2 ppt)	Surface Water	2.2	3.40	15.0	19.5	20
	Total	**2.2**	**3.40**	**15.0**	**19.5**	**20**
Georgia (20 ppt)	Ground Water	--	--	--	--	--
	Surface Water	49	49	49	49	49
	Total	**49**	**49**	**49**	**49**	**49**
Idaho (0.5 - 1 ppt)	Ground Water	--	--	--	--	--
	Surface Water	--	--	--	--	--
	Total	**--**	**--**	**--**	**--**	**--**
Illinois (1.7 - 8 ppt)	Ground Water	2	3.10	13.4	24.7	42
	Surface Water	2	2.40	3.30	4.30	4.5
	Total	**2**	**2.70**	**8.37**	**18.2**	**42**
Indiana (2 ppt)	Ground Water	2.4	3.20	4.49	6.13	6.317
	Surface Water	2.7	2.7	2.7	2.7	2.7
	Total	**2.4**	**3.15**	**4.19**	**6.10**	**6.317**
Iowa (1.7 - 4 ppt)	Ground Water	2	4.15	8.45	31.2	32
	Surface Water	2.3	3.35	5.54	6.04	6.1
	Total	**2**	**3.70**	**7.90**	**30.9**	**32**
Kentucky (3.24 ppt)	Ground Water	1.09	3.28	14.1	22.3	23.2
	Surface Water	1.1	1.68	4.85	5.53	5.62
	Total	**1.09**	**1.98**	**5.07**	**19.2**	**23.2**
Maine (PFAS Task Force)[2] (1.78 - 20 ppt)	Ground Water	--	--	--	--	--
	Surface Water	2.87	2.90	3.14	3.19	3.2
	Unknown	3.7	11.4	32.5	51.4	55.6
	Total	**2.87**	**5.71**	**32.1**	**50.8**	**55.6**
Maine (Compliance) (2 ppt)	Ground Water	2	4.98	21.2	311	361
	Surface Water	2	4.21	8.90	13.5	14
	Total	**2**	**4.95**	**19.3**	**301.8**	**361**

State (Reporting Threshold)	Source Water Type	Concentration Value of Detections (ppt)				
		Minimum	Median	90th Percentile	99th Percentile	Maximum
Maryland (Phase 1) (1 ppt)	Ground Water	1.02	3.16	8.26	19.2	23.98
	Surface Water	1.03	3.37	11.1	21.6	22.9
	Total	**1.02**	**3.34**	**9.49**	**22.9**	**23.98**
Maryland (Phase 2) (1 ppt)	Ground Water	2.27	3.32	17.9	21.2	21.54
	Surface Water	--	--	--	--	--
	Total	**2.27**	**3.32**	**17.9**	**21.2**	**21.54**
Maryland (Phase 3) (1 ppt)	Ground Water	1.49	8.00	22.5	28.8	29.3
	Surface Water	--	--	--	--	--
	Total	**1.49**	**8.00**	**22.5**	**28.8**	**29.3**
Massachusetts (0.56 - 10 ppt)	Ground Water	1.54	5.60	11.6	33.0	122
	Surface Water	1.7	4.94	9.51	36.0	59
	Total	**1.54**	**5.40**	**11.0**	**34.4**	**122**
Michigan (2 ppt)	Ground Water	2	4.00	9.23	29.2	83
	Surface Water	2	2.00	3.00	4.00	4
	Unknown	2	3.00	4.30	4.93	5
	Total	**2**	**3.00**	**9.00**	**26.3**	**83**
Minnesota (Not reported)	Ground Water	0.46	--	--	--	52
	Surface Water	1.6	--	--	--	1.6
	Total	**0.46**	**--**	**--**	**--**	**52**
Missouri, 2016 - 2017 (Not reported)	Unknown	0.24	0.310	0.542	0.657	0.67
	Total	**0.24**	**0.310**	**0.542**	**0.657**	**0.67**
Missouri, 2022 - 2023 (Not reported)	Ground Water	3.6	6.40	20.8	22.8	23
	Surface Water	0.51	1.80	2.14	2.28	2.3
	Total	**0.51**	**4.60**	**19.8**	**22.7**	**23**
New Hampshire (2 - 5 ppt)	Ground Water	2	6.00	16.3	98.8	153
	Surface Water	2	3.47	5.93	10.1	10.9
	Unknown	3.82	3.82	3.82	3.82	3.82

State (Reporting Threshold)	Source Water Type	Concentration Value of Detections (ppt)				
		Minimum	Median	90th Percentile	99th Percentile	Maximum
	Total	**2**	**5.61**	**15.8**	**96.4**	**153**
New Jersey (0.17 - 5 ppt)	Ground Water	0.21	6.55	16.1	34.0	173
	Surface Water	1.5	7.48	21.8	32.7	51
	Unknown	3.2	4.35	5.97	6.10	6.11
	Total	**0.21**	**6.70**	**18.0**	**34.0**	**173**
New Mexico (Not reported)	Ground Water	--	--	--	--	--
	Surface Water	--	--	--	--	--
	Total	**--**	**--**	**--**	**--**	**--**
New York (0.000000001 - 2,020 ppt)	Ground Water	0.255	4.00	14.1	69.7	426
	Surface Water	0.253	2.20	6.27	589	650
	Unknown	2.91	4.26	5.33	5.57	5.6
	Total	**0.253**	**3.30**	**13.5**	**460**	**650**
North Carolina, Cape Fear River[1] (Not Reported)	Unknown	0.71	40.0	40.0	130	130
	Total	**0.71**	**40.0**	**40.0**	**130**	**130**
North Carolina, 2022 (Not Reported)	Ground Water	1.38	4.16	7.34	8.03	8.11
	Surface Water	1	4.29	8.58	19.5	25.3
	Total	**1**	**4.29**	**8.52**	**19.3**	**25.3**
North Dakota, 2018 (Not reported)	Ground Water	0.45	0.670	0.846	0.886	0.89
	Surface Water	0.77	0.800	0.840	0.849	0.85
	Total	**0.45**	**0.800**	**0.874**	**0.888**	**0.89**
North Dakota, 2020 (Not reported)	Ground Water	--	--	--	--	--
	Surface Water	--	--	--	--	--
	Total	**--**	**--**	**--**	**--**	**--**
North Dakota, 2021 (Not reported)	Ground Water	1.34	1.34	1.34	1.34	1.34
	Surface Water	1.2	1.2	1.2	1.2	1.2
	Total	**1.2**	**1.27**	**1.33**	**1.34**	**1.34**
Ohio[3]	Ground Water	5.06	9.90	70.0	88.4	95.8

State (Reporting Threshold)	Source Water Type	Concentration Value of Detections (ppt)				
		Minimum	Median	90th Percentile	99th Percentile	Maximum
(5 ppt)	Surface Water	5.03	5.60	6.67	6.70	6.7
	Total	**5.03**	**9.40**	**53.9**	**88.2**	**95.8**
Oregon (10.1 - 12.4 ppt)	Ground Water	12	12	12	12	12
	Surface Water	--	--	--	--	--
	Total	**12**	**12**	**12**	**12**	**12**
Pennsylvania, 2019 (2 ppt)	Ground Water	2.1	3.20	6.96	18.0	20
	Surface Water	2.1	4.10	7.68	11.5	12
	Total	**2.1**	**3.40**	**7.58**	**17.8**	**20**
Pennsylvania, 2021 (1.7 - 4 ppt)	Ground Water	1.7	5.20	12.8	36.4	59.6
	Surface Water	2.1	6.40	11.9	22.6	25
	Total	**1.7**	**5.30**	**12.8**	**31.3**	**59.6**
South Carolina (2 ppt)	Ground Water	2	3.10	7.80	79.0	130
	Surface Water	2.1	4.20	9.33	13.7	18
	Total	**2**	**4.10**	**9.10**	**26.4**	**130**
Tennessee (Not reported)	Ground Water	--	--	--	--	--
	Surface Water	--	--	--	--	--
	Total	**--**	**--**	**--**	**--**	**--**
Vermont (2 ppt)	Ground Water	2	4.95	11.5	36.6	44
	Surface Water	2.7	2.7	2.7	2.7	2.7
	Total	**2**	**4.93**	**11.5**	**36.6**	**44**
Virginia (3.5 ppt)	Ground Water	--	--	--	--	--
	Surface Water	4.2	5.00	5.50	5.50	5.5
	Total	**4.2**	**5.00**	**5.50**	**5.50**	**5.5**
West Virginia (Not reported)	Ground Water	--	--	--	--	--
	Surface Water	0.31	5.05	11.0	12.8	13
	Total	**0.31**	**5.05**	**11.0**	**12.8**	**13**
Wisconsin	Ground Water	0.297	1.80	4.99	9.04	9.9

State (Reporting Threshold)	Source Water Type	Concentration Value of Detections (ppt)				
		Minimum	Median	90th Percentile	99th Percentile	Maximum
(Not reported)	Surface Water	0.58	1.80	2.40	2.74	2.8
	Total	**0.297**	**1.80**	**4.87**	**8.78**	**9.9**

Note: With limited exceptions, calculated concentration values (i.e., median, 90th percentile and 99th percentile concentrations) were rounded to three significant figures for consistent presentation across the datasets and may not indicate exact laboratory precision.
[1] Only reported detections were available in this state's dataset.
[2] Reported data from Maine may include results from public and private finished drinking water sources. Based on available state data information, the EPA could not verify PWSIDs for all included samples.

Exhibit 3-12: PFOA State Reported Drinking Water Occurrence Data - Summary of Systems with Finished Water Data

State (Reporting Threshold)	Source Water Type	Total Number of Systems	Systems with Detections		Systems with Detections > 4.0 ppt		Systems with Detections > 5.0 ppt		Systems with Detections > 10.0 ppt	
			Number	Percent	Number	Percent	Number	Percent	Number	Percent
Alabama[1] (Not reported)	Ground Water	--	17	--	9	--	6	--	4	--
	Surface Water	--	48	--	27	--	24	--	14	--
	Total	**--**	**65**	**--**	**36**	**--**	**30**	**--**	**18**	**--**
Arizona, ADEQ Sampling (1.6 - 2 ppt)	Ground Water	6	3	50.0%	2	33.3%	2	33.3%	2	33.3%
	Surface Water	1	1	100.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**7**	**4**	**57.1%**	**2**	**28.6%**	**2**	**28.6%**	**2**	**28.6%**
Arizona, Luke Air Force Base (Not reported)	Ground Water	1	1	100.0%	1	100.0%	1	100.0%	1	100.0%
	Surface Water	1	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**2**	**1**	**50.0%**	**1**	**50.0%**	**1**	**50.0%**	**1**	**50.0%**
Arizona (All Systems)[2] (Not reported)	Ground Water	6	3	50.0%	2	33.3%	2	33.3%	2	33.3%
	Surface Water	2	1	50.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**8**	**4**	**50.0%**	**2**	**25.0%**	**2**	**25.0%**	**2**	**25.0%**
California (0.002 - 20 ppt)	Ground Water	43	14	32.6%	12	27.9%	12	27.9%	10	23.3%
	Surface Water	79	30	38.0%	24	30.4%	19	24.1%	16	20.3%

State (Reporting Threshold)	Source Water Type	Total Number of Systems	Systems with Detections		Systems with Detections > 4.0 ppt		Systems with Detections > 5.0 ppt		Systems with Detections > 10.0 ppt	
			Number	Percent	Number	Percent	Number	Percent	Number	Percent
	Unknown	1	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**123**	**44**	**35.8%**	**36**	**29.3%**	**31**	**25.2%**	**26**	**21.1%**
Colorado (2013 - 2017) (2 - 20 ppt)	Distribution (Finished)	23	12	52.2%	11	47.8%	11	47.8%	11	47.8%
	Surface Water (Finished)	5	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**28**	**12**	**42.9%**	**11**	**39.3%**	**11**	**39.3%**	**11**	**39.3%**
Colorado (2020) (1.6 - 2.4 ppt)	Ground Water	221	25	11.3%	13	5.9%	10	4.5%	2	0.9%
	Surface Water	176	20	11.4%	5	2.8%	4	2.3%	0	0.0%
	Total	**397**	**45**	**11.3%**	**18**	**4.5%**	**14**	**3.5%**	**2**	**0.5%**
Delaware (2 ppt)	Ground Water	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	1	1	100.0%	1	100.0%	1	100.0%	1	100.0%
	Total	**1**	**1**	**100.0%**	**1**	**100.0%**	**1**	**100.0%**	**1**	**100.0%**
Georgia (20 ppt)	Ground Water	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	1	1	100.0%	1	100.0%	1	100.0%	1	100.0%
	Total	**1**	**1**	**100.0%**	**1**	**100.0%**	**1**	**100.0%**	**1**	**100.0%**
Idaho (0.5 - 1 ppt)	Ground Water	10	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**10**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**
Illinois (1.7 - 8 ppt)	Ground Water	899	38	4.2%	18	2.0%	13	1.4%	7	0.8%
	Surface Water	97	29	29.9%	4	4.1%	0	0.0%	0	0.0%
	Total	**996**	**67**	**6.7%**	**22**	**2.2%**	**13**	**1.3%**	**7**	**0.7%**
Indiana (2 ppt)	Ground Water	341	7	2.1%	1	0.3%	1	0.3%	0	0.0%
	Surface Water	31	1	3.2%	0	0.0%	0	0.0%	0	0.0%
	Total	**372**	**8**	**2.2%**	**1**	**0.3%**	**1**	**0.3%**	**0**	**0.0%**
Iowa (1.7 - 4 ppt)	Ground Water	90	8	8.9%	5	5.6%	3	3.3%	1	1.1%
	Surface Water	26	5	19.2%	2	7.7%	1	3.8%	0	0.0%
	Total	**116**	**13**	**11.2%**	**7**	**6.0%**	**4**	**3.4%**	**1**	**0.9%**

State (Reporting Threshold)	Source Water Type	Total Number of Systems	Systems with Detections		Systems with Detections > 4.0 ppt		Systems with Detections > 5.0 ppt		Systems with Detections > 10.0 ppt	
			Number	Percent	Number	Percent	Number	Percent	Number	Percent
Kentucky (3.24 ppt)	Ground Water	30	5	16.7%	3	10.0%	2	6.7%	1	3.3%
	Surface Water	44	17	38.6%	6	13.6%	2	4.5%	0	0.0%
	Total	**74**	**22**	**29.7%**	**9**	**12.2%**	**4**	**5.4%**	**1**	**1.4%**
Maine (PFAS Task Force)[3] (1.78 - 20 ppt)	Ground Water	7	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	1	1	100.0%	0	0.0%	0	0.0%	0	0.0%
	Unknown	10	5	50.0%	5	50.0%	5	50.0%	4	40.0%
	Total	**18**	**6**	**33.3%**	**5**	**27.8%**	**5**	**27.8%**	**4**	**22.2%**
Maine (Compliance) (2 ppt)	Ground Water	593	126	21.2%	73	12.3%	65	11.0%	31	5.2%
	Surface Water	53	6	11.3%	3	5.7%	2	3.8%	1	1.9%
	Total	**646**	**132**	**20.4%**	**76**	**11.8%**	**67**	**10.4%**	**32**	**5.0%**
Maine (All Systems)[2] (1.78 - 40 ppt)	Ground Water	593	126	21.2%	73	12.3%	65	11.0%	31	5.2%
	Surface Water	53	6	11.3%	3	5.7%	2	3.8%	1	1.9%
	Unknown	10	5	50.0%	5	50.0%	5	50.0%	4	40.0%
	Total	**656**	**137**	**20.9%**	**81**	**12.3%**	**72**	**11.0%**	**36**	**5.5%**
Maryland (Phase 1) (1 ppt)	Ground Water	30	18	60.0%	9	30.0%	7	23.3%	2	6.7%
	Surface Water	36	20	55.6%	8	22.2%	7	19.4%	4	11.1%
	Total	**66**	**38**	**57.6%**	**17**	**25.8%**	**14**	**21.2%**	**6**	**9.1%**
Maryland (Phase 2) (1 ppt)	Ground Water	6	3	50.0%	1	16.7%	1	16.7%	1	16.7%
	Surface Water	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**6**	**3**	**50.0%**	**1**	**16.7%**	**1**	**16.7%**	**1**	**16.7%**
Maryland (Phase 3) (1 ppt)	Ground Water	63	10	15.9%	8	12.7%	8	12.7%	7	11.1%
	Surface Water	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**63**	**10**	**15.9%**	**8**	**12.7%**	**8**	**12.7%**	**7**	**11.1%**
Maryland (All Systems)[2] (1 ppt)	Ground Water	99	31	31.3%	18	18.2%	16	16.2%	10	10.1%
	Surface Water	36	20	55.6%	8	22.2%	7	19.4%	4	11.1%
	Total	**135**	**51**	**37.8%**	**26**	**19.3%**	**23**	**17.0%**	**14**	**10.4%**
Massachusetts	Ground Water	1,209	432	35.7%	281	23.2%	232	19.2%	108	8.9%

State (Reporting Threshold)	Source Water Type	Total Number of Systems	Systems with Detections		Systems with Detections > 4.0 ppt		Systems with Detections > 5.0 ppt		Systems with Detections > 10.0 ppt	
			Number	Percent	Number	Percent	Number	Percent	Number	Percent
(0.56 - 10 ppt)	Surface Water	122	88	72.1%	54	44.3%	48	39.3%	15	12.3%
	Total	**1,331**	**520**	**39.1%**	**335**	**25.2%**	**280**	**21.0%**	**123**	**9.2%**
Michigan (2 ppt)	Ground Water	2,370	115	4.9%	46	1.9%	35	1.5%	17	0.7%
	Surface Water	84	17	20.2%	0	0.0%	0	0.0%	0	0.0%
	Unknown	54	3	5.6%	1	1.9%	0	0.0%	0	0.0%
	Total	**2,508**	**135**	**5.4%**	**47**	**1.9%**	**35**	**1.4%**	**17**	**0.7%**
Minnesota (Not reported)	Ground Water	561	68	12.1%	15	2.7%	12	2.1%	4	0.7%
	Surface Water	16	1	6.3%	0	0.0%	0	0.0%	0	0.0%
	Total	**577**	**69**	**12.0%**	**15**	**2.6%**	**12**	**2.1%**	**4**	**0.7%**
Missouri, 2016 - 2017 (Not reported)	Unknown	15	7	46.7%	0	0.0%	0	0.0%	0	0.0%
	Total	**15**	**7**	**46.7%**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**
Missouri, 2022 - 2023 (Not reported)	Ground Water	105	4	3.8%	3	2.9%	3	2.9%	1	1.0%
	Surface Water	20	3	15.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**125**	**7**	**5.6%**	**3**	**2.4%**	**3**	**2.4%**	**1**	**0.8%**
New Hampshire (2 - 5 ppt)	Ground Water	529	296	56.0%	200	37.8%	179	33.8%	82	15.5%
	Surface Water	30	13	43.3%	10	33.3%	7	23.3%	1	3.3%
	Unknown	1	1	100.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**560**	**310**	**55.4%**	**210**	**37.5%**	**186**	**33.2%**	**83**	**14.8%**
New Jersey (0.17 - 5 ppt)	Ground Water	1,012	535	52.9%	384	37.9%	341	33.7%	182	18.0%
	Surface Water	107	88	82.2%	71	66.4%	67	62.6%	41	38.3%
	Unknown	4	2	50.0%	2	50.0%	1	25.0%	0	0.0%
	Total	**1,123**	**625**	**55.7%**	**457**	**40.7%**	**409**	**36.4%**	**223**	**19.9%**
New Mexico (Not reported)	Ground Water	2	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**2**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**
New York	Ground Water	1,600	436	27.3%	193	12.1%	164	10.3%	63	3.9%
	Surface Water	277	120	43.3%	23	8.3%	18	6.5%	1	0.4%

State (Reporting Threshold)	Source Water Type	Total Number of Systems	Systems with Detections		Systems with Detections > 4.0 ppt		Systems with Detections > 5.0 ppt		Systems with Detections > 10.0 ppt	
			Number	Percent	Number	Percent	Number	Percent	Number	Percent
(0.000000001 - 2,020 ppt)	Unknown	9	2	22.2%	1	11.1%	1	11.1%	0	0.0%
	Total	**1,886**	**558**	**29.6%**	**217**	**11.5%**	**183**	**9.7%**	**64**	**3.4%**
North Carolina, Cape Fear River[1] (Not Reported)	Unknown	--	5	--	5	--	5	--	5	--
	Total	**--**	**5**	**--**	**5**	**--**	**5**	**--**	**5**	**--**
North Carolina, 2022 (Not Reported)	Ground Water	7	2	28.6%	1	14.3%	1	14.3%	0	0.0%
	Surface Water	43	41	95.3%	26	60.5%	19	44.2%	4	9.3%
	Total	**50**	**43**	**86.0%**	**27**	**54.0%**	**20**	**40.0%**	**4**	**8.0%**
North Dakota, 2018 (Not reported)	Ground Water	4	2	50.0%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	3	3	100.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**7**	**5**	**71.4%**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**
North Dakota, 2020 (Not reported)	Ground Water	41	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	9	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**50**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**
North Dakota, 2021 (Not reported)	Ground Water	56	1	1.8%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	7	1	14.3%	0	0.0%	0	0.0%	0	0.0%
	Total	**63**	**2**	**3.2%**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**
North Dakota (All Systems)[2] (Not reported)	Ground Water	95	3	3.2%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	17	4	23.5%	0	0.0%	0	0.0%	0	0.0%
	Total	**112**	**7**	**6.3%**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**
Ohio[4] (5 ppt)	Ground Water	1,372	27	2.0%	27	2.0%	27	2.0%	15	1.1%
	Surface Water	107	6	5.6%	6	5.6%	6	5.6%	0	0.0%
	Total	**1,479**	**33**	**2.2%**	**33**	**2.2%**	**33**	**2.2%**	**15**	**1.0%**
Oregon (10.1 - 12.4 ppt)	Ground Water	116	1	0.9%	1	0.9%	1	0.9%	1	0.9%
	Surface Water	27	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**143**	**1**	**0.7%**	**1**	**0.7%**	**1**	**0.7%**	**1**	**0.7%**
Pennsylvania, 2019 (2 ppt)	Ground Water	71	15	21.1%	5	7.0%	3	4.2%	1	1.4%
	Surface Water	16	8	50.0%	5	31.3%	3	18.8%	1	6.3%

State (Reporting Threshold)	Source Water Type	Total Number of Systems	Systems with Detections		Systems with Detections > 4.0 ppt		Systems with Detections > 5.0 ppt		Systems with Detections > 10.0 ppt	
			Number	Percent	Number	Percent	Number	Percent	Number	Percent
	Total	**87**	**23**	**26.4%**	**10**	**11.5%**	**6**	**6.9%**	**2**	**2.3%**
Pennsylvania, 2021 (1.7 - 4 ppt)	Ground Water	269	71	26.4%	55	20.4%	40	14.9%	14	5.2%
	Surface Water	73	19	26.0%	17	23.3%	14	19.2%	4	5.5%
	Total	**342**	**90**	**26.3%**	**72**	**21.1%**	**54**	**15.8%**	**18**	**5.3%**
Pennsylvania (All Systems)[2] (1.7 - 4 ppt)	Ground Water	270	77	28.5%	57	21.1%	41	15.2%	14	5.2%
	Surface Water	73	22	30.1%	19	26.0%	15	20.5%	5	6.8%
	Total	**343**	**99**	**28.9%**	**76**	**22.2%**	**56**	**16.3%**	**19**	**5.5%**
South Carolina (2 ppt)	Ground Water	234	40	17.1%	18	7.7%	11	4.7%	4	1.7%
	Surface Water	66	45	68.2%	34	51.5%	27	40.9%	4	6.1%
	Total	**300**	**85**	**28.3%**	**52**	**17.3%**	**38**	**12.7%**	**8**	**2.7%**
Tennessee (Not reported)	Ground Water	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	1	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**1**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**
Vermont (2 ppt)	Ground Water	526	48	9.1%	27	5.1%	23	4.4%	7	1.3%
	Surface Water	38	1	2.6%	0	0.0%	0	0.0%	0	0.0%
	Total	**564**	**49**	**8.7%**	**27**	**4.8%**	**23**	**4.1%**	**7**	**1.2%**
Virginia (3.5 ppt)	Ground Water	5	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	20	4	20.0%	4	20.0%	2	10.0%	0	0.0%
	Total	**25**	**4**	**16.0%**	**4**	**16.0%**	**2**	**8.0%**	**0**	**0.0%**
West Virginia (Not reported)	Ground Water	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	1	1	100.0%	1	100.0%	1	100.0%	1	100.0%
	Total	**1**	**1**	**100.0%**	**1**	**100.0%**	**1**	**100.0%**	**1**	**100.0%**
Wisconsin (Not reported)	Ground Water	217	48	22.1%	11	5.1%	5	2.3%	0	0.0%
	Surface Water	22	18	81.8%	0	0.0%	0	0.0%	0	0.0%
	Total	**239**	**66**	**27.6%**	**11**	**4.6%**	**5**	**2.1%**	**0**	**0.0%**

[1] Only reported detections were available in this state's dataset.
[2] The "All Systems" counts represent a summary of all unique systems across multiple sampling efforts within the state. For some states (e.g., CO, MO, NC), the EPA could not verify this number due to the sample site ID reporting.

[3] Reported data from Maine may include results from public and private finished drinking water sources. Based on available state data information, the EPA could not verify PWSIDs for all included samples.
[4] The reporting threshold for Ohio is 5 ppt; thus, any occurrence estimates relative to the final MCL of 4.0 ppt only include results greater than or equal to 5 ppt.

Exhibit 3-13: PFOA State Reported Drinking Water Occurrence Data - Summary of Population Served by Systems with Finished Water Data

State (Reporting Threshold)	Source Water Type	Total Population Served by Systems	Population Served by Systems with Detections		Population Served by Systems with Detections > 4.0 ppt		Population Served by Systems with Detections > 5.0 ppt		Population Served by Systems with Detections > 10.0 ppt	
			Number	Percent	Number	Percent	Number	Percent	Number	Percent
Alabama[1] (Not reported)	Ground Water	--	312,751	--	107,491	--	41,095	--	32,224	--
	Surface Water	--	2,469,247	--	647,484	--	576,172	--	315,958	--
	Total	**--**	**2,781,998**	**--**	**754,975**	**--**	**617,267**	**--**	**348,182**	**--**
Arizona, ADEQ Sampling (1.6 - 2 ppt)	Ground Water	94,712	55,853	59.0%	55,535	58.6%	55,535	58.6%	55,535	58.6%
	Surface Water	50,001	50,001	100.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**144,713**	**105,854**	**73.1%**	**55,535**	**38.4%**	**55,535**	**38.4%**	**55,535**	**38.4%**
Arizona, Luke Air Force Base (Not reported)	Ground Water	50,770	50,770	100.0%	50,770	100.0%	50,770	100.0%	50,770	100.0%
	Surface Water	234,766	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**285,536**	**50,770**	**17.8%**	**50,770**	**17.8%**	**50,770**	**17.8%**	**50,770**	**17.8%**
Arizona (All Systems)[2] (Not reported)	Ground Water	94,712	55,853	59.0%	55,535	58.6%	55,535	58.6%	55,535	58.6%
	Surface Water	284,767	50,001	17.6%	0	0.0%	0	0.0%	0	0.0%
	Total	**379,479**	**105,854**	**27.9%**	**55,535**	**14.6%**	**55,535**	**14.6%**	**55,535**	**14.6%**
California (0.002 - 20 ppt)	Ground Water	1,098,122	545,250	49.7%	538,033	49.0%	538,033	49.0%	450,292	41.0%
	Surface Water	13,505,270	4,181,477	31.0%	3,491,853	25.9%	3,142,564	23.3%	2,944,399	21.8%
	Unknown	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**14,603,392**	**4,726,727**	**32.4%**	**4,029,886**	**27.6%**	**3,680,597**	**25.2%**	**3,394,691**	**23.2%**
Colorado (2013 - 2017)[3] (2 - 20 ppt)	Distribution (Finished)	--	--	--	--	--	--	--	--	--
	Surface Water (Finished)	--	--	--	--	--	--	--	--	--
	Total	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**

State (Reporting Threshold)	Source Water Type	Total Population Served by Systems	Population Served by Systems with Detections		Population Served by Systems with Detections > 4.0 ppt		Population Served by Systems with Detections > 5.0 ppt		Population Served by Systems with Detections > 10.0 ppt	
			Number	Percent	Number	Percent	Number	Percent	Number	Percent
Colorado (2020) (1.6 - 2.4 ppt)	Ground Water	261,162	57,385	22.0%	37,131	14.2%	33,411	12.8%	505	0.2%
	Surface Water	4,191,774	920,514	22.0%	167,742	4.0%	161,914	3.9%	0	0.0%
	Total	**4,452,936**	**977,899**	**22.0%**	**204,873**	**4.6%**	**195,325**	**4.4%**	**505**	**0.0%**
Delaware (2 ppt)	Ground Water	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	231,114	231,114	100.0%	231,114	100.0%	231,114	100.0%	231,114	100.0%
	Total	**231,114**	**231,114**	**100.0%**	**231,114**	**100.0%**	**231,114**	**100.0%**	**231,114**	**100.0%**
Georgia (20 ppt)	Ground Water	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	9,993	9,993	100.0%	9,993	100.0%	9,993	100.0%	9,993	100.0%
	Total	**9,993**	**9,993**	**100.0%**	**9,993**	**100.0%**	**9,993**	**100.0%**	**9,993**	**100.0%**
Idaho (0.5 - 1 ppt)	Ground Water	81,985	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**81,985**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**
Illinois (1.7 - 8 ppt)	Ground Water	2,916,219	453,497	15.6%	262,840	9.0%	197,132	6.8%	121,850	4.2%
	Surface Water	4,628,949	1,122,623	24.3%	169,883	3.7%	0	0.0%	0	0.0%
	Total	**7,545,168**	**1,576,120**	**20.9%**	**432,723**	**5.7%**	**197,132**	**2.6%**	**121,850**	**1.6%**
Indiana (2 ppt)	Ground Water	545,838	25,100	4.6%	7,125	1.3%	7,125	1.3%	0	0.0%
	Surface Water	97,448	2,175	2.2%	0	0.0%	0	0.0%	0	0.0%
	Total	**643,286**	**27,275**	**4.2%**	**7,125**	**1.1%**	**7,125**	**1.1%**	**0**	**0.0%**
Iowa (1.7 - 4 ppt)	Ground Water	491,495	146,935	29.9%	88,239	18.0%	28,467	5.8%	100	0.0%
	Surface Water	987,522	338,155	34.2%	111,812	11.3%	85,797	8.7%	0	0.0%
	Total	**1,479,017**	**485,090**	**32.8%**	**200,051**	**13.5%**	**114,264**	**7.7%**	**100**	**0.0%**
Kentucky (3.24 ppt)	Ground Water	171,212	77,953	45.5%	69,139	40.4%	67,449	39.4%	6,798	4.0%
	Surface Water	1,922,023	1,380,792	71.8%	895,351	46.6%	18,073	0.9%	0	0.0%
	Total	**2,093,235**	**1,458,745**	**69.7%**	**964,490**	**46.1%**	**85,522**	**4.1%**	**6,798**	**0.3%**
Maine (PFAS Task Force)[3,4] (1.78 - 20 ppt)	Ground Water	3,995	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	21,808	21,808	100.0%	0	0.0%	0	0.0%	0	0.0%
	Unknown	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%

State (Reporting Threshold)	Source Water Type	Total Population Served by Systems	Population Served by Systems with Detections		Population Served by Systems with Detections > 4.0 ppt		Population Served by Systems with Detections > 5.0 ppt		Population Served by Systems with Detections > 10.0 ppt	
			Number	Percent	Number	Percent	Number	Percent	Number	Percent
	Total	**25,803**	**21,808**	**84.5%**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**
Maine (Compliance) (2 ppt)	Ground Water	274,866	83,393	30.3%	57,541	20.9%	42,326	15.4%	8,898	3.2%
	Surface Water	464,453	45,244	9.7%	27,491	5.9%	24,923	5.4%	3,115	0.7%
	Total	**739,319**	**128,637**	**17.4%**	**85,032**	**11.5%**	**67,249**	**9.1%**	**12,013**	**1.6%**
Maine (All Systems)[2,3] (1.78 - 40 ppt)	Ground Water	274,866	83,393	30.3%	57,541	20.9%	42,326	15.4%	8,898	3.2%
	Surface Water	464,453	45,244	9.7%	27,491	5.9%	24,923	5.4%	3,115	0.7%
	Unknown	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**739,319**	**128,637**	**17.4%**	**85,032**	**11.5%**	**67,249**	**9.1%**	**12,013**	**1.6%**
Maryland (Phase 1) (1 ppt)	Ground Water	384,007	73,634	19.2%	61,428	16.0%	61,178	15.9%	10,100	2.6%
	Surface Water	4,059,154	3,843,541	94.7%	94,394	2.3%	93,397	2.3%	62,481	1.5%
	Total	**4,443,161**	**3,917,175**	**88.2%**	**155,822**	**3.5%**	**154,575**	**3.5%**	**72,581**	**1.6%**
Maryland (Phase 2) (1 ppt)	Ground Water	3,896	315	8.1%	50	1.3%	50	1.3%	50	1.3%
	Surface Water	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**3,896**	**315**	**8.1%**	**50**	**1.3%**	**50**	**1.3%**	**50**	**1.3%**
Maryland (Phase 3) (1 ppt)	Ground Water	41,063	3,203	7.8%	3,034	7.4%	3,034	7.4%	2,584	6.3%
	Surface Water	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**41,063**	**3,203**	**7.8%**	**3,034**	**7.4%**	**3,034**	**7.4%**	**2,584**	**6.3%**
Maryland (All Systems)[2] (1 ppt)	Ground Water	428,966	77,152	18.0%	64,512	15.0%	64,262	15.0%	12,734	3.0%
	Surface Water	4,059,154	3,843,541	94.7%	94,394	2.3%	93,397	2.3%	62,481	1.5%
	Total	**4,488,120**	**3,920,693**	**87.4%**	**158,906**	**3.5%**	**157,659**	**3.5%**	**75,215**	**1.7%**
Massachusetts (0.56 - 10 ppt)	Ground Water	1,828,984	1,313,240	71.8%	1,021,308	55.8%	943,086	51.6%	401,076	21.9%
	Surface Water	5,860,701	2,703,141	46.1%	1,628,689	27.8%	1,345,668	23.0%	368,445	6.3%
	Total	**7,689,685**	**4,016,381**	**52.2%**	**2,649,997**	**34.5%**	**2,288,754**	**29.8%**	**769,521**	**10.0%**
Michigan[3] (2 ppt)	Ground Water	1,945,734	320,806	16.5%	26,367	1.4%	11,491	0.6%	4,493	0.2%
	Surface Water	1,314,601	470,947	35.8%	0	0.0%	0	0.0%	0	0.0%
	Unknown	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**3,260,335**	**791,753**	**24.3%**	**26,367**	**0.8%**	**11,491**	**0.4%**	**4,493**	**0.1%**

State (Reporting Threshold)	Source Water Type	Total Population Served by Systems	Population Served by Systems with Detections		Population Served by Systems with Detections > 4.0 ppt		Population Served by Systems with Detections > 5.0 ppt		Population Served by Systems with Detections > 10.0 ppt	
			Number	Percent	Number	Percent	Number	Percent	Number	Percent
Minnesota (Not reported)	Ground Water	2,752,594	1,095,531	39.8%	114,152	4.1%	85,828	3.1%	31,506	1.1%
	Surface Water	1,106,268	89,987	8.1%	0	0.0%	0	0.0%	0	0.0%
	Total	**3,858,862**	**1,185,518**	**30.7%**	**114,152**	**3.0%**	**85,828**	**2.2%**	**31,506**	**0.8%**
Missouri, 2016 – 2017[3] (Not reported)	Unknown	--	--	--	--	--	--	--	--	--
	Total	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**
Missouri, 2022 - 2023 (Not reported)	Ground Water	257,420	4,949	1.9%	4,879	1.9%	4,879	1.9%	2,377	0.9%
	Surface Water	425,658	21,613	5.1%	0	0.0%	0	0.0%	0	0.0%
	Total	**683,078**	**26,562**	**3.9%**	**4,879**	**0.7%**	**4,879**	**0.7%**	**2,377**	**0.3%**
New Hampshire (2 - 5 ppt)	Ground Water	267,029	177,997	66.7%	149,081	55.8%	142,290	53.3%	114,635	42.9%
	Surface Water	476,367	388,304	81.5%	353,804	74.3%	278,458	58.5%	140	0.0%
	Unknown	10	10	100.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**743,406**	**566,311**	**76.2%**	**502,885**	**67.6%**	**420,748**	**56.6%**	**114,775**	**15.4%**
New Jersey (0.17 - 5 ppt)	Ground Water	2,485,837	1,225,754	49.3%	1,072,557	43.1%	983,033	39.5%	605,447	24.4%
	Surface Water	5,794,947	5,402,878	93.2%	4,636,191	80.0%	4,589,721	79.2%	3,610,604	62.3%
	Unknown	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**8,280,784**	**6,628,632**	**80.0%**	**5,708,748**	**68.9%**	**5,572,754**	**67.3%**	**4,216,051**	**50.9%**
New Mexico[3] (Not reported)	Ground Water	--	--	--	--	--	--	--	--	--
	Surface Water	--	--	--	--	--	--	--	--	--
	Total	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**
New York (0.000000001 - 2,020 ppt)	Ground Water	2,109,018	791,773	37.5%	472,049	22.4%	442,389	21.0%	267,915	12.7%
	Surface Water	3,850,284	2,093,183	54.4%	717,288	18.6%	621,001	16.1%	4,925	0.1%
	Unknown	1,089	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**5,960,391**	**2,884,956**	**48.4%**	**1,189,337**	**20.0%**	**1,063,390**	**17.8%**	**272,840**	**4.6%**
North Carolina, Cape Fear River[1,3] (Not Reported)	Unknown	--	--	--	--	--	--	--	--	--
	Total	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**
	Ground Water	26,914	3,620	13.5%	965	3.6%	965	3.6%	0	0.0%

State (Reporting Threshold)	Source Water Type	Total Population Served by Systems	Population Served by Systems with Detections		Population Served by Systems with Detections > 4.0 ppt		Population Served by Systems with Detections > 5.0 ppt		Population Served by Systems with Detections > 10.0 ppt	
			Number	Percent	Number	Percent	Number	Percent	Number	Percent
North Carolina, 2022 (Not Reported)	Surface Water	2,649,927	2,643,626	99.8%	1,883,832	71.1%	1,067,084	40.3%	193,311	7.3%
	Total	**2,676,841**	**2,647,246**	**98.9%**	**1,884,797**	**70.4%**	**1,068,049**	**39.9%**	**193,311**	**7.2%**
North Dakota, 2018 (Not reported)	Ground Water	67,981	51,801	76.2%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	250,518	250,518	100.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**318,499**	**302,319**	**94.9%**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**
North Dakota, 2020 (Not reported)	Ground Water	68,280	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	57,469	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**125,749**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**
North Dakota, 2021 (Not reported)	Ground Water	113,623	244	0.2%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	194,121	4,284	2.2%	0	0.0%	0	0.0%	0	0.0%
	Total	**307,744**	**4,528**	**1.5%**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**
North Dakota (All Systems)[2] (Not reported)	Ground Water	181,514	52,045	28.7%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	324,007	254,802	78.6%	0	0.0%	0	0.0%	0	0.0%
	Total	**505,521**	**306,847**	**60.7%**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**
Ohio[5] (5 ppt)	Ground Water	2,883,252	99,659	3.5%	99,659	3.5%	99,659	3.5%	41,456	1.4%
	Surface Water	6,215,644	86,324	1.4%	86,324	1.4%	86,324	1.4%	0	0.0%
	Total	**9,098,896**	**185,983**	**2.0%**	**185,983**	**2.0%**	**185,983**	**2.0%**	**41,456**	**0.5%**
Oregon (10.1 - 12.4 ppt)	Ground Water	114,194	802	0.7%	802	0.7%	802	0.7%	802	0.7%
	Surface Water	125,239	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**239,433**	**802**	**0.3%**	**802**	**0.3%**	**802**	**0.3%**	**802**	**0.3%**
Pennsylvania, 2019 (2 ppt)	Ground Water	162,825	41,152	25.3%	12,288	7.5%	2,890	1.8%	110	0.1%
	Surface Water	431,370	225,466	52.3%	134,502	31.2%	77,698	18.0%	45,013	10.4%
	Total	**594,195**	**266,618**	**44.9%**	**146,790**	**24.7%**	**80,588**	**13.6%**	**45,123**	**7.6%**
Pennsylvania, 2021 (1.7 - 4 ppt)	Ground Water	471,651	201,749	42.8%	153,336	32.5%	115,882	24.6%	39,243	8.3%
	Surface Water	4,296,097	1,489,172	34.7%	1,320,172	30.7%	1,229,741	28.6%	116,774	2.7%
	Total	**4,767,748**	**1,690,921**	**35.5%**	**1,473,508**	**30.9%**	**1,345,623**	**28.2%**	**156,017**	**3.3%**
Pennsylvania	Ground Water	471,891	209,249	44.3%	153,784	32.6%	116,232	24.6%	39,243	8.3%

State (Reporting Threshold)	Source Water Type	Total Population Served by Systems	Population Served by Systems with Detections		Population Served by Systems with Detections > 4.0 ppt		Population Served by Systems with Detections > 5.0 ppt		Population Served by Systems with Detections > 10.0 ppt	
			Number	Percent	Number	Percent	Number	Percent	Number	Percent
(All Systems)[2] (1.7 - 4 ppt)	Surface Water	4,296,097	1,581,476	36.8%	1,376,976	32.1%	1,274,754	29.7%	161,787	3.8%
	Total	**4,767,988**	**1,790,725**	**37.6%**	**1,530,760**	**32.1%**	**1,390,986**	**29.2%**	**201,030**	**4.2%**
South Carolina (2 ppt)	Ground Water	485,992	19,188	3.9%	12,454	2.6%	11,125	2.3%	3,424	0.7%
	Surface Water	2,499,980	1,595,891	63.8%	1,377,099	55.1%	1,173,861	47.0%	72,093	2.9%
	Total	**2,985,972**	**1,615,079**	**54.1%**	**1,389,553**	**46.5%**	**1,184,986**	**39.7%**	**75,517**	**2.5%**
Tennessee (Not reported)	Ground Water	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	2,551	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**2,551**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**
Vermont (2 ppt)	Ground Water	211,357	12,297	5.8%	6,155	2.9%	4,565	2.2%	1,269	0.6%
	Surface Water	174,473	367	0.2%	0	0.0%	0	0.0%	0	0.0%
	Total	**385,830**	**12,664**	**3.3%**	**6,155**	**1.6%**	**4,565**	**1.2%**	**1,269**	**0.3%**
Virginia (3.5 ppt)	Ground Water	2,975	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	4,839,373	1,759,253	36.4%	1,759,253	36.4%	1,274,613	26.3%	0	0.0%
	Total	**4,842,348**	**1,759,253**	**36.3%**	**1,759,253**	**36.3%**	**1,274,613**	**26.3%**	**0**	**0.0%**
West Virginia (Not reported)	Ground Water	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	15,652	15,652	100.0%	15,652	100.0%	15,652	100.0%	15,652	100.0%
	Total	**15,652**	**15,652**	**100.0%**	**15,652**	**100.0%**	**15,652**	**100.0%**	**15,652**	**100.0%**
Wisconsin (Not reported)	Ground Water	1,514,437	857,072	56.6%	184,913	12.2%	105,466	7.0%	0	0.0%
	Surface Water	1,333,737	1,277,594	95.8%	0	0.0%	0	0.0%	0	0.0%
	Total	**2,848,174**	**2,134,666**	**74.9%**	**184,913**	**6.5%**	**105,466**	**3.7%**	**0**	**0.0%**

[1] Only reported detections were available in this state's dataset.
[2] The "All Systems" counts represent a summary of all unique systems across multiple sampling efforts within the state.
[3] There were some instances where the population served by a system could not be identified. Thus, there are systems with detections but no associated population served by those systems with detections.
[4] Reported data from Maine may include results from public and private finished drinking water sources. Based on available state data information, the EPA could not verify PWSIDs for all included samples.
[5] The reporting threshold for Ohio is 5 ppt; thus, any occurrence estimates relative to the final MCL of 4.0 ppt only include results greater than or equal to 5 ppt.

3.2.1.3 Additional Secondary Source Water and Drinking Water Studies

Boone et al. (2019) measured 17 PFAS in both source and treated water from 25 DWTPs in the United States. The results indicated that only five of the sampling locations demonstrated a significant difference in PFAS concentration between the source and treated water. The median concentration of PFOA in source water was 6.32 ng/L and 4.15 ng/L in treated water. PFOA was detected in 76 percent of treated drinking water samples (Boone et al., 2019).

Post et al. (2013) re-evaluated PFOA, PFOS, and perfluorinated compounds (PFC) occurrence data in drinking water systems throughout New Jersey to update previous PFAS research in the area from 2006. PFCs were found in 70 percent of PWSs sampled at concentrations ranging from 5-174 ng/L. PFOA was the most commonly detected PFC which was detected in 57 percent of samples at a maximum concentration of 100 ng/L. Post et al. (2013) found that multiple PFCs are commonly detected in raw water from New Jersey PWSs, with even higher levels found near industrial sources.

McMahon et al. (2022) collected samples from aquifer systems in the eastern United States in 2019 to evaluate PFAS occurrence in ground water used as a source of drinking water. The study found that 14 of the 24 analyzed PFAS were detected in ground water samples. Furthermore, at least one PFAS was detected in 54 percent of the ground water samples and two or more PFAS were detected in 47 percent of the ground water samples. In the public supply and domestic wells, 60 and 20 percent of the samples, respectively, had at least one PFAS detection. Two or more PFAS were detected in 53 percent of the public-supply wells and 10 percent of domestic wells. The six PFAS outlined in the EPA's UCMR 3 program (i.e., PFBS, PFHxS, PFOS, PFHpA, PFOA, and PFNA) were the most detected PFAS in the study's samples. PFOA and PFOS were the two most frequently detected PFAS sampled. PFOA was detected in 30 percent of the 254 samples; 24 percent of samples were reported detections greater than 4 ng/L (McMahon et al., 2022).

As part of a joint study by the EPA and USGS to assess human exposure to contaminants of emerging concern, water samples were collected from 25 DWTPs in 24 states (Glassmeyer et al., 2017). Participation in the study was voluntary, and candidate locations were selected based on nomination by the EPA and USGS regional personnel and DWTP self-nomination as well as consideration of high wastewater contribution and the availability of pharmaceutical concentration data. Final sample locations were chosen to represent a wide range of geography, diversity in disinfectant type used, and a range of production volumes. Phase I of the study (2007) analyzed a subset of contaminants and sites to test experimental design; PFOA was not included in Phase 1. During Phase II of the study (2010-2012), samples were collected from ground water and surface water sources and treated drinking water from 25 DWTPs and analyzed for PFOA occurrence. The LCMRL for PFOA was equal to 0.56 ng/L. PFOA was detected in 76 percent of the 25 source water samples and 76 percent of the 25 treated drinking water samples. The maximum detected concentrations in source water and treated water were 112 ng/L and 104 ng/L, respectively.

Reyes (2021) conducted a ground water-quality study to describe the occurrence and distribution of PFAS in the Columbia aquifer public water-supply wells in the Delaware Coastal Plain region in 2018. One or more PFAS were detected in 16 of the sampled wells with as many as 8 different PFAS detected in a single sample. PFOA was most frequently detected out of the total PFAS detected during the study (47 percent), followed by PFHxA (33 percent), and PFOS and PFHxS, both detected at 27 percent. PFOS was detected in 8 of the 30 public water-supply wells sampled in the study. The maximum PFOA concentration detected was 57 ng/L.

3.2.2 Other Data

3.2.2.1 Department of Defense (DoD) Drinking Water Sampling

The DoD conducted sampling of off-base drinking water located in "covered areas" (i.e., areas that are adjacent to and down gradient from a military installation) to identify potential impacts of PFAS resulting from DoD activities. Sampling was conducted for multiple PFAS, including PFOA. The EPA downloaded available DOD off-base sampling results in September 2023.

The EPA summarized off-base sampling results for PFOA collected "post treatment" from drinking water systems and private wells located in covered areas adjacent to 47 installations located in 22 states. Detected concentrations ranged from an estimated concentration of 0.071 ng/L to 333 ng/L. Sampling was conducted utilizing multiple analytical methods including EPA methods 533, 537, 537.1, 1633, and DoD Quality Systems Manual Table B-15 (DoD, 2023a). Results are based on DLs which vary between both sampling sites and across different PFAS. Results for PFOA are presented in Exhibit 3-14.

Exhibit 3-14: Summary of PFOA Drinking Water Sampling Results Collected Post-Treatment from Department of Defense Off-Base "Covered Areas"

State	Installation Name	Sampling Dates	Analysis Method	# Samples	# Detections	% Detections	Range of Detections (ng/L)
AK	Eielson AFB	11/3/2022	537	1	0	0.00%	NA
AZ	Luke AFB	3/31/2022	QSM_B15	2	2	100.00%	5.4 (est) - 6 (est)
AZ	YUMA AZ MCAS	5/26/2023	533	1	0	0.00%	NA
AR	Little Rock AFB	5/5/2022	537	3	2	66.67%	70.9 - 71.7
AR	Little Rock AFB	06/16/2022 - 03/22/2023	QSM_B15	6	1	16.67%	8.8 (est)
CA	Castle AFB	07/05/2022 - 04/05/2023	537	26	3	11.54%	0.45 - 0.668 (est)
CA	Castle AFB	11/17/2021 - 01/11/2022	QSM_B15	12	0	0.00%	NA
CA	George AFB	03/23/2023 - 04/20/2023	1633	3	0	0.00%	NA
CA	March AFB	01/03/2023 - 04/10/2023	533	3	1	33.33%	0.62 (est)
CA	March AFB	01/03/2022 - 12/01/2022	537.1	11	5	45.45%	3.4 - 32
CA	March AFB	9/1/2022	QSM_B15	1	0	0.00%	NA
CA	Mather AFB	7/28/2022	537	1	0	0.00%	NA
CA	Mather AFB	01/27/2022 - 04/26/2022	QSM_B15	3	0	0.00%	NA
CA	Travis AFB	01/25/2022 - 01/16/2023	QSM_B15	19	1	5.26%	14.3
CO	Peterson Space Force Base	12/14/2021 - 02/07/2023	537.1	8	0	0.00%	NA
CO	Peterson Space Force Base	03/01/2022 - 09/14/2022	QSM_B15	16	0	0.00%	NA
DE	Dover AFB	01/22/2022 - 10/25/2022	QSM_B15	10	0	0.00%	NA
FL	Homestead Air Reserve Base	02/21/2022 - 03/30/2023	QSM_B15	13	0	0.00%	NA
FL	WHITING FLD FL NAS	9/1/2022	537.1	2	1	50.00%	1.15 (est)
IL	Scott AFB	03/22/2022 - 03/28/2023	QSM_B15	3	0	0.00%	NA
ME	Loring AFB	7/25/2022	QSM_B15	1	0	0.00%	NA
ME	NCTAMSLANT DET CUTLER	04/20/2022 - 12/06/2022	537.1	66	4	6.06%	0.714 (est) - 15.7 (est)
MA	Otis ANG (Joint Base Cape Cod - Massachusetts Military Reservation)	02/28/2022 - 11/22/2022	QSM_B15	11	7	63.64%	0.48 (est) - 6
MI	KI Sawyer AFB	7/13/2022	QSM_B15	2	0	0.00%	NA
MT	Great Falls International Airport	06/15/2022 - 07/07/2022	537	3	1	33.33%	2.14 (est)
NH	Pease AFB	09/22/2021 - 03/30/2023	QSM_B15	16	7	43.75%	8.6 - 55
NJ	Joint Base McGuire-Dix-Lakehurst	03/03/2022 - 05/25/2022	QSM_B15	2	0	0.00%	NA
NM	Cannon AFB	11/11/2021 - 12/13/2021	QSM_B15	2	0	0.00%	NA

State	Installation Name	Sampling Dates	Analysis Method	# Samples	# Detections	% Detections	Range of Detections (ng/L)
NY	Plattsburgh AFB	05/20/2022 - 08/10/2022	537	8	1	12.50%	0.6 (est)
NY	Plattsburgh AFB	11/18/2021 - 09/15/2022	537.1	16	0	0.00%	NA
NY	Plattsburgh AFB	11/29/2021 - 06/27/2023	QSM_B15	15	2	13.33%	8.4 - 8.6
OK	Tinker AFB	2/2/2023	QSM_B15	3	0	0.00%	NA
RI	NAVAL AUX LANDING FIELD	5/19/2022	537.1	2	0	0.00%	NA
RI	NAVAL AUX LANDING FIELD	10/17/2022 - 02/28/2023	QSM_B15	31	28	90.32%	0.893 (est) - 155
SD	Ellsworth AFB	3/14/2022	537	1	0	0.00%	NA
SD	Ellsworth AFB	06/09/2022 - 09/07/2022	537.1	2	0	0.00%	NA
SD	Ellsworth AFB	02/07/2022 - 06/23/2022	QSM_B15	36	4	11.11%	13.6 - 164
TX	Goodfellow AFB	08/18/2022 - 11/15/2022	537	11	1	9.09%	0.43 (est)
TX	Goodfellow AFB	12/06/2022 - 04/27/2023	QSM_B15	28	1	3.57%	333
TX	Reese AFB	09/14/2022 - 06/13/2023	1633	504	16	3.17%	0.67 (est) - 34.7
TX	Reese AFB	09/28/2021 - 08/29/2022	QSM_B15	839	23	2.74%	2 (est) - 124
VA	OCEANA VA NAS	10/19/2022 - 04/14/2023	537.1	13	0	0.00%	NA
WA	BREMERTON WA NAVBASE	10/11/2022 - 07/21/2023	537.1	3	2	66.67%	12.2 - 12.5
WA	Fairchild AFB	09/19/2022 - 09/27/2022	537	87	2	2.30%	2.1 (est) - 14.1
WA	Fairchild AFB	02/20/2023 - 03/06/2023	537.1	87	37	42.53%	0.071 (est) - 0.27 (est)
WA	Fairchild AFB	01/31/2022 - 07/21/2022	QSM_B15	187	2	1.07%	2.7 (est) - 18.7
WA	WHIDBEY IS WA NAS	04/21/2022 - 04/20/2023	537.1	11	2	18.18%	2.52 - 9.47

Source: DOD, 2023a

3.2.3 Occurrence in Ambient Water

Lakes, rivers, and aquifers are the ambient sources of most drinking water. Contaminant occurrence in ambient water provides information on the potential for contaminants to adversely affect drinking water supplies. Occurrence data for PFOA in ambient water are available from the USGS NWIS database and the EPA's legacy STORET data available through the WQP.

3.2.3.1 National Water Information System (NWIS) Data

The NWIS is the Nation's principal repository of water resources data USGS collects from more than 1.9 million sites (USGS, 2023). NWIS-Web is the general online interface to the USGS NWIS database. Discrete water-sample and time-series data are available from sites in all 50 States, including 5 million water samples with 90 million water-quality results. All USGS water quality and flow data are stored in NWIS, including site characteristics, streamflow, ground water level, precipitation, and chemical analyses of water, sediment, and biological media, though not all parameters are available for every site. NWIS houses the NAWQA data and includes other USGS data from unspecified projects. NWIS contains many more samples at many more sites than the NAWQA Program. Although NWIS is comprised of primarily ambient water data, some finished drinking water data are included as well. This section presents analyses of non-NAWQA data in NWIS, downloaded from the WQP in November 2023 (WQP, 2023).

The results of the non-NAWQA NWIS PFOA analysis are presented in Exhibit 3-15. NWIS data for PFOA were listed under the characteristic name "PFOA ion." PFOA was detected in approximately 55 percent of samples (1,609 out of 2,950 samples) and at approximately 46 percent of sites (804 out of 1,759 sites). The median concentration based on detections was equal to 4.70 ng/L. (Note that the NWIS data are presented as downloaded; potential outliers were not evaluated or excluded from the analysis.)

Exhibit 3-15: PFOA NWIS Data

Site Type	Detection Frequency (detections are results ≥ reporting level)				Concentration Values (of detections, in ng/L)				
	No. of Samples	No. of Samples with Detections	No. of Sites	No. of Sites with Detections	Minimum	Median	90th Percentile	99th Percentile	Maximum
Ground Water	1,344	373	1,233	369	1	7.20	29.8	85.0	150
Surface Water	1,606	1,236	526	435	0.1	4.30	14.0	35.3	330
All Sites	**2,950**	**1,609**	**1,759**	**804**	**0.1**	**4.70**	**16.4**	**55.9**	**330**

Source: WQP, 2023

3.2.3.2 Storage and Retrieval (STORET) Data / Water Quality Portal (WQP)

From its launch in 1999 until it was decommissioned in June 2018, the EPA's STORET Data Warehouse was collaboratively populated with raw biological, chemical, and physical data from surface water and ground water sampling by federal, state and local agencies, Native American tribes, volunteer groups, academics, and others. Legacy STORET data are accessible through the WQP: https://www.waterqualitydata.us/portal/.

STORET data are from monitoring locations in all 50 states as well as multiple territories and jurisdictions of the United States. Most data are from ambient waters, but in some cases finished drinking water data are included as well. STORET's data quality limitations include variations in the extent of national coverage and data completeness from parameter to parameter. Data may have been collected as part of targeted, rather than randomized, monitoring.

This section presents analyses of STORET data, downloaded from the WQP in November 2023 (WQP, 2023). The EPA reviewed STORET ground water data from wells and springs and surface water data from lakes, rivers, streams, and reservoirs (WQP, 2023). STORET data for PFOA STORET data were listed under the characteristic name of "PFOA ion" and "Perfluorooctanoic acid." The results of the STORET analysis for PFOA are presented in Exhibit 3-16 and Exhibit 3-17. More than 1,300 PFOA samples were available for analysis. These PFOA samples were collected between 2005 and May 2023. Of the 763 sites sampled, more than 70 percent reported detections of PFOA. Detected concentrations ranged from 0 to 1,200 ng/L. (Note: A minimum value of zero could represent a detection that was entered into the database as a non-numerical value (e.g., "Present").)

Exhibit 3-16: PFOA STORET Data - Summary of Detected Concentrations

Source Water Type	Concentration Value of Detections (ng/L)			
	Minimum[1]	Median	90th Percentile	Maximum
Ground Water	0	0	100	1,200
Surface Water	0.81	7.36	28.5	256
Unknown	0	1.24	5.56	20.4
Total	**0**	**0**	**90.0**	**1,200**

Source: WQP, 2023
[1]A minimum value of zero may represent a detection that was entered into the database as a non-numerical value (e.g., "Present").

Exhibit 3-17: PFOA STORET Data - Summary of Samples and Sites

Source Water Type	Total Number of Samples	Samples with Detections		Total Number of Sites	Sites with Detections	
		Number	Percent		Number	Percent
Ground Water	772	726	94.04%	520	484	93.08%
Surface Water	88	38	43.18%	73	26	35.62%
Unknown	491	28	5.70%	170	27	15.88%
Total	**1,351**	**792**	**58.62%**	**763**	**537**	**70.38%**

Source: WQP, 2023

3.3 Analytical Methods

For the purposes of compliance with the PFAS NPDWR, the EPA has published two analytical methods that are available for the analysis of PFOA and other PFAS in drinking water. The performance metrics that are presented, including the DL, LCMRL, mean recoveries and Relative Standard Deviation (RSDs) are specific to PFOA for each of the listed analytical methods. Ranges of mean recoveries and RSDs are presented for the matrices listed; data from holding time studies are not included since these studies are designed to demonstrate a degradation in method performance over time and thus are not indicative of method performance that should be observed when holding times are not exceeded:

- EPA Method 537.1, Version 2.0, *Determination of Selected Per- and Polyfluorinated Alkyl Substances in Drinking Water by Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometry (LC/MS/MS)*. The DL and LCMRL generated by the laboratory that developed the method are 0.53 ng/L and 0.82 ng/L, respectively. Mean recoveries in fortified reagent water, tap water from a ground water source (total organic carbon (TOC) = 0.53 mg/L and hardness = 377 mg/L), tap water from a surface water source (TOC = 2.4 mg/L and hardness = 103 mg/L), and tap water from a private well (TOC = 0.56 mg/L and hardness = 394 mg/L) range from 91.1 to 106%, with RSDs of 1.5 to 5.2% (USEPA, 2020d).
- EPA Method 533, *Determination of Per- and Polyfluoroalkyl Substances in Drinking Water by Isotope Dilution Anion Exchange Solid Phase Extraction and Liquid Chromatography / Tandem Mass Spectrometry*. The LCMRL generated by the laboratory that developed the method is 3.4 ng/L (DLs were not calculated). Mean recoveries (excluding ^{13}C isotope analogue data) in fortified reagent water, finished drinking water from a ground water source (hardness = 320 mg/L, pH = 7.88 at 17° C, free Cl_2 = 0.64 mg/L, and total Cl_2 = 0.74 mg/L) and clarified surface water (prior to granular activated carbon (GAC) treatment and chlorinated in the laboratory; pH = 8.1 at 20 °C, free Cl_2 = 0.98 mg/L, total Cl_2 = 1.31 mg/L. and TOC = 3.8 mg/L) range from 91.9 to 108%, with RSDs of 4.9 to 9.8% (USEPA, 2019b).

Laboratories participating in UCMR 3 were required to use EPA Method 537 and, as described in Section 4.4.2, were required to report PFOA values at or above the EPA-defined MRL of 20 ng/L (77 FR 26072; USEPA, 2012b). The MRL was set based on the capability of multiple laboratories at the time. The EPA Method 537.1 was originally published in November 2018 as Version 1.0 as a more sensitive update to EPA Method 537 (with a slightly expanded target analyte list). Version 2.0 was published in March 2020 and contains minor editorial changes to Version 1.0. Use of EPA Method 537.1 is preferable to use of EPA Method 537 (it may not be feasible to reliably quantitate down to health levels of concern for certain PFAS when using EPA Method 537). For this reason, only EPA methods 533 and 537.1 are accepted for use in demonstrating compliance with this final rule.

4 Perfluorooctanesulfonic Acid (PFOS)

This chapter presents information and analysis specific to PFOS, including background information on the contaminant, information on contaminant sources and environmental fate, an analysis of health effects, an analysis of occurrence in ambient and drinking water, and information about the availability of analytical methods and treatment technologies.

4.1 Contaminant Background, Chemical and Physical Properties

Synonyms for PFOS include perfluorooctylsulfonic acid and heptadecafluorooctanesulfonic acid. The acronym PFOS is also used to refer to the deprotonated anionic form of the compound, perfluorooctane sulfonate, according to the Hazardous Substances Data Bank (NCBI, 2022b).

PFOS is a perfluorinated aliphatic sulfonic acid. It has been used as a surfactant or emulsifier in firefighting foam, circuit board etching acids, alkaline cleaners, and floor polish; and as a pesticide active ingredient for insect bait traps (NCBI, 2022b). The sole manufacturer of PFOS In the United States agreed to a voluntary phaseout in 2000, and the last reported production was in 2002 (USEPA, 2000; USEPA, 2022d). There are some limited ongoing uses of PFOS and PFOS precursors (40 CFR § 721.9582) such as use as a component of a photoresist substance, including a photo acid generator or surfactant, or as a component of an anti-reflective coating, used in a photomicrolithography process to produce semiconductors or similar components of electronic or other miniaturized devices.

The EPA has taken a range of regulatory actions to address PFAS in manufacturing and consumer products. Since 2002, the EPA has finalized many TSCA Section 5(a) SNURs covering hundreds of existing PFAS no longer in use. These regulatory actions require notice to the EPA, as well as agency review and regulation, as necessary, before manufacture (including import) or processing for significant new uses of these chemicals can begin or resume. The SNURs also apply to imported articles containing certain PFAS, including consumer products such as carpets, furniture, electronics, and household appliances. The EPA also has issued SNURs for dozens of PFAS that have undergone the EPA's new chemicals review prior to commercialization; these actions ensure that any new uses which may present risk concerns but were not part of the EPA new chemicals review, do not commence unless the EPA is notified, conducts a risk review, and regulates as appropriate under TSCA section 5.

Since PFOS production ceased in the United States, serum concentrations taken in biomonitoring studies in the United States' population have been declining (CDC, 2022). National Health and Nutrition Examination Survey (NHANES) data show that 95th-percentile serum PFOS concentrations have decreased from 75,700 ng/L in the 1999-2000 cycle to 14,600 ng/L in the 2017-2018 cycle (CDC, 2022).

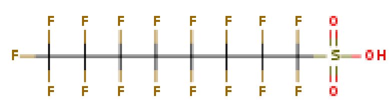
PFOS may also be formed in the environment as a terminal degradation product of commercial PFAS produced by electrochemical fluorination. Perfluorooctane sulfonyl fluoride and *N*-alkyl sulfonamido PFAS such as *N*-methyl perfluorooctanesulfonamido ethanol and *N*-ethyl perfluorooctanesulfonamido ethanol are used to produce surfactants and polymers that may degrade to PFOS (ITRC, 2020a; ITRC, 2020b; Buck et al., 2011).

The diagram in Exhibit 4-1 shows the straight-chain chemical structure of PFOS. PFOS and related compounds can exist as either branched-chain or straight-chain isomers depending on their method of manufacture (ATSDR, 2021). Physical and chemical properties and other reference information are listed in Exhibit 4-2 (these properties typically represent mixtures of branched and linear isomers rather than any particular isomer). There is uncertainty as to whether values for certain physical/chemical properties of PFOS can be measured or estimated. For example, NCBI (2022b) reports a value for the log K_{ow} that is estimated using EPISuite™, while ATSDR (2021) and Lange et al. (2006) indicate that log K_{ow} is not applicable or cannot be measured since PFOS is expected to form multiple layers in octanol and water mixtures. While uncharged and very long-chain perfluoroalkyls form layers in water/hydrocarbon mixtures, forms that are charged/ionized at typical environmental pH (such as PFOS) are fairly soluble in water (ATSDR, 2021). Another example of apparent uncertainty is the Henry's Law Constant. NCBI (2022b) presents a value for K_H for PFOS, while ATSDR (2021) indicates that no data are available for this property. The value for K_H was estimated from vapor pressure and water solubility using EPISuite™.

PFOS is a PFAA that exists as its sulfonate anion at typical environmental pH values. Physical and chemical property data for various PFAS often correspond to the protonated acid form of the compound in contrast to the deprotonated anion (ITRC, 2020a). Thus, the available physical and chemical property data for PFOS may not be representative of how PFOS partitions in the environment.

In cases where there are different conclusions in the literature, information describing differences is presented to highlight the uncertainty in this area.

Exhibit 4-1: Chemical Structure of PFOS - Straight-Chain Isomer



Source: NCBI, 2022b

Exhibit 4-2: Physical and Chemical Properties of PFOS

Property	Data
Chemical Abstracts Service (CAS) Registry Number	1763-23-1 (NCBI, 2022b)
EPA Pesticide Chemical Code	Not Applicable
Chemical Formula	$C_8HF_{17}O_3S$ (NCBI, 2022b)
Molecular Weight	500.13 g/mol (NCBI, 2022b)
Color/Physical State	Liquid (NCBI, 2022b)
Boiling Point	249 deg C (NCBI, 2022b)
Melting Point	-- (liquid)
Density	1.84-1.85 g/cm^3 (ITRC, 2021)
Freundlich Adsorption Coefficient	25.1 in clay, 14.0 in clay loam, 28.2 in sandy loam, 8.70 in river sediment (NCBI, 2022b)
Vapor Pressure	0.002 mm Hg at 25 deg C (est) (NCBI, 2022b)
K_H	4.1E-04 atm-m^3/mol at 25 deg C (NCBI, 2022b; est from vapor pressure and water solubility)[a] No data (ATSDR, 2021)

Property	Data
Log K_{ow}	4.49 (est) (dimensionless)[b] (NCBI, 2022b) Cannot be measured (Lange et al., 2006) Not applicable (ATSDR, 2021)
K_{oc}	1,000 ±5.0 L/kg (mean of values ±1 standard deviation from Zareitalabad et al., 2013; converted from log K_{oc} to K_{oc})
pK_a	<1.0 (NCBI, 2022b)
Solubility in Water	0.0032 mg/L at 25 deg C (est) (NCBI, 2022b) 570 mg/L (ATSDR, 2021; potassium salt in pure water)
Other Solvents	--
Conversion Factors (at 25 deg C, 1 atm)	1 PPM = 20.45 mg/m^3; 1 mg/m^3 = 0.049 PPM (ATSDR, 2021)

Note: "--" indicates that no information was found.
[a] These values should not be used to estimate portioning between water and air.
[b] Surfactants are surface acting agents that contain both a hydrophilic part and a hydrophobic part which causes them to accumulate at interfaces hampering the determination of their aqueous concentration. These surfactant properties present difficulties in applying existing methods for the experimental determination of log K_{ow} and produce unreliable results.
.

4.1.1 Sources and Environmental Fate

4.1.1.1 Production, Use, and Release

Production data for PFOS are available from the EPA's IUR and CDR programs and industrial release data are available from the EPA's TRI, as described below.

Inventory Update Reporting (IUR) / Chemical Data Reporting (CDR) Program

Under the authority of the TSCA, the EPA gathers information on production (including both manufacture and importation) of industrial chemicals. As a compound with a TSCA section 5(a)(2) SNUR, PFOS is among those contaminants to which the 2,500-pound threshold applies. See Chapter 2 for further discussion.

Exhibit 4-3 presents the publicly available information on production of PFOS in the United States from 1986 to 2006 as reported under IUR. Production did not exceed 500,000 pounds in any year with reported data. No data were reported in 1986, 1990, 1998, or 2006. PFOS was phased out by 3M in 2002 and the most recently reported data for PFOS are from the 2002 reporting cycle (which includes production information from 2001 only).

Although PFOS is subject to CDR reporting, there are no reports of manufacture or importation in the CDR dataset (USEPA, 2022e). Absence of recent reporting may indicate that production (including import) of PFOS has halted or has been below the CDR reporting thresholds. Although PFOS is not produced domestically or imported by the companies participating in the 2010/2015 PFOA Stewardship Program, PFOS may still be produced domestically or imported below the CDR reporting thresholds by companies not participating in the PFOA Stewardship Program.

Exhibit 4-3: IUR Reported Annual Manufacture and Importation of PFOS in the United States, 1986-2006 (pounds)

	Reporting Cycle					
	1986	**1990**	**1994**	**1998**	**2002**	**2006**
Range of Production Volume	No Reports	No Reports	10,000 - 500,000	No Reports	10,000 - 500,000	No Reports

Source: USEPA, 2008

Toxics Release Inventory (TRI)

The EPA established TRI in 1987 in response to section 313 of the EPCRA. EPCRA section 313 requires the reporting of annual information on toxic chemical releases from facilities that meet specific criteria. This reported information is maintained in a database accessible through TRI Explorer (USEPA, 2023b).

Although TRI can provide a general idea of release trends, it has limitations. Not all facilities are required to report all releases. Facilities are required to report releases if they manufacture, process, or otherwise use a listed toxic chemical in quantities above the respective activity threshold. For PFOS, the reporting threshold is 100 lbs. manufactured, processed, or otherwise used over the year. It should also be noted that, as of this publication, quantities of PFOS at concentrations under 0.1 percent within mixtures may be exempt from TRI reporting requirements. Reporting requirements have changed over time (e.g., the chemical list has changed), so conclusions about temporal trends should be drawn with caution. TRI data are meant to reflect releases and other waste management activities and should not be used to estimate general public exposure to a chemical (USEPA, 2023b).

TRI data for PFOS are available for 2020 through 2022 (USEPA, 2023b). As shown in Exhibit 4-4, there were 482 pounds of total on-site disposals and 362 pounds of total off-site disposals across all industries in 2020. In 2021, a total of 16,308 on- and off-site releases were reported and in 2022, a total of 6,819 on- and off-site releases were reported. A total of five facilities from five states reported releases of PFOS in 2022.

Exhibit 4-4: Environmental Releases of PFOS in the United States, 2020-2022

Year	On-Site Releases (in pounds)				Total Off-Site Releases (in pounds)	Total On- and Off-Site Releases (in pounds)
	Air Emissions	**Surface Water Discharges**	**Underground Injection**	**Releases to Land**		
2020	0	1	5	476	362	844
2021	0	0	0	4,000	12,308	16,308
2022	0	0	0	443	6,376	6,819

Source: USEPA, 2023b

4.1.1.2 Environmental Fate

The primary measures used by the EPA to assess mobility include (where available) K_{oc}, log K_{ow}, K_H, water solubility and vapor pressure. For PFOS, the log of the pK_a is also important.

Modeling of atmospheric behavior at a vapor pressure of 0.002 mm Hg at 25 degrees C suggest that PFOS will be present as a vapor if released to the atmosphere (NCBI, 2022b). PFOS can react with photochemically produced hydroxyl radicals in the atmosphere to degrade (NCBI, 2022b). A half-life for this reaction in air is estimated to be 115 days, based on a structure estimation method (NCBI, 2022b). (Note that radical reactions typically proceed more rapidly than chemically- or microbially-mediated degradation reactions in other environmental media such as water, soil, and/or sediment.) PFOS is not expected to undergo direct photolysis (NCBI, 2022b).

Based on findings from laboratory studies, Zareitalabad et al. (2013) calculate an average log K_{oc} of 3.0 ±0.7, equivalent to a K_{oc} of 1,000 ±5.0 L/kg, which suggests a propensity for PFOS to be mobilized to ground water and surface water rather than to bind to suspended solids or sediments. The authors note that field studies indicate a greater propensity for PFOS to bind to soil and sediment than the lab-derived K_{oc} values would predict.

Based on the vapor pressure, PFOS is not expected to volatilize from dry soil (NCBI, 2022b). With a pK_a of less than 1.0 (NCBI, 2022b), PFOS is expected to exist in its ionized form at typical environment pH ranges of natural waters (NCBI, 2022b; Lange et al., 2006). Thus, volatilization from water at typical environment pH is not expected (NCBI, 2022b).

PFOS is very stable chemically and is resistant to hydrolysis, photolysis, and biodegradation (NCBI, 2022b; Lange et al., 2006). Washington et al. (2010) found that PFOS had a modeled disappearance half-life of 1.2 years in sludge-applied soils near Decatur, Alabama. Washington et al. (2010) noted that this disappearance half-life is the time over which PFOS concentration in the surface soil was diminished by half due to *all* environmental processes: these processes could potentially include uptake into plants (c.f. Yoo et al., 2011), erosion, leaching, generation from precursors, and degradation. Washington et al. (2010) posits that among these possible processes, leaching was likely a leading mode of loss. However, the chemical stability of PFOS is much longer than this modeled disappearance half-life. Additionally, labile PFAS precursors commonly present in sludge may degrade in soil settings, leading to ingrowth of recalcitrant PFAS such as PFOS, PFOA, and related compounds (Wang et al., 2009; Martin et al., 2010; Washington et al., 2014; Washington et al., 2015).

Under CCL 3, the EPA created scales[4] to informally rank chemical contaminants' likely mobility (understood as their tendency to partition to water rather than other media) and persistence as "high," "moderate," or "low" based on physical and chemical properties (see USEPA, 2021b and USEPA, 2009). For PFOS, an estimated log K_{ow} of 4.49, and a water solubility of 0.0032 mg/L at 25 degrees C predict a low likelihood of partitioning to water. The water solubility of the potassium salt of PFOS, 570 mg/L, which may be more indicative of the anionic form that occurs at typical environmental pH, predicts a moderate likelihood of partitioning to water (certain properties can vary substantially for the acid and salt forms of a given PFAS; for example, the water solubility of PFOS (acid form) and the potassium salt of PFOS may vary by approximately five orders of magnitude, which can be seen in the two water

[4] See Exhibit A.8 here: https://www.epa.gov/sites/default/files/2014-05/documents/ccl3_pccltoccl_08-31-09_508.pdf

solubility values above). The K_H of <4.9E-09 atm-m^3/mol predicts a high likelihood of partitioning to water. NCBI (2022b) also lists a K_H of 4.1E-04 atm-m^3/mol, but this value was estimated from vapor pressure and water solubility using EPISuite™. A K_{oc} value of 1,000 ±5.0 L/kg predicts a moderate likelihood of partitioning to water. A resistance to essentially all forms of degradation other than atmospheric processes indicates high persistence.

4.2 PFOS Occurrence

This section presents data on the occurrence of PFOS in drinking water and ambient water in the United States. The EPA is finalizing an MCLG of 0 ppt for PFOS. Under SDWA, the EPA must establish an enforceable MCL, the maximum concentration of a contaminant that is allowed in PWSs, as close to the MCLG as feasible, taking several factors into consideration, including analytical methods capable of measuring the contaminant, available treatment technologies to remove the contaminant, and costs. Based on these factors, the EPA is finalizing an MCL of 4.0 ppt for PFOS. Occurrence data from various sources presented below are analyzed with respect to the MCL and two alternative MCLs for PFOS of 5.0 ppt and 10.0 ppt that the EPA evaluated under its HRRCA for the proposed rule. When possible, estimates of the population exposed at concentrations above the MCL and alternative MCLs are presented. Also, when possible, studies that are meant to be representative and studies that are targeted at known or suspected sites of contamination are identified as such.

The drinking water analyses presented in this section were performed for UCMR 3 and select state data sources. In addition, this section presents PFOS findings from occurrence analyses conducted by non-EPA researchers. Chapter 10 describes the Bayesian hierarchical model used to extrapolate PFOS occurrence to the nation and also points the reader to examine Cadwallader et al. (2022) for further details.

For additional background information about data sources used to evaluate occurrence, please refer to Chapter 2.

4.2.1 Occurrence in Drinking Water

Data sources reviewed by the agency for information on PFOS occurrence in drinking water included UCMR 3, state drinking water monitoring programs, and the DoD PFAS drinking water testing, as well as additional studies from the literature.

Note that there may be some overlap, as sources with different purposes and audiences may have reported the same underlying data. UCMR 3 is a nationally representative data source. Other data sources profiled in this section are considered "supplemental" sources. Also note that 29 PFAS, including PFOS, are being monitored for under UCMR 5, that data collection effort is occurring from 2023 to 2025. Analysis of partial UCMR 5 results (the first three quarters of data that were made available as of February 2024) are discussed in section 11 of this document. The EPA notes that the UCMR 3 MRL for PFOS is higher than that utilized within the majority of state monitoring data and for the UCMR 5.

4.2.1.1 UCMR 3 Data

UCMR 3 monitoring, designed to provide nationally representative contaminant occurrence data, was conducted from 2013 through 2015. UCMR 3 Assessment Monitoring occurrence data are available for PFOS from all large and very large public water systems or PWSs (serving between 10,001 and 100,000 people and serving more than 100,000 people, respectively), plus a statistically representative national sample of 800 small PWSs (serving 10,000 people or fewer).[5] Surface water and GWUDI sampling points were monitored four times during the applicable year of monitoring, and ground water sample points were monitored twice during the applicable year of monitoring. See USEPA (2012b) and USEPA (2019a) for more information on the UCMR 3 study design and data analysis.

Exhibit 4-5 through Exhibit 4-7 provide an overview of PFOS occurrence results from the UCMR 3 Assessment Monitoring. Laboratories participating in UCMR 3 were required to report values at or above MRLs defined by the EPA. The UCMR MRLs are not intended to represent the lowest achievable measurement level an individual laboratory may achieve. Rather, the MRLs are established to ensure reliable and consistent results from the array of laboratories needed for a national monitoring program and are set based on the quantitation level capability of multiple commercial laboratories prior to beginning each UCMR round. The MRL used for PFOS in the UCMR 3 survey was 40 ng/L (77 FR 26072; USEPA, 2012b). Exhibit 4-5 presents a sample-level summary of the results. Exhibit 4-6 shows a statistical summary of PFOS concentrations by system size and source water type (including the minimum, 25th percentile, median, 75th percentile, 90th percentile, 99th percentile, and maximum). Exhibit 4-7 shows system-level results for detections greater than or equal to the MRL.

A total of 36,972 finished water samples for PFOS were collected from 4,920 PWSs. PFOS was reported ≥ MRL of 40 ng/L in 0.79 percent of UCMR 3 samples. Reported PFOS concentrations for these results ranged from 40 ng/L (the MRL) to 7,000 ng/L. Of 4,920 systems, 95 (1.9 percent of systems, serving 4.3 percent of the PWS-served population) reported at least one detection.

Exhibit 4-5: PFOS National Occurrence Measures Based on UCMR 3 Assessment Monitoring Data - Summary of Samples

Source Water Type	Total # of Samples	Samples with Detections ≥ MRL of 40 ng/L	
		Number	**Percent**
Small Systems (serving ≤ 10,000 people)			
Ground Water	1,853	2	0.11%
Surface Water	1,421	4	0.28%
All Small Systems	**3,274**	**6**	**0.18%**
Large Systems (serving 10,001 - 100,000 people) -- CENSUS			
Ground Water	11,707	66	0.56%
Surface Water	14,860	138	0.93%
All Large Systems	**26,567**	**204**	**0.77%**
Very Large Systems (serving > 100,000 people) -- CENSUS			
Ground Water	2,020	29	1.44%
Surface Water	5,111	53	1.04%
All Very Large Systems	**7,131**	**82**	**1.15%**
All Systems			
All Water Systems	**36,972**	**292**	**0.79%**

[5] A total of 799 small systems submitted Assessment Monitoring results.

Exhibit 4-6: PFOS Occurrence Data from UCMR 3 Assessment Monitoring - Summary of Reported Concentrations

Source Water Type	Concentration Value of Detections (in ng/L) ≥ MRL of 40 ng/L						
	Minimum	**25th percentile**	**Median**	**75th percentile**	**90th Percentile**	**99th Percentile**	**Maximum**
Small Systems (serving ≤ 10,000 people)							
Ground Water	230	250	270	280	290	300	300
Surface Water	50	50	50	50	60	60	58.53
All Small Systems	**50**	**50**	**60**	**190**	**270**	**300**	**300**
Large Systems (serving 10,001 - 100,000 people) -- CENSUS							
Ground Water	40	50	60	160	240	540	600
Surface Water	40	50	70	130	370	3,570	7,000
All Large Systems	**40**	**50**	**60**	**140**	**280**	**1,290**	**7,000**
Very Large Systems (serving > 100,000 people) -- CENSUS							
Ground Water	41	60	90	160	340	500	530
Surface Water	41	40	50	60	110	1350	1800
All Very Large Systems	**41**	**50**	**50**	**90**	**180**	**1,100**	**1,800**
All Systems							
All Water Systems	**40**	**50**	**60**	**130**	**250**	**1,340**	**7,000**

Exhibit 4-7: PFOS National Occurrence Measures Based on UCMR 3 Assessment Monitoring Data - Summary of System and Population Served Data - Reported Detections

Source Water Type	UCMR 3 Samples		Number With At Least One Detection ≥ MRL of 40 ng/L		Percent With At Least One Detection ≥ MRL of 40 ng/L		National Inventory		Percent of National Inventory Included	
	Systems	Population	Systems	Population	Systems	Population	Systems	Population	Systems	Population
Small Systems (serving ≤ 10,000 people)										
Ground Water	527	1,498,845	1	536	0.19%	0.04%	55,700	38,730,597	0.95%	3.87%
Surface Water	272	1,250,215	3	22,363	1.10%	1.79%	9,728	20,007,917	2.80%	6.25%
All Small Systems	**799**	**2,749,060**	**4**	**22,899**	**0.50%**	**0.83%**	**65,428**	**58,738,514**	**1.22%**	**4.68%**
Large Systems (serving 10,001 - 100,000 people) -- CENSUS										
Ground Water	1,453	37,141,418	29	1,070,732	2.00%	2.88%	1,470	37,540,614	98.84%	98.94%
Surface Water	2,260	69,619,878	38	1,314,380	1.68%	1.89%	2,310	70,791,005	97.84%	98.35%
All Large Systems	**3,713**	**106,761,296**	**67**	**2,385,112**	**1.80%**	**2.23%**	**3,780**	**108,331,619**	**98.23%**	**98.55%**
Very Large Systems (serving > 100,000 people) -- CENSUS										
Ground Water	68	16,355,951	9	4,739,185	13.24%	28.98%	68	16,355,951	100.00%	100.00%
Surface Water	340	115,158,260	15	3,279,997	4.41%	2.85%	343	120,785,622	99.13%	95.34%
All Very Large Systems	**408**	**131,514,211**	**24**	**8,019,182**	**5.88%**	**6.10%**	**411**	**137,141,573**	**99.27%**	**95.90%**
All Systems										
All Water Systems	**4,920**	**241,024,567**	**95**	**10,427,193**	**1.93%**	**4.33%**	**69,619**	**304,211,706**	**7.07%**	**79.23%**

4.2.1.2 State Monitoring Data

In the development of the proposed and final NPDWR, the agency supplemented its UCMR 3 data with more recent publicly available data collected by states. In general, these more recent state data were collected using newer analytical methods and state results reflect lower reporting and detection limits than those in the UCMR 3. The EPA downloaded publicly available monitoring data for PWSs from state websites through May 2023. Drinking water occurrence data for PFOS were available from several states, including Alabama, Arizona, California, Colorado, Delaware, Georgia, Idaho, Illinois, Indiana, Iowa, Kentucky, Maine, Maryland, Massachusetts, Michigan, Minnesota, Missouri, New Hampshire, New Jersey, New Mexico, New York, North Carolina, North Dakota, Ohio, Oregon, Pennsylvania, South Carolina, Tennessee, Vermont, Virginia, West Virginia, and Wisconsin. Note that while some states did have available raw water data as indicated in Exhibit 4-8, for the subsequent analyses the EPA only evaluated finished water results.

Exhibit 4-8 provides a summary of the available state reported monitoring data for PFOS, including date range and a description of coverage and representativeness (including whether monitoring was non-targeted or targeted (i.e., monitoring in areas of known or potential PFAS contamination). A description of those studies is also included in Exhibit 4-8. Within state reported data there may be overlap with UCMR 3 results from 2013 - 2015, though the EPA notes that the large majority of the available state data are from 2019 and later. In addition, the EPA excluded UCMR 3 results from the state data whenever possible. State reporting thresholds are also provided, where available, in Exhibit 4-8. The EPA notes that different states utilized various reporting thresholds when analyzing and presenting their data, and for some states there were no clearly defined thresholds publicly provided; in these cases, minimum detected concentrations reported may be indicative of reporting thresholds used. Further, for some states, the thresholds varied when reporting results for the same analyte, as well as the laboratory analyzing the data. For those states, a range of thresholds is provided. As shown in Exhibit 4-8, some states reported at thresholds and/or presented data at concentrations below the EPA's final MCL and/or PQL for PFOS. However, to present the best available occurrence information, the EPA collected and evaluated the data based on the information as reported directly by the states and when conducting data analyses incorporated individual state-specific reporting thresholds where possible. Additionally, the EPA notes that the majority of the data were analyzed via an EPA-approved drinking water analytical method.

Exhibit 4-8: Summary of Available PFOS State Reported Monitoring Data

State (Reference)	Date Range	Type of Water Tested	Reporting Threshold (ppt)	Notes on Coverage	Survey Type
Alabama (ADEM, 2023)	2013 - 2022	Ground Water and Surface Water - Finished Water	Not reported	ADPH instructed water systems to carry out PFAS monitoring at all PWSs not previously sampled during UCMR 3. In 2022, water systems that had not been sampled since UCMR 3 were required to sample between January and June 2022 using current analytical methods. Only results that are above the MRL are posted online; thus, only reported detections were available for use in the occurrence analyses.	Non-Targeted
Arizona (ADEQ, 2021; ADEQ, 2023)	2016 - February 2021	Ground Water and Surface Water - Finished Water	Not reported	ADEQ made publicly available PFAS sampling data from systems near the Luke Airforce Base. Finished water data were available from two PWSs.	Targeted
	2018 - June 2021	Ground Water and Surface Water - Raw and Finished Water	1.6 - 2	ADEQ presents a PFAS Interactive Data Map that displays the results of testing conducted by ADEQ since 2018 at PWSs across Arizona.	Targeted
California (CADDW, 2023)	2013 - April 2023	Ground Water and Surface Water - Raw, Finished, and Unknown Water	0.002 - 40	The EPA reviewed the California PFOS data available online through April 2023. Finished water data were available from approximately 120 PWSs. For this analysis, the EPA only included results that were explicitly marked as being from treated water. Sampling in California is ongoing.	Targeted
Colorado (CDPHE, 2018;CDPHE, 2020)	2013 - 2017	Surface Water (Finished Water) and Drinking Water Distribution Samples	2 - 40	Data available from 28 “drinking water distribution zones” (one or more per PWS) in targeted sampling efforts at a known contaminated aquifer region. Data were collected by El Paso County Public Health, local water districts and utilities, and the CDPHE.	Targeted
	2020	Ground Water and Surface Water - Raw and Finished Water	1.6 - 2.4	CDPHE offered free testing to PWSs serving communities, schools, and workplaces and also to fire districts with wells. Approximately 50% of PWSs in Colorado participated in the 2020 PFAS sampling project. Data included in this report were collected in March through May of 2020.	Non-Targeted
Delaware (DE ODW, 2021)	2019 - 2020	Surface Water - Finished and Unknown Water	2	Sampling of finished drinking water data between January 2019 and October 2020 from one public water system. The EPA notes that the data no longer appear to be publicly available through the Drinking Water Watch link.	Targeted

State (Reference)	Date Range	Type of Water Tested	Reporting Threshold (ppt)	Notes on Coverage	Survey Type
Georgia (GA EPD, 2020)	2020	Surface Water - Raw, Finished, and Unknown Water	18	The EPA and the GA EPD conducted joint sampling of the City of Summerville's drinking water sources and finished drinking water in January 2020.	Targeted
Idaho (Idaho DEQ, 2023)	2021 - April 2023	Ground Water - Finished and Unknown Water	0.5 - 1	Sampling of finished drinking water data between available on the state's Drinking Water Watch website.	Not specified
Illinois (IL EPA, 2023)	2020 - May 2023	Ground Water and Surface Water - Raw and Finished Water	1.7 - 8	In 2020, the IL EPA initiated a statewide investigation into the prevalence and occurrence of PFAS in finished drinking water at 1,749 community water supplies across Illinois. The EPA reviewed finished drinking water data collected between September 2020 and May 2023 that were available on the state's Drinking Water Watch website. Limited PFOS data were also available from 2017. Sampling in Illinois is ongoing.	Non-Targeted
Indiana (IDEM, 2023)	2021 - January 2023	Ground Water and Surface Water - Raw, Finished, and Unknown Water	2	Beginning in February 2021, the IDEM facilitated PFAS monitoring at all CWSs throughout the state of Indiana. Samples were to be collected at all raw water (i.e., wells and intakes) and finished (after treatment) water points in a CWS's supply to evaluate the statewide occurrence of PFAS compounds in CWS across the state and determine the efficacy of conventional drinking water treatment for PFAS.	Non-Targeted
Iowa (IA DNR, 2023)	2021 - April 2023	Ground Water and Surface Water - Raw and Finished Water	1.7 - 4	In January 2020, the Iowa DNR developed an Action Plan to protect the health of Iowa residents and the environment from PFAS. Data were downloaded from the PFAS Sampling Interactive Dashboard and Map.	Targeted
Kentucky (KYDEP, 2019)	2019	Ground Water and Surface Water - Finished Water	3.24	Sampling of finished drinking water data between June and October 2019. Under this sampling effort, data are available from 81 community public DWTPs, representing 74 PWSs, and serving more than 2.4 million people.	Non-Targeted
Maine (Maine DEP, 2020; Maine DHHS, 2023)	2013 - 2020	Drinking Water - Raw, Finished, and Unknown Water	1.78 - 40	In March 2019, the Maine PFAS Task Force was created to review the extent of PFAS contamination in Maine. Finished water results collected from 2013 through 2020 have been collected at 23 locations throughout the state. Data may include results from public and private finished drinking water sources. Sampling in Maine is ongoing.	Targeted
	2021 - January 2023	Ground Water and Surface Water - Finished Water	2	The EPA reviewed the finished water data reported to the Maine CDC Drinking Water Program as compliance samples since June 2021 and	Non-Targeted

State (Reference)	Date Range	Type of Water Tested	Reporting Threshold (ppt)	Notes on Coverage	Survey Type
				processed in the database as of 3/10/2023. Sampling in Maine is ongoing.	
Maryland (MDE, 2021; MDE, 2022a; MDE, 2022b)	2020 - 2022	Ground Water and Surface Water - Raw and Finished Water	2	In 2020, MDE initiated a project to identify potential sources of PFAS in Maryland and to prioritize water sources for PFAS sampling. The EPA reviewed the finished water results from the first three phases of MDE's Public Water System study for the occurrence of PFAS in State drinking water sources. Under Phase 1 (September 2020 - February 2021), sites were selected for priority sampling based on MDE's evaluation of potential relative risk for PFAS exposure through drinking water. Under Phase 2 (March 2021 - May 2021), MDE conducted sampling at sites that were selected based on their geological setting and proximity to potential sources of PFAS. Under Phase 3 (August 2021- June 2022), MDE tested the remaining CWSs in the state.	Targeted (Phase 1, Phase 2); Non-Targeted (Phase 3)
Massachusetts (MA EEA, 2023)	2016 - April 2023	Ground Water and Surface Water - Raw and Finished Water	0.44 - 19	The EPA reviewed the finished water data available online through April 2023. Data were available from 1,330 PWSs. Sampling in Massachusetts is ongoing.	Targeted
Michigan (Michigan EGLE, 2023)	2020 - March 2023	Ground Water and Surface Water - Finished Water	2	The Michigan EGLE developed MCLs for seven PFAS compounds in Michigan, which took effect in August 2020. The EPA reviewed available PFOS finished compliance monitoring results through March 2023. Sampling in Michigan is ongoing.	Non-Targeted
Minnesota (MDH, 2023)	2020 - 2023	Ground Water and Surface Water - Finished Water	Not reported	Through the Statewide PFAS Monitoring Project, MDH is testing CWSs across the state for PFAS. The EPA reviewed finished water data through MDH's Interactive Dashboard for PFAS Testing in Drinking Water.	Non-Targeted
Missouri (Missouri DNR, 2018; Missouri DNR, 2023)	2016 - 2017	Ground Water and Surface Water - Raw and Finished Water	Not reported	The Missouri DNR conducted sampling of finished drinking water data between September 2016 and February 2017. Under this sampling effort, 30 finished water samples were collected from 15 PWSs.	Targeted
	2022 - 2023	Ground Water and Surface Water - Raw and Finished Water	Not reported	The EPA reviewed the finished water data available online from Missouri DNR's "PFAS Viewer Tool" which identifies the location of voluntary sampling for PFAS in public drinking water systems in Missouri. The EPA reviewed finished water data collected from approximately 125 PWSs from 2022 through 2023. Limited data were also available from 2013 through 2017.	Non-Targeted

State (Reference)	Date Range	Type of Water Tested	Reporting Threshold (ppt)	Notes on Coverage	Survey Type
New Hampshire (NHDES, 2021)	2016 - May 2021	Ground Water and Surface Water - Raw and Finished Water	2 - 5	The EPA reviewed the New Hampshire PFOS data available online through May 2021. Finished water data were available from more than 500 PWSs. Sampling in New Hampshire is ongoing.	Non-Targeted
New Jersey (NJDEP, 2023)	2019 - May 2023	Ground Water and Surface Water - Raw, Finished, and Unknown Water	0.018 - 8.9	Statewide sampling of finished drinking water data was available from 2019-2023. The EPA reviewed data available online through May 2023 from more than 1,100 PWSs. Sampling in New Jersey is ongoing.	Non-Targeted
New Mexico (NMED, 2019)	2016	Ground Water - Raw and Finished Water	Not reported	NMED, Department of Health and the U.S. Air Force conducted testing at public drinking water supplies at or around Cannon Air Force Base up to 2019.	Targeted
New York (NYDOH, 2022)	2017 - 2022	Ground Water and Surface Water - Raw, Finished, and Unknown Water	0.000000001 - 2020	The EPA reviewed finished water data voluntarily provided by the state to the EPA. Data were available from nearly 2,600 PWSs from 2017 through 2022. Limited data were also available from 2016.	Non-Targeted
North Carolina (NCDEQ, 2021; NCDEQ, 2023)	2017 - 2019	Finished and unknown water	Not reported	NCDEQ and the Department of Health and Human Services investigated the presence of HFPO-DA and other PFAS in the Cape Fear River in June 2017. Monthly results were also collected from five water treatment plants on the Cape Fear River. Data were available from June 2017 through October 2019. Only results above the DL were reported; thus, only reported detections were available for use in the occurrence analyses.	Targeted
	September 2022 - November 2022	Ground Water and Surface Water - Raw, Finished, and Unknown Water	Not reported	In late 2022, NCDEQ performed three months of sampling at 50 municipal and county water systems identified in the 2019 PFAS Testing Network study with PFOA/PFOS detections above the MRL indicated by the 2022 EPA interim health advisories.	Targeted
North Dakota (NDDEQ, 2019; NDDEQ, date unknown; NDDEQ, date unknown)	2018, 2020, 2021	Ground Water and Surface Water - Raw and Finished Water	Not reported	NDDEQ published a 2018, a 2020, and a 2021 survey report of North Dakota Statewide PFAS Presence/Absence results. The first phase of sampling in October of 2018 included raw and finished water from seven drinking WTPs that were chosen based on either the population served or proximity to an industrial site. The second sampling effort in October of 2020 sought to determine if there was a PFAS presence in a representative portion of the state's public water supply. In 2021, sampling conducted as part of the third phase of the survey focused on drinking water sites not evaluated in the first two surveys.	Targeted (2018); Non-Targeted (2020); Non-Targeted (2021)

State (Reference)	Date Range	Type of Water Tested	Reporting Threshold (ppt)	Notes on Coverage	Survey Type
Ohio (Ohio EPA, 2023)	December 2019 - December 2021	Ground Water and Surface Water - Raw and Finished Water	5	The Ohio EPA coordinated sampling of raw and finished drinking water from PWSs throughout the state. The EPA reviewed the finished water data available online through December 2021. During this timeframe, data were available from 1,479 PWSs.	Non-Targeted
Oregon (OHA-DWS, 2022)	2021 - July 2022	Ground Water and Surface Water - Finished Water	10.1 - 12.4	OHA conducted a PFAS drinking water monitoring project in 2021 at PWSs in Oregon identified as at risk due to their proximity to a known or suspected PFAS use or contamination site. The EPA reviewed the finished water data from more than 140 PWSs.	Targeted
Pennsylvania (PADEP, 2019)	2019	Ground Water and Surface Water - Finished Water	1.9	A PFAS Sampling Plan was developed to test PWSs across the state. Finished water data were collected for 87 PWSs in 2019.	Targeted
Pennsylvania (PADEP, 2021)	2020 - March 2021	Ground Water and Surface Water - Finished Water	1.7 - 4	Beginning in 2020 and running through March of 2021, finished water data were collected by more than 340 PWSs.	Targeted
South Carolina (SCDHEC, 2020; SCDHEC, 2023)	2017 - March 2023	Ground Water and Surface Water -Raw and Finished Water	2	The EPA reviewed PFAS sampling results collected by the South Carolina Bureau of Water for community drinking water systems. Data were available from 300 PWSs.	Non-Targeted
Tennessee (TDEC, 2023)	2019	Surface Water - Raw and Finished Water	Not reported	In 2019, Metro Water Services conducted a voluntary sampling of Nashville's drinking water systems for PFAS. Their stated goal was to go above and beyond current federal and state monitoring requirements to understand the potential presence of PFAS in Nashville's drinking water.	Non-Targeted
Vermont (VT DEC, 2023)	2019 -April 2023	Ground Water and Surface Water -Raw, Finished, and Unknown Water	2	The Vermont Water Supply Rule required all CWSs and NTNCWSs to sample for PFAS. The EPA reviewed finished water data available online from July 2019 - April 2023 from approximately 560 PWSs. Sampling in Vermont is ongoing.	Non-Targeted
Virginia (VDH ODW, 2021)	2021	Ground Water and Surface Water - Raw and Finished Water	3.5	The Virginia ODW, in conjunction with VA PFAS work group, designed the sample study to prioritize sites for measuring PFAS concentrations in drinking water and major sources of water and generate statewide occurrence data.	Targeted / Non-Targeted
West Virginia (WV DHHR. 2023)	2017 - 2019	Ground Water and Surface Water - Raw, Finished, and Unknown Water	Not reported	The EPA reviewed finished drinking water data collected from 2017-2019 that were available on the state's Drinking Water Watch website. PFOS and PFOA results were available from one PWS.	Not specified

State (Reference)	Date Range	Type of Water Tested	Reporting Threshold (ppt)	Notes on Coverage	Survey Type
Wisconsin (WI DNR, 2023)	2022 - April 2023	Ground Water and Surface Water - Raw, Finished, and Unknown Water	Not reported	The EPA reviewed the finished water data available online from 2022 - 2023. Data were available from nearly 250 PWSs. On Aug. 1, 2022, the state's safe drinking water code ch. NR 809 Wis. Adm. Code was revised to include standards for PFOA and PFOS. Sampling in Wisconsin is ongoing.	Non-Targeted

A summary of state reported monitoring data from public water systems for PFOS is presented in Exhibit 4-9 through Exhibit 4-12. As noted above, some of the monitoring data from each state are limited and may not be representative of occurrence in the state. In addition, states have varying reporting thresholds, as described earlier and indicated in the first column of Exhibit 4-9. For states with available reporting thresholds, only detected concentrations greater than the reporting thresholds were counted as detections. For states that did not provide reporting thresholds, the EPA included all detected concentrations reported in the count of detections. Overall, state reported detected concentrations ranged from 0.22 ppt (North Carolina) to 650 ppt (Massachusetts). Note that for a small number of systems, population served information could not be identified. These systems were included in the counts and analysis presented in Exhibit 4-11; however, no associated population served was included in the counts and analysis presented in Exhibit 4-12.

Exhibit 4-9: PFOS State Reported Drinking Water Occurrence Data - Summary of Finished Water Samples

State (Reporting Threshold)	Source Water Type	Total # Samples	All Detections[1]		Detections > 4.0 ppt		Detections > 5.0 ppt		Detections > 10.0 ppt	
			Number	Percent	Number	Percent	Number	Percent	Number	Percent
Alabama[1] (Not reported)	Ground Water	--	73	--	53	--	51	--	27	--
	Surface Water	--	176	--	117	--	103	--	77	--
	Total	**--**	**249**	**--**	**170**	**--**	**154**	**--**	**104**	**--**
Arizona, ADEQ Sampling (1.6 - 2 ppt)	Ground Water	24	12	50.0%	9	37.5%	8	33.3%	6	25.0%
	Surface Water	2	1	50.0%	1	50.0%	0	0.0%	0	0.0%
	Total	**26**	**13**	**50.0%**	**10**	**38.5%**	**8**	**30.8%**	**6**	**23.1%**
Arizona, Luke Air Force Base (Not reported)	Ground Water	264	76	28.8%	60	22.7%	47	17.8%	28	10.6%
	Surface Water	16	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**280**	**76**	**27.1%**	**60**	**21.4%**	**47**	**16.8%**	**28**	**10.0%**

State (Reporting Threshold)	Source Water Type	Total # Samples	All Detections[1]		Detections > 4.0 ppt		Detections > 5.0 ppt		Detections > 10.0 ppt	
			Number	Percent	Number	Percent	Number	Percent	Number	Percent
California (0.002 - 40 ppt)	Ground Water	1,898	481	25.3%	339	17.9%	289	15.2%	204	10.7%
	Surface Water	4,134	670	16.2%	423	10.2%	362	8.8%	201	4.9%
	Unknown	29	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**6,061**	**1,151**	**19.0%**	**762**	**12.6%**	**651**	**10.7%**	**405**	**6.7%**
Colorado (2013 - 2017) (2 - 40 ppt)	Distribution (Finished)	96	38	39.6%	36	37.5%	34	35.4%	33	34.4%
	Surface Water (Finished)	11	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**107**	**38**	**35.5%**	**36**	**33.6%**	**34**	**31.8%**	**33**	**30.8%**
Colorado (2020) (1.6 - 2.4 ppt)	Ground Water	339	37	10.9%	17	5.0%	12	3.5%	2	0.6%
	Surface Water	244	23	9.4%	11	4.5%	8	3.3%	1	0.4%
	Total	**583**	**60**	**10.3%**	**28**	**4.8%**	**20**	**3.4%**	**3**	**0.5%**
Delaware (2 ppt)	Ground Water	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	34	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**34**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**
Georgia (18 ppt)	Ground Water	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	2	1	50.0%	1	50.0%	1	50.0%	1	50.0%
	Total	**2**	**1**	**50.0%**	**1**	**50.0%**	**1**	**50.0%**	**1**	**50.0%**
Idaho (0.5 - 1 ppt)	Ground Water	18	1	5.6%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**18**	**1**	**5.6%**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**
Illinois (1.7 - 8 ppt)	Ground Water	1,831	180	9.8%	94	5.1%	47	2.6%	20	1.1%
	Surface Water	302	126	41.7%	31	10.3%	18	6.0%	3	1.0%
	Total	**2,133**	**306**	**14.3%**	**125**	**5.9%**	**65**	**3.0%**	**23**	**1.1%**
Indiana (2 ppt)	Ground Water	422	6	1.4%	1	0.2%	1	0.2%	0	0.0%
	Surface Water	59	2	3.4%	0	0.0%	0	0.0%	0	0.0%
	Total	**481**	**8**	**1.7%**	**1**	**0.2%**	**1**	**0.2%**	**0**	**0.0%**
Iowa (1.7 - 4 ppt)	Ground Water	154	46	29.9%	32	20.8%	22	14.3%	10	6.5%
	Surface Water	65	11	16.9%	3	4.6%	0	0.0%	0	0.0%

State (Reporting Threshold)	Source Water Type	Total # Samples	All Detections[1]		Detections > 4.0 ppt		Detections > 5.0 ppt		Detections > 10.0 ppt	
			Number	Percent	Number	Percent	Number	Percent	Number	Percent
	Total	**219**	**57**	**26.0%**	**35**	**16.0%**	**22**	**10.0%**	**10**	**4.6%**
Kentucky (3.24 ppt)	Ground Water	33	4	12.1%	1	3.0%	1	3.0%	1	3.0%
	Surface Water	48	29	60.4%	3	6.3%	2	4.2%	0	0.0%
	Total	**81**	**33**	**40.7%**	**4**	**4.9%**	**3**	**3.7%**	**1**	**1.2%**
Maine (PFAS Task Force)[2] (1.78 - 40 ppt)	Ground Water	9	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	3	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Unknown	75	12	16.0%	7	9.3%	6	8.0%	5	6.7%
	Total	**87**	**12**	**13.8%**	**7**	**8.0%**	**6**	**6.9%**	**5**	**5.7%**
Maine (Compliance) (2 ppt)	Ground Water	646	99	15.3%	52	8.0%	42	6.5%	12	1.9%
	Surface Water	62	2	3.2%	1	1.6%	0	0.0%	0	0.0%
	Total	**708**	**101**	**14.3%**	**53**	**7.5%**	**42**	**5.9%**	**12**	**1.7%**
Maryland (Phase 1) (2 ppt)	Ground Water	70	27	38.6%	14	20.0%	12	17.1%	3	4.3%
	Surface Water	76	30	39.5%	19	25.0%	17	22.4%	8	10.5%
	Total	**146**	**57**	**39.0%**	**33**	**22.6%**	**29**	**19.9%**	**11**	**7.5%**
Maryland (Phase 2) (2 ppt)	Ground Water	9	3	33.3%	3	33.3%	2	22.2%	2	22.2%
	Surface Water	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**9**	**3**	**33.3%**	**3**	**33.3%**	**2**	**22.2%**	**2**	**22.2%**
Maryland (Phase 3) (2 ppt)	Ground Water	88	17	19.3%	14	15.9%	10	11.4%	8	9.1%
	Surface Water	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**88**	**17**	**19.3%**	**14**	**15.9%**	**10**	**11.4%**	**8**	**9.1%**
Massachusetts (0.44 - 19 ppt)	Ground Water	7,215	3,394	47.0%	2,197	30.5%	1,665	23.1%	521	7.2%
	Surface Water	2,130	1,038	48.7%	553	26.0%	399	18.7%	85	4.0%
	Total	**9,345**	**4,432**	**47.4%**	**2,750**	**29.4%**	**2,064**	**22.1%**	**606**	**6.5%**
Michigan (2 ppt)	Ground Water	10,007	394	3.9%	156	1.6%	123	1.2%	72	0.7%
	Surface Water	519	89	17.1%	5	1.0%	5	1.0%	1	0.2%
	Unknown	164	6	3.7%	5	3.0%	5	3.0%	4	2.4%
	Total	**10,690**	**489**	**4.6%**	**166**	**1.6%**	**133**	**1.2%**	**77**	**0.7%**

State (Reporting Threshold)	Source Water Type	Total # Samples	All Detections[1]		Detections > 4.0 ppt		Detections > 5.0 ppt		Detections > 10.0 ppt	
			Number	Percent	Number	Percent	Number	Percent	Number	Percent
Missouri, 2016 - 2017 (Not reported)	Unknown	29	12	41.4%	0	0.0%	0	0.0%	0	0.0%
	Total	**29**	**12**	**41.4%**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**
Missouri, 2022 - 2023 (Not reported)	Ground Water	213	19	8.9%	8	3.8%	6	2.8%	0	0.0%
	Surface Water	26	3	11.5%	0	0.0%	0	0.0%	0	0.0%
	Total	**239**	**22**	**9.2%**	**8**	**3.3%**	**6**	**2.5%**	**0**	**0.0%**
New Hampshire (2 - 5 ppt)	Ground Water	1,656	465	28.1%	248	15.0%	199	12.0%	80	4.8%
	Surface Water	157	30	19.1%	6	3.8%	1	0.6%	1	0.6%
	Unknown	1	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**1,814**	**495**	**27.3%**	**254**	**14.0%**	**200**	**11.0%**	**81**	**4.5%**
New Jersey (0.018 - 8.9 ppt)	Ground Water	12,715	4,947	38.9%	3,343	26.3%	2,742	21.6%	1,050	8.3%
	Surface Water	3,168	1,549	48.9%	878	27.7%	687	21.7%	188	5.9%
	Unknown	16	6	37.5%	2	12.5%	1	6.3%	0	0.0%
	Total	**15,899**	**6,502**	**40.9%**	**4,223**	**26.6%**	**3,430**	**21.6%**	**1,238**	**7.8%**
New Mexico (Not reported)	Ground Water	2	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**2**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**
New York (0.000000001 - 2,020 ppt)	Ground Water	5,516	1,171	21.2%	576	10.4%	438	7.9%	160	2.9%
	Surface Water	1,520	403	26.5%	63	4.1%	47	3.1%	8	0.5%
	Unknown	21	2	9.5%	0	0.0%	0	0.0%	0	0.0%
	Total	**7,057**	**1,576**	**22.3%**	**639**	**9.1%**	**485**	**6.9%**	**168**	**2.4%**
North Carolina, Cape Fear River[1] (Not Reported)	Unknown	--	372	--	347	--	347	--	339	--
	Total	**--**	**372**	**--**	**347**	**--**	**347**	**--**	**339**	**--**
North Carolina, 2022 (Not Reported)	Ground Water	21	6	28.6%	6	28.6%	6	28.6%	4	19.0%
	Surface Water	141	129	91.5%	96	68.1%	85	60.3%	34	24.1%
	Total	**162**	**135**	**83.3%**	**102**	**63.0%**	**91**	**56.2%**	**38**	**23.5%**
	Ground Water	4	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	3	3	100.0%	0	0.0%	0	0.0%	0	0.0%

State (Reporting Threshold)	Source Water Type	Total # Samples	All Detections[1]		Detections > 4.0 ppt		Detections > 5.0 ppt		Detections > 10.0 ppt	
			Number	Percent	Number	Percent	Number	Percent	Number	Percent
North Dakota, 2018 (Not reported)	**Total**	**7**	**3**	**42.9%**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**
North Dakota, 2020 (Not reported)	Ground Water	42	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	9	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**51**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**
North Dakota, 2021 (Not reported)	Ground Water	56	2	3.6%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	7	1	14.3%	0	0.0%	0	0.0%	0	0.0%
	Total	**63**	**3**	**4.8%**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**
Ohio[3] (5 ppt)	Ground Water	1,775	97	5.5%	97	5.5%	96	5.4%	58	3.3%
	Surface Water	170	16	9.4%	16	9.4%	16	9.4%	9	5.3%
	Total	**1,945**	**113**	**5.8%**	**113**	**5.8%**	**112**	**5.8%**	**67**	**3.4%**
Oregon (10.1 - 12.4 ppt)	Ground Water	131	5	3.8%	5	3.8%	5	3.8%	5	3.8%
	Surface Water	29	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**160**	**5**	**3.1%**	**5**	**3.1%**	**5**	**3.1%**	**5**	**3.1%**
Pennsylvania, 2019 (1.9 ppt)	Ground Water	75	14	18.7%	8	10.7%	7	9.3%	2	2.7%
	Surface Water	21	11	52.4%	8	38.1%	6	28.6%	1	4.8%
	Total	**96**	**25**	**26.0%**	**16**	**16.7%**	**13**	**13.5%**	**3**	**3.1%**
Pennsylvania, 2021 (1.7 - 4 ppt)	Ground Water	314	76	24.2%	57	18.2%	45	14.3%	20	6.4%
	Surface Water	98	27	27.6%	20	20.4%	18	18.4%	5	5.1%
	Total	**412**	**103**	**25.0%**	**77**	**18.7%**	**63**	**15.3%**	**25**	**6.1%**
South Carolina (2 ppt)	Ground Water	572	41	7.2%	18	3.1%	16	2.8%	10	1.7%
	Surface Water	197	94	47.7%	51	25.9%	32	16.2%	5	2.5%
	Total	**769**	**135**	**17.6%**	**69**	**9.0%**	**48**	**6.2%**	**15**	**2.0%**
Tennessee (Not reported)	Ground Water	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	2	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**2**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**
Vermont	Ground Water	1,463	192	13.1%	110	7.5%	90	6.2%	35	2.4%

State (Reporting Threshold)	Source Water Type	Total # Samples	All Detections[1]		Detections > 4.0 ppt		Detections > 5.0 ppt		Detections > 10.0 ppt	
			Number	Percent	Number	Percent	Number	Percent	Number	Percent
(2 ppt)	Surface Water	102	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**1,565**	**192**	**12.3%**	**110**	**7.0%**	**90**	**5.8%**	**35**	**2.2%**
Virginia (3.5 ppt)	Ground Water	5	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	36	7	19.4%	6	16.7%	4	11.1%	0	0.0%
	Total	**41**	**7**	**17.1%**	**6**	**14.6%**	**4**	**9.8%**	**0**	**0.0%**
West Virginia (Not reported)	Ground Water	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	31	24	77.4%	17	54.8%	16	51.6%	12	38.7%
	Total	**31**	**24**	**77.4%**	**17**	**54.8%**	**16**	**51.6%**	**12**	**38.7%**
Wisconsin (Not reported)	Ground Water	728	147	20.2%	35	4.8%	29	4.0%	22	3.0%
	Surface Water	54	40	74.1%	0	0.0%	0	0.0%	0	0.0%
	Total	**782**	**187**	**23.9%**	**35**	**4.5%**	**29**	**3.7%**	**22**	**2.8%**

[1] Only reported detections were available in this state's dataset.
[2] Reported data from Maine may include results from public and private finished drinking water sources. Based on available state data information, the EPA could not verify PWSIDs for all included samples.
[3] The reporting threshold for Ohio is 5 ppt; thus, any occurrence estimates relative to the final MCL of 4.0 ppt only include results greater than or equal to 5 ppt.

Exhibit 4-10: PFOS State Reported Drinking Water Occurrence Data - Summary of Detected Concentrations

State (Reporting Threshold)	Source Water Type	Concentration Value of Detections (ppt)				
		Minimum	Median	90th Percentile	99th Percentile	Maximum
Alabama[1] (Not reported)	Ground Water	1.2	7.70	22.4	36.2	47
	Surface Water	1	7.40	25.5	74.5	120
	Total	**1**	**7.60**	**24.3**	**65.8**	**120**
Arizona, ADEQ Sampling (1.6 - 2 ppt)	Ground Water	1.9	10.8	53.3	58.5	59
	Surface Water	4.4	4.4	4.4	4.4	4.4
	Total	**1.9**	**8.50**	**52.6**	**58.4**	**59**
Arizona, Luke Air Force Base	Ground Water	2.1	8.55	19.5	51.0	78

State (Reporting Threshold)	Source Water Type	Concentration Value of Detections (ppt)				
		Minimum	Median	90th Percentile	99th Percentile	Maximum
(Not reported)	Surface Water	--	--	--	--	--
	Total	**2.1**	**8.55**	**19.5**	**51.0**	**78**
California (0.002 - 40 ppt)	Ground Water	1.7	8.10	21.0	45.0	74
	Surface Water	0.4	5.40	31.9	58.9	250
	Unknown	--	--	--	--	--
	Total	**0.4**	**5.90**	**26.0**	**56.5**	**250**
Colorado (2013 - 2017) (2 - 40 ppt)	Distribution (Finished)	2.3	60.0	103	192	210
	Surface Water (Finished)	--	--	--	--	--
	Total	**2.3**	**60.0**	**103**	**192**	**210**
Colorado (2020) (1.6 - 2.4 ppt)	Ground Water	1.7	3.80	8.46	15.5	18
	Surface Water	2	4.00	6.40	10.2	11
	Total	**1.7**	**3.90**	**7.31**	**13.9**	**18**
Delaware (2 ppt)	Ground Water	--	--	--	--	--
	Surface Water	--	--	--	--	--
	Total	**--**	**--**	**--**	**--**	**--**
Georgia (18 ppt)	Ground Water	--	--	--	--	--
	Surface Water	49	49	49	49	49
	Total	**49**	**49**	**49**	**49**	**49**
Idaho (0.5 - 1 ppt)	Ground Water	1.33	1.33	1.33	1.33	1.33
	Surface Water	--	--	--	--	--
	Total	**1.33**	**1.33**	**1.33**	**1.33**	**1.33**
Illinois (1.7 - 8 ppt)	Ground Water	1.9	4.10	11.0	75.8	150
	Surface Water	2	2.60	5.40	11.0	15
	Total	**1.9**	**3.45**	**7.95**	**18.0**	**150**
Indiana (2 ppt)	Ground Water	2.451	3.35	4.80	5.52	5.6
	Surface Water	2.233	2.57	2.83	2.89	2.9
	Total	**2.233**	**2.95**	**4.48**	**5.49**	**5.6**

State (Reporting Threshold)	Source Water Type	Concentration Value of Detections (ppt)				
		Minimum	Median	90th Percentile	99th Percentile	Maximum
Iowa (1.7 - 4 ppt)	Ground Water	2.1	5.00	15.5	52.3	59
	Surface Water	2	3.30	4.40	4.85	4.9
	Total	**2**	**4.60**	**14.4**	**50.6**	**59**
Kentucky (3.24 ppt)	Ground Water	1	2.43	14.1	18.4	18.9
	Surface Water	1.01	1.40	4.11	7.54	8.35
	Total	**1**	**1.51**	**4.43**	**15.5**	**18.9**
Maine (PFAS Task Force)[2] (1.78 - 40 ppt)	Ground Water	--	--	--	--	--
	Surface Water	--	--	--	--	--
	Unknown	2.52	7.50	79.7	99.5	102
	Total	**2.52**	**7.50**	**79.7**	**99.5**	**102**
Maine (Compliance) (2 ppt)	Ground Water	2	4.18	11.4	32.6	138
	Surface Water	2.83	3.67	4.33	4.48	4.5
	Total	**2**	**4.18**	**11.3**	**30.4**	**138**
Maryland (Phase 1) (2 ppt)	Ground Water	2.05	4.42	10.8	234	235
	Surface Water	2.24	6.45	24.1	107	136.03
	Total	**2.05**	**5.07**	**21.0**	**233**	**235**
Maryland (Phase 2) (2 ppt)	Ground Water	4.7	21.2	30.8	32.9	33.18
	Surface Water	--	--	--	--	--
	Total	**4.7**	**21.2**	**30.8**	**32.9**	**33.18**
Maryland (Phase 3) (2 ppt)	Ground Water	2.17	10.0	51.7	87.1	93.1
	Surface Water	--	--	--	--	--
	Total	**2.17**	**10.0**	**51.7**	**87.1**	**93.1**
Massachusetts (0.44 - 19 ppt)	Ground Water	1.78	4.99	13.4	40.1	650
	Surface Water	1.7	4.21	9.43	140	270
	Total	**1.7**	**4.80**	**12.0**	**41.3**	**650**
Michigan (2 ppt)	Ground Water	2	4.00	20.0	73.2	150
	Surface Water	2	2.20	3.42	8.36	11

State (Reporting Threshold)	Source Water Type	Concentration Value of Detections (ppt)				
		Minimum	Median	90th Percentile	99th Percentile	Maximum
	Unknown	3	11.0	14.5	15.9	16
	Total	**2**	**3.00**	**17.0**	**70.4**	**150**
Minnesota (Not reported)	Ground Water	0.68	--	--	--	27
	Surface Water	--	--	--	--	--
	Total	**0.68**	**--**	**--**	**--**	**27**
Missouri, 2016 - 2017 (Not reported)	Unknown	0.24	0.500	1.03	1.19	1.21
	Total	**0.24**	**0.500**	**1.03**	**1.19**	**1.21**
Missouri, 2022 - 2023 (Not reported)	Ground Water	0.46	3.50	6.16	7.14	7.3
	Surface Water	0.6	0.720	0.984	1.04	1.05
	Total	**0.46**	**3.40**	**6.08**	**7.11**	**7.3**
New Hampshire (2 - 5 ppt)	Ground Water	2	4.37	16.1	193	261
	Surface Water	2.12	2.76	4.41	14.7	18.8
	Unknown	--	--	--	--	--
	Total	**2**	**4.15**	**15.9**	**190**	**261**
New Jersey (0.018 - 8.9 ppt)	Ground Water	0.5	5.60	16.9	78.0	359
	Surface Water	0.68	4.50	11.0	22.7	64
	Unknown	3.2	3.56	4.85	5.26	5.3
	Total	**0.5**	**5.30**	**15.0**	**59.6**	**359**
New Mexico (Not reported)	Ground Water	--	--	--	--	--
	Surface Water	--	--	--	--	--
	Total	**--**	**--**	**--**	**--**	**--**
New York (0.000000001 - 2,020 ppt)	Ground Water	0.24	3.94	11.8	34.2	389
	Surface Water	0.4	2.68	5.58	14.8	47.5
	Unknown	2.4	2.68	2.90	2.95	2.96
	Total	**0.24**	**3.30**	**10.6**	**32.7**	**389**
North Carolina, Cape Fear River[1] (Not Reported)	Unknown	0.22	40.0	40.0	79.3	80
	Total	**0.22**	**40.0**	**40.0**	**79.3**	**80**

State (Reporting Threshold)	Source Water Type	Concentration Value of Detections (ppt)				
		Minimum	Median	90th Percentile	99th Percentile	Maximum
North Carolina, 2022 (Not Reported)	Ground Water	8.15	13.8	20.1	21.6	21.8
	Surface Water	0.739	6.54	17.7	38.6	41
	Total	**0.739**	**6.58**	**18.6**	**38.4**	**41**
North Dakota, 2018 (Not reported)	Ground Water	--	--	--	--	--
	Surface Water	0.37	0.450	0.970	1.09	1.1
	Total	**0.37**	**0.450**	**0.970**	**1.09**	**1.1**
North Dakota, 2020 (Not reported)	Ground Water	--	--	--	--	--
	Surface Water	--	--	--	--	--
	Total	**--**	**--**	**--**	**--**	**--**
North Dakota, 2021 (Not reported)	Ground Water	0.805	1.14	1.40	1.46	1.47
	Surface Water	1.21	1.21	1.21	1.21	1.21
	Total	**0.805**	**1.21**	**1.42**	**1.46**	**1.47**
Ohio[3] (5 ppt)	Ground Water	5	12.1	25.3	49.9	66
	Surface Water	5.3	10.9	15.4	18.5	19
	Total	**5**	**12.1**	**24.0**	**49.2**	**66**
Oregon (10.1 - 12.4 ppt)	Ground Water	13.2	16.3	17.9	18.5	18.6
	Surface Water	--	--	--	--	--
	Total	**13.2**	**16.3**	**17.9**	**18.5**	**18.6**
Pennsylvania, 2019 (1.9 ppt)	Ground Water	2.6	4.80	12.4	83.6	94
	Surface Water	1.9	6.00	8.40	12.5	13
	Total	**1.9**	**5.10**	**11.3**	**74.8**	**94**
Pennsylvania, 2021 (1.7 - 4 ppt)	Ground Water	1.8	6.35	13.2	93.4	187.1
	Surface Water	2	7.10	11.8	19.1	19.8
	Total	**1.8**	**6.50**	**13.0**	**61.4**	**187.1**
South Carolina (2 ppt)	Ground Water	2	3.80	17.0	19.0	19
	Surface Water	2	4.30	8.77	16.4	22
	Total	**2**	**4.20**	**11.0**	**19.0**	**22**

State (Reporting Threshold)	Source Water Type	Concentration Value of Detections (ppt)				
		Minimum	Median	90th Percentile	99th Percentile	Maximum
Tennessee (Not reported)	Ground Water	--	--	--	--	--
	Surface Water	--	--	--	--	--
	Total	**--**	**--**	**--**	**--**	**--**
Vermont (2 ppt)	Ground Water	2	4.60	16.1	234	262
	Surface Water	--	--	--	--	--
	Total	**2**	**4.60**	**16.1**	**234**	**262**
Virginia (3.5 ppt)	Ground Water	--	--	--	--	--
	Surface Water	3.9	5.10	6.68	7.06	7.1
	Total	**3.9**	**5.10**	**6.68**	**7.06**	**7.1**
West Virginia (Not reported)	Ground Water	--	--	--	--	--
	Surface Water	0.41	10.4	39.7	45.9	47
	Total	**0.41**	**10.4**	**39.7**	**45.9**	**47**
Wisconsin (Not reported)	Ground Water	0.29	1.59	15.2	31.7	47.4
	Surface Water	0.31	1.58	2.10	2.30	2.3
	Total	**0.29**	**1.59**	**11.5**	**30.6**	**47.4**

Note: With limited exceptions, calculated concentration values (i.e., median, 90th percentile and 99th percentile concentrations) were rounded to three significant figures for consistent presentation across the datasets and may not indicate exact laboratory precision.
[1] Only reported detections were available in this state's dataset.
[2] Reported data from Maine may include results from public and private finished drinking water sources. Based on available state data information, the EPA could not verify PWSIDs for all included samples.

Exhibit 4-11: PFOS State Reported Drinking Water Occurrence Data - Summary of Systems with Finished Water Data

State (Reporting Threshold)	Source Water Type	Total Number of Systems	Systems with Detections		Systems with Detections > 4.0 ppt		Systems with Detections > 5.0 ppt		Systems with Detections > 10.0 ppt	
			Number	Percent	Number	Percent	Number	Percent	Number	Percent
Alabama[1]	Ground Water	--	31	--	24	--	22	--	15	--

State (Reporting Threshold)	Source Water Type	Total Number of Systems	Systems with Detections		Systems with Detections > 4.0 ppt		Systems with Detections > 5.0 ppt		Systems with Detections > 10.0 ppt	
			Number	Percent	Number	Percent	Number	Percent	Number	Percent
(Not reported)	Surface Water	--	57	--	40	--	31	--	19	--
	Total	**--**	**88**	**--**	**64**	**--**	**53**	**--**	**34**	**--**
Arizona, ADEQ Sampling (1.6 - 2 ppt)	Ground Water	6	2	33.3%	2	33.3%	2	33.3%	2	33.3%
	Surface Water	1	1	100.0%	1	100.0%	0	0.0%	0	0.0%
	Total	**7**	**3**	**42.9%**	**3**	**42.9%**	**2**	**28.6%**	**2**	**28.6%**
Arizona, Luke Air Force Base (Not reported)	Ground Water	1	1	100.0%	1	100.0%	1	100.0%	1	100.0%
	Surface Water	1	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**2**	**1**	**50.0%**	**1**	**50.0%**	**1**	**50.0%**	**1**	**50.0%**
Arizona (All Systems)[2] (Not reported)	Ground Water	6	2	33.3%	2	33.3%	2	33.3%	2	33.3%
	Surface Water	2	1	50.0%	1	50.0%	0	0.0%	0	0.0%
	Total	**8**	**3**	**37.5%**	**3**	**37.5%**	**2**	**25.0%**	**2**	**25.0%**
California (0.002 - 40 ppt)	Ground Water	43	16	37.2%	14	32.6%	14	32.6%	12	27.9%
	Surface Water	79	32	40.5%	24	30.4%	23	29.1%	18	22.8%
	Unknown	1	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**123**	**48**	**39.0%**	**38**	**30.9%**	**37**	**30.1%**	**30**	**24.4%**
Colorado (2013 - 2017) (2 - 40 ppt)	Distribution (Finished)	23	12	52.2%	12	52.2%	12	52.2%	12	52.2%
	Surface Water (Finished)	5	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**28**	**12**	**42.9%**	**12**	**42.9%**	**12**	**42.9%**	**12**	**42.9%**
Colorado (2020) (1.6 - 2.4 ppt)	Ground Water	221	31	14.0%	14	6.3%	10	4.5%	2	0.9%
	Surface Water	176	19	10.8%	8	4.5%	6	3.4%	1	0.6%
	Total	**397**	**50**	**12.6%**	**22**	**5.5%**	**16**	**4.0%**	**3**	**0.8%**
Delaware (2 ppt)	Ground Water	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	1	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**1**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**
Georgia (18 ppt)	Ground Water	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	1	1	100.0%	1	100.0%	1	100.0%	1	100.0%

State (Reporting Threshold)	Source Water Type	Total Number of Systems	Systems with Detections		Systems with Detections > 4.0 ppt		Systems with Detections > 5.0 ppt		Systems with Detections > 10.0 ppt	
			Number	Percent	Number	Percent	Number	Percent	Number	Percent
	Total	**1**	**1**	**100.0%**	**1**	**100.0%**	**1**	**100.0%**	**1**	**100.0%**
Idaho (0.5 - 1 ppt)	Ground Water	10	1	10.0%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**10**	**1**	**10.0%**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**
Illinois (1.7 - 8 ppt)	Ground Water	899	42	4.7%	21	2.3%	17	1.9%	4	0.4%
	Surface Water	97	31	32.0%	9	9.3%	6	6.2%	1	1.0%
	Total	**996**	**73**	**7.3%**	**30**	**3.0%**	**23**	**2.3%**	**5**	**0.5%**
Indiana (2 ppt)	Ground Water	341	5	1.5%	1	0.3%	1	0.3%	0	0.0%
	Surface Water	31	2	6.5%	0	0.0%	0	0.0%	0	0.0%
	Total	**372**	**7**	**1.9%**	**1**	**0.3%**	**1**	**0.3%**	**0**	**0.0%**
Iowa (1.7 - 4 ppt)	Ground Water	90	9	10.0%	7	7.8%	6	6.7%	3	3.3%
	Surface Water	26	5	19.2%	1	3.8%	0	0.0%	0	0.0%
	Total	**116**	**14**	**12.1%**	**8**	**6.9%**	**6**	**5.2%**	**3**	**2.6%**
Kentucky (3.24 ppt)	Ground Water	30	4	13.3%	1	3.3%	1	3.3%	1	3.3%
	Surface Water	44	26	59.1%	3	6.8%	2	4.5%	0	0.0%
	Total	**74**	**30**	**40.5%**	**4**	**5.4%**	**3**	**4.1%**	**1**	**1.4%**
Maine (PFAS Task Force)[3] (1.78 - 40 ppt)	Ground Water	7	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	1	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Unknown	10	5	50.0%	5	50.0%	4	40.0%	3	30.0%
	Total	**18**	**5**	**27.8%**	**5**	**27.8%**	**4**	**22.2%**	**3**	**16.7%**
Maine (Compliance) (2 ppt)	Ground Water	593	92	15.5%	47	7.9%	38	6.4%	10	1.7%
	Surface Water	53	2	3.8%	1	1.9%	0	0.0%	0	0.0%
	Total	**646**	**94**	**14.6%**	**48**	**7.4%**	**38**	**5.9%**	**10**	**1.5%**
Maine (All Systems)[2] (1.78 - 40 ppt)	Ground Water	593	92	15.5%	47	7.9%	38	6.4%	10	1.7%
	Surface Water	53	2	3.8%	1	1.9%	0	0.0%	0	0.0%
	Unknown	10	5	50.0%	5	50.0%	4	40.0%	3	30.0%
	Total	**656**	**99**	**15.1%**	**53**	**8.1%**	**42**	**6.4%**	**13**	**2.0%**

State (Reporting Threshold)	Source Water Type	Total Number of Systems	Systems with Detections		Systems with Detections > 4.0 ppt		Systems with Detections > 5.0 ppt		Systems with Detections > 10.0 ppt	
			Number	Percent	Number	Percent	Number	Percent	Number	Percent
Maryland (Phase 1) (1 ppt)	Ground Water	30	13	43.3%	7	23.3%	7	23.3%	2	6.7%
	Surface Water	36	13	36.1%	8	22.2%	8	22.2%	5	13.9%
	Total	**66**	**26**	**39.4%**	**15**	**22.7%**	**15**	**22.7%**	**7**	**10.6%**
Maryland (Phase 2) (2 ppt)	Ground Water	6	3	50.0%	3	50.0%	2	33.3%	2	33.3%
	Surface Water	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**6**	**3**	**50.0%**	**3**	**50.0%**	**2**	**33.3%**	**2**	**33.3%**
Maryland (Phase 3) (2 ppt)	Ground Water	63	9	14.3%	9	14.3%	5	7.9%	5	7.9%
	Surface Water	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**63**	**9**	**14.3%**	**9**	**14.3%**	**5**	**7.9%**	**5**	**7.9%**
Maryland (All Systems)[2] (2 ppt)	Ground Water	99	25	25.3%	19	19.2%	14	14.1%	9	9.1%
	Surface Water	36	13	36.1%	8	22.2%	8	22.2%	5	13.9%
	Total	**135**	**38**	**28.1%**	**27**	**20.0%**	**22**	**16.3%**	**14**	**10.4%**
Massachusetts (0.44 - 19 ppt)	Ground Water	1,208	348	28.8%	221	18.3%	185	15.3%	97	8.0%
	Surface Water	122	69	56.6%	40	32.8%	35	28.7%	15	12.3%
	Total	**1,330**	**417**	**31.4%**	**261**	**19.6%**	**220**	**16.5%**	**112**	**8.4%**
Michigan (2 ppt)	Ground Water	2,370	81	3.4%	36	1.5%	32	1.4%	14	0.6%
	Surface Water	84	22	26.2%	3	3.6%	3	3.6%	1	1.2%
	Unknown	54	2	3.7%	1	1.9%	1	1.9%	1	1.9%
	Total	**2,508**	**105**	**4.2%**	**40**	**1.6%**	**36**	**1.4%**	**16**	**0.6%**
Minnesota (Not reported)	Ground Water	561	55	9.8%	8	1.4%	7	1.2%	2	0.4%
	Surface Water	16	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**577**	**55**	**9.5%**	**8**	**1.4%**	**7**	**1.2%**	**2**	**0.3%**
Missouri, 2016 - 2017 (Not reported)	Unknown	15	7	46.7%	0	0.0%	0	0.0%	0	0.0%
	Total	**15**	**7**	**46.7%**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**
Missouri, 2022 - 2023 (Not reported)	Ground Water	105	9	8.6%	3	2.9%	2	1.9%	0	0.0%
	Surface Water	20	2	10.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**125**	**11**	**8.8%**	**3**	**2.4%**	**2**	**1.6%**	**0**	**0.0%**

State (Reporting Threshold)	Source Water Type	Total Number of Systems	Systems with Detections		Systems with Detections > 4.0 ppt		Systems with Detections > 5.0 ppt		Systems with Detections > 10.0 ppt	
			Number	Percent	Number	Percent	Number	Percent	Number	Percent
New Hampshire (2 - 5 ppt)	Ground Water	529	180	34.0%	103	19.5%	85	16.1%	38	7.2%
	Surface Water	30	9	30.0%	4	13.3%	1	3.3%	1	3.3%
	Unknown	1	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**560**	**189**	**33.8%**	**107**	**19.1%**	**86**	**15.4%**	**39**	**7.0%**
New Jersey (0.018 - 8.9 ppt)	Ground Water	1,012	459	45.4%	302	29.8%	260	25.7%	135	13.3%
	Surface Water	107	81	75.7%	53	49.5%	45	42.1%	24	22.4%
	Unknown	4	1	25.0%	1	25.0%	1	25.0%	0	0.0%
	Total	**1,123**	**541**	**48.2%**	**356**	**31.7%**	**306**	**27.2%**	**159**	**14.2%**
New Mexico (Not reported)	Ground Water	2	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**2**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**
New York (0.000000001 - 2,020 ppt)	Ground Water	1,601	395	24.7%	177	11.1%	137	8.6%	53	3.3%
	Surface Water	277	99	35.7%	24	8.7%	17	6.1%	4	1.4%
	Unknown	9	2	22.2%	0	0.0%	0	0.0%	0	0.0%
	Total	**1,887**	**496**	**26.3%**	**201**	**10.7%**	**154**	**8.2%**	**57**	**3.0%**
North Carolina, Cape Fear River[1] (Not Reported)	Unknown	--	5	--	5	--	5	--	5	--
	Total	**--**	**5**	**--**	**5**	**--**	**5**	**--**	**5**	**--**
North Carolina, 2022 (Not Reported)	Ground Water	7	2	28.6%	2	28.6%	2	28.6%	2	28.6%
	Surface Water	43	41	95.3%	31	72.1%	29	67.4%	11	25.6%
	Total	**50**	**43**	**86.0%**	**33**	**66.0%**	**31**	**62.0%**	**13**	**26.0%**
North Dakota, 2018 (Not reported)	Ground Water	4	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	3	3	100.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**7**	**3**	**42.9%**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**
North Dakota, 2020 (Not reported)	Ground Water	41	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	9	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**50**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**
	Ground Water	56	2	3.6%	0	0.0%	0	0.0%	0	0.0%

State (Reporting Threshold)	Source Water Type	Total Number of Systems	Systems with Detections		Systems with Detections > 4.0 ppt		Systems with Detections > 5.0 ppt		Systems with Detections > 10.0 ppt	
			Number	Percent	Number	Percent	Number	Percent	Number	Percent
North Dakota, 2021 (Not reported)	Surface Water	7	1	14.3%	0	0.0%	0	0.0%	0	0.0%
	Total	**63**	**3**	**4.8%**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**
North Dakota (All Systems)[2] (Not reported)	Ground Water	95	2	2.1%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	17	4	23.5%	0	0.0%	0	0.0%	0	0.0%
	Total	**112**	**6**	**5.4%**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**
Ohio[4] (5 ppt)	Ground Water	1,372	24	1.7%	24	1.7%	24	1.7%	18	1.3%
	Surface Water	107	5	4.7%	5	4.7%	5	4.7%	3	2.8%
	Total	**1,479**	**29**	**2.0%**	**29**	**2.0%**	**29**	**2.0%**	**21**	**1.4%**
Oregon (10.1 - 12.4 ppt)	Ground Water	116	3	2.6%	3	2.6%	3	2.6%	3	2.6%
	Surface Water	27	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**143**	**3**	**2.1%**	**3**	**2.1%**	**3**	**2.1%**	**3**	**2.1%**
Pennsylvania, 2019 (1.9 ppt)	Ground Water	71	12	16.9%	6	8.5%	5	7.0%	2	2.8%
	Surface Water	16	8	50.0%	6	37.5%	5	31.3%	1	6.3%
	Total	**87**	**20**	**23.0%**	**12**	**13.8%**	**10**	**11.5%**	**3**	**3.4%**
Pennsylvania, 2021 (1.7 - 4 ppt)	Ground Water	269	65	24.2%	51	19.0%	39	14.5%	20	7.4%
	Surface Water	73	20	27.4%	15	20.5%	14	19.2%	4	5.5%
	Total	**342**	**85**	**24.9%**	**66**	**19.3%**	**53**	**15.5%**	**24**	**7.0%**
Pennsylvania (All Systems)[2] (1.7 - 4 ppt)	Ground Water	270	68	25.2%	51	18.9%	39	14.4%	20	7.4%
	Surface Water	73	22	30.1%	16	21.9%	15	20.5%	5	6.8%
	Total	**343**	**90**	**26.2%**	**67**	**19.5%**	**54**	**15.7%**	**25**	**7.3%**
South Carolina (2 ppt)	Ground Water	234	33	14.1%	16	6.8%	14	6.0%	8	3.4%
	Surface Water	66	47	71.2%	29	43.9%	22	33.3%	4	6.1%
	Total	**300**	**80**	**26.7%**	**45**	**15.0%**	**36**	**12.0%**	**12**	**4.0%**
Tennessee (Not reported)	Ground Water	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	1	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**1**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**
Vermont	Ground Water	526	38	7.2%	20	3.8%	16	3.0%	7	1.3%

State (Reporting Threshold)	Source Water Type	Total Number of Systems	Systems with Detections		Systems with Detections > 4.0 ppt		Systems with Detections > 5.0 ppt		Systems with Detections > 10.0 ppt	
			Number	Percent	Number	Percent	Number	Percent	Number	Percent
(2 ppt)	Surface Water	38	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**564**	**38**	**6.7%**	**20**	**3.5%**	**16**	**2.8%**	**7**	**1.2%**
Virginia (3.5 ppt)	Ground Water	5	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	20	6	30.0%	5	25.0%	4	20.0%	0	0.0%
	Total	**25**	**6**	**24.0%**	**5**	**20.0%**	**4**	**16.0%**	**0**	**0.0%**
West Virginia (Not reported)	Ground Water	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	1	1	100.0%	1	100.0%	1	100.0%	1	100.0%
	Total	**1**	**1**	**100.0%**	**1**	**100.0%**	**1**	**100.0%**	**1**	**100.0%**
Wisconsin (Not reported)	Ground Water	217	51	23.5%	12	5.5%	10	4.6%	8	3.7%
	Surface Water	22	19	86.4%	0	0.0%	0	0.0%	0	0.0%
	Total	**239**	**70**	**29.3%**	**12**	**5.0%**	**10**	**4.2%**	**8**	**3.3%**

[1] Only reported detections were available in this state's dataset.
[2] The "All Systems" counts represent a summary of all unique systems across multiple sampling efforts within the state. For some states (e.g., CO, MO, NC), the EPA could not verify this number due to the sample site ID reporting.
[3] Reported data from Maine may include results from public and private finished drinking water sources. Based on available state data information, the EPA could not verify PWSIDs for all included samples.
[4] The reporting threshold for Ohio is 5 ppt; thus, any occurrence estimates relative to the final MCL of 4.0 ppt only include results greater than or equal to 5 ppt.

Exhibit 4-12: PFOS State Reported Drinking Water Occurrence Data - Summary of Population Served by Systems with Finished Water Data

State (Reporting Threshold)	Source Water Type	Total Population Served by Systems	Population Served by Systems with Detections		Population Served by Systems with Detections > 4.0 ppt		Population Served by Systems with Detections > 5.0 ppt		Population Served by Systems with Detections > 10.0 ppt	
			Number	Percent	Number	Percent	Number	Percent	Number	Percent
Alabama[1] (Not reported)	Ground Water	--	427,167	--	265,818	--	251,631	--	145,653	--
	Surface Water	--	2,378,180	--	1,139,921	--	929,142	--	286,273	--
	Total	**--**	**2,805,347**	**--**	**1,405,739**	**--**	**1,180,773**	**--**	**431,926**	**--**

State (Reporting Threshold)	Source Water Type	Total Population Served by Systems	Population Served by Systems with Detections		Population Served by Systems with Detections > 4.0 ppt		Population Served by Systems with Detections > 5.0 ppt		Population Served by Systems with Detections > 10.0 ppt	
			Number	Percent	Number	Percent	Number	Percent	Number	Percent
Arizona, ADEQ Sampling (1.6 - 2 ppt)	Ground Water	94,712	55,535	58.6%	55,535	58.6%	55,535	58.6%	55,535	58.6%
	Surface Water	50,001	50,001	100.0%	50,001	100.0%	0	0.0%	0	0.0%
	Total	**144,713**	**105,536**	**72.9%**	**105,536**	**72.9%**	**55,535**	**38.4%**	**55,535**	**38.4%**
Arizona, Luke Air Force Base (Not reported)	Ground Water	50,770	50,770	100.0%	50,770	100.0%	50,770	100.0%	50,770	100.0%
	Surface Water	234,766	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**285,536**	**50,770**	**17.8%**	**50,770**	**17.8%**	**50,770**	**17.8%**	**50,770**	**17.8%**
Arizona (All Systems) [2] (Not reported)	Ground Water	94,712	55,535	58.6%	55,535	58.6%	55,535	58.6%	55,535	58.6%
	Surface Water	284,767	50,001	17.6%	50,001	17.6%	0	0.0%	0	0.0%
	Total	**379,479**	**105,536**	**27.8%**	**105,536**	**27.8%**	**55,535**	**14.6%**	**55,535**	**14.6%**
California (0.002 - 40 ppt)	Ground Water	1,098,122	692,464	63.1%	647,726	59.0%	647,726	59.0%	536,584	48.9%
	Surface Water	13,505,270	4,330,203	32.1%	3,672,550	27.2%	3,633,656	26.9%	2,961,439	21.9%
	Unknown	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**14,603,392**	**5,022,667**	**34.4%**	**4,320,276**	**29.6%**	**4,281,382**	**29.3%**	**3,498,023**	**24.0%**
Colorado (2013 - 2017)[3] (2 - 40 ppt)	Distribution (Finished)	--	--	--	--	--	--	--	--	--
	Surface Water (Finished)	--	--	--	--	--	--	--	--	--
	Total	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**
Colorado (2020) (1.6 - 2.4 ppt)	Ground Water	261,162	82,186	31.5%	38,715	14.8%	37,359	14.3%	302	0.1%
	Surface Water	4,191,774	843,845	20.1%	136,028	3.2%	132,578	3.2%	4,495	0.1%
	Total	**4,452,936**	**926,031**	**20.8%**	**174,743**	**3.9%**	**169,937**	**3.8%**	**4,797**	**0.1%**
Delaware (2 ppt)	Ground Water	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	231,114	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**231,114**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**
Georgia (18 ppt)	Ground Water	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	9,993	9,993	100.0%	9,993	100.0%	9,993	100.0%	9,993	100.0%
	Total	**9,993**	**9,993**	**100.0%**	**9,993**	**100.0%**	**9,993**	**100.0%**	**9,993**	**100.0%**
Idaho	Ground Water	81,985	303	0.4%	0	0.0%	0	0.0%	0	0.0%

State (Reporting Threshold)	Source Water Type	Total Population Served by Systems	Population Served by Systems with Detections		Population Served by Systems with Detections > 4.0 ppt		Population Served by Systems with Detections > 5.0 ppt		Population Served by Systems with Detections > 10.0 ppt	
			Number	Percent	Number	Percent	Number	Percent	Number	Percent
(0.5 - 1 ppt)	Surface Water	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**81,985**	**303**	**0.4%**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**
Illinois (1.7 - 8 ppt)	Ground Water	2,916,219	397,990	13.6%	195,498	6.7%	192,087	6.6%	64,406	2.2%
	Surface Water	4,628,949	1,150,863	24.9%	269,340	5.8%	227,657	4.9%	1,595	0.0%
	Total	**7,545,168**	**1,548,853**	**20.5%**	**464,838**	**6.2%**	**419,744**	**5.6%**	**66,001**	**0.9%**
Indiana (2 ppt)	Ground Water	545,838	15,732	2.9%	1,758	0.3%	1,758	0.3%	0	0.0%
	Surface Water	97,448	5,768	5.9%	0	0.0%	0	0.0%	0	0.0%
	Total	**643,286**	**21,500**	**3.3%**	**1,758**	**0.3%**	**1,758**	**0.3%**	**0**	**0.0%**
Iowa (1.7 - 4 ppt)	Ground Water	491,495	151,869	30.9%	88,143	17.9%	88,038	17.9%	5,934	1.2%
	Surface Water	987,522	338,155	34.2%	85,797	8.7%	0	0.0%	0	0.0%
	Total	**1,479,017**	**490,024**	**33.1%**	**173,940**	**11.8%**	**88,038**	**6.0%**	**5,934**	**0.4%**
Kentucky (3.24 ppt)	Ground Water	171,212	72,019	42.1%	6,798	4.0%	6,798	4.0%	6,798	4.0%
	Surface Water	1,922,023	1,453,530	75.6%	105,914	5.5%	42,977	2.2%	0	0.0%
	Total	**2,093,235**	**1,525,549**	**72.9%**	**112,712**	**5.4%**	**49,775**	**2.4%**	**6,798**	**0.3%**
Maine (PFAS Task Force)[3,4] (1.78 - 40 ppt)	Ground Water	3,995	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	21,808	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Unknown	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**25,803**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**
Maine (Compliance) (2 ppt)	Ground Water	274,866	69,753	25.4%	39,942	14.5%	38,379	14.0%	3,073	1.1%
	Surface Water	464,453	12,365	2.7%	3,115	0.7%	0	0.0%	0	0.0%
	Total	**739,319**	**82,118**	**11.1%**	**43,057**	**5.8%**	**38,379**	**5.2%**	**3,073**	**0.4%**
Maine (All Systems)[2,3] (1.78 - 40 ppt)	Ground Water	274,866	69,753	25.4%	39,942	14.5%	38,379	14.0%	3,073	1.1%
	Surface Water	464,453	12,365	2.7%	3,115	0.7%	0	0.0%	0	0.0%
	Unknown	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**739,319**	**82,118**	**11.1%**	**43,057**	**5.8%**	**38,379**	**5.2%**	**3,073**	**0.4%**
Maryland (Phase 1)	Ground Water	384,007	68,126	17.7%	61,816	16.1%	61,816	16.1%	13,350	3.5%
	Surface Water	4,059,154	3,717,211	91.6%	94,394	2.3%	94,394	2.3%	64,053	1.6%

State (Reporting Threshold)	Source Water Type	Total Population Served by Systems	Population Served by Systems with Detections		Population Served by Systems with Detections > 4.0 ppt		Population Served by Systems with Detections > 5.0 ppt		Population Served by Systems with Detections > 10.0 ppt	
			Number	Percent	Number	Percent	Number	Percent	Number	Percent
(1 ppt)	**Total**	**4,443,161**	**3,785,337**	**85.2%**	**156,210**	**3.5%**	**156,210**	**3.5%**	**77,403**	**1.7%**
Maryland (Phase 2) (2 ppt)	Ground Water	3,896	315	8.1%	315	8.1%	230	5.9%	230	5.9%
	Surface Water	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**3,896**	**315**	**8.1%**	**315**	**8.1%**	**230**	**5.9%**	**230**	**5.9%**
Maryland (Phase 3) (2 ppt)	Ground Water	41,063	3,138	7.6%	3,138	7.6%	2,380	5.8%	2,380	5.8%
	Surface Water	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**41,063**	**3,138**	**7.6%**	**3,138**	**7.6%**	**2,380**	**5.8%**	**2,380**	**5.8%**
Maryland (All Systems)[2] (2 ppt)	Ground Water	428,966	71,579	16.7%	65,269	15.2%	64,426	15.0%	15,960	3.7%
	Surface Water	4,059,154	3,717,211	91.6%	94,394	2.3%	94,394	2.3%	64,053	1.6%
	Total	**4,488,120**	**3,788,790**	**84.4%**	**159,663**	**3.6%**	**158,820**	**3.5%**	**80,013**	**1.8%**
Massachusetts (0.44 - 19 ppt)	Ground Water	1,828,934	1,235,488	67.6%	975,530	53.3%	847,476	46.3%	400,766	21.9%
	Surface Water	5,860,701	2,050,074	35.0%	1,109,099	18.9%	886,464	15.1%	551,731	9.4%
	Total	**7,689,635**	**3,285,562**	**42.7%**	**2,084,629**	**27.1%**	**1,733,940**	**22.5%**	**952,497**	**12.4%**
Michigan[3] (2 ppt)	Ground Water	1,945,734	312,213	16.0%	220,902	11.4%	219,910	11.3%	6,897	0.4%
	Surface Water	1,314,601	631,716	48.1%	55,087	4.2%	55,087	4.2%	8,184	0.6%
	Unknown	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**3,260,335**	**943,929**	**29.0%**	**275,989**	**8.5%**	**274,997**	**8.4%**	**15,081**	**0.5%**
Minnesota (Not reported)	Ground Water	2,752,594	1,015,561	36.9%	57,612	2.1%	52,892	1.9%	7,881	0.3%
	Surface Water	1,106,268	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**3,858,862**	**1,015,561**	**26.3%**	**57,612**	**1.5%**	**52,892**	**1.4%**	**7,881**	**0.2%**
Missouri, 2016 - 2017 [3] (Not reported)	Unknown	--	--	--	--	--	--	--	--	--
	Total	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**
Missouri, 2022 - 2023 (Not reported)	Ground Water	257,420	35,399	13.8%	3,549	1.4%	2,447	1.0%	0	0.0%
	Surface Water	425,658	20,613	4.8%	0	0.0%	0	0.0%	0	0.0%
	Total	**683,078**	**56,012**	**8.2%**	**3,549**	**0.5%**	**2,447**	**0.4%**	**0**	**0.0%**
New Hampshire (2 - 5 ppt)	Ground Water	267,029	150,228	56.3%	117,670	44.1%	88,836	33.3%	42,925	16.1%
	Surface Water	476,367	148,257	31.1%	51,507	10.8%	6,131	1.3%	6,131	1.3%

State (Reporting Threshold)	Source Water Type	Total Population Served by Systems	Population Served by Systems with Detections		Population Served by Systems with Detections > 4.0 ppt		Population Served by Systems with Detections > 5.0 ppt		Population Served by Systems with Detections > 10.0 ppt	
			Number	Percent	Number	Percent	Number	Percent	Number	Percent
	Unknown	10	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**743,406**	**298,485**	**40.2%**	**169,177**	**22.8%**	**94,967**	**12.8%**	**49,056**	**6.6%**
New Jersey (0.018 - 8.9 ppt)	Ground Water	2,485,837	1,185,337	47.7%	901,937	36.3%	790,511	31.8%	633,615	25.5%
	Surface Water	5,794,947	5,031,191	86.8%	4,079,848	70.4%	3,604,820	62.2%	2,480,425	42.8%
	Unknown	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**8,280,784**	**6,216,528**	**75.1%**	**4,981,785**	**60.2%**	**4,395,331**	**53.1%**	**3,114,040**	**37.6%**
New Mexico[3] (Not reported)	Ground Water	--	--	--	--	--	--	--	--	--
	Surface Water	--	--	--	--	--	--	--	--	--
	Total	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**
New York (0.000000001 - 2,020 ppt)	Ground Water	2,109,118	938,685	44.5%	469,275	22.2%	438,891	20.8%	152,686	7.2%
	Surface Water	3,850,284	1,765,447	45.9%	407,968	10.6%	106,987	2.8%	4,710	0.1%
	Unknown	1,089	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**5,960,491**	**2,704,132**	**45.4%**	**877,243**	**14.7%**	**545,878**	**9.2%**	**157,396**	**2.6%**
North Carolina, Cape Fear River[1,3] (Not Reported)	Unknown	--	--	--	--	--	--	--	--	--
	Total	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**
North Carolina, 2022 (Not Reported)	Ground Water	26,914	3,620	13.5%	3,620	13.5%	3,620	13.5%	3,620	13.5%
	Surface Water	2,649,927	2,643,626	99.8%	1,806,794	68.2%	1,806,794	68.2%	1,067,028	40.3%
	Total	**2,676,841**	**2,647,246**	**98.9%**	**1,810,414**	**67.6%**	**1,810,414**	**67.6%**	**1,070,648**	**40.0%**
North Dakota, 2018 (Not reported)	Ground Water	67,981	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	250,518	250,518	100.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**318,499**	**250,518**	**78.7%**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**
North Dakota, 2020 (Not reported)	Ground Water	68,280	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	57,469	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**125,749**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**
	Ground Water	113,623	15,671	13.8%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	194,121	4,284	2.2%	0	0.0%	0	0.0%	0	0.0%

State (Reporting Threshold)	Source Water Type	Total Population Served by Systems	Population Served by Systems with Detections		Population Served by Systems with Detections > 4.0 ppt		Population Served by Systems with Detections > 5.0 ppt		Population Served by Systems with Detections > 10.0 ppt	
			Number	Percent	Number	Percent	Number	Percent	Number	Percent
North Dakota, 2021 (Not reported)	**Total**	**307,744**	**19,955**	**6.5%**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**
North Dakota (All Systems)[2] (Not reported)	Ground Water	181,514	15,671	8.6%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	324,007	254,802	78.6%	0	0.0%	0	0.0%	0	0.0%
	Total	**505,521**	**270,473**	**53.5%**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**
Ohio[5] (5 ppt)	Ground Water	2,883,252	202,301	7.0%	202,301	7.0%	202,301	7.0%	155,606	5.4%
	Surface Water	6,215,644	194,156	3.1%	194,156	3.1%	194,156	3.1%	52,449	0.8%
	Total	**9,098,896**	**396,457**	**4.4%**	**396,457**	**4.4%**	**396,457**	**4.4%**	**208,055**	**2.3%**
Oregon (10.1 - 12.4 ppt)	Ground Water	114,194	279	0.2%	279	0.2%	279	0.2%	279	0.2%
	Surface Water	125,239	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**239,433**	**279**	**0.1%**	**279**	**0.1%**	**279**	**0.1%**	**279**	**0.1%**
Pennsylvania, 2019 (1.9 ppt)	Ground Water	162,825	36,798	22.6%	25,588	15.7%	22,406	13.8%	5,693	3.5%
	Surface Water	431,370	225,466	52.3%	138,966	32.2%	87,966	20.4%	45,013	10.4%
	Total	**594,195**	**262,264**	**44.1%**	**164,554**	**27.7%**	**110,372**	**18.6%**	**50,706**	**8.5%**
Pennsylvania, 2021 (1.7 - 4 ppt)	Ground Water	471,651	190,979	40.5%	150,193	31.8%	120,915	25.6%	87,988	18.7%
	Surface Water	4,296,097	1,383,930	32.2%	1,073,662	25.0%	1,069,198	24.9%	112,694	2.6%
	Total	**4,767,748**	**1,574,909**	**33.0%**	**1,223,855**	**25.7%**	**1,190,113**	**25.0%**	**200,682**	**4.2%**
Pennsylvania (All Systems)[2] (1.7 - 4 ppt)	Ground Water	471,891	191,719	40.6%	150,193	31.8%	120,915	25.6%	87,988	18.6%
	Surface Water	4,296,097	1,470,430	34.2%	1,124,662	26.2%	1,073,662	25.0%	157,707	3.7%
	Total	**4,767,988**	**1,662,149**	**34.9%**	**1,274,855**	**26.7%**	**1,194,577**	**25.1%**	**245,695**	**5.2%**
South Carolina (2 ppt)	Ground Water	485,992	17,569	3.6%	4,399	0.9%	4,268	0.9%	3,893	0.8%
	Surface Water	2,499,980	1,675,562	67.0%	1,347,102	53.9%	933,419	37.3%	211,385	8.5%
	Total	**2,985,972**	**1,693,131**	**56.7%**	**1,351,501**	**45.3%**	**937,687**	**31.4%**	**215,278**	**7.2%**
Tennessee (Not reported)	Ground Water	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	2,551	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**2,551**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**
Vermont	Ground Water	211,357	7,061	3.3%	3,029	1.4%	2,754	1.3%	1,304	0.6%

State (Reporting Threshold)	Source Water Type	Total Population Served by Systems	Population Served by Systems with Detections		Population Served by Systems with Detections > 4.0 ppt		Population Served by Systems with Detections > 5.0 ppt		Population Served by Systems with Detections > 10.0 ppt	
			Number	Percent	Number	Percent	Number	Percent	Number	Percent
(2 ppt)	Surface Water	174,473	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Total	**385,830**	**7,061**	**1.8%**	**3,029**	**0.8%**	**2,754**	**0.7%**	**1,304**	**0.3%**
Virginia (3.5 ppt)	Ground Water	2,975	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	4,839,373	2,000,972	41.3%	1,841,772	38.1%	1,688,772	34.9%	0	0.0%
	Total	**4,842,348**	**2,000,972**	**41.3%**	**1,841,772**	**38.0%**	**1,688,772**	**34.9%**	**0**	**0.0%**
West Virginia (Not reported)	Ground Water	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Surface Water	15,652	15,652	100.0%	15,652	100.0%	15,652	100.0%	15,652	100.0%
	Total	**15,652**	**15,652**	**100.0%**	**15,652**	**100.0%**	**15,652**	**100.0%**	**15,652**	**100.0%**
Wisconsin (Not reported)	Ground Water	1,514,437	880,722	58.2%	131,753	8.7%	62,883	4.2%	52,619	3.5%
	Surface Water	1,333,737	1,290,335	96.7%	0	0.0%	0	0.0%	0	0.0%
	Total	**2,848,174**	**2,171,057**	**76.2%**	**131,753**	**4.6%**	**62,883**	**2.2%**	**52,619**	**1.8%**

[1] Only reported detections were available in this state's dataset.
[2] The "All Systems" counts represent a summary of all unique systems across multiple sampling efforts within the state.
[3] There were some instances where the population served by a system could not be identified. Thus, there are systems with detections but no associated population served by those systems with detections.
[4] Reported data from Maine may include results from public and private finished drinking water sources. Based on available state data information, the EPA could not verify PWSIDs for all included samples.
[5] The reporting threshold for Ohio is 5 ppt; thus, any occurrence estimates relative to the final MCL of 4.0 ppt only include results greater than or equal to 5 ppt.

4.2.1.3 Additional Secondary Source Water and Drinking Water Studies

Boone et al. (2019) measured 17 PFAS in both source and treated water from 25 DWTPs in the United States. The results indicated that only five of the sampling locations demonstrated a significant difference in PFAS concentration between the source and treated water. The median concentration of PFOS in source water was 2.28 ng/L and 1.62 ng/L in treated water. PFOS was detected in 80 percent of treated drinking water samples (Boone et al., 2019).

Post et al. (2013) re-evaluated PFOA, PFOS, and PFC occurrence data in drinking water systems throughout New Jersey to update previous PFAS research in the area from 2006. The EPA notes that PFCs is a term that some researchers use to refer to the group of chemicals that includes PFOA, PFOS, and other PFAS. PFCs were found in 70 percent of PWSs sampled at concentrations ranging from 5-174 ng/L. PFOS was detected in 30 percent of samples at a maximum concentration of 43 ng/L. Post et al. (2013) found that multiple PFCs are commonly detected in raw water from New Jersey PWSs, with even higher levels found near industrial sources.

McMahon et al. (2022) collected samples from aquifer systems in the eastern United States in 2019 to evaluate PFAS occurrence in ground water used as a source of drinking water. The study found that 14 of the 24 analyzed PFAS were detected in ground water samples. Furthermore, at least one PFAS was detected in 54 percent of the ground water samples and two or more PFAS were detected in 47 percent of the ground water samples. In the public supply and domestic wells, 60 and 20 percent of the samples, respectively, had at least one PFAS detection. Two or more PFAS were detected in 53 percent of the public-supply wells and 10 percent of domestic wells. The six PFAS outlined in the EPA's UCMR 3 program (i.e., PFBS, PFHxS, PFOS, PFHpA, PFOA, and PFNA) were the most detected PFAS in the study's samples. PFOA and PFOS were the two most frequently detected PFAS sampled. PFOS was detected in 30 percent of the 254 samples; 27 percent of samples were reported detections greater than 4 ng/L (McMahon et al., 2022).

As part of a joint study by the EPA and USGS to assess human exposure to contaminants of emerging concern, water samples were collected from 25 DWTPs in 24 states (Glassmeyer et al., 2017). Participation in the study was voluntary, and candidate locations were selected based on nomination by the EPA and USGS regional personnel and DWTP self-nomination as well as consideration of high wastewater contribution and the availability of pharmaceutical concentration data. Final sample locations were chosen to represent a wide range of geography, diversity in disinfectant type used, and a range of production volumes. Phase I of the study (2007) analyzed a subset of contaminants and sites to test experimental design; PFOS was not included in Phase 1. During Phase II of the study (2010-2012), samples were collected from ground water and surface water sources and treated drinking water from 25 DWTPs and analyzed for PFOS occurrence. The LCMRL for PFOS was equal to 0.13 ng/L. PFOS was detected in 88 percent of the 25 source water samples and 80 percent of the 25 treated drinking water samples. The maximum detected concentrations in source water and treated water were 48.3 ng/L and 46.9 ng/L, respectively.

Reyes (2021) conducted a ground water-quality study to describe the occurrence and distribution of PFAS in the Columbia aquifer public water-supply wells in the Delaware Coastal Plain region in 2018. One or more PFAS were detected in 16 of the sampled wells with as many as 8 different PFAS detected in a single sample. PFOA was most frequently detected out of the total PFAS detected during the study (47 percent), followed by perfluorohexanoic acid (PFHxA) (33 percent), and PFOS and PFHxS, both detected at 27 percent. PFOS was detected in 8 of the 30 public water-supply wells sampled in the study. The maximum PFOS concentration detected was 59 ng/L.

4.2.2 Other Data

4.2.2.1 Department of Defense (DoD) Drinking Water Sampling

The DoD conducted sampling of off-base drinking water located in “covered areas” (i.e., areas that are adjacent to and down gradient from a military installation) to identify potential impacts of PFAS resulting from DoD activities. Sampling was conducted for multiple PFAS, including PFOS. The EPA downloaded available DOD off-base sampling results in September 2023.

The EPA summarized off-base sampling results for PFOS collected “post treatment” from drinking water systems and private wells located in covered areas adjacent to 47 installations located in 22 states. Detected concentrations ranged from an estimated concentration of 0.063 ng/L to 8,750 ng/L. Sampling was conducted utilizing multiple analytical methods including EPA methods 533, 537, 537.1, 1633, and DoD Quality Systems Manual Table B-15 (DoD, 2023a). Results are based on DLs which vary between both sampling sites and across different PFAS. Results for PFOS are presented in Exhibit 4-13.

Exhibit 4-13: Summary of PFOS Drinking Water Sampling Results Collected Post-Treatment from Department of Defense Off-Base "Covered Areas"

State	Installation Name	Sampling Dates	Analysis Method	# Samples	# Detections	% Detections	Range of Detections (ng/L)
AK	Eielson AFB	11/3/2022	537	1	0	0.00%	NA
AZ	Luke AFB	3/31/2022	QSM_B15	2	2	100.00%	26.2 - 28.3
AZ	YUMA AZ MCAS	5/26/2023	533	1	0	0.00%	NA
AR	Little Rock AFB	5/5/2022	537	3	2	66.67%	47.7 (est) - 50.3 (est)
AR	Little Rock AFB	6/16/2022 - 3/22/2023	QSM_B15	6	1	16.67%	24.2 (est)
CA	Castle AFB	7/5/2022 - 4/5/2023	537	26	2	7.69%	0.479 (est) - 0.76 (est)
CA	Castle AFB	11/17/2021 - 1/11/2022	QSM_B15	12	2	16.67%	0.397 (est) - 0.91 (est)
CA	George AFB	3/23/2023 - 4/20/2023	1633	3	0	0.00%	NA
CA	March AFB	1/3/2023 - 4/10/2023	533	3	0	0.00%	NA
CA	March AFB	1/3/2022 - 12/1/2022	537.1	11	2	18.18%	2.4 - 4.2
CA	March AFB	9/1/2022	QSM_B15	1	0	0.00%	NA
CA	Mather AFB	7/28/2022	537	1	0	0.00%	NA
CA	Mather AFB	1/27/2022 - 4/26/2022	QSM_B15	3	0	0.00%	NA
CA	Travis AFB	1/25/2022 - 1/16/2023	QSM_B15	19	1	5.26%	18.4 (est)
CO	Peterson Space Force Base	12/14/2021 - 2/7/2023	537.1	8	0	0.00%	NA
CO	Peterson Space Force Base	3/1/2022 - 9/14/2022	QSM_B15	16	0	0.00%	NA
DE	Dover AFB	1/22/2022 - 10/25/2022	QSM_B15	10	1	10.00%	2.2 (est)
FL	Homestead Air Reserve Base	2/21/2022 - 3/30/2023	QSM_B15	13	0	0.00%	NA
FL	WHITING FLD FL NAS	9/1/2022	537.1	2	1	50.00%	2.22
IL	Scott AFB	3/22/2022 - 3/28/2023	QSM_B15	3	1	33.33%	8.1
ME	Loring AFB	7/25/2022	QSM_B15	1	1	100.00%	1.1 (est)
ME	NCTAMSLANT DET CUTLER	4/20/2022 - 12/6/2022	537.1	66	3	4.55%	1.71 (est) - 238
MA	Otis ANG (Joint Base Cape Cod - Massachusetts Military Reservation)	2/28/2022 - 11/22/2022	QSM_B15	11	7	63.64%	0.45 (est) - 9.2
MI	KI Sawyer AFB	7/13/2022	QSM_B15	2	0	0.00%	NA
MT	Great Falls International Airport	6/15/2022 - 7/7/2022	537	3	1	33.33%	2.39 (est)
NH	Pease AFB	9/22/2021 - 3/30/2023	QSM_B15	16	7	43.75%	8.3 - 440
NJ	Joint Base McGuire-Dix-Lakehurst	3/3/2022 - 5/25/2022	QSM_B15	2	0	0.00%	NA

State	Installation Name	Sampling Dates	Analysis Method	# Samples	# Detections	% Detections	Range of Detections (ng/L)
NM	Cannon AFB	11/11/2021 - 12/13/2021	QSM_B15	2	0	0.00%	NA
NY	Plattsburgh AFB	5/20/2022 - 8/10/2022	537	8	0	0.00%	NA
NY	Plattsburgh AFB	11/18/2021 - 9/15/2022	537.1	16	1	6.25%	0.46 (est)
NY	Plattsburgh AFB	11/29/2021 - 6/27/2023	QSM_B15	15	5	33.33%	0.494 (est) - 5.4 (est)
OK	Tinker AFB	2/2/2023	QSM_B15	3	0	0.00%	NA
RI	NAVAL AUX LANDING FIELD	5/19/2022	537.1	2	0	0.00%	NA
RI	NAVAL AUX LANDING FIELD	10/17/2022 - 2/28/2023	QSM_B15	31	23	74.19%	0.805 (est) - 5.9
SD	Ellsworth AFB	3/14/2022	537	1	0	0.00%	NA
SD	Ellsworth AFB	6/9/2022 - 9/7/2022	537.1	2	0	0.00%	NA
SD	Ellsworth AFB	2/7/2022 - 6/23/2022	QSM_B15	36	5	13.89%	0.732 (est) - 1370
TX	Goodfellow AFB	8/18/2022 - 11/15/2022	537	11	5	45.45%	1.2 (est) - 2.5 (est)
TX	Goodfellow AFB	12/6/2022 - 4/27/2023	QSM_B15	28	2	7.14%	32 - 8750
TX	Reese AFB	9/14/2022 - 6/13/2023	1633	504	13	2.58%	0.77 (est) - 8.5
TX	Reese AFB	9/28/2021 - 8/29/2022	QSM_B15	839	15	1.79%	2.4 (est) - 433
VA	OCEANA VA NAS	10/19/2022 - 4/14/2023	537.1	13	0	0.00%	NA
WA	BREMERTON WA NAVBASE	10/11/2022 - 7/21/2023	537.1	3	2	66.67%	25.8 - 25.9
WA	Fairchild AFB	9/19/2022 - 9/27/2022	537	87	2	2.30%	5.6 (est) - 285
WA	Fairchild AFB	2/20/2023 - 3/6/2023	537.1	87	72	82.76%	0.063 (est) - 1.3
WA	Fairchild AFB	1/31/2022 - 7/21/2022	QSM_B15	187	11	5.88%	1.7 (est) - 40.6
WA	WHIDBEY IS WA NAS	4/21/2022 - 4/20/2023	537.1	11	0	0.00%	NA

Source: DOD, 2023a

4.2.3 Occurrence in Ambient Water

Lakes, rivers, and aquifers are the ambient sources of most drinking water. Contaminant occurrence in ambient water provides information on the potential for contaminants to adversely affect drinking water supplies. Occurrence data for PFOS in ambient water are available from the USGS NWIS database and the EPA's legacy STORET data available through the WQP. Occurrence data for PFOS in ambient water are available from one published study is summarized below.

4.2.3.1 National Water Information System (NWIS) Data

The NWIS is the Nation's principal repository of water resources data USGS collects from more than 1.9 million sites (USGS, 2023). NWIS-Web is the general online interface to the USGS NWIS database. Discrete water-sample and time-series data are available from sites in all 50 States, including 5 million water samples with 90 million water-quality results. All USGS water quality and flow data are stored in NWIS, including site characteristics, streamflow, ground water level, precipitation, and chemical analyses of water, sediment, and biological media, though not all parameters are available for every site. NWIS houses the NAWQA data and includes other USGS data from unspecified projects. NWIS contains many more samples at many more sites than the NAWQA Program. Although NWIS is comprised of primarily ambient water data, some finished drinking water data are included as well. This section presents analyses of non-NAWQA data in NWIS, downloaded from the WQP in November 2023 (WQP, 2023).

The results of the non-NAWQA NWIS PFOS analysis are presented in Exhibit 4-14. NWIS data for PFOS were listed under the characteristic name "Perfluorooctanesulfonate." PFOS was detected in approximately 49 percent of samples (1,456 out of 2,945 samples) and at approximately 40 percent of sites (708 out of 1,756 sites). The median concentration based on detections was equal to 4.65 ng/L. (Note that the NWIS data are presented as downloaded; potential outliers were not evaluated or excluded from the analysis.)

Exhibit 4-14: PFOS NWIS Data

Site Type	Detection Frequency (detections are results ≥ reporting level)				Concentration Values (of detections, in ng/L)				
	No. of Samples	No. of Samples with Detections	No. of Sites	No. of Sites with Detections	Minimum	Median	90th Percentile	99th Percentile	Maximum
Ground Water	1,341	321	1,230	318	0.7	6.70	63.0	328	1300
Surface Water	1,604	1,135	526	390	0.1	4.31	17.8	140	1900
All Sites	**2,945**	**1,456**	**1,756**	**708**	**0.1**	**4.65**	**26.5**	**300**	**1900**

Source: WQP, 2023

4.2.3.2 Storage and Retrieval (STORET) Data / Water Quality Portal (WQP)

From its launch in 1999 until it was decommissioned in June 2018, the EPA's STORET Data Warehouse was collaboratively populated with raw biological, chemical, and physical data from surface water and ground water sampling by federal, state and local agencies, Native American tribes, volunteer groups,

academics, and others. Legacy STORET data are accessible through the WQP: https://www.waterqualitydata.us/portal/.

STORET data are from monitoring locations in all 50 states as well as multiple territories and jurisdictions of the United States. Most data are from ambient waters, but in some cases finished drinking water data are included as well. STORET's data quality limitations include variations in the extent of national coverage and data completeness from parameter to parameter. Data may have been collected as part of targeted, rather than randomized, monitoring.

This section presents analyses of STORET data, downloaded from the WQP in November 2023 (WQP, 2023). The EPA reviewed STORET ground water data from wells and springs and surface water data from lakes, rivers, streams, and reservoirs (WQP, 2023). STORET data for PFOS were listed under the characteristic name of "Perfluorooctanesulfonate (PFOS)", "1-Octanesulfonic acid, 1,1,2,2,3,3,4,4,5,5,6,6,7,7,8,8,8-heptadecafluoro-, sodium salt (1:1)" and "Perfluorooctanesulfonate." The results of the STORET analysis for PFOS are presented in Exhibit 4-15 and Exhibit 4-16. Almost 1,300 PFOS samples were available for analysis. These PFOS samples were collected between 2005 and 2023. Of the 705 sites sampled, more than 70 percent reported detections of PFOS. Detected concentrations ranged from 0 to 500 ng/L. (Note: A minimum value of zero could represent a detection that was entered into the database as a non-numerical value (e.g., "Present").)

Exhibit 4-15: PFOS STORET Data - Summary of Detected Concentrations

Source Water Type	Concentration Value of Detections (ng/L)			
	Minimum[1]	Median	90th Percentile	Maximum
Ground Water	0	0	100	500
Surface Water	5.16	23.3	104	115
Unknown	0	0	3.79	8.17
Total	**0**	**0**	**100**	**500**

Source: WQP, 2023
[1]A minimum value of zero may represent a detection that was entered into the database as a non-numerical value (e.g., "Present").

Exhibit 4-16: PFOS STORET Data - Summary of Samples and Sites

Source Water Type	Total Number of Samples	Samples with Detections		Total Number of Sites	Sites with Detections	
		Number	Percent		Number	Percent
Ground Water	771	706	91.57%	519	470	90.56%
Surface Water	58	19	32.76%	46	13	28.26%
Unknown	460	18	3.91%	140	15	10.71%
Total	**1,289**	**743**	**57.64%**	**705**	**498**	**70.64%**

Source: WQP, 2023

4.2.3.3 Additional Ambient Water Studies

Jarvis et al. (2021) summarized the current literature on PFOS occurrence in the surface waters across the United States and highlighted data gaps. The study reportedly found that concentrations of detected PFOS varied widely among sample sites, ranging from picograms to milligrams per liter. The median concentration of samples was 3.6 ng/L, though the author cautioned this may not be representative of all measured PFOS concentrations in the United States. Approximately 91 percent of measured PFOS concentrations in the literature were below 300 ng/L. The author attributed the higher frequency of PFOS concentrations below 300 ng/L to the increased tendency of studies to include sites with no known previous exposures to PFAS and compare them to sites with known previous exposure to PFOS. PFOS were widely reported across the United States and their presence in surface water is dependent on the presence of a nearby source and positively correlated with increased levels of urbanization. Jarvis et al. (2021) noted that some studies suggested that PFOS concentrations are decreasing since the 2002 PFOS voluntary phaseout.

4.3 Analytical Methods

For the purposes of compliance with the PFAS NPDWR, the EPA has published two analytical methods that are available for the analysis of PFOS and other PFAS in drinking water. The performance metrics that are presented, including the DL, LCMRL, mean recoveries and RSDs are specific to PFOS for each of the listed analytical methods. Ranges of mean recoveries and RSDs are presented for the matrices listed; data from holding time studies are not included since these studies are designed to demonstrate a degradation in method performance over time and thus are not indicative of method performance that should be observed when holding times are not exceeded:

- EPA Method 537.1, Version 2.0, *Determination of Selected Per- and Polyfluorinated Alkyl Substances in Drinking Water by Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometry (LC/MS/MS)*. The DL and LCMRL generated by the laboratory that developed the method are 1.1 ng/L and 2.7 ng/L, respectively. Mean recoveries in fortified reagent water, tap water from a ground water source (TOC = 0.53 mg/L and hardness = 377 mg/L), tap water from a surface water source (TOC = 2.4 mg/L and hardness = 103 mg/L), and tap water from a private well (TOC = 0.56 mg/L and hardness = 394 mg/L) range from 93.5 to 111%, with RSDs of 1.9 to 5.9% (USEPA, 2020d).
- EPA Method 533, *Determination of Per- and Polyfluoroalkyl Substances in Drinking Water by Isotope Dilution Anion Exchange Solid Phase Extraction and Liquid Chromatography / Tandem Mass Spectrometry*. The LCMRL generated by the laboratory that developed the method is 4.4 ng/L (DLs were not calculated). Mean recoveries (excluding ^{13}C isotope analogue data) in fortified reagent water, finished drinking water from a ground water source (hardness = 320 mg/L, pH = 7.88 at 17° C, free Cl_2 = 0.64 mg/L, and total Cl_2 = 0.74 mg/L) and clarified surface water (prior to GAC treatment and chlorinated in the laboratory; pH = 8.1 at 20 °C, free Cl_2 = 0.98 mg/L, total Cl_2 = 1.31 mg/L. and TOC = 3.8 mg/L) range from 95.1 to 109%, with RSDs of 4.3 to 11% (USEPA, 2019b).

Laboratories participating in UCMR 3 were required to use EPA Method 537 and were required to report PFOS values at or above the EPA-defined MRL of 40 ng/L (77 FR 26072; USEPA, 2012b). The MRL was set based on the capability of multiple laboratories at the time. EPA Method 537.1 was originally published in November 2018 as Version 1.0 as a more sensitive update to EPA Method 537 (with a slightly expanded target analyte list). Version 2.0 was published in March 2020 and contains minor editorial changes to Version 1.0. Use of EPA Method 537.1 is preferable to use of EPA Method 537 (it may not be feasible to reliably quantitate down to health levels of concern for certain PFAS when using EPA Method 537). For this reason, only EPA methods 533 and 537.1 are accepted for use in demonstrating compliance with this final rule.

5 Perfluorohexane Sulfonic Acid (PFHxS)

This chapter presents information and analysis specific to PFHxS, including background information on the contaminant, information on contaminant sources and environmental fate, an analysis of health effects, an analysis of occurrence in ambient and drinking water, and information about the availability of analytical methods and treatment technologies.

5.1 Contaminant Background, Chemical and Physical Properties

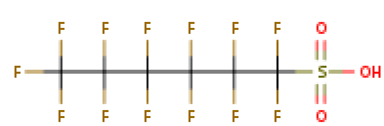
Synonyms for PFHxS include perfluorohexane-1-sulphonic acid, and tridecafluorohexane-1-sulfonic acid according to NCBI (2022c). PFHxS is a long chain perfluorinated aliphatic sulfonic acid. Its salts differ from PFHxS by being associated with either a potassium ion, sodium ion, or lithium ion. For the purposes of this document PFHxS will signify the ion, acid, or any salt of PFHxS.

PFHxS is used mainly as a raw material for the production of PFAS (NCBI, 2022c). PFHxS is contained in legacy PFOS aqueous film-forming foam used for firefighting (ITRC, 2021). It has also been used as a surfactant stain and water repellant for carpet treatment solutions (NCBI, 2022c) and in the semiconductor industry (UNEP, 2019). It may have also been used for electroplating applications, or in uses such as pesticides, flame retardants, cook wear or in the paper industry (UNEP; 2017; UNEP, 2019) The sole manufacturer of PFOS In the United States agreed to a voluntary phaseout in 2000, and the last reported production of PFHxS was in 2002 (ITRC, 2021) although international imports continued after that date. In 2019, PFHxS was recommended to the United Nations' Stockholm Convention on Persistent Organic Pollutants (POPs) for consideration of a full manufacturing ban (UNEP, 2019).

The diagram of Exhibit 5-1 shows the straight-chain chemical structure of PFHxS. Depending on their method of manufacture, PFHxS and related compounds can exist as either branched-chain or straight-chain isomers (ATSDR, 2021). The chemical and physical properties of PFHxS are listed in Exhibit 5-2 and typically represent mixtures of branched and linear isomers rather than any particular isomer.

Although chemical properties commonly are reported for PFAS in the acid form, PFHxS does not have available laboratory standards in the acid form and is commonly reported as the corresponding potassium or sodium salts (ITRC, 2021). When looking at the physical and chemical properties, whether the compound exists as an acid, an anion, or a salt (cation) will affect how they behave in the environment (ITRC, 2021).

Exhibit 5-1: Chemical Structure of PFHxS



Source: NCBI, 2022c

NCBI (2022c) reports a value of 3.16 for the log K_{ow} that is estimated using the EPA's EPISuite™, while ATSDR (2021) indicated that log K_{ow} is not applicable or cannot be measured since PFHxS is expected to form multiple layers in octanol and water mixtures. Although very long-chain perfluoroalkyls that are uncharged form layers in water/hydrocarbon mixtures, PFHxS is charged/ionized and at typical environmental pH can have low to moderate solubility in water (ITRC, 2021; NCBI, 2022c). ATSDR reports no data available for Henry's Law Constant while ITRC and HSDB present a value for K_H. The K_H value presented by HSDB was estimated from vapor pressure and water solubility using EPISuite™.

Where there are different conclusions in the literature for the properties of PFHxS, information is presented to highlight the range of uncertainty for this compound.

Exhibit 5-2: Physical and Chemical Properties of PFHxS

Property	Data
Chemical Abstracts Service (CAS) Registry Number	355-46-4 (NCBI, 2022c)
EPA Pesticide Chemical Code	Not Applicable
Chemical Formula	$C_6HF_{13}O_3S$ (NCBI, 2022c)
Molecular Weight	400.12 g/mol (NCBI, 2022c)
Color/Physical State	No data (NCBI, 2022c)
Boiling Point	238-239 deg C (NCBI, 2022c) 95-452 deg C (ITRC, 2021)
Melting Point	190 deg C (ITRC, 2021) No data (ATSDR, 2021)
Density	1.841 g/mL (NCBI, 2022c)
Freundlich Adsorption Coefficient	--
Vapor Pressure	0.36 mm Hg at 25 deg C (ITRC, 2021; converted from 1.68 log-Pa) 0.0046 mm Hg at 25 deg C (est) (NCBI, 2022c)
K_H	3.5 atm-m^3/mol at 25 deg C (ITRC, 2021; converted from 2.15 log) 4.0E-04 atm-m^3/mol at 25 deg C (est) (NCBI, 2022c)[a] No data (ATSDR, 2021)
Log K_{ow}	3.16 (est) (dimensionless) (NCBI, 2022c)[b] Not applicable (ATSDR, 2021)
K_{oc}	50 - 1.3E04 soil (dimensionless) (ITRC, 2021; converted from Log K_{oc} 1.7 - 4.1) 14 - 3.2E04 sediment (dimensionless) (ITRC, 2021; converted from Log K_{oc} 1.15 - 4.5) 320 (dimensionless) (ATSDR, 2021; converted from Log K_{oc} 2.28 avg (n=7)) 9.3 (dimensionless) (est) (NCBI, 2022c)
pK_a	0.14 (est) (NCBI, 2022c) 0.14 (est) (ATSDR, 2021)
Solubility in Water	236 mg/L (ITRC, 2021; converted from -3.23 log-mol/L) 6.2 mg/L at 25 deg C (est) (NCBI, 2022c)
Other Solvents	--
Conversion Factors (at 25 deg C, 1 atm)	1 PPM = 16.36 mg/m^3; 1 mg/m^3 = 0.061 PPM (ATSDR, 2021)

Note: "-" indicates that no information was found.

[a] These values should not be used to estimate portioning between water and air.

[b] Surfactants are surface acting agents that contain both a hydrophilic part and a hydrophobic part which causes them to accumulate at interfaces hampering the determination of their aqueous concentration. These surfactant properties

present difficulties in applying existing methods for the experimental determination of log K_{ow} and produce unreliable results.

5.1.1 Sources and Environmental Fate

5.1.1.1 Production, Use, and Release

No production data for PFHxS are available from the EPA's IUR and CDR programs.[6] Industrial release data are available from the EPA's TRI, described below.

Toxics Release Inventory (TRI)

The EPA established TRI in 1987 in response to section 313 of the EPCRA. EPCRA section 313 requires the reporting of annual information on toxic chemical releases from facilities that meet specific criteria. This reported information is maintained in a database accessible through TRI Explorer (USEPA, 2023b).

Although TRI can provide a general idea of release trends, it has limitations. Not all facilities are required to report all releases. Facilities are required to report releases if they manufacture, process, or otherwise use a listed toxic chemical in quantities above the respective activity threshold. For PFHxS, the reporting threshold is 100 lbs. manufactured, processed, or otherwise used over the year. It should also be noted that, as of this publication, quantities of PFHxS at concentrations under 1.0 percent within mixtures may be exempt from TRI reporting requirements. Reporting requirements have changed over time (e.g., the chemical list has been updated), so conclusions about temporal trends should be drawn with caution. TRI data are meant to reflect releases and other waste management activities and should not be used to estimate general public exposure to a chemical (USEPA, 2023b).

TRI data for PFHxS are available for 2020 through 2022 (USEPA, 2023b). As shown in Exhibit 5-3, there were 7 pounds of total on-site disposals and 115 pounds of total off-site disposals across all industries in 2020. A total of two facilities from two states reported releases of PFHxS. In 2021, there were 500 pounds of total on-site releases and no off-site releases reported. PFHxS releases were reported by one facility in one state in 2021. In 2022, a total of 3,400 pounds of total on-site releases were reported and no off-site releases were reported. PFHxS releases were reported by one facility in Alabama in 2022.

Exhibit 5-3: Environmental Releases of PFHxS in the United States, 2020-2022

Year	On-Site Releases (in pounds)				Total Off-Site Releases (in pounds)	Total On- and Off-Site Releases (in pounds)
	Air Emissions	Surface Water Discharges	Underground Injection	Releases to Land		
2020	0	6	1	0	115	123
2021	0	0	0	500	0	500
2022	0	0	0	3,400	0	3,400

[6] Note that there are 2020 CDR data listed for "Perfluoro compounds, C5-18." Those data are not summarized in this report.

Source: USEPA, 2023b

5.1.1.2 Environmental Fate

The primary measures used by the EPA to assess mobility include (where available) K_{oc}, log K_{ow}, K_H, water solubility and vapor pressure. For PFHxS, pK_a is also important.

Modeling of atmospheric behavior of PFHxS suggest that PFHxS will be present as a vapor if released to the atmosphere (NCBI, 2022c). PFHxS can react with photochemically produced hydroxyl radicals in the atmosphere to degrade (NCBI, 2022c). A half-life for this reaction in air is estimated to be 115 days (NCBI, 2022c). (Note that radical reactions typically proceed more rapidly than chemically- or microbially-mediated degradation reactions in other environmental media such as water, soil, and/or sediment.) PFHxS is not expected to undergo direct photolysis (NCBI, 2022c).

Based on findings from laboratory studies as reported by ITRC (2021) for soil, experimental log K_{oc} which suggests a moderate propensity for PFHxS to be mobilized to ground water and surface water rather than to bind to suspended solids or sediments. PFHxS is expected to have low mobility to sediment based upon estimates of log K_{oc} having an estimated value ranging from 1.15 - 4.5.

Based on the vapor pressure, PFHxS is not expected to volatilize from dry soil (NCBI, 2022c). With a pK_a of less than 1.0, PFHxS is expected to exist in its ionized form at typical environment pH ranges of natural waters (NCBI, 2022c). Thus, volatilization from water at typical environment pH is not expected (NCBI, 2022c).

PFHxS is very stable chemically and is resistant to hydrolysis, photolysis; biodegradation data in soil or water were not available (NCBI, 2022c).

Under CCL 3, the EPA created scales[7] to informally rank chemical contaminants' likely mobility (understood as their tendency to partition to water rather than other media) and persistence as "high," "moderate," or "low" based on physical and chemical properties (see USEPA, 2021b and USEPA, 2009). For PFHxS, a log K_{ow} of 3.16, and a moderate water solubility of more than 6.2 mg/L at 25 degrees C (NCBI, 2022c) predict a moderate favorability of partitioning to water.

A resistance to essentially all forms of degradation other than atmospheric processes indicates high persistence.

5.2 PFHxS Occurrence

This section presents data on the occurrence of PFHxS in drinking water and ambient water in the United States. The EPA is finalizing an MCLG of 10 ppt for PFHxS. Under SDWA, the EPA must establish an enforceable MCL, the maximum concentration of a contaminant that is allowed in PWSs, as close to the MCLG as feasible, taking several factors into consideration, including analytical methods capable of measuring the contaminant, available treatment technologies to remove the contaminant, and costs. Based on these factors, the EPA is finalizing an MCL of 10 ppt for PFHxS. Occurrence data from various sources presented below are analyzed with respect to the MCL. When possible, estimates of the

[7] See Exhibit A.8 here: https://www.epa.gov/sites/default/files/2014-05/documents/ccl3_pccltoccl_08-31-09_508.pdf

population exposed at concentrations above the MCL are presented. Also, when possible, studies that are meant to be representative and studies that are targeted at known or suspected sites of contamination are identified as such.

The drinking water analyses presented in this section were performed for UCMR 3 and select state data sources. In addition, this section presents PFHxS findings from occurrence analyses conducted by non-EPA researchers. Chapter 10 describes the Bayesian hierarchical model used to extrapolate PFHxS occurrence to the nation and also points the reader to examine Cadwallader et al. (2022) for further details. For additional background information about data sources used to evaluate occurrence, please refer to Chapter 2.

The EPA is also finalizing an HI MCL for the regulation of PFHxS, PFNA, HFPO-DA, and PFBS when co-occurring in mixture combinations containing two or more of these four PFAS. Refer to Chapter 8 for more information on the HI MCL and chapter 9 for co-occurrence information.

5.2.1 Occurrence in Drinking Water

Data sources reviewed by the agency for information on PFHxS occurrence in drinking water included UCMR 3, more recent state drinking water monitoring programs, and the DoD PFAS drinking water testing, as well as additional studies from the literature.

Note that there may be some overlap, as sources with different purposes and audiences may have reported the same underlying data. UCMR 3 is a nationally representative data source. Other data sources profiled in this section are considered “supplemental” sources. Also note that PFHxS is being monitored for under UCMR 5, which is occurring from 2023 to 2025. Analysis of partial UCMR 5 results (the first three quarters of data that were made available as of February 2024) are discussed in section 11 of this document. Additionally, the EPA notes that the UCMR 3 MRL for PFHxS is higher than that utilized within the majority of state monitoring data and for the UCMR 5.

5.2.1.1 UCMR 3 Data

PFHxS was included as part of the nationally representative UCMR 3 monitoring from 2013 through 2015. UCMR 3 Assessment Monitoring occurrence data are available for PFHxS from all large and very large PWSs (serving between 10,001 and 100,000 people and serving more than 100,000 people, respectively), plus a statistically representative national sample of 800 small PWSs (serving 10,000 people or fewer).[8] Surface water and GWUDI sampling points were monitored four times during the applicable year of monitoring, and ground water sample points were monitored twice during the applicable year of monitoring. See USEPA (2012b) and USEPA (2019a) for more information on the UCMR 3 study design and data analysis.

Exhibit 5-4 through Exhibit 5-6 provide an overview of PFHxS occurrence results from the UCMR 3 Assessment Monitoring. Laboratories participating in UCMR 3 were required to report values at or above MRLs defined by the EPA. The UCMR MRLs are not intended to represent the lowest achievable measurement level an individual laboratory may achieve. Rather, the MRLs are established to ensure reliable and consistent results from the array of laboratories needed for a national monitoring program and are set based on the quantitation level capability of multiple commercial laboratories prior to

[8] A total of 799 small systems submitted Assessment Monitoring results.

beginning each UCMR round. The MRL used for PFHxS in the UCMR 3 survey was 30 ng/L (77 FR 26072; USEPA, 2012b). Exhibit 5-4 presents a sample-level summary of the results. Exhibit 5-5 shows a statistical summary of PFHxS concentrations by system size and source water type (including the minimum, 25^{th} percentile, median, 75^{th} percentile, 90^{th} percentile, 99^{th} percentile, and maximum). Exhibit 5-6 shows system-level results for detections greater than or equal to the MRL.

A total of 36,971 finished water samples for PFHxS were collected from 4,920 PWSs. PFHxS was reported ≥ MRL of 30 ng/L in 0.56 percent of UCMR 3 samples. Reported PFHxS concentrations for these results ranged from 30 ng/L (the MRL) to 1,600 ng/L. Of 4,920 systems, 55 (1.12 percent of systems, serving 2.36 percent of the PWS-served population) reported at least one detection.

Exhibit 5-4: PFHxS National Occurrence Measures Based on UCMR 3 Assessment Monitoring Data - Summary of Samples

Source Water Type	Total # of Samples	Samples with Detections ≥ MRL of 30 ng/L	
		Number	Percent
Small Systems (serving ≤ 10,000 people)			
Ground Water	1,853	4	0.22%
Surface Water	1,421	0	0.00%
All Small Systems	**3,274**	**4**	**0.12%**
Large Systems (serving 10,001 - 100,000 people) -- CENSUS			
Ground Water	11,707	49	0.42%
Surface Water	14,859	103	0.69%
All Large Systems	**26,566**	**152**	**0.57%**
Very Large Systems (serving > 100,000 people) -- CENSUS			
Ground Water	2,020	27	1.34%
Surface Water	5,111	24	0.47%
All Very Large Systems	**7,131**	**51**	**0.72%**
All Systems			
All Water Systems	**36,971**	**207**	**0.56%**

Exhibit 5-5: PFHxS Occurrence Data from UCMR 3 Assessment Monitoring - Summary of Reported Detected Concentrations

Source Water Type	Concentration Value of Detections (in ng/L) ≥ MRL of 30 ng/L						
	Minimum	**25th percentile**	**Median**	**75th percentile**	**90th Percentile**	**99th Percentile**	**Maximum**
Small Systems (serving ≤ 10,000 people)							
Ground Water	100	112.975	403.65	700	718	728.8	730
Surface Water	--	--	--	--	--	--	--
All Small Systems	**100**	**112.975**	**403.65**	**700**	**718**	**728.8**	**730**
Large Systems (serving 10,001 - 100,000 people) -- CENSUS							
Ground Water	30	40	62	100	152	256.08	270
Surface Water	30	59.75	100	235	348	884	1600
All Large Systems	**30**	**52.825**	**77.55**	**187.75**	**329**	**737**	**1,600**
Very Large Systems (serving > 100,000 people) -- CENSUS							
Ground Water	30	44.5	68	95	156	378.4	420
Surface Water	34	48.465	59.5	91	117	624.8	680
All Very Large Systems	**30**	**45.93**	**60**	**93**	**140**	**560**	**680**
All Systems							
All Water Systems	**30**	**50.5**	**73**	**160**	**324**	**727.6**	**1,600**

Exhibit 5-6: PFHxS National Occurrence Measures Based on UCMR 3 Assessment Monitoring Data - Summary of System and Population Served Data - Reported Detections

Source Water Type	UCMR 3 Samples		Number With At Least One Detection ≥ MRL of 30 ng/L		Percent With At Least One Detection ≥ MRL of 30 ng/L		National Inventory		Percent of National Inventory Included	
	Systems	**Population**	**Systems**	**Population**	**Systems**	**Population**	**Systems**	**Population**	**Systems**	**Population**
Small Systems (serving ≤ 10,000 people)										
Ground Water	527	1,498,845	2	7,963	0.38%	0.53%	55,700	38,730,597	0.95%	3.87%
Surface Water	272	1,250,215	0	0	0.00%	0.00%	9,728	20,007,917	2.80%	6.25%
All Small Systems	**799**	**2,749,060**	**2**	**7,963**	**0.25%**	**0.29%**	**65,428**	**58,738,514**	**1.22%**	**4.68%**
Large Systems (serving 10,001 - 100,000 people) -- CENSUS										
Ground Water	1,453	37,141,418	21	591,679	1.45%	1.59%	1,470	37,540,614	98.84%	98.94%
Surface Water	2,260	69,619,878	18	580,941	0.80%	0.83%	2,310	70,791,005	97.84%	98.35%
All Large Systems	**3,713**	**106,761,296**	**39**	**1,172,620**	**1.05%**	**1.10%**	**3,780**	**108,331,619**	**98.23%**	**98.55%**
Very Large Systems (serving > 100,000 people) -- CENSUS										
Ground Water	68	16,355,951	6	2,416,685	8.82%	14.78%	68	16,355,951	100.00%	100.00%
Surface Water	340	115,158,260	8	2,083,447	2.35%	1.81%	343	120,785,622	99.13%	95.34%
All Very Large Systems	**408**	**131,514,211**	**14**	**4,500,132**	**3.43%**	**3.42%**	**411**	**137,141,573**	**99.27%**	**95.90%**
All Systems										
All Water Systems	**4,920**	**241,024,567**	**55**	**5,680,715**	**1.12%**	**2.36%**	**69,619**	**304,211,706**	**7.07%**	**79.23%**

5.2.1.2 State Monitoring Data

In the development of the proposed and final NPDWR, the agency supplemented its UCMR 3 data with more recent publicly available data collected by states. In general, these more recent state data were collected using newer analytical methods and state results reflect lower reporting and detection limits than those in the UCMR 3. Drinking water occurrence data from PWSs for PFHxS were available from several states, including Alabama, Arizona, California, Colorado, Georgia, Idaho, Illinois, Indiana, Iowa, Kentucky, Maine, Maryland, Massachusetts, Michigan, Minnesota, Missouri, New Hampshire, New Jersey, New Mexico, New York, North Carolina, North Dakota, Ohio, Oregon, Pennsylvania, South Carolina, Tennessee, Vermont, Virginia, and Wisconsin. The EPA downloaded publicly available monitoring data from state websites through May 2023. Note that while some states did have available raw water data as indicated in Exhibit 5-7, for the subsequent analyses the EPA only evaluated finished water results.

Exhibit 5-7 provides a summary of the available state reported monitoring data for PFHxS, including date range and a description of coverage and representativeness (including whether monitoring was non-targeted or targeted (i.e., monitoring in areas of known or potential PFAS contamination)). A description of those studies is also included in Exhibit 5-7. State reporting thresholds are also provided, where available, in Exhibit 5-7. The EPA notes that different states utilized various reporting thresholds when analyzing and presenting their data, and for some states there were no clearly defined thresholds publicly provided; in these cases, minimum detected concentrations reported may be indicative of reporting thresholds used. Further, for some states, the thresholds varied when reporting results for the same analyte, as well as the laboratory analyzing the data. For those states, a range of thresholds is provided. As shown in Exhibit 5-7, some states reported at thresholds and/or presented data at concentrations below the EPA's final MCL and/or PQL for PFHxS. However, to present the best available occurrence information, the EPA collected and evaluated the data based on the information as reported directly by the states and when conducting data analyses incorporated individual state-specific reporting thresholds where possible. Additionally, the EPA notes that the majority of the data were analyzed via an EPA-approved drinking water analytical method.

Exhibit 5-7: Summary of Available PFHxS State Reported Monitoring Data

State (Reference)	Date Range	Type of Water Tested	Reporting Threshold (ppt)	Notes on Coverage	Survey Type
Alabama (ADEM, 2023)	2013 - 2022	Ground Water and Surface Water - Finished Water	Not reported	ADPH instructed water systems to carry out PFAS monitoring at all PWSs not previously sampled during UCMR 3. In 2022, water systems that had not been sampled since UCMR 3 were required to sample between January and June 2022 using current analytical methods. Only results that are above the MRL are posted online; thus, only reported detections were available for use in the occurrence analyses.	Non-Targeted
Arizona (ADEQ, 2023)	2021	Ground Water and Surface Water - Raw and Finished Water	1.6 - 2	ADEQ presents a PFAS Interactive Data Map that displays the results of testing conducted by ADEQ since 2018 at PWSs across Arizona.	Targeted
California (CADDW, 2023)	2016 - April 2023	Ground Water and Surface Water - Raw, Finished, and Unknown Water	0.002 - 30	The EPA reviewed the California PFHxS data available online through April 2023. Finished water data were available from approximately 120 PWSs. For this analysis, the EPA only included results that were explicitly marked as being from treated water. Sampling in California is ongoing.	Targeted
Colorado (CDPHE, 2018;CDPHE, 2020)	2013 - 2017	Surface Water (Finished Water) and Drinking Water Distribution Samples	2 - 30	Data available from 28 “drinking water distribution zones” (one or more per PWS) in targeted sampling efforts at a known contaminated aquifer region. Data were collected by El Paso County Public Health, local water districts and utilities, and the CDPHE.	Targeted
	2020	Ground Water and Surface Water - Raw and Finished Water	1.6 - 2.4	CDPHE offered free testing to PWSs serving communities, schools, and workplaces and also to fire districts with wells. Approximately 50% of PWSs in Colorado participated in the 2020 PFAS sampling project. Data included in this report were collected in March through May of 2020.	Non-Targeted
Georgia (GA EPD, 2020)	2020	Surface Water - Raw, Finished, and Unknown Water	18	The EPA and the GA EPD conducted joint sampling of the City of Summerville’s drinking water sources and finished drinking water in January 2020.	Targeted
Idaho (Idaho DEQ, 2023)	2021 - April 2023	Ground Water - Finished and Unknown Water	0.5 - 1	Sampling of finished drinking water data between September 2021 and April 2023 that were available on the state’s Drinking Water Watch website.	Not specified

State (Reference)	Date Range	Type of Water Tested	Reporting Threshold (ppt)	Notes on Coverage	Survey Type
Illinois (IL EPA, 2023)	2020 - May 2023	Ground Water and Surface Water - Raw and Finished Water	1.7 - 3.7	In 2020, the IL EPA initiated a statewide investigation into the prevalence and occurrence of PFAS in finished drinking water at 1,749 community water supplies across Illinois. The EPA reviewed finished drinking water data collected between September 2020 and May 2023 that were available on the state's Drinking Water Watch website. Sampling in Illinois is ongoing.	Non-Targeted
Indiana (IDEM, 2023)	2021 - January 2023	Ground Water and Surface Water - Raw, Finished, and Unknown Water	2	Beginning in February 2021, the IDEM facilitated PFAS monitoring at all CWSs throughout the state of Indiana. Samples were to be collected at all raw water (i.e., wells and intakes) and finished (after treatment) water points in a CWS's supply to evaluate the statewide occurrence of PFAS compounds in CWS across the state and determine the efficacy of conventional drinking water treatment for PFAS.	Non-Targeted
Iowa (IA DNR, 2023)	2021 - April 2023	Ground Water and Surface Water - Raw and Finished Water	1.7 - 3	In January 2020, the Iowa DNR developed an Action Plan to protect the health of Iowa residents and the environment from PFAS. Data were downloaded from the PFAS Sampling Interactive Dashboard and Map.	Targeted
Kentucky (KYDEP, 2019)	2019	Ground Water and Surface Water - Finished Water	3.24	Sampling of finished drinking water data between June and October 2019. Under this sampling effort, data are available from 81 community public DWTPs, representing 74 PWSs, and serving more than 2.4 million people.	Non-Targeted
Maine (Maine DEP, 2020; Maine DHHS, 2023)	2013 - 2020	Drinking Water - Raw, Finished, and Unknown Water	1.78 - 30	In March 2019, the Maine PFAS Task Force was created to review the extent of PFAS contamination in Maine. Finished water results collected from 2013 through 2020 have been collected at 23 locations throughout the state. Data may include results from public and private finished drinking water sources. Sampling in Maine is ongoing.	Targeted
	2021 - January 2023	Ground Water and Surface Water - Finished Water	2	The EPA reviewed the finished water data reported to the Maine CDC Drinking Water Program as compliance samples since June 2021 and processed in the database as of 3/10/2023. Sampling in Maine is ongoing.	Non-Targeted
Maryland (MDE, 2021; MDE, 2022a; MDE, 2022b)	2020 - 2022	Ground Water and Surface Water - Raw and Finished Water	1	In 2020, MDE initiated a project to identify potential sources of PFAS in Maryland and to prioritize water sources for PFAS sampling. The EPA reviewed the finished water results from the first three phases of MDE's Public Water System study for the occurrence of PFAS in State drinking water sources. Under Phase 1 (September 2020 - February 2021), sites were selected for priority sampling based on MDE's evaluation of potential relative risk for PFAS exposure through drinking water. Under Phase 2 (March 2021 - May 2021), MDE conducted sampling at sites that were selected based on their geological setting and proximity to potential sources of PFAS. Under Phase 3 (August 2021- June 2022), MDE tested the remaining CWSs in the state.	Targeted(Phase 1, Phase 2); Non-Targeted (Phase 3)

State (Reference)	Date Range	Type of Water Tested	Reporting Threshold (ppt)	Notes on Coverage	Survey Type
Massachusetts (MA EEA, 2023)	2016 - April 2023	Ground Water and Surface Water - Raw and Finished Water	0.43 - 25	The EPA reviewed the finished water data available online through April 2023. Data were available from 1,330 PWSs. Sampling in Massachusetts is ongoing.	Targeted
Michigan (Michigan EGLE, 2023)	2020 - March 2023	Ground Water and Surface Water - Finished Water	2	The Michigan EGLE developed MCLs for seven PFAS compounds in Michigan, which took effect in August 2020. The EPA reviewed available finished compliance monitoring results through March 2023. Sampling in Michigan is ongoing.	Non-Targeted
Minnesota (MDH, 2023)	2020 - 2023	Ground Water and Surface Water - Finished Water	Not reported	Through the Statewide PFAS Monitoring Project, MDH is testing CWSs across the state for PFAS. The EPA reviewed finished water data through MDH's Interactive Dashboard for PFAS Testing in Drinking Water.	Non-Targeted
Missouri (Missouri DNR, 2023)	2022 - 2023	Ground Water and Surface Water - Raw and Finished Water	Not reported	The EPA reviewed the finished water data available online from Missouri DNR's "PFAS Viewer Tool" which identifies the location of voluntary sampling for PFAS in public drinking water systems in Missouri. The EPA reviewed finished water data collected from approximately 113 PWSs from 2022 through 2023. Limited data were also available from 2013 through 2017.	Non-Targeted
New Hampshire (NHDES, 2021)	2016 - May 2021	Ground Water and Surface Water - Raw and Finished Water	Not reported	The EPA reviewed the New Hampshire PFHxS data available online through May 2021. Finished water data were available from more than 500 PWSs. Sampling in New Hampshire is ongoing.	Non-Targeted
New Jersey (NJDEP, 2023)	2019 - May 2023	Ground Water and Surface Water - Raw, Finished, and Unknown Water	0.43 - 6	Statewide sampling of finished drinking water data was available from 2019-2023. The EPA reviewed data available online through May 2023 from more than 660 PWSs. Sampling in New Jersey is ongoing.	Non-Targeted
New Mexico (NMED, 2019)	2016	Ground Water - Raw and Finished Water	Not reported	NMED, Department of Health and the U.S. Air Force conducted testing at public drinking water supplies at or around Cannon Air Force Base up to 2019.	Targeted
New York (NYDOH, 2022)	2017 - 2022	Ground Water and Surface Water - Raw, Finished, and Unknown Water	0.000000001 - 2,020	The EPA reviewed finished water data voluntarily provided by the state to the EPA. Data were available from nearly 700 PWSs from 2017 through 2022. Limited data were also available from 2013 through 2016.	Non-Targeted
North Carolina (NCDEQ, 2021)	2017 - 2019	Finished and unknown water	Not reported	NCDEQ and the Department of Health and Human Services investigated the presence of HFPO-DA and other PFAS in the Cape Fear River in June 2017. Monthly results were also collected from five water treatment plants on the Cape Fear River. Data were available from June 2017 through October	Targeted

State (Reference)	Date Range	Type of Water Tested	Reporting Threshold (ppt)	Notes on Coverage	Survey Type
				2019. Only results above the DL were reported; thus, only reported detections were available for use in the occurrence analyses.	
North Dakota (NDDEQ, date unknown; NDDEQ, date unknown)	2020, 2021	Ground Water and Surface Water - Raw and Finished Water	Not reported	NDDEQ published a 2020 and a 2021 survey report of North Dakota Statewide Per- and Polyfluoroalkyl Substances (PFAS) Presence/Absence results. The sampling effort in October of 2020 sought to determine if there was a PFAS presence in a representative portion of the state's public water supply. In 2021, sampling conducted as part of the third phase of the survey focused on drinking water sites not evaluated in the first two surveys.	Non-Targeted
Ohio (Ohio EPA, 2023)	December 2019 - December 2021	Ground Water and Surface Water - Raw and Finished Water	5	The Ohio EPA coordinated sampling of raw and finished drinking water from PWSs throughout the state. The EPA reviewed the finished water data available online through December 2021. During this timeframe, data were available from 1,479 PWSs.	Non-Targeted
Oregon (OHA-DWS, 2022)	2021 - July 2022	Ground Water and Surface Water - Finished Water	10.1 - 12.4	OHA conducted a PFAS drinking water monitoring project in 2021 at PWSs in Oregon identified as at risk due to their proximity to a known or suspected PFAS use or contamination site. The EPA reviewed the finished water data from more than 140 PWSs.	Targeted
Pennsylvania (PADEP, 2019)	2019	Ground Water and Surface Water - Finished Water	1.9	A PFAS Sampling Plan was developed to test PWSs across the state. Finished water data were collected for 87 PWSs in 2019.	Targeted
Pennsylvania (PADEP, 2021)	2020 - March 2021	Ground Water and Surface Water - Finished Water	1.7 - 4	Beginning in 2020 and running through March of 2021, finished water data were collected by more than 340 PWSs.	Targeted
South Carolina (SCDHEC, 2020; SCDHEC, 2023)	2017 - March 2023	Ground Water and Surface Water - Raw and Finished Water	2.1	The EPA reviewed PFAS sampling results collected by the South Carolina Bureau of Water for community drinking water systems. Data were available from 300 PWSs.	Non-Targeted
Tennessee (TDEC, 2023)	2019	Surface Water - Raw and Finished Water	Not reported	In 2019, Metro Water Services conducted a voluntary sampling of Nashville's drinking water systems for PFAS. Their stated goal was to go above and beyond current federal and state monitoring requirements to understand the potential presence of PFAS in Nashville's drinking water.	Non-Targeted

State (Reference)	Date Range	Type of Water Tested	Reporting Threshold (ppt)	Notes on Coverage	Survey Type
Vermont (VT DEC, 2023)	2019 -April 2023	Ground Water and Surface Water - Raw, Finished, and Unknown	2	The Vermont Water Supply Rule required all CWSs and NTNCWSs to sample for PFAS. The EPA reviewed finished water data available online from July 2019 - April 2023 from approximately 560 PWSs. Sampling in Vermont is ongoing.	Non-Targeted
Virginia (VDH ODW, 2021)	2021	Ground Water and Surface Water - Raw and Finished Water	3.5	The Virginia ODW, in conjunction with VA PFAS work group, designed the sample study to prioritize sites for measuring PFAS concentrations in drinking water and major sources of water and generate statewide occurrence data.	Targeted / Non-Targeted
Wisconsin (WI DNR, 2023)	2022 -April 2023	Ground Water and Surface Water - Raw, Finished, and Unknown Water	Not reported	The EPA reviewed the finished water data available online from 2022 - 2023. Data were available from nearly 250 PWSs. Sampling in Wisconsin is ongoing.	Non-Targeted

A summary of state reported monitoring data from PWSs for PFHxS is presented in Exhibit 5-8 through Exhibit 5-10. As noted above, some of the monitoring data from each state are limited and may not be representative of occurrence in the state. In addition, states have varying reporting thresholds, as indicated in the first column of Exhibit 5-8. For states with available reporting thresholds, only detected concentrations greater than the reporting thresholds were counted as detections. For states that did not provide reporting thresholds, the EPA included all detected concentrations reported in the count of detections. Overall, state reported detected concentrations ranged from 0.2 ppt (Alabama) to 856 ppt (New York). Note that for a small number of systems, population served information could not be identified. These systems were included in the counts and analysis presented in Exhibit 5-10; however, no associated population served was included in the counts and analysis presented in Exhibit 5-10.

Exhibit 5-8: PFHxS State Reported Drinking Water Occurrence Data - Summary of Finished Water Samples

State (Reporting Threshold)	Source Water Type	Total Number of Samples	All Detections		All Detections > 10 ppt	
			Number	Percent	Number	Percent
Alabama[1] (Not reported)	Ground Water	--	42	--	5	--
	Surface Water	--	82	--	4	--
	Total	**--**	**124**	**--**	**9**	**--**
Arizona (1.6 - 2 ppt)	Ground Water	23	18	78.3%	5	21.7%
	Surface Water	2	1	50.0%	0	0.0%
	Total	**25**	**19**	**76.0%**	**5**	**20.0%**
California (0.002 - 30 ppt)	Ground Water	1,883	489	26.0%	180	9.6%
	Surface Water	3,947	610	15.5%	109	2.8%
	Unknown	4	0	0.0%	0	0.0%
	Total	**5,834**	**1,099**	**18.8%**	**289**	**5.0%**
Colorado (2013-2017) (2 - 30 ppt)	Distribution (Finished)	94	46	48.9%	33	35.1%
	Surface water (Finished)	11	0	0.0%	0	0.0%
	Total	**105**	**46**	**43.8%**	**33**	**31.4%**
Colorado (2020) (1.6 - 2.4 ppt)	Ground Water	339	36	10.6%	1	0.3%
	Surface Water	244	27	11.1%	1	0.4%
	Total	**583**	**63**	**10.8%**	**2**	**0.3%**
Georgia (18 ppt)	Ground Water	0	0	0.0%	0	0.0%
	Surface Water	2	0	0.0%	0	0.0%
	Total	**2**	**0**	**0.0%**	**0**	**0.0%**
Idaho (0.5 - 1 ppt)	Ground Water	18	2	11.1%	0	0.0%
	Surface Water	0	0	0.0%	0	0.0%
	Total	**18**	**2**	**11.1%**	**0**	**0.0%**
Illinois (1.7 - 3.7 ppt)	Ground Water	1,823	258	14.2%	16	0.9%
	Surface Water	302	27	8.9%	0	0.0%
	Total	**2,125**	**285**	**13.4%**	**16**	**0.8%**
Indiana	Ground Water	422	7	1.7%	0	0.0%

State (Reporting Threshold)	Source Water Type	Total Number of Samples	All Detections		All Detections > 10 ppt	
			Number	Percent	Number	Percent
(2 ppt)	Surface Water	59	0	0.0%	0	0.0%
	Total	**481**	**7**	**1.5%**	**0**	**0.0%**
Iowa (1.7 - 3 ppt)	Ground Water	152	29	19.1%	3	2.0%
	Surface Water	63	4	6.3%	4	6.3%
	Total	**215**	**33**	**15.3%**	**7**	**3.3%**
Kentucky (3.24 ppt)	Ground Water	33	4	12.1%	0	0.0%
	Surface Water	48	3	6.3%	0	0.0%
	Total	**81**	**7**	**8.6%**	**0**	**0.0%**
Maine (PFAS Task Force)[2] (1.78 - 30 ppt)	Ground Water	9	0	0.0%	0	0.0%
	Surface Water	3	0	0.0%	0	0.0%
	Unknown	75	6	8.0%	3	4.0%
	Total	**87**	**6**	**6.9%**	**3**	**3.4%**
Maine (Compliance) (2 ppt)	Ground Water	646	21	3.3%	1	0.2%
	Surface Water	62	0	0.0%	0	0.0%
	Total	**708**	**21**	**3.0%**	**1**	**0.1%**
Maryland (Phase 1) (1 ppt)	Ground Water	70	33	47.1%	3	4.3%
	Surface Water	76	35	46.1%	3	3.9%
	Total	**146**	**68**	**46.6%**	**6**	**4.1%**
Maryland (Phase 2) (1 ppt)	Ground Water	9	3	33.3%	1	11.1%
	Surface Water	0	0	0.0%	0	0.0%
	Total	**9**	**3**	**33.3%**	**1**	**11.1%**
Maryland (Phase 3) (1 ppt)	Ground Water	88	16	18.2%	3	3.4%
	Surface Water	0	0	0.0%	0	0.0%
	Total	**88**	**16**	**18.2%**	**3**	**3.4%**
Massachusetts (0.43 - 25 ppt)	Ground Water	7,215	1,771	24.5%	125	1.7%
	Surface Water	2,136	437	20.5%	11	0.5%
	Total	**9,351**	**2,208**	**23.6%**	**136**	**1.5%**
Michigan (2 ppt)	Ground Water	10,007	446	4.5%	49	0.5%
	Surface Water	519	2	0.4%	0	0.0%
	Unknown	164	13	7.9%	3	1.8%
	Total	**10,690**	**461**	**4.3%**	**52**	**0.5%**
Missouri, 2022 - 2023 (Not reported)	Ground Water	192	7	3.6%	1	0.5%
	Surface Water	22	0	0.0%	0	0.0%
	Total	**214**	**7**	**3.3%**	**1**	**0.5%**
New Hampshire (Not reported)	Ground Water	1,656	293	17.7%	34	2.1%
	Surface Water	157	11	7.0%	0	0.0%
	Unknown	1	0	0.0%	0	0.0%
	Total	**1,814**	**304**	**16.8%**	**34**	**1.9%**
New Jersey (0.43 - 6 ppt)	Ground Water	5,346	1,169	21.9%	99	1.9%
	Surface Water	1,770	697	39.4%	14	0.8%

State (Reporting Threshold)	Source Water Type	Total Number of Samples	All Detections		All Detections > 10 ppt	
			Number	Percent	Number	Percent
	Unknown	3	0	0.0%	0	0.0%
	Total	**7,119**	**1,866**	**26.2%**	**113**	**1.6%**
New Mexico (Not reported)	Ground Water	2	1	50.0%	0	0.0%
	Surface Water	0	0	0.0%	0	0.0%
	Total	**2**	**1**	**50.0%**	**0**	**0.0%**
New York (0.000000001-2,020 ppt)	Ground Water	1,839	423	23.0%	15	0.8%
	Surface Water	401	63	15.7%	2	0.5%
	Unknown	9	0	0.0%	0	0.0%
	Total	**2,249**	**486**	**21.6%**	**17**	**0.8%**
North Carolina[1] (Not Reported)	Unknown	--	372	--	327	--
	Total	**--**	**372**	**--**	**327**	**--**
North Dakota (2020) (Not reported)	Ground Water	42	1	2.4%	0	0.0%
	Surface Water	9	0	0.0%	0	0.0%
	Total	**51**	**1**	**2.0%**	**0**	**0.0%**
North Dakota (2021) (Not reported)	Ground Water	56	4	7.1%	0	0.0%
	Surface Water	7	1	14.3%	0	0.0%
	Total	**63**	**5**	**7.9%**	**0**	**0.0%**
Ohio (5 ppt)	Ground Water	1,775	117	6.6%	55	3.1%
	Surface Water	170	11	6.5%	0	0.0%
	Total	**1,945**	**128**	**6.6%**	**55**	**2.8%**
Oregon (10.1 - 12.4 ppt)	Ground Water	131	3	2.3%	1	0.8%
	Surface Water	29	0	0.0%	0	0.0%
	Total	**160**	**3**	**1.9%**	**1**	**0.6%**
Pennsylvania (2019) (1.9 - 2 ppt)	Ground Water	75	11	14.7%	1	1.3%
	Surface Water	21	6	28.6%	0	0.0%
	Total	**96**	**17**	**17.7%**	**1**	**1.0%**
Pennsylvania (2021) (1.7 - 4 ppt)	Ground Water	314	38	12.1%	6	1.9%
	Surface Water	98	14	14.3%	0	0.0%
	Total	**412**	**52**	**12.6%**	**6**	**1.5%**
South Carolina (2.1 ppt)	Ground Water	572	42	7.3%	2	0.3%
	Surface Water	193	20	10.4%	0	0.0%
	Total	**765**	**62**	**8.1%**	**2**	**0.3%**
Tennessee (Not reported)	Ground Water	0	0	0.0%	0	0.0%
	Surface Water	2	0	0.0%	0	0.0%
	Total	**2**	**0**	**0.0%**	**0**	**0.0%**
Vermont (2 ppt)	Ground Water	1,463	65	4.4%	10	0.7%
	Surface Water	102	0	0.0%	0	0.0%
	Total	**1,565**	**65**	**4.2%**	**10**	**0.6%**
Virginia (3.5 ppt)	Ground Water	5	0	0.0%	0	0.0%
	Surface Water	36	1	2.8%	0	0.0%

State (Reporting Threshold)	Source Water Type	Total Number of Samples	All Detections		All Detections > 10 ppt	
			Number	Percent	Number	Percent
	Total	**41**	**1**	**2.4%**	**0**	**0.0%**
Wisconsin (Not reported)	Ground Water	733	189	25.8%	14	1.9%
	Surface Water	54	25	46.3%	0	0.0%
	Total	**787**	**214**	**27.2%**	**14**	**1.8%**

[1] Only reported detections were available in this state's dataset.
[2] Reported data from Maine may include results from public and private finished drinking water sources. Based on available state data information, the EPA could not verify PWSIDs for all included samples.

Exhibit 5-9: PFHxS State Reported Drinking Water Occurrence Data - Summary of Detected Concentrations

State (Reporting Threshold)	Source Water Type	Concentration Value of Detections (ppt)				
		Minimum	Median	90th Percentile	99th Percentile	Maximum
Alabama[1] (Not reported)	Ground Water	0.8	5.70	15.8	23.0	23
	Surface Water	0.2	2.60	8.49	22.4	24
	Total	**0.2**	**3.00**	**12.7**	**23.0**	**24**
Arizona (1.6 - 2 ppt)	Ground Water	3.7	7.15	30.3	34.3	35
	Surface Water	3	3	3	3	3
	Total	**3**	**7.10**	**30.2**	**34.3**	**35**
California (0.002 - 30 ppt)	Ground Water	1.1	9.40	24.0	35.4	50
	Surface Water	1.7	4.70	24.0	109	160
	Unknown	--	--	--	--	--
	Total	**1.1**	**6.30**	**24.0**	**91.1**	**160**
Colorado (2013-2017) (2 - 30 ppt)	Distribution (Finished)	3.9	76.0	380	523	590
	Surface water (Finished)	--	--	--	--	--
	Total	**3.9**	**76.0**	**380**	**523**	**590**
Colorado (2020) (1.6 - 2.4 ppt)	Ground Water	1.8	3.75	8.95	15.9	18
	Surface Water	1.6	2.80	5.80	27.3	34
	Total	**1.6**	**3.60**	**8.28**	**24.1**	**34**
Georgia (18 ppt)	Ground Water	--	--	--	--	--
	Surface Water	--	--	--	--	--
	Total	**--**	**--**	**--**	**--**	**--**
Idaho (0.5 - 1 ppt)	Ground Water	1.11	1.32	1.48	1.52	1.52
	Surface Water	--	--	--	--	--
	Total	**1.11**	**1.32**	**1.48**	**1.52**	**1.52**
Illinois (1.7 - 3.7 ppt)	Ground Water	1.9	4.05	12.0	109	200
	Surface Water	2.2	3.80	7.46	11.3	12
	Total	**1.9**	**4.00**	**11.0**	**93.8**	**200**
Indiana	Ground Water	2.1	2.30	2.62	2.78	2.8

State (Reporting Threshold)	Source Water Type	Concentration Value of Detections (ppt)				
		Minimum	Median	90th Percentile	99th Percentile	Maximum
(2 ppt)	Surface Water	--	--	--	--	--
	Total	**2.1**	**2.30**	**2.62**	**2.78**	**2.8**
Iowa (1.7 - 3 ppt)	Ground Water	2	4.00	14.2	41.9	43
	Surface Water	36	39.0	44.2	45.8	46
	Total	**2**	**5.50**	**38.8**	**45.0**	**46**
Kentucky (3.24 ppt)	Ground Water	1.62	2.65	8.54	10.8	11
	Surface Water	1.74	1.96	2.15	2.20	2.2
	Total	**1.62**	**2.20**	**6.08**	**10.5**	**11**
Maine (PFAS Task Force)[2] (1.78 - 30 ppt)	Ground Water	--	--	--	--	--
	Surface Water	--	--	--	--	--
	Unknown	5.81	25.9	58.2	71.0	72.4
	Total	**5.81**	**25.9**	**58.2**	**71.0**	**72.4**
Maine (Compliance) (2 ppt)	Ground Water	2.02	3.18	7.94	21.8	24
	Surface Water	--	--	--	--	--
	Total	**2.02**	**3.18**	**7.94**	**21.8**	**24**
Maryland (Phase 1) (1 ppt)	Ground Water	1	1.80	7.17	58.6	61.49
	Surface Water	1	2.49	9.21	91.6	123.18
	Total	**1**	**2.43**	**9.01**	**81.8**	**123.18**
Maryland (Phase 2) (1 ppt)	Ground Water	2.05	9.26	18.4	20.4	20.66
	Surface Water	--	--	--	--	--
	Total	**2.05**	**9.26**	**18.4**	**20.4**	**20.66**
Maryland (Phase 3) (1 ppt)	Ground Water	1.46	3.78	53.0	143	158
	Surface Water	--	--	--	--	--
	Total	**1.46**	**3.78**	**53.0**	**143**	**158**
Massachusetts (0.43 - 25 ppt)	Ground Water	0.72	3.08	11.5	57.5	222
	Surface Water	1.66	2.70	5.76	18.3	31
	Total	**0.72**	**2.92**	**11.0**	**56.9**	**222**
Michigan (2 ppt)	Ground Water	2	3.40	16.0	260	347
	Surface Water	3.2	3.40	3.56	3.60	3.6
	Unknown	3	8.00	22.6	26.6	27
	Total	**2**	**3.50**	**16.0**	**257**	**347**
Minnesota (Not reported)	Ground Water	0.74	--	--	--	31
	Surface Water	0.65	--	--	--	0.65
	Total	**0.65**	**--**	**--**	**--**	**31**
Missouri, 2022 - 2023 (Not reported)	Ground Water	2	2.40	12.1	24.6	26
	Surface Water	--	--	--	--	--
	Total	**2**	**2.40**	**12.1**	**24.6**	**26**
New Hampshire (Not reported)	Ground Water	0.7	3.22	18.5	235	269
	Surface Water	1.7	2.67	6.20	7.84	8.02

State (Reporting Threshold)	Source Water Type	Concentration Value of Detections (ppt)				
		Minimum	Median	90th Percentile	99th Percentile	Maximum
	Unknown	--	--	--	--	--
	Total	**0.7**	**3.17**	**17.9**	**234**	**269**
New Jersey (0.43 - 6 ppt)	Ground Water	0.46	3.20	12.7	77.3	260
	Surface Water	1.74	3.45	7.80	34.1	100
	Unknown	--	--	--	--	--
	Total	**0.46**	**3.30**	**9.60**	**65.0**	**260**
New Mexico (Not reported)	Ground Water	2.6	2.6	2.6	2.6	2.6
	Surface Water	--	--	--	--	--
	Total	**2.6**	**2.6**	**2.6**	**2.6**	**2.6**
New York (0.000000001-2,020 ppt)	Ground Water	0.33	2.33	5.58	29.9	856
	Surface Water	0.52	2.00	7.92	15.8	16.2
	Unknown	--	--	--	--	--
	Total	**0.33**	**2.31**	**5.80**	**27.5**	**856**
North Carolina[1] (Not Reported)	Unknown	0.26	40.0	40.0	80.0	80
	Total	**0.26**	**40.0**	**40.0**	**80.0**	**80**
North Dakota (2020) (Not reported)	Ground Water	2.14	2.14	2.14	2.14	2.14
	Surface Water	--	--	--	--	--
	Total	**2.14**	**2.14**	**2.14**	**2.14**	**2.14**
North Dakota (2021) (Not reported)	Ground Water	0.751	1.01	1.62	1.79	1.81
	Surface Water	1.47	1.47	1.47	1.47	1.47
	Total	**0.751**	**1.17**	**1.67**	**1.80**	**1.81**
Ohio (5 ppt)	Ground Water	5	13.5	32.4	120	140
	Surface Water	5.28	7.68	9.56	11.1	11.3
	Total	**5**	**12.1**	**31.4**	**113**	**140**
Oregon (10.1 - 12.4 ppt)	Ground Water	12.5	12.7	15.8	16.5	16.6
	Surface Water	--	--	--	--	--
	Total	**12.5**	**12.7**	**15.8**	**16.5**	**16.6**
Pennsylvania (2019) (1.9 - 2 ppt)	Ground Water	2.3	2.90	7.40	66.4	73
	Surface Water	2.4	3.35	12.5	13.0	13
	Total	**2.3**	**3.00**	**12.4**	**63.4**	**73**
Pennsylvania (2021) (1.7 - 4 ppt)	Ground Water	1.9	4.60	23.6	118	140
	Surface Water	1.9	4.05	5.82	6.35	6.4
	Total	**1.9**	**4.50**	**17.0**	**109**	**140**
South Carolina (2.1 ppt)	Ground Water	2.1	3.85	7.56	238	380
	Surface Water	2.1	3.25	4.81	4.98	5
	Total	**2.1**	**3.55**	**7.03**	**169**	**380**
Tennessee (Not reported)	Ground Water	--	--	--	--	--
	Surface Water	--	--	--	--	--
	Total	**--**	**--**	**--**	**--**	**--**

State (Reporting Threshold)	Source Water Type	Concentration Value of Detections (ppt)				
		Minimum	Median	90th Percentile	99th Percentile	Maximum
Vermont (2 ppt)	Ground Water	2	3.84	54.9	134	134
	Surface Water	--	--	--	--	--
	Total	**2**	**3.84**	**54.9**	**134**	**134**
Virginia (3.5 ppt)	Ground Water	--	--	--	--	--
	Surface Water	4.9	4.9	4.9	4.9	4.9
	Total	**4.9**	**4.9**	**4.9**	**4.9**	**4.9**
Wisconsin (Not reported)	Ground Water	0.276	1.60	9.44	37.5	43.3
	Surface Water	0.43	0.680	0.876	1.00	1
	Total	**0.276**	**1.44**	**6.35**	**36.3**	**43.3**

Note: With limited exceptions, calculated concentration values (i.e., median, 90th percentile and 99th percentile concentrations) were rounded to three significant figures for consistent presentation across the datasets and may not indicate exact laboratory precision.
[1] Only reported detections were available in this state's dataset.
[2] Reported data from Maine may include results from public and private finished drinking water sources. Based on available state data information, the EPA could not verify PWSIDs for all included samples.

Exhibit 5-10: PFHxS State Reported Drinking Water Occurrence Data – Summary of Systems with Finished Water Data

State (Reporting Threshold)	Source Water Type	Total Number of Systems	Systems with Detections		Systems with Detections > 10 ppt	
			Number	Percent	Number	Number
Alabama[1] (Not reported)	Ground Water	--	20	--	3	--
	Surface Water	--	33	--	1	--
	Total	**--**	**53**	**--**	**4**	**--**
Arizona (1.6 – 2 ppt)	Ground Water	5	3	60.0%	2	40.0%
	Surface Water	1	1	100.0%	0	0.0%
	Total	**6**	**4**	**66.7%**	**2**	**33.3%**
California (0.002 – 30 ppt)	Ground Water	43	17	39.5%	7	16.3%
	Surface Water	78	30	38.5%	12	15.4%
	Unknown	1	0	0.0%	0	0.0%
	Total	**122**	**47**	**38.5%**	**19**	**15.6%**
Colorado (2013-2017) (2 – 30 ppt)	Distribution (Finished)	22	13	59.1%	11	50.0%
	Surface water (Finished)	5	0	0.0%	0	0.0%
	Total	**27**	**13**	**48.1%**	**11**	**40.7%**
Colorado (2020) (1.6 – 2.4 ppt)	Ground Water	221	31	14.0%	1	0.5%
	Surface Water	176	22	12.5%	1	0.6%
	Total	**397**	**53**	**13.4%**	**2**	**0.5%**
Georgia (18 ppt)	Ground Water	0	0	0.0%	0	0.0%
	Surface Water	1	0	0.0%	0	0.0%

State (Reporting Threshold)	Source Water Type	Total Number of Systems	Systems with Detections		Systems with Detections > 10 ppt	
			Number	Percent	Number	Number
	Total	**1**	**0**	**0.0%**	**0**	**0.0%**
Idaho (0.5 – 1 ppt)	Ground Water	10	2	20.0%	0	0.0%
	Surface Water	0	0	0.0%	0	0.0%
	Total	**10**	**2**	**20.0%**	**0**	**0.0%**
Illinois (1.7 – 3.7 ppt)	Ground Water	899	44	4.9%	7	0.8%
	Surface Water	97	2	2.1%	0	0.0%
	Total	**996**	**46**	**4.6%**	**7**	**0.7%**
Indiana (2 ppt)	Ground Water	341	5	1.5%	0	0.0%
	Surface Water	31	0	0.0%	0	0.0%
	Total	**372**	**5**	**1.3%**	**0**	**0.0%**
Iowa (1.7 – 3 ppt)	Ground Water	90	10	11.1%	2	2.2%
	Surface Water	26	1	3.8%	1	3.8%
	Total	**116**	**11**	**9.5%**	**3**	**2.6%**
Kentucky (3.24 ppt)	Ground Water	30	4	13.3%	0	0.0%
	Surface Water	44	3	6.8%	0	0.0%
	Total	**74**	**7**	**9.5%**	**0**	**0.0%**
Maine (PFAS Task Force)[2] (1.78 – 30 ppt)	Ground Water	7	0	0.0%	0	0.0%
	Surface Water	1	0	0.0%	0	0.0%
	Unknown	10	4	40.0%	3	30.0%
	Total	**18**	**4**	**22.2%**	**3**	**16.7%**
Maine (Compliance) (2 ppt)	Ground Water	593	18	3.0%	1	0.2%
	Surface Water	53	0	0.0%	0	0.0%
	Total	**646**	**18**	**2.8%**	**1**	**0.2%**
Maine (All Systems)[3] (1.78 – 30 ppt)	Ground Water	593	18	3.0%	1	0.2%
	Surface Water	53	0	0.0%	0	0.0%
	Unknown	10	4	40.0%	3	30.0%
	Total	**656**	**22**	**3.4%**	**4**	**0.6%**
Maryland (Phase 1) (1 ppt)	Ground Water	30	15	50.0%	2	6.7%
	Surface Water	36	18	50.0%	2	5.6%
	Total	**66**	**33**	**50.0%**	**4**	**6.1%**
Maryland (Phase 2) (1 ppt)	Ground Water	6	3	50.0%	1	16.7%
	Surface Water	0	0	0.0%	0	0.0%
	Total	**6**	**3**	**50.0%**	**1**	**16.7%**
Maryland (Phase 3) (1 ppt)	Ground Water	63	8	12.7%	2	3.2%
	Surface Water	0	0	0.0%	0	0.0%
	Total	**63**	**8**	**12.7%**	**2**	**3.2%**
Maryland (All Systems)[3] (1 ppt)	Ground Water	99	26	26.3%	5	5.1%
	Surface Water	36	18	50.0%	2	5.6%
	Total	**135**	**44**	**32.6%**	**7**	**5.2%**

State (Reporting Threshold)	Source Water Type	Total Number of Systems	Systems with Detections		Systems with Detections > 10 ppt	
			Number	Percent	Number	Number
Massachusetts (0.43 – 25 ppt)	Ground Water	1,209	201	16.6%	24	2.0%
	Surface Water	122	40	32.8%	4	3.3%
	Total	**1,331**	**241**	**18.1%**	**28**	**2.1%**
Michigan (2 ppt)	Ground Water	2,370	98	4.1%	13	0.5%
	Surface Water	84	1	1.2%	0	0.0%
	Unknown	54	3	5.6%	1	1.9%
	Total	**2,508**	**102**	**4.1%**	**14**	**0.6%**
Minnesota (Not reported)	Ground Water	561	60	10.7%	2	0.4%
	Surface Water	16	1	6.3%	0	0.0%
	Total	**577**	**61**	**10.6%**	**2**	**0.3%**
Missouri, 2022 – 2023 (Not reported)	Ground Water	95	3	3.2%	1	1.1%
	Surface Water	18	0	0.0%	0	0.0%
	Total	**113**	**3**	**2.7%**	**1**	**0.9%**
New Hampshire (Not reported)	Ground Water	529	122	23.1%	14	2.6%
	Surface Water	30	4	13.3%	0	0.0%
	Unknown	1	0	0.0%	0	0.0%
	Total	**560**	**126**	**22.5%**	**14**	**2.5%**
New Jersey (0.43 – 6 ppt)	Ground Water	599	180	30.1%	15	2.5%
	Surface Water	65	39	60.0%	3	4.6%
	Unknown	1	0	0.0%	0	0.0%
	Total	**665**	**219**	**32.9%**	**18**	**2.7%**
New Mexico (Not reported)	Ground Water	2	1	50.0%	0	0.0%
	Surface Water	0	0	0.0%	0	0.0%
	Total	**2**	**1**	**50.0%**	**0**	**0.0%**
New York (0.000000001-2,020 ppt)	Ground Water	568	148	26.1%	9	1.6%
	Surface Water	123	26	21.1%	2	1.6%
	Unknown	4	0	0.0%	0	0.0%
	Total	**695**	**174**	**25.0%**	**11**	**1.6%**
North Carolina[1] (Not Reported)	Unknown	--	5	--	5	--
	Total	**--**	**5**	**--**	**5**	**--**
North Dakota (2020) (Not reported)	Ground Water	41	1	2.4%	0	0.0%
	Surface Water	9	0	0.0%	0	0.0%
	Total	**50**	**1**	**2.0%**	**0**	**0.0%**
North Dakota (2021) (Not reported)	Ground Water	56	4	7.1%	0	0.0%
	Surface Water	7	1	14.3%	0	0.0%
	Total	**63**	**5**	**7.9%**	**0**	**0.0%**
North Dakota (All Systems)[3] (Not reported)	Ground Water	95	5	5.3%	0	0.0%
	Surface Water	16	1	6.3%	0	0.0%
	Total	**111**	**6**	**5.4%**	**0**	**0.0%**

State (Reporting Threshold)	Source Water Type	Total Number of Systems	Systems with Detections		Systems with Detections > 10 ppt	
			Number	Percent	Number	Number
Ohio (5 ppt)	Ground Water	1,372	29	2.1%	15	1.1%
	Surface Water	107	3	2.8%	0	0.0%
	Total	**1,479**	**32**	**2.2%**	**15**	**1.0%**
Oregon (10.1 – 12.4 ppt)	Ground Water	116	2	1.7%	1	0.9%
	Surface Water	27	0	0.0%	0	0.0%
	Total	**143**	**2**	**1.4%**	**1**	**0.7%**
Pennsylvania (2019) (1.9 – 2 ppt)	Ground Water	71	8	11.3%	1	1.4%
	Surface Water	16	5	31.3%	0	0.0%
	Total	**87**	**13**	**14.9%**	**1**	**1.1%**
Pennsylvania (2021) (1.7 – 4 ppt)	Ground Water	269	32	11.9%	6	2.2%
	Surface Water	73	10	13.7%	0	0.0%
	Total	**342**	**42**	**12.3%**	**6**	**1.8%**
Pennsylvania (All Systems)[3] (1.7 – 4 ppt)	Ground Water	270	35	13.0%	6	2.2%
	Surface Water	73	12	16.4%	0	0.0%
	Total	**343**	**47**	**13.7%**	**6**	**1.7%**
South Carolina (2.1 ppt)	Ground Water	234	30	12.8%	2	0.9%
	Surface Water	65	11	16.9%	0	0.0%
	Total	**299**	**41**	**13.7%**	**2**	**0.7%**
Tennessee (Not reported)	Ground Water	0	0	0.0%	0	0.0%
	Surface Water	1	0	0.0%	0	0.0%
	Total	**1**	**0**	**0.0%**	**0**	**0.0%**
Vermont (2 ppt)	Ground Water	526	15	2.9%	1	0.2%
	Surface Water	38	0	0.0%	0	0.0%
	Total	**564**	**15**	**2.7%**	**1**	**0.2%**
Virginia (3.5 ppt)	Ground Water	5	0	0.0%	0	0.0%
	Surface Water	20	1	5.0%	0	0.0%
	Total	**25**	**1**	**4.0%**	**0**	**0.0%**
Wisconsin (Not reported)	Ground Water	217	62	28.6%	7	3.2%
	Surface Water	22	14	63.6%	0	0.0%
	Total	**239**	**76**	**31.8%**	**7**	**2.9%**

[1] Only reported detections were available in this state's dataset.
[2] Reported data from Maine may include results from public and private finished drinking water sources. Based on available state data information, the EPA could not verify PWSIDs for all included samples.
[3] The "All Systems" counts represent a summary of all unique systems across multiple sampling efforts within the state. For some states (e.g., CO), the EPA could not verify this number due to the sample site ID reporting.

Exhibit 5-11: PFHxS State Reported Drinking Water Occurrence Data - Summary of Population Served by Systems with Finished Water Data

State (Reporting Threshold)	Source Water Type	Total Population Served by Systems	Total Population Served by Systems with Detections		Total Population Served by Systems with Detections > 10 ppt	
			Number	Percent	Number	Number
Alabama[1] (Not reported)	Ground Water	--	331,485	--	35,991	--
	Surface Water	--	1,230,184	--	4,350	--
	Total	**--**	**1,561,669**	**--**	**40,341**	**--**
Arizona (1.6 - 2 ppt)	Ground Water	94,569	55,853	59.1%	55,535	58.7%
	Surface Water	50,001	50,001	100.0%	0	0.0%
	Total	**144,570**	**105,854**	**73.2%**	**55,535**	**38.4%**
California (0.002 - 30 ppt)	Ground Water	1,098,122	693,964	63.2%	134,039	12.2%
	Surface Water	13,500,188	4,269,361	31.6%	2,665,573	19.7%
	Unknown	0	0	0.0%	0	0.0%
	Total	**14,598,310**	**4,963,325**	**34.0%**	**2,799,612**	**19.2%**
Colorado (2013 - 2017)[2] (2 - 30 ppt)	Distribution (Finished)	--	--	--	--	--
	Surface water (Finished)	--	--	--	--	--
	Total	**--**	**--**	**--**	**--**	**--**
Colorado (2020) (1.6 - 2.4 ppt)	Ground Water	261,162	81,445	31.2%	70	0.0%
	Surface Water	4,191,774	904,295	21.6%	4,495	0.1%
	Total	**4,452,936**	**985,740**	**22.1%**	**4,565**	**0.1%**
Georgia (18 ppt)	Ground Water	0	0	0.0%	0	0.0%
	Surface Water	9,993	0	0.0%	0	0.0%
	Total	**9,993**	**0**	**0.0%**	**0**	**0.0%**
Idaho (0.5 - 1 ppt)	Ground Water	81,985	14,977	18.3%	0	0.0%
	Surface Water	0	0	0.0%	0	0.0%
	Total	**81,985**	**14,977**	**18.3%**	**0**	**0.0%**
Illinois (1.7 - 3.7 ppt)	Ground Water	2,916,219	536,360	18.4%	83,168	2.9%
	Surface Water	4,628,949	123,073	2.7%	0	0.0%
	Total	**7,545,168**	**659,433**	**8.7%**	**83,168**	**1.1%**
Indiana (2 ppt)	Ground Water	545,838	6,571	1.2%	0	0.0%
	Surface Water	97,448	0	0.0%	0	0.0%
	Total	**643,286**	**6,571**	**1.0%**	**0**	**0.0%**
Iowa (1.7 - 3 ppt)	Ground Water	491,495	77,979	15.9%	5,834	1.2%
	Surface Water	987,522	85,797	8.7%	85,797	8.7%
	Total	**1,479,017**	**163,776**	**11.1%**	**91,631**	**6.2%**
Kentucky (3.24 ppt)	Ground Water	171,212	12,391	7.2%	0	0.0%
	Surface Water	1,922,023	70,010	3.6%	0	0.0%
	Total	**2,093,235**	**82,401**	**3.9%**	**0**	**0.0%**

State (Reporting Threshold)	Source Water Type	Total Population Served by Systems	Total Population Served by Systems with Detections		Total Population Served by Systems with Detections > 10 ppt	
			Number	Percent	Number	Number
Maine (PFAS Task Force)[2,3] (1.78 - 30 ppt)	Ground Water	3,995	0	0.0%	0	0.0%
	Surface Water	21,808	0	0.0%	0	0.0%
	Unknown	0	0	0.0%	0	0.0%
	Total	**25,803**	**0**	**0.0%**	**0**	**0.0%**
Maine (Compliance) (2 ppt)	Ground Water	274,866	24,012	8.7%	140	0.1%
	Surface Water	464,453	0	0.0%	0	0.0%
	Total	**739,319**	**24,012**	**3.2%**	**140**	**0.0%**
Maine (All Systems)[2,4] (1.78 - 30 ppt)	Ground Water	274,866	24,012	8.7%	140	0.1%
	Surface Water	464,453	0	0.0%	0	0.0%
	Unknown	0	0	0.0%	0	0.0%
	Total	**739,319**	**24,012**	**3.2%**	**140**	**0.0%**
Maryland (Phase 1) (1 ppt)	Ground Water	384,007	72,696	18.9%	7,000	1.8%
	Surface Water	4,059,154	3,829,519	94.3%	40,656	1.0%
	Total	**4,443,161**	**3,902,215**	**87.8%**	**47,656**	**1.1%**
Maryland (Phase 2) (1 ppt)	Ground Water	3,896	315	8.1%	180	4.6%
	Surface Water	0	0	0.0%	0	0.0%
	Total	**3,896**	**315**	**8.1%**	**180**	**4.6%**
Maryland (Phase 3) (1 ppt)	Ground Water	41,063	3,034	7.4%	295	0.7%
	Surface Water	0	0	0.0%	0	0.0%
	Total	**41,063**	**3,034**	**7.4%**	**295**	**0.7%**
Maryland (All Systems)[4] (1 ppt)	Ground Water	428,966	76,045	17.7%	7,475	1.7%
	Surface Water	4,059,154	3,829,519	94.3%	40,656	1.0%
	Total	**4,488,120**	**3,905,564**	**87.0%**	**48,131**	**1.1%**
Massachusetts (0.43 - 25 ppt)	Ground Water	1,828,984	1,086,532	59.4%	245,748	13.4%
	Surface Water	5,860,701	1,329,491	22.7%	175,785	3.0%
	Total	**7,689,685**	**2,416,023**	**31.4%**	**421,533**	**5.5%**
Michigan[2] (2 ppt)	Ground Water	1,945,734	430,649	22.1%	221,394	11.4%
	Surface Water	1,314,601	42,271	3.2%	0	0.0%
	Unknown	0	0	0.0%	0	0.0%
	Total	**3,260,335**	**472,920**	**14.5%**	**221,394**	**6.8%**
Minnesota (Not reported)	Ground Water	2,752,594	1,290,853	46.9%	35,115	1.3%
	Surface Water	1,106,268	61,747	5.6%	0	0.0%
	Total	**3,858,862**	**1,352,600**	**35.1%**	**35,115**	**0.9%**
Missouri, 2022 - 2023 (Not reported)	Ground Water	190,274	4,410	2.3%	1,963	1.0%
	Surface Water	405,045	0	0.0%	0	0.0%
	Total	**595,319**	**4,410**	**0.7%**	**1,963**	**0.3%**
New Hampshire (Not reported)	Ground Water	267,029	144,523	54.1%	33,551	12.6%
	Surface Water	476,367	47,826	10.0%	0	0.0%

State (Reporting Threshold)	Source Water Type	Total Population Served by Systems	Total Population Served by Systems with Detections		Total Population Served by Systems with Detections > 10 ppt	
			Number	Percent	Number	Number
	Unknown	10	0	0.0%	0	0.0%
	Total	**743,406**	**192,349**	**25.9%**	**33,551**	**4.5%**
New Jersey (0.43 - 6 ppt)	Ground Water	1,520,763	589,240	38.7%	157,170	10.3%
	Surface Water	4,783,734	3,900,556	81.5%	180,066	3.8%
	Unknown	0	0	0.0%	0	0.0%
	Total	**6,304,497**	**4,489,796**	**71.2%**	**337,236**	**5.3%**
New Mexico[2] (Not reported)	Ground Water	--	--	--	--	--
	Surface Water	--	--	--	--	--
	Total	**--**	**--**	**--**	**--**	**--**
New York (0.000000001-2,020 ppt)	Ground Water	1,459,428	624,391	42.8%	2,313	0.2%
	Surface Water	2,850,536	494,790	17.4%	11,200	0.4%
	Unknown	1,024	0	0.0%	0	0.0%
	Total	**4,310,988**	**1,119,181**	**26.0%**	**13,513**	**0.3%**
North Carolina[1,2] (Not Reported)	Unknown	--	--	--	--	--
	Total	**--**	**--**	**--**	**--**	**--**
North Dakota (2020) (Not reported)	Ground Water	68,280	50	0.1%	0	0.0%
	Surface Water	57,469	0	0.0%	0	0.0%
	Total	**125,749**	**50**	**0.0%**	**0**	**0.0%**
North Dakota (2021) (Not reported)	Ground Water	113,623	64,496	56.8%	0	0.0%
	Surface Water	194,121	4,284	2.2%	0	0.0%
	Total	**307,744**	**68,780**	**22.3%**	**0**	**0.0%**
North Dakota (All Systems)[4] (Not reported)	Ground Water	181,514	64,546	35.6%	0	0.0%
	Surface Water	251,590	4,284	1.7%	0	0.0%
	Total	**433,104**	**68,830**	**15.9%**	**0**	**0.0%**
Ohio (5 ppt)	Ground Water	2,883,252	95,659	3.3%	66,341	2.3%
	Surface Water	6,215,644	152,856	2.5%	0	0.0%
	Total	**9,098,896**	**248,515**	**2.7%**	**66,341**	**0.7%**
Oregon (10.1 - 12.4 ppt)	Ground Water	114,194	344	0.3%	289	0.3%
	Surface Water	125,239	0	0.0%	0	0.0%
	Total	**239,433**	**344**	**0.1%**	**289**	**0.1%**
Pennsylvania (2019) (1.9 - 2 ppt)	Ground Water	162,825	25,756	15.8%	110	0.1%
	Surface Water	431,370	134,502	31.2%	0	0.0%
	Total	**594,195**	**160,258**	**27.0%**	**110**	**0.0%**
Pennsylvania (2021) (1.7 - 4 ppt)	Ground Water	471,651	102,203	21.7%	5,170	1.1%
	Surface Water	4,296,097	1,046,132	24.4%	0	0.0%
	Total	**4,767,748**	**1,148,335**	**24.1%**	**5,170**	**0.1%**
Pennsylvania (All Systems)[4]	Ground Water	471,891	105,553	22.4%	5,170	1.1%
	Surface Water	4,296,097	1,098,879	25.6%	0	0.0%

State (Reporting Threshold)	Source Water Type	Total Population Served by Systems	Total Population Served by Systems with Detections		Total Population Served by Systems with Detections > 10 ppt	
			Number	Percent	Number	Number
(1.7 - 4 ppt)	**Total**	**4,767,988**	**1,204,432**	**25.3%**	**5,170**	**0.1%**
South Carolina (2.1 ppt)	Ground Water	485,992	8,376	1.7%	709	0.1%
	Surface Water	2,489,351	344,016	13.8%	0	0.0%
	Total	**2,975,343**	**352,392**	**11.8%**	**709**	**0.0%**
Tennessee (Not reported)	Ground Water	0	0	0.0%	0	0.0%
	Surface Water	2,551	0	0.0%	0	0.0%
	Total	**2,551**	**0**	**0.0%**	**0**	**0.0%**
Vermont (2 ppt)	Ground Water	211,357	2,185	1.0%	120	0.1%
	Surface Water	174,473	0	0.0%	0	0.0%
	Total	**385,830**	**2,185**	**0.6%**	**120**	**0.0%**
Virginia (3.5 ppt)	Ground Water	2,975	0	0.0%	0	0.0%
	Surface Water	4,839,373	407,300	8.4%	0	0.0%
	Total	**4,842,348**	**407,300**	**8.4%**	**0**	**0.0%**
Wisconsin (Not reported)	Ground Water	1,514,437	1,028,037	67.9%	56,862	3.8%
	Surface Water	1,333,737	649,446	48.7%	0	0.0%
	Total	**2,848,174**	**1,677,483**	**58.9%**	**56,862**	**2.0%**

[1] Only reported detections were available in this state's dataset.
[2] There were some instances where the population served by a system could not be identified. Thus, there are systems with detections but no associated population served by those systems with detections.
[3] Reported data from Maine may include results from public and private finished drinking water sources. Based on available state data information, the EPA could not verify PWSIDs for all included samples.
[4] The "All Systems" counts represent a summary of all unique systems across multiple sampling efforts within the state.

5.2.1.3 Additional Secondary Source Water and Drinking Water Studies

Boone et al. (2019) measured 17 PFAS in both source and treated water from 25 DWTPs in the United States. The results indicated that only five of the sampling locations demonstrated a significant difference in PFAS concentration between the source and treated water. The median concentration of PFHxS in source water was 0.86 ng/L and 0.79 ng/L in treated water. PFHxS was detected in 80 percent of treated drinking water samples (Boone et al., 2019).

Post et al. (2013) re-evaluated PFOA, PFOS, and PFC occurrence data in drinking water systems throughout New Jersey to update previous PFAS research in the area from 2006. PFCs were found in 70 percent of PWSs sampled at concentrations ranging from 5-174 ng/L. PFHxS was detected in 13 percent of samples at a maximum concentration of 46 ng/L.

McMahon et al. (2022) collected samples from aquifer systems in the eastern United States in 2019 to evaluate PFAS occurrence in ground water used as a source of drinking water. The study found that 14 of the 24 analyzed PFAS were detected in ground water samples. Furthermore, at least one PFAS was detected in 54 percent of the ground water samples and two or more PFAS were detected in 47 percent of the ground water samples. In the public supply and domestic wells, 60 and 20 percent of the samples, respectively, had at least one PFAS detection. Two or more PFAS were detected in 53 percent of the public-supply wells and 10 percent of domestic wells. The six PFAS outlined in the EPA's UCMR 3 program (i.e., PFBS, PFHxS, PFOS, PFHpA, PFOA, and PFNA) were the most detected PFAS in the study's samples. PFHxS was detected in 20 percent of the 254 samples (McMahon et al., 2022).

As part of a joint study by the EPA and USGS to assess human exposure to contaminants of emerging concern, water samples were collected from 25 DWTPs in 24 states (Glassmeyer et al., 2017). Participation in the study was voluntary, and candidate locations were selected based on nomination by the EPA and USGS regional personnel and DWTP self-nomination as well as consideration of high wastewater contribution and the availability of pharmaceutical concentration data. Final sample locations were chosen to represent a wide range of geography, diversity in disinfectant type used, and a range of production volumes. Phase I of the study (2007) analyzed a subset of contaminants and sites to test experimental design; PFHxS was not included in Phase 1. During Phase II of the study (2010-2012), samples were collected from ground water and surface water sources and treated drinking water from 25 DWTPs and analyzed for PFHxS occurrence. The LCMRL for PFHxS was equal to 0.034 ng/L. PFHxS was detected in 92 percent of the 25 source water samples and 84 percent of the 25 treated drinking water samples. The maximum detected concentrations in source water and treated water were 44.8 ng/L and 38.4 ng/L, respectively.

Reyes (2021) conducted a ground water-quality study to describe the occurrence and distribution of PFAS in the Columbia aquifer public water-supply wells in the Delaware Coastal Plain region in 2018. One or more PFAS were detected in 16 of the sampled wells with as many as 8 different PFAS detected in a single sample. PFHxS was detected in 8 of the 30 public water-supply wells sampled in the study. The maximum PFHxS concentration detected was 130 ng/L.

5.2.2 Other Data

5.2.2.1 Department of Defense (DoD) Drinking Water Sampling

The DoD conducted sampling of off-base drinking water located in "covered areas" (i.e., areas that are adjacent to and down gradient from a military installation) to identify potential impacts of PFAS resulting from DoD activities. Sampling was conducted for multiple PFAS, including PFHxS. The EPA downloaded available DOD off-base sampling results in September 2023.

The EPA summarized off-base sampling results for PFHxS collected "post treatment" from drinking water systems and private wells located in covered areas adjacent to 47 installations located in 22 states. Detected concentrations ranged from an estimated concentration of 0.38 ng/L to 2,900 ng/L. Sampling was conducted utilizing multiple analytical methods including EPA methods 533, 537, 537.1, 1633, and DoD Quality Systems Manual Table B-15 (DoD, 2023a). Results are based on DLs which vary between both sampling sites and across different PFAS. Results for PFHxS are presented in Exhibit 5-12.

Exhibit 5-12: Summary of PFHxS Drinking Water Sampling Results Collected Post-Treatment from Department of Defense Off-Base "Covered Areas"

State	Installation Name	Sampling Dates	Analysis Method	# Samples	# Detections	% Detections	Range of Detections (ng/L)
AK	Eielson AFB	11/3/2022	537	1	0	0.00%	NA
AZ	Luke AFB	3/31/2022	QSM_B15	2	2	100.00%	4.9 (est) - 5 (est)
AZ	YUMA AZ MCAS	5/26/2023	533	1	0	0.00%	NA
AR	Little Rock AFB	5/5/2022	537	3	2	66.67%	163 - 164
AR	Little Rock AFB	6/16/2022 - 3/22/2023	QSM_B15	6	1	16.67%	30.9 (est)
CA	Castle AFB	7/5/2022 - 4/5/2023	537	26	4	15.38%	1.37 (est) - 2.22
CA	Castle AFB	11/17/2021 - 1/11/2022	QSM_B15	12	2	16.67%	1.12 (est) - 1.86 (est)
CA	George AFB	3/23/2023 - 4/20/2023	1633	3	0	0.00%	NA
CA	March AFB	1/3/2023 - 4/10/2023	533	3	1	33.33%	1.4 (est)
CA	March AFB	1/3/2022 - 12/1/2022	537.1	11	6	54.55%	2 - 63
CA	March AFB	9/1/2022	QSM_B15	1	0	0.00%	NA
CA	Mather AFB	7/28/2022	537	1	0	0.00%	NA
CA	Mather AFB	1/27/2022 - 4/26/2022	QSM_B15	3	0	0.00%	NA
CA	Travis AFB	1/25/2022 - 1/16/2023	QSM_B15	19	1	5.26%	22.6
CO	Peterson Space Force Base	12/14/2021 - 2/7/2023	537.1	8	0	0.00%	NA
CO	Peterson Space Force Base	3/1/2022 - 9/14/2022	QSM_B15	16	0	0.00%	NA
DE	Dover AFB	1/22/2022 - 10/25/2022	QSM_B15	10	0	0.00%	NA
FL	Homestead Air Reserve Base	2/21/2022 - 3/30/2023	QSM_B15	13	0	0.00%	NA
FL	WHITING FLD FL NAS	9/1/2022	537.1	2	1	50.00%	3.36
IL	Scott AFB	3/22/2022 - 3/28/2023	QSM_B15	3	0	0.00%	NA
ME	Loring AFB	7/25/2022	QSM_B15	1	0	0.00%	NA
ME	NCTAMSLANT DET CUTLER	4/20/2022 - 12/6/2022	537.1	66	2	3.03%	34.9 (est) - 147
MA	Otis ANG (Joint Base Cape Cod - Massachusetts Military Reservation)	2/28/2022 - 11/22/2022	QSM_B15	11	4	36.36%	0.81 (est) - 4.5 (est)
MI	KI Sawyer AFB	7/13/2022	QSM_B15	2	0	0.00%	NA
MT	Great Falls International Airport	6/15/2022 - 7/7/2022	537	3	1	33.33%	3.26 (est)
NH	Pease AFB	9/22/2021 - 3/30/2023	QSM_B15	16	8	50.00%	0.84 (est) - 190
NJ	Joint Base McGuire-Dix-Lakehurst	3/3/2022 - 5/25/2022	QSM_B15	2	0	0.00%	NA
NM	Cannon AFB	11/11/2021 - 12/13/2021	QSM_B15	2	0	0.00%	NA

State	Installation Name	Sampling Dates	Analysis Method	# Samples	# Detections	% Detections	Range of Detections (ng/L)
NY	Plattsburgh AFB	5/20/2022 - 8/10/2022	537	8	1	12.50%	2.2
NY	Plattsburgh AFB	11/18/2021 - 9/15/2022	537.1	16	1	6.25%	0.56 (est)
NY	Plattsburgh AFB	11/29/2021 - 6/27/2023	QSM_B15	15	2	13.33%	2.8 - 3.1
OK	Tinker AFB	2/2/2023	QSM_B15	3	0	0.00%	NA
RI	NAVAL AUX LANDING FIELD	5/19/2022	537.1	2	0	0.00%	NA
RI	NAVAL AUX LANDING FIELD	10/17/2022 - 2/28/2023	QSM_B15	31	17	54.84%	0.38 (est) - 7.03
SD	Ellsworth AFB	3/14/2022	537	1	0	0.00%	NA
SD	Ellsworth AFB	6/9/2022 - 9/7/2022	537.1	2	0	0.00%	NA
SD	Ellsworth AFB	2/7/2022 - 6/23/2022	QSM_B15	36	4	11.11%	10.3 - 1,320
TX	Goodfellow AFB	8/18/2022 - 11/15/2022	537	11	1	9.09%	0.58 (est)
TX	Goodfellow AFB	12/6/2022 - 4/27/2023	QSM_B15	28	2	7.14%	6.6 (est) - 2,900
TX	Reese AFB	9/14/2022 - 6/13/2023	1633	504	24	4.76%	0.64 (est) - 104
TX	Reese AFB	9/28/2021 - 8/29/2022	QSM_B15	839	33	3.93%	2.1 (est) - 551
VA	OCEANA VA NAS	10/19/2022 - 4/14/2023	537.1	13	0	0.00%	NA
WA	BREMERTON WA NAVBASE	10/11/2022 - 7/21/2023	537.1	3	2	66.67%	18.4 - 18.9
WA	Fairchild AFB	9/19/2022 - 9/27/2022	537	87	1	1.15%	4.6 (est)
WA	Fairchild AFB	2/20/2023 - 3/6/2023	537.1	87	0	0.00%	NA
WA	Fairchild AFB	1/31/2022 - 7/21/2022	QSM_B15	187	2	1.07%	2.2 (est) - 46.3
WA	WHIDBEY IS WA NAS	4/21/2022 - 4/20/2023	537.1	11	2	18.18%	1.24 (est) - 4.51

Source: DOD, 2023a

5.2.3 Occurrence in Ambient Water

Lakes, rivers, and aquifers are the ambient sources of most drinking water. Contaminant occurrence in ambient water can provide useful information on the potential for contaminants to adversely affect drinking water supplies. Occurrence data for PFHxS in ambient water are available from the USGS NWIS database and the EPA's legacy STORET data available through the WQP.

5.2.3.1 National Water Information System (NWIS) Data

The NWIS is the Nation's principal repository of water resources data USGS collects from more than 1.9 million sites (USGS, 2023). NWIS-Web is the general online interface to the USGS NWIS database. Discrete water-sample and time-series data are available from sites in all 50 States, including 5 million water samples with 90 million water-quality results. All USGS water quality and flow data are stored in NWIS, including site characteristics, streamflow, ground water level, precipitation, and chemical analyses of water, sediment, and biological media, though not all parameters are available for every site. NWIS houses the NAWQA data and includes other USGS data from unspecified projects. NWIS contains many more samples at many more sites than the NAWQA Program. Although NWIS is comprised of primarily ambient water data, some finished drinking water data are included as well. This section presents analyses of non-NAWQA data in NWIS, downloaded from the WQP in November 2023 (WQP, 2023).

The results of the non-NAWQA NWIS PFHxS analysis are presented in Exhibit 5-13. NWIS data for PFHxS were listed under the characteristic name "Perfluorohexanesulfonate." PFHxS was detected in approximately 38 percent of samples (1,122 out of 2,951 samples) and at approximately 34 percent of sites (594 out of 1,759 sites). The median concentration based on detections was equal to 2.50 ng/L. (Note that the NWIS data are presented as downloaded; potential outliers were not evaluated or excluded from the analysis.)

Exhibit 5-13: PFHxS NWIS Data

Site Type	Detection Frequency (detections are results ≥ reporting level)				Concentration Values (of detections, in ng/L)				
	No. of Samples	No. of Samples with Detections	No. of Sites	No. of Sites with Detections	Minimum	Median	90th Percentile	99th Percentile	Maximum
Ground Water	1,344	305	1,233	300	0.9	3.10	62.0	340	680
Surface Water	1,607	817	526	294	0	2.35	16.0	420	3100
All Sites	**2,951**	**1,122**	**1,759**	**594**	**0**	**2.50**	**22.0**	**356**	**3100**

Source: WQP, 2023

5.2.3.2 Storage and Retrieval (STORET) Data / Water Quality Portal (WQP)

From its launch in 1999 until it was decommissioned in June 2018, the EPA's STORET Data Warehouse was collaboratively populated with raw biological, chemical, and physical data from surface water and ground water sampling by federal, state and local agencies, Native American tribes, volunteer groups,

academics, and others. Legacy STORET data are accessible through the WQP: https://www.waterqualitydata.us/portal/.

STORET data are from monitoring locations in all 50 states as well as multiple territories and jurisdictions of the United States. Most data are from ambient waters, but in some cases finished drinking water data are included as well. STORET's data quality limitations include variations in the extent of national coverage and data completeness from parameter to parameter. Data may have been collected as part of targeted, rather than randomized, monitoring.

This section presents analyses of STORET data, downloaded from the WQP in November 2023 (WQP, 2023). The EPA reviewed STORET ground water data from wells and springs and surface water data from lakes, rivers, streams, and reservoirs (WQP, 2023). STORET data for PFHxS were listed under the characteristic name of "Perfluorohexanesulfonate" and "Perfluorohexanesulfonic acid." The results of the STORET analysis for PFHxS are presented in Exhibit 5-14 and Exhibit 5-15. Approximately 860 samples were available for analysis. These PFHxS samples were collected between 2006 and 2022. Of the 614 sites sampled, nearly 78 percent reported detections of PFHxS. Detected concentrations ranged from 0 to 667 ng/L. (Note: A minimum value of zero could represent a detection that was entered into the database as a non-numerical value (e.g., "Present").)

Exhibit 5-14: PFHxS STORET Data - Summary of Detected Concentrations

Source Water Type	Concentration Value of Detections (ng/L)			
	Minimum[1]	Median	90^{th} Percentile	Maximum
Ground Water	0	0	0	200
Surface Water	0.54	4.00	28.4	667
Unknown	0	0	2.62	3.7
Total	**0**	**0**	**0.929**	**667**

Source: WQP, 2023
[1]A minimum value of zero may represent a detection that was entered into the database as a non-numerical value (e.g., "Present").

Exhibit 5-15: PFHxS STORET Data - Summary of Samples and Sites

Source Water Type	Total Number of Samples	Samples with Detections		Total Number of Sites	Sites with Detections	
		Number	Percent		Number	Percent
Ground Water	729	655	89.85%	495	447	90.30%
Surface Water	88	24	27.27%	73	19	26.03%
Unknown	47	12	25.53%	46	11	23.91%
Total	**864**	**691**	**79.98%**	**614**	**477**	**77.69%**

Source: WQP, 2023

5.3 Analytical Methods

For the purposes of compliance with the PFAS NPDWR, the EPA has published two analytical methods that are available for the analysis of PFHxS and other PFAS in drinking water. The performance metrics that are presented, including the DL, LCMRL, mean recoveries and RSDs are specific to PFHxS for each of the listed analytical methods. Ranges of mean recoveries and RSDs are presented for the matrices listed; data from holding time studies are not included since these studies are designed to demonstrate a degradation in method performance over time and thus are not indicative of method performance that should be observed when holding times are not exceeded:

- EPA Method 537.1, Version 2.0, *Determination of Selected Per- and Polyfluorinated Alkyl Substances in Drinking Water by Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometry (LC/MS/MS)*. The DL and LCMRL generated by the laboratory that developed the method are 1.4 ng/L and 2.4 ng/L, respectively. Mean recoveries in fortified reagent water, tap water from a ground water source (TOC = 0.53 mg/L and hardness = 377 mg/L), tap water from a surface water source (TOC = 2.4 mg/L and hardness = 103 mg/L), and tap water from a private well (TOC = 0.56 mg/L and hardness = 394 mg/L) range from 93.5 to 110%, with RSDs of 0.9 to 6.7% (USEPA, 2020d).
- EPA Method 533, *Determination of Per- and Polyfluoroalkyl Substances in Drinking Water by Isotope Dilution Anion Exchange Solid Phase Extraction and Liquid Chromatography / Tandem Mass Spectrometry*. The LCMRL generated by the laboratory that developed the method is 3.7 ng/L (DLs were not calculated Mean recoveries (excluding ^{13}C isotope analogue data) in fortified reagent water, finished drinking water from a ground water source (hardness = 320 mg/L, pH = 7.88 at 17° C, free Cl_2 = 0.64 mg/L, and total Cl_2 = 0.74 mg/L) and clarified surface water (prior to GAC treatment and chlorinated in the laboratory; pH = 8.1 at 20 °C, free Cl_2 = 0.98 mg/L, total Cl_2 = 1.31 mg/L. and TOC = 3.8 mg/L) range from 78.5 to 108%, with RSDs of 5.3 to 18% (USEPA, 2019b).

Laboratories participating in UCMR 3 were required to use EPA Method 537 and were required to report PFHxS values at or above the EPA-defined MRL of 30 ng/L (77 FR 26072; USEPA, 2012b). The MRL was set based on the capability of multiple laboratories at the time. EPA Method 537.1 was originally published in November 2018 as Version 1.0 as a more sensitive update to EPA Method 537 (with a slightly expanded target analyte list). Version 2.0 was published in March 2020 and contains minor editorial changes to Version 1.0. Use of EPA Method 537.1 is preferable to use of EPA Method 537 (it may not be feasible to reliably quantitate down to health levels of concern for certain PFAS when using EPA Method 537). For this reason, only EPA methods 533 and 537.1 are accepted for use in demonstrating compliance with this final rule.

6 Perfluorononanoic Acid (PFNA)

This chapter presents information and analysis specific to PFNA, including background information on the contaminant, information on contaminant sources and environmental fate, an analysis of health effects, an analysis of occurrence in ambient and drinking water, and information about the availability of analytical methods and treatment technologies.

6.1 Contaminant Background, Chemical and Physical Properties

Synonyms for PFNA include, perfluoro-n-nonanoic acid, heptadecafluorononanoic acid (NCBI, 2022d), and perfluorononan-1-oic acid (ATSDR, 2021). The acronym PFNA is also used to refer to the deprotonated anionic form of the compound, perfluorononanoate, also known as heptadecafluorononanoic acid anion (NCBI, 2022d).

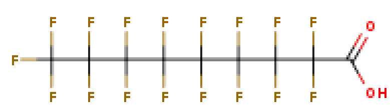
PFNA is a long chain perfluorinated aliphatic carboxylic acid. Its salts differ from PFNA by being associated with either an ammonium, potassium ion, sodium ion, or lithium ion. For the purposes of this document PFNA will signify the ion, acid, or any salt of PFNA.

As a long chain perfluoroalkane carboxylic acid, PFNA is a surfactant that could be used as a wetting dispersing, emulsifying or foaming agent (NCBI, 2022d). The ammonium salt of PFNA was historically used to make fluoropolymers including polyvinylidene fluoride (ITRC, 2021) and may be present as a trace contaminant. PFNA has also been found in semiconductor waste streams (ITRC, 2021).

Eight participating PFNA manufacturers committed to cease PFNA production in the United States by 2015 (ITRC, 2021). Products manufactured and imported prior to 2015 may still contain PFNA and international manufacturing continued after that date. In 2021, PFNA was petitioned to the United Nations' Stockholm Convention on POPs for consideration of a manufacturing ban or best available techniques recommendation (UNEP, 2021). In addition, PFNA may be inadvertently formed as by-products in commercial products (USEPA, 2021c).

The diagram of Exhibit 6-1 shows the straight-chain chemical structure of PFNA. Depending on their method of manufacture, PFNA and related compounds may exist as either branched-chain or straight-chain isomers (ATSDR, 2021). The chemical and physical properties of PFNA are listed in Exhibit 6-2 and typically represent mixtures of branched and linear isomers rather than any particular isomer.

Exhibit 6-1: Chemical Structure of PFNA - Straight-Chain Isomer



PFNA Structure

Source: NCBI, 2022d

NCBI (2022d) reports a value of 5.48 for the log K_{ow} that is estimated using the EPA's EPISuite™, while ATSDR (2021) indicated that log K_{ow} is not applicable or cannot be measured since PFBS is expected to form multiple layers in octanol and water mixtures. Although long-chain perfluoroalkyls that are uncharged form layers in water/hydrocarbon mixtures, PFNA is charged/ionized and at typical environmental pH and has low to moderate solubility in water (NCBI, 2022d; ITRC, 2021). ATSDR reports no data available for this property while ITRC and HSDB present a value for K_H. The K_H value presented by HSDB was estimated from vapor pressure and water solubility using EPISuite™.

Where there are different conclusions in the literature for the properties of PFNA, information is presented to highlight the range of uncertainty for this compound.

Exhibit 6-2: Physical and Chemical Properties of PFNA

Property	Data
Chemical Abstracts Service (CAS) Registry Number	375-95-1 (NCBI, 2022d)
EPA Pesticide Chemical Code	Not Applicable
Chemical Formula	$C_9HF_{17}O_2$ (NCBI, 2022d)
Molecular Weight	464.08 g/mol (NCBI, 2022d)
Color/Physical State	Beige Crystalline solid (NCBI, 2022d)
Boiling Point	218 deg C (ITRC, 2021)
Melting Point	53.2-66.5 deg C (ITRC, 2021) No data (ATSDR, 2021)
Density	1.75-1.80 g/mL (est) (ITRC, 2021)
Freundlich Adsorption Coefficient	--
Vapor Pressure	0.010 mm Hg at 25 deg C (ITRC, 2021; converted from 0.12 log-Pa) 8.4 mm Hg at 99.63 deg C (ITRC, 2021; converted from 1.12 kPa) 0.083 mm Hg at 25 deg C (est) (NCBI, 2022d)
K_H	33.8 atm-m^3/mol at 25 deg C (ITRC, 2021; converted from 3.14 log) No data (ATSDR, 2021)[a]
Log K_{ow}	5.48 (est) (dimensionless) (NCBI, 2022d)[b] Not applicable[c] (ATSDR, 2021)
K_{oc}	2.09E02 - 7.9E03 soil (dimensionless) (ITRC, 2021; converted from Log K_{oc} 2.32 - 3.9)[b] 2.0E02 - 7.9E05 sediment (dimensionless) (ITRC, 2021; Log K_{oc} 2.3 - 5.9) 2.45E02 (ATSDR, 2021; converted from Log K_{oc} 2.39) 1.2E05 (dimensionless) (est) (NCBI, 2022d) [d]
pK_a	-0.21 (NCBI, 2022d) -0.21 (est) (ATSDR, 2021) <1.6 (dimensionless) (ITRC, 2021) 0.82 (est) (ECHA, 2015)
Solubility in Water	12 mg/L (ITRC, 2021; converted from -4.6 log-mol/L) 6.25E-02 mg/L at 25 deg C (est) (NCBI, 2022d)
Other Solvents	--
Conversion Factors (at 25 deg C, 1 atm)	1 PPM = 18.98 mg/m^3; 1 mg/m^3 = 0.053 PPM (ATSDR, 2021)

Note: "--" indicates that no information was found.
[a]These values should not be used to estimate portioning between water and air.
[b]Surfactants are surface acting agents that contain both a hydrophilic part and a hydrophobic part which causes them to accumulate at interfaces hampering the determination of their aqueous concentration. These surfactant properties present difficulties in applying existing methods for the experimental determination of log K_{ow} and produce unreliable results.
[c] The log K_{ow} is not measurable since these substances are expected to form multiple layers in an octanol-water mixture (3M 1999, 2008).

[d] An experimental value for log K_{oc} (0.62 to 1.9) was not included due to an incomplete mass balance (ITRC, 2021).

6.1.1 Sources and Environmental Fate

6.1.1.1 Production, Use, and Release

No production data for PFNA are available from the EPA's IUR and CDR programs.[9] Industrial release data are available from the EPA's TRI, described below.

Toxics Release Inventory (TRI)

The EPA established TRI in 1987 in response to section 313 of the EPCRA. EPCRA section 313 requires the reporting of annual information on toxic chemical releases from facilities that meet specific criteria. This reported information is maintained in a database accessible through TRI Explorer (USEPA, 2023b).

Although TRI can provide a general idea of release trends, it has limitations. Not all facilities are required to report all releases. Facilities are required to report releases if they manufacture, process, or otherwise use a listed toxic chemical in quantities above the respective activity threshold. For PFNA, the reporting threshold is 100 lbs. manufactured, processed, or otherwise used over the year. It should also be noted that, as of this publication, quantities of PFNA at concentrations under 1.0 percent within mixtures may be exempt from TRI reporting requirements. Reporting requirements have changed over time (e.g., the chemical list have been updated), so conclusions about temporal trends should be drawn with caution. TRI data are meant to reflect releases and other waste management activities and should not be used to estimate general public exposure to a chemical (USEPA, 2023b).

TRI data for PFNA are available for 2020 through 2022 (USEPA, 2023b). As shown in Exhibit 3-5, no releases were reported for 2020 or 2021. In 2022, 3,400 pounds of on-site releases to land were reported by one facility in Alabama (USEPA, 2023b).

Exhibit 6-3: Environmental Releases of PFNA in the United States, 2020-2022

Year	On-Site Releases (in pounds)				Total Off-Site Releases (in pounds)	Total On- and Off-Site Releases (in pounds)
	Air Emissions	Surface Water Discharges	Underground Injection	Releases to Land		
2020	0	0	0	0	0	0
2021	0	0	0	0	0	0
2022	0	0	0	3,400	0	3,400

Source: USEPA, 2023b

[9] Note that there are 2020 CDR data listed for "Perfluoro compounds, C5-18." Those data are not summarized in this report.

6.1.1.2 Environmental Fate

The primary measures used by the EPA to assess mobility include (where available) K_{oc}, log K_{ow}, K_H, water solubility and vapor pressure. For PFNA, pK_a is also important.

Modeling of atmospheric behavior of PFNA suggest that PFNA will be present predominantly as a vapor if released to the atmosphere (NCBI, 2022d). PFNA can react with photochemically produced hydroxyl radicals in the atmosphere to degrade (NCBI, 2022d). A half-life for this reaction in air is estimated to be 31 days (NCBI, 2022d). (Note that radical reactions typically proceed more rapidly than chemically- or microbially-mediated degradation reactions in other environmental media such as water, soil, and/or sediment.) PFNA is not expected to undergo direct photolysis (NCBI, 2022d).

Based on findings from laboratory studies and estimation methods, log K_{oc} suggests a propensity for PFNA to adsorb to suspended solids or sediments (NCBI, 2022d). Based on the vapor pressure, PFNA is not expected to volatilize from dry soil (NCBI, 2022d). With a pK_a of less than 1.0, PFNA is expected to exist in its ionized form at typical environment pH ranges of natural waters (NCBI, 2022d). Thus, volatilization from water at typical environment pH is not expected (NCBI, 2022d).

PFNA is very stable chemically and is resistant to hydrolysis, photolysis, and biodegradation (NCBI, 2022d; ECHA, 2015). A resistance to essentially all forms of degradation other than atmospheric processes indicates high persistence.

Under CCL 3, the EPA created scales[10] to informally rank chemical contaminants' likely mobility (understood as their tendency to partition to water rather than other media) and persistence as "high," "moderate," or "low" based on physical and chemical properties (see USEPA, 2021b and USEPA, 2009). For PFNA, a log K_{ow} of 5.48, and a water solubility of 12 mg/L (ITRC, 2021) at 25 degrees C predict a moderate favorability of partitioning to water.

6.2 PFNA Occurrence

This section presents data on the occurrence of PFNA in drinking water and ambient water in the United States. The EPA is finalizing an MCLG of 10 ppt for PFNA. Under SDWA, the EPA must establish an enforceable MCL, the maximum concentration of a contaminant that is allowed in PWSs, as close to the MCLG as feasible, taking several factors into consideration, including analytical methods capable of measuring the contaminant, available treatment technologies to remove the contaminant, and costs. Based on these factors, the EPA is finalizing an MCL of 10 ppt for PFNA. Occurrence data from various sources presented below are analyzed with respect to the MCL. When possible, estimates of the population exposed at concentrations above the MCL are presented. Also, when possible, studies that are meant to be representative and studies that are targeted at known or suspected sites of contamination are identified as such.

The drinking water analyses presented in this section were performed for UCMR 3 and select state data sources. In addition, this section presents PFNA findings from occurrence analyses conducted by non-EPA researchers. For additional background information about data sources used to evaluate occurrence, please refer to Chapter 2.

[10] See Exhibit A.8 here: https://www.epa.gov/sites/default/files/2014-05/documents/ccl3_pccltoccl_08-31-09_508.pdf

The EPA is also finalizing an HI MCL for the regulation of PFHxS, PFNA, HFPO-DA, and PFBS when co-occurring in mixture combinations containing two or more of these four PFAS. Refer to Chapter 8 for more information on the HI MCL and chapter 9 for co-occurrence information.

6.2.1 Occurrence in Drinking Water

Data sources reviewed by the agency for information on PFNA occurrence in drinking water included UCMR 3, more recent state drinking water monitoring programs, and the DoD PFAS drinking water testing, as well as additional studies from the literature. Note that there may be some overlap, as sources with different purposes and audiences may have reported the same underlying data. UCMR 3 is a nationally representative data source. Other data sources profiled in this section are considered "supplemental" sources. Also note that PFNA is being monitored for under UCMR 5, which is occurring from 2023 to 2025. Analysis of partial UCMR 5 results (the first three quarters of data that were made available as of February 2024) are discussed in section 11 of this document. Additionally, the EPA notes that the UCMR 3 MRL for PFNA is higher than that utilized within the majority of state monitoring data and for the UCMR 5.

6.2.1.1 UCMR 3 Data

PFNA was included as part of the nationally representative UCMR 3 monitoring from 2013 through 2015. UCMR 3 Assessment Monitoring occurrence data are available for PFNA from all large and very large PWSs (serving between 10,001 and 100,000 people and serving more than 100,000 people, respectively), plus a statistically representative national sample of 800 small PWSs (serving 10,000 people or fewer).[11] Surface water and GWUDI sampling points were monitored four times during the applicable year of monitoring, and ground water sample points were monitored twice during the applicable year of monitoring. See USEPA (2012b) and USEPA (2019a) for more information on the UCMR 3 study design and data analysis.

Exhibit 6-3 through Exhibit 6-5 provide an overview of PFNA occurrence results from the UCMR 3 Assessment Monitoring. Laboratories participating in UCMR 3 were required to report values at or above MRLs defined by the EPA. The UCMR MRLs are not intended to represent the lowest achievable measurement level an individual laboratory may achieve. Rather, the MRLs are established to ensure reliable and consistent results from the array of laboratories needed for a national monitoring program and are set based on the quantitation level capability of multiple commercial laboratories prior to beginning each UCMR round. The MRL used for PFNA in the UCMR 3 survey was 20 ng/L (77 FR 26072; USEPA, 2012b). Exhibit 6-3 presents a sample-level summary of the results. Exhibit 6-4 shows a statistical summary of PFNA concentrations by system size and source water type (including the minimum, 25^{th} percentile, median, 75^{th} percentile, 90^{th} percentile, 99^{th} percentile, and maximum). Exhibit 6-5 shows system-level results for detections greater than or equal to the MRL.

A total of 36,972 finished water samples for PFNA were collected from 4,920 PWSs. PFNA was reported ≥ MRL of 20 ng/L in 0.05 percent of UCMR 3 samples. Reported PFNA concentrations for these results ranged from 22 ng/L to 55.88 ng/L. Of 4,920 systems, 14 (0.28 percent of systems, serving 0.22 percent of the PWS-served population) reported at least one detection.

[11] A total of 799 small systems submitted Assessment Monitoring results.

Exhibit 6-4: PFNA National Occurrence Measures Based on UCMR 3 Assessment Monitoring Data - Summary of Samples

Source Water Type	Total # of Samples	Samples with Detections ≥ MRL of 20 ng/L	
		Number	Percent
Small Systems (serving ≤ 10,000 people)			
Ground Water	1,853	0	0.00%
Surface Water	1,421	1	0.07%
All Small Systems	**3,274**	**1**	**0.03%**
Large Systems (serving 10,001 - 100,000 people) -- CENSUS			
Ground Water	11,707	11	0.09%
Surface Water	14,860	5	0.03%
All Large Systems	**26,567**	**16**	**0.06%**
Very Large Systems (serving > 100,000 people) -- CENSUS			
Ground Water	2,020	1	0.05%
Surface Water	5,111	1	0.02%
All Very Large Systems	**7,131**	**2**	**0.03%**
All Systems			
All Water Systems	**36,972**	**19**	**0.05%**

Exhibit 6-5: PFNA Occurrence Data from UCMR 3 Assessment Monitoring - Summary of Reported Concentrations

Source Water Type	Concentration Value of Detections (in ng/L) ≥ MRL of 20 ng/L						
	Minimum	25th percentile	Median	75th percentile	90th Percentile	99th Percentile	Maximum
Small Systems (serving ≤ 10,000 people)							
Ground Water	--	--	--	--	--	--	--
Surface Water	26	26	26	26	26	26	26
All Small Systems	**26**	**26**	**26**	**26**	**26**	**26**	**26**
Large Systems (serving 10,001 - 100,000 people) -- CENSUS							
Ground Water	22	26.8	28.1	34.9	52.1	52.64	52.7
Surface Water	29	30	46.16	46.6	52.168	55.5088	55.88
All Large Systems	**22**	**27.75**	**31.15**	**46.27**	**52.4**	**55.403**	**55.88**
Very Large Systems (serving > 100,000 people) -- CENSUS							
Ground Water	32	32	32	32	32	32	32
Surface Water	53.8	53.8	53.8	53.8	53.8	53.8	53.8
All Very Large Systems	**32**	**37.45**	**42.9**	**48.35**	**51.62**	**53.582**	**53.8**
All Systems							
All Water Systems	**22**	**27.5**	**32**	**46.38**	**52.92**	**55.5056**	**55.88**

Exhibit 6-6: PFNA National Occurrence Measures Based on UCMR 3 Assessment Monitoring Data - Summary of System and Population Served Data - Reported Detections

Source Water Type	UCMR 3 Samples		Number With At Least One Detection ≥ MRL of 20 ng/L		Percent With At Least One Detection ≥ MRL of 20 ng/L		National Inventory		Percent of National Inventory Included	
	Systems	Population	Systems	Population	Systems	Population	Systems	Population	Systems	Population
Small Systems (serving ≤ 10,000 people)										
Ground Water	527	1,498,845	0	0	0.00%	0.00%	55,700	38,730,597	0.95%	3.87%
Surface Water	272	1,250,215	1	8,323	0.37%	0.67%	9,728	20,007,917	2.80%	6.25%
All Small Systems	**799**	**2,749,060**	**1**	**8,323**	**0.13%**	**0.30%**	**65,428**	**58,738,514**	**1.22%**	**4.68%**
Large Systems (serving 10,001 - 100,000 people) -- CENSUS										
Ground Water	1,453	37,141,418	7	140,373	0.48%	0.38%	1,470	37,540,614	98.84%	98.94%
Surface Water	2,260	69,619,878	4	148,645	0.18%	0.21%	2,310	70,791,005	97.84%	98.35%
All Large Systems	**3,713**	**106,761,296**	**11**	**289,018**	**0.30%**	**0.27%**	**3,780**	**108,331,619**	**98.23%**	**98.55%**
Very Large Systems (serving > 100,000 people) -- CENSUS										
Ground Water	68	16,355,951	1	120,000	1.47%	0.73%	68	16,355,951	100.00%	100.00%
Surface Water	340	115,158,260	1	109,000	0.29%	0.09%	343	120,785,622	99.13%	95.34%
All Very Large Systems	**408**	**131,514,211**	**2**	**229,000**	**0.49%**	**0.17%**	**411**	**137,141,573**	**99.27%**	**95.90%**
All Systems										
All Water Systems	**4,920**	**241,024,567**	**14**	**526,341**	**0.28%**	**0.22%**	**69,619**	**304,211,706**	**7.07%**	**79.23%**

6.2.1.2 State Monitoring Data

In the development of the proposed and final NPDWR, the agency supplemented its UCMR 3 data with more recent publicly available data collected by states. In general, these more recent state data were collected using newer analytical methods and state results reflect lower reporting and detection limits than those in the UCMR 3. Drinking water occurrence data from PWSs for PFNA were available online from several states, including Alabama, Arizona, California, Colorado, Georgia, Idaho, Illinois, Indiana, Iowa, Kentucky, Maine, Maryland, Massachusetts, Michigan, Missouri, New Hampshire, New Jersey, New Mexico, New York, North Carolina, North Dakota, Ohio, Oregon, Pennsylvania, South Carolina, Tennessee, Vermont, Virginia, and Wisconsin. The EPA downloaded publicly available monitoring data from state websites through May 2023. Note that while some states did have available raw water data as indicated in Exhibit 6-6, for the subsequent analyses the EPA only evaluated finished water results.

Exhibit 6-6 provides a summary of the available state reported monitoring data for PFNA, including date range and a description of coverage and representativeness (including whether monitoring was non-targeted or targeted (i.e., monitoring in areas of known or potential PFAS contamination)). A description of those studies is also included in Exhibit 6-6. State reporting thresholds are also provided, where available, in Exhibit 6-6. The EPA notes that different states utilized various reporting thresholds when analyzing and presenting their data, and for some states there were no clearly defined thresholds publicly provided; in these cases, minimum detected concentrations reported may be indicative of reporting thresholds used. Further, for some states, the thresholds varied when reporting results for the same analyte, as well as the laboratory analyzing the data. For those states, a range of thresholds is provided. As shown in Exhibit 6-6, some states reported at thresholds and/or presented data at concentrations below the EPA's final MCL and/or PQL for PFNA. However, to present the best available occurrence information, the EPA collected and evaluated the data based on the information as reported directly by the states and when conducting data analyses incorporated individual state-specific reporting thresholds where possible. Additionally, the EPA notes that the majority of the data were analyzed via an EPA-approved drinking water analytical method.

Exhibit 6-7: Summary of Available PFNA State Reported Monitoring Data

State (Reference)	Date Range	Type of Water Tested	Reporting Threshold (ppt)	Notes on Coverage	Survey Type
Alabama (ADEM, 2023)	2020-2022	Ground Water and Surface Water - Finished Water	Not reported	ADPH instructed water systems to carry out PFAS monitoring at all PWSs not previously sampled during UCMR 3. In 2022, water systems that had not been sampled since UCMR 3 were required to sample between January and June 2022 using current analytical methods . Only results that are above the MRL are posted online; thus, only reported detections were available for use in the occurrence analyses.	Non-Targeted
Arizona (ADEQ, 2023)	2021	Ground Water and Surface Water - Raw and Finished Water	1.6 - 2	ADEQ presents a PFAS Interactive Data Map that displays the results of testing conducted by ADEQ since 2018 at PWSs across Arizona.	Targeted
California (CADDW, 2023)	2013 - April 2023	Ground Water and Surface Water - Raw, Finished, and Unknown Water	0.002 - 20	The EPA reviewed the California PFNA data available online through April 2023. Finished water data were available from approximately 120 PWSs. For this analysis, the EPA only included results that were explicitly marked as being from treated water. Sampling in California is ongoing.	Targeted
Colorado (CDPHE, 2018;CDPHE, 2020)	2013 - 2017	Surface Water (Finished Water) and Drinking Water Distribution Samples	2 - 30	Data available from 28 “drinking water distribution zones” (one or more per PWS) in targeted sampling efforts at a known contaminated aquifer region. Data were collected by El Paso County Public Health, local water districts and utilities, and the CDPHE.	Targeted
	2020	Ground Water and Surface Water - Raw and Finished Water	1.6 - 2.4	CDPHE offered free testing to PWSs serving communities, schools, and workplaces and also to fire districts with wells. Approximately 50% of PWSs in Colorado participated in the 2020 PFAS sampling project. Data included in this report were collected in March through May of 2020.	Non-Targeted
Georgia (GA EPD, 2020)	2020	Surface Water - Raw, Finished, and Unknown Water	20	The EPA and the GA EPD conducted joint sampling of the City of Summerville’s drinking water sources and finished drinking water in January 2020.	Targeted
Idaho (Idaho DEQ, 2023)	2021 - April 2023	Ground Water - Finished and Unknown Water	0.5 - 1	Sampling of finished drinking water data between September 2021 and April 2023 that were available on the state’s Drinking Water Watch website.	Not specified

State (Reference)	Date Range	Type of Water Tested	Reporting Threshold (ppt)	Notes on Coverage	Survey Type
Illinois (IL EPA, 2023)	2020 - May 2023	Ground Water and Surface Water - Raw and Finished Water	1.7 - 2	In 2020, the IL EPA initiated a statewide investigation into the prevalence and occurrence of PFAS in finished drinking water at 1,749 community water supplies across Illinois. The EPA reviewed finished drinking water data collected between September 2020 and May 2023 that were available on the state's Drinking Water Watch website. Sampling in Illinois is ongoing.	Non-Targeted
Indiana (IDEM, 2023)	2021 - January 2023	Ground Water and Surface Water - Raw, Finished, and Unknown Water	2	Beginning in February 2021, the IDEM facilitated PFAS monitoring at all CWSs throughout the state of Indiana. Samples were to be collected at all raw water (i.e., wells and intakes) and finished (after treatment) water points in a CWS's supply to evaluate the statewide occurrence of PFAS compounds in CWS across the state and determine the efficacy of conventional drinking water treatment for PFAS.	Non-Targeted
Iowa (IA DNR, 2023)	2021 - April 2023	Ground Water and Surface Water - Raw and Finished Water	1.7 - 4	In January 2020, the Iowa DNR developed an Action Plan to protect the health of Iowa residents and the environment from PFAS. Data were downloaded from the PFAS Sampling Interactive Dashboard and Map.	Targeted
Kentucky (KYDEP, 2019)	2019	Ground Water and Surface Water - Finished Water	3.24	Sampling of finished drinking water data between June and October 2019. Under this sampling effort, data are available from 81 community public DWTPs, representing 74 PWSs, and serving more than 2.4 million people.	Non-Targeted
Maine (Maine DEP, 2020; Maine DHHS, 2023)	2013 - 2020	Drinking Water - Raw, Finished, and Unknown Water	1.78 - 20	In March 2019, the Maine PFAS Task Force was created to review the extent of PFAS contamination in Maine. Finished water results collected from 2013 through 2020 have been collected at 23 locations throughout the state. Data may include results from public and private finished drinking water sources. Sampling in Maine is ongoing.	Targeted
	2021 - January 2023	Ground Water and Surface Water - Finished Water	2	The EPA reviewed the finished water data reported to the Maine CDC Drinking Water Program as compliance samples since June 2021 and processed in the database as of 3/10/2023. Sampling in Maine is ongoing.	Non-Targeted
Maryland (MDE, 2021; MDE, 2022a; MDE, 2022b)	2020 - 2022	Raw and Finished Water	2	In 2020, MDE initiated a project to identify potential sources of PFAS in Maryland and to prioritize water sources for PFAS sampling. The EPA reviewed the finished water results from the first three phases of MDE's Public Water System study for the occurrence of PFAS in State drinking water sources. Under Phase 1 (September 2020 - February 2021), sites were selected for priority sampling based on MDE's evaluation of potential relative risk for PFAS exposure through drinking water. Under Phase 2 (March 2021 - May 2021), MDE conducted sampling at sites that were selected based on their geological setting and proximity to	Targeted (Phase 1, Phase 2); Non-Targeted (Phase 3)

State (Reference)	Date Range	Type of Water Tested	Reporting Threshold (ppt)	Notes on Coverage	Survey Type
				potential sources of PFAS. Under Phase 3 (August 2021- June 2022), MDE tested the remaining CWSs in the state.	
Massachusetts (MA EEA, 2023)	2016 - April 2023	Ground Water and Surface Water - Raw and Finished Water	0.43 - 10	The EPA reviewed the finished water data available online through April 2023. Data were available from 226 PWSs. Sampling in Massachusetts is ongoing.	Targeted
Michigan (Michigan EGLE, 2023)	2020 - March 2023	Ground Water and Surface Water - Finished Water	2	The Michigan EGLE developed MCLs for seven PFAS compounds in Michigan, which took effect in August 2020. The EPA reviewed available finished compliance monitoring results through March 2023. Sampling in Michigan is ongoing.	Non-Targeted
Minnesota (MDH, 2023)	2020 - 2023	Ground Water and Surface Water - Finished Water	Not reported	Through the Statewide PFAS Monitoring Project, MDH is testing CWSs across the state for PFAS. The EPA reviewed finished water data through MDH's Interactive Dashboard for PFAS Testing in Drinking Water.	Non-Targeted
Missouri (Missouri DNR, 2023)	2022 - 2023	Ground Water and Surface Water - Raw and Finished Water	Not reported	The EPA reviewed the finished water data available online from Missouri DNR's "PFAS Viewer Tool" which identifies the location of voluntary sampling for PFAS in public drinking water systems in Missouri. The EPA reviewed finished water data collected from approximately 113 PWSs from 2022 through 2023. Limited data were also available from 2013 through 2017.	Non-Targeted
New Hampshire (NHDES, 2021)	2016 - May 2021	Ground Water and Surface Water - Raw and Finished Water	Not reported	The EPA reviewed the New Hampshire PFNA data available online through May 2021. Finished water data were available from more than 500 PWSs. Sampling in New Hampshire is ongoing.	Non-Targeted
New Jersey (NJDEP, 2023)	2019 - May 2023	Ground Water and Surface Water - Raw, Finished, and Unknown Water	0.019 - 2,000	Statewide sampling of finished drinking water data was available from 2019-2023. The EPA reviewed data available online through May 2023. Sampling in New Jersey is ongoing.	Non-Targeted
New Mexico (NMED, 2019)	2016	Ground Water - Raw and Finished Water	Not reported	NMED, Department of Health and the U.S. Air Force conducted testing at public drinking water supplies at or around Cannon Air Force Base up to 2019.	Targeted
New York (NYDOH, 2022)	2017 - 2022	Ground Water and Surface Water - Raw, Finished, and Unknown Water	0.000000001 - 2,020	The EPA reviewed finished water data voluntarily provided by the state to the EPA. Data were available from nearly 2,600 PWSs from 2017 through 2022. Limited data were also available from 2013 and 2016.	Non-Targeted

State (Reference)	Date Range	Type of Water Tested	Reporting Threshold (ppt)	Notes on Coverage	Survey Type
North Carolina (NCDEQ, 2021)	2017 - 2019	Finished and unknown water	Not reported	NCDEQ and the Department of Health and Human Services investigated the presence of HFPO-DA and other PFAS in the Cape Fear River in June 2017. Monthly results were also collected from five water treatment plants on the Cape Fear River. Data were available from June 2017 through October 2019. Only results above the DL were reported; thus, only reported detections were available for use in the occurrence analyses.	Targeted
North Dakota (NDDEQ, date unknown; NDDEQ, date unknown)	2020, 2021	Ground Water and Surface Water - Raw and Finished Water	Not reported	NDDEQ published a 2020 and a 2021 survey report of North Dakota Statewide PFAS Presence/Absence results. The sampling effort in October of 2020 sought to determine if there was a PFAS presence in a representative portion of the state's public water supply. In 2021, sampling conducted as part of the third phase of the survey focused on drinking water sites not evaluated in the first two surveys.	Non-Targeted
Ohio (Ohio EPA, 2023)	December 2019 - December 2021	Ground Water and Surface Water - Raw and Finished Water	5	The Ohio EPA coordinated sampling of raw and finished drinking water from PWSs throughout the state. The EPA reviewed the finished water data available online through December 2021. During this timeframe, data were available from 1,479 PWSs.	Non-Targeted
Oregon (OHA-DWS, 2022)	2021 - July 2022	Ground Water and Surface Water - Finished Water	10.1 - 12.4	OHA conducted a PFAS drinking water monitoring project in 2021 at PWSs in Oregon identified as at risk due to their proximity to a known or suspected PFAS use or contamination site. The EPA reviewed the finished water data from more than 140 PWSs.	Targeted
Pennsylvania (PADEP, 2019)	2019	Ground Water and Surface Water - Finished Water	1.9	A PFAS Sampling Plan was developed to test PWSs across the state. Finished water data were collected for 87 PWSs in 2019.	Targeted
Pennsylvania (PADEP, 2021)	2020 - March 2021	Ground Water and Surface Water - Finished Water	1.7 - 4	Beginning in 2020 and running through March of 2021, finished water data were collected by more than 340 PWSs.	Targeted
South Carolina (SCDHEC, 2020; SCDHEC, 2023)	2017 - March 2023	Ground Water and Surface Water -Raw and Finished Water	2.1	The EPA reviewed PFAS sampling results collected by the South Carolina Bureau of Water for community drinking water systems Data were available from 300 PWSs..	Non-Targeted
Tennessee (TDEC, 2023)	2019	Surface Water - Raw and Finished Water	Not reported	In 2019, Metro Water Services conducted a voluntary sampling of Nashville's drinking water systems for PFAS. Their stated goal was to go above and beyond current federal and state monitoring requirements to understand the potential presence of PFAS in Nashville's drinking water.	Non-Targeted

State (Reference)	Date Range	Type of Water Tested	Reporting Threshold (ppt)	Notes on Coverage	Survey Type
Vermont (VT DEC, 2023)	2019 -April 2023	Ground Water and Surface Water - Raw, Finished, and Unknown Water	2	The Vermont Water Supply Rule required all CWSs and NTNCWSs to sample for PFAS. The EPA reviewed finished water data available online from July 2019 - April 2023 from approximately 560 PWSs. Sampling in Vermont is ongoing.	Non-Targeted
Virginia (VDH ODW, 2021)	2021	Ground Water and Surface Water - Raw and Finished Water	3.5	The Virginia ODW, in conjunction with VA PFAS work group, designed the sample study to prioritize sites for measuring PFAS concentrations in drinking water and major sources of water and generate statewide occurrence data.	Targeted / Non-Targeted
Wisconsin (WI DNR, 2023)	2022 - April 2023	Ground Water and Surface Water - Raw, Finished, and Unknown Water	Not reported	The EPA reviewed the finished water data available online from 2022 - 2023. Data were available from nearly 250 PWSs. Sampling in Wisconsin is ongoing.	Non-Targeted

A summary of state reported monitoring data from PWSs for PFNA is presented in Exhibit 6-7 through Exhibit 6-9. As noted above, some of the monitoring data from each state are limited and may not be representative of occurrence in the state. In addition, states have varying reporting thresholds, as indicated in the first column of Exhibit 6-7. For states with available reporting thresholds, only detected concentrations greater than the reporting thresholds were counted as detections. For states that did not provide reporting thresholds, the EPA included all detected concentrations reported in the count of detections. Overall, state reported detected concentrations ranged from 0.22 ppt (North Carolina) to 330 ppt (New York). Note that for a small number of systems, population served information could not be identified. These systems were included in the counts and analysis presented in Exhibit 6-9; however, no associated population served was included in the counts and analysis presented in Exhibit 6-9.

Exhibit 6-8: PFNA State Reported Drinking Water Occurrence Data - Summary of Finished Water Samples

State (Reporting Threshold)	Source Water Type	Total Number of Samples	All Detections		All Detections > 10 ppt	
			Number	Percent	Number	Percent
Alabama[1] (Not reported)	Ground Water	--	2	--	1	--
	Surface Water	--	17	--	0	--
	Total	**--**	**19**	**--**	**1**	**--**
Arizona (1.6 - 2 ppt)	Ground Water	23	1	4.3%	0	0.0%
	Surface Water	2	1	50.0%	0	0.0%
	Total	**25**	**2**	**8.0%**	**0**	**0.0%**
California (0.002 - 20 ppt)	Ground Water	1,882	24	1.3%	0	0.0%
	Surface Water	3,946	49	1.2%	0	0.0%
	Unknown	4	0	0.0%	0	0.0%
	Total	**5,832**	**73**	**1.3%**	**0**	**0.0%**
Colorado (2013-2017) (2 - 30 ppt)	Distribution (Finished)	94	5	5.3%	4	4.3%
	Surface water (Finished)	11	0	0.0%	0	0.0%
	Total	**105**	**5**	**4.8%**	**4**	**3.8%**
Colorado (2020) (1.6 - 2.4 ppt)	Ground Water	339	4	1.2%	0	0.0%
	Surface Water	244	1	0.4%	0	0.0%
	Total	**583**	**5**	**0.9%**	**0**	**0.0%**
Georgia (20 ppt)	Ground Water	0	0	0.0%	0	0.0%
	Surface Water	2	0	0.0%	0	0.0%
	Total	**2**	**0**	**0.0%**	**0**	**0.0%**
Idaho (0.5 - 1 ppt)	Ground Water	18	0	0.0%	0	0.0%
	Surface Water	0	0	0.0%	0	0.0%
	Total	**18**	**0**	**0.0%**	**0**	**0.0%**
Illinois (1.7 - 2 ppt)	Ground Water	1,823	3	0.2%	0	0.0%
	Surface Water	302	10	3.3%	0	0.0%
	Total	**2,125**	**13**	**0.6%**	**0**	**0.0%**
Indiana	Ground Water	422	0	0.0%	0	0.0%

State (Reporting Threshold)	Source Water Type	Total Number of Samples	All Detections		All Detections > 10 ppt	
			Number	Percent	Number	Percent
(2 ppt)	Surface Water	59	1	1.7%	0	0.0%
	Total	**481**	**1**	**0.2%**	**0**	**0.0%**
Iowa (1.7 - 4 ppt)	Ground Water	151	0	0.0%	0	0.0%
	Surface Water	63	0	0.0%	0	0.0%
	Total	**214**	**0**	**0.0%**	**0**	**0.0%**
Kentucky (3.24 ppt)	Ground Water	33	0	0.0%	0	0.0%
	Surface Water	48	2	4.2%	0	0.0%
	Total	**81**	**2**	**2.5%**	**0**	**0.0%**
Maine (PFAS Task Force)[2] (1.78 - 20 ppt)	Ground Water	9	0	0.0%	0	0.0%
	Surface Water	3	0	0.0%	0	0.0%
	Unknown	75	6	8.0%	0	0.0%
	Total	**87**	**6**	**6.9%**	**0**	**0.0%**
Maine (Compliance) (2 ppt)	Ground Water	646	23	3.6%	3	0.5%
	Surface Water	62	2	3.2%	0	0.0%
	Total	**708**	**25**	**3.5%**	**3**	**0.4%**
Maryland (Phase 1) (2 ppt)	Ground Water	70	2	2.9%	0	0.0%
	Surface Water	76	3	3.9%	0	0.0%
	Total	**146**	**5**	**3.4%**	**0**	**0.0%**
Maryland (Phase 2) (2 ppt)	Ground Water	9	1	11.1%	0	0.0%
	Surface Water	0	0	0.0%	0	0.0%
	Total	**9**	**1**	**11.1%**	**0**	**0.0%**
Maryland (Phase 3) (2 ppt)	Ground Water	88	2	2.3%	0	0.0%
	Surface Water	0	0	0.0%	0	0.0%
	Total	**88**	**2**	**2.3%**	**0**	**0.0%**
Massachusetts (0.43 - 10 ppt)	Ground Water	7,201	245	3.4%	8	0.1%
	Surface Water	2,133	28	1.3%	0	0.0%
	Total	**9,334**	**273**	**2.9%**	**8**	**0.1%**
Michigan (2 ppt)	Ground Water	10,007	64	0.6%	6	0.1%
	Surface Water	519	1	0.2%	0	0.0%
	Unknown	164	1	0.6%	0	0.0%
	Total	**10,690**	**66**	**0.6%**	**6**	**0.1%**
Missouri, 2022 - 2023 (Not reported)	Ground Water	192	0	0.0%	0	0.0%
	Surface Water	22	0	0.0%	0	0.0%
	Total	**214**	**0**	**0.0%**	**0**	**0.0%**
New Hampshire (Not reported)	Ground Water	1,656	59	3.6%	14	0.8%
	Surface Water	157	1	0.6%	0	0.0%
	Unknown	1	0	0.0%	0	0.0%
	Total	**1,814**	**60**	**3.3%**	**14**	**0.8%**
New Jersey (0.019 - 2,000 ppt)	Ground Water	12,891	888	6.9%	40	0.3%
	Surface Water	3,356	360	10.7%	30	0.9%

State (Reporting Threshold)	Source Water Type	Total Number of Samples	All Detections		All Detections > 10 ppt	
			Number	Percent	Number	Percent
	Unknown	18	0	0.0%	0	0.0%
	Total	**16,265**	**1,248**	**7.7%**	**70**	**0.4%**
New Mexico (Not reported)	Ground Water	2	0	0.0%	0	0.0%
	Surface Water	0	0	0.0%	0	0.0%
	Total	**2**	**0**	**0.0%**	**0**	**0.0%**
New York (0.000000001-2,020 ppt)	Ground Water	1,827	171	9.4%	8	0.4%
	Surface Water	397	21	5.3%	0	0.0%
	Unknown	9	0	0.0%	0	0.0%
	Total	**2,233**	**192**	**8.6%**	**8**	**0.4%**
North Carolina[1] (Not Reported)	Unknown	--	372	--	323	--
	Total	**--**	**372**	**--**	**323**	**--**
North Dakota (2020) (Not reported)	Ground Water	42	0	0.0%	0	0.0%
	Surface Water	9	0	0.0%	0	0.0%
	Total	**51**	**0**	**0.0%**	**0**	**0.0%**
North Dakota (2021) (Not reported)	Ground Water	56	0	0.0%	0	0.0%
	Surface Water	7	0	0.0%	0	0.0%
	Total	**63**	**0**	**0.0%**	**0**	**0.0%**
Ohio (5 ppt)	Ground Water	1,775	5	0.3%	2	0.1%
	Surface Water	170	1	0.6%	0	0.0%
	Total	**1,945**	**6**	**0.3%**	**2**	**0.1%**
Oregon (10.1 - 12.4 ppt)	Ground Water	131	0	0.0%	0	0.0%
	Surface Water	29	0	0.0%	0	0.0%
	Total	**160**	**0**	**0.0%**	**0**	**0.0%**
Pennsylvania (2019) (1.9 ppt)	Ground Water	75	4	5.3%	0	0.0%
	Surface Water	21	2	9.5%	0	0.0%
	Total	**96**	**6**	**6.3%**	**0**	**0.0%**
Pennsylvania (2021) (1.7 - 4 ppt)	Ground Water	314	16	5.1%	1	0.3%
	Surface Water	98	7	7.1%	1	1.0%
	Total	**412**	**23**	**5.6%**	**2**	**0.5%**
South Carolina (2.1 ppt)	Ground Water	572	0	0.0%	0	0.0%
	Surface Water	188	1	0.5%	0	0.0%
	Total	**760**	**1**	**0.1%**	**0**	**0.0%**
Tennessee (Not reported)	Ground Water	0	0	0.0%	0	0.0%
	Surface Water	2	0	0.0%	0	0.0%
	Total	**2**	**0**	**0.0%**	**0**	**0.0%**
Vermont (2 ppt)	Ground Water	1,463	39	2.7%	10	0.7%
	Surface Water	102	0	0.0%	0	0.0%
	Total	**1,565**	**39**	**2.5%**	**10**	**0.6%**
Virginia (3.5 ppt)	Ground Water	5	0	0.0%	0	0.0%
	Surface Water	36	0	0.0%	0	0.0%

State (Reporting Threshold)	Source Water Type	Total Number of Samples	All Detections		All Detections > 10 ppt	
			Number	Percent	Number	Percent
	Total	**41**	**0**	**0.0%**	**0**	**0.0%**
Wisconsin (Not reported)	Ground Water	690	13	1.9%	0	0.0%
	Surface Water	47	3	6.4%	0	0.0%
	Total	**737**	**16**	**2.2%**	**0**	**0.0%**

[1] Only reported detections were available in this state's dataset.
[2] Reported data from Maine may include results from public and private finished drinking water sources. Based on available state data information, the EPA could not verify PWSIDs for all included samples.

Exhibit 6-9: PFNA State Reported Drinking Water Occurrence Data - Summary of Detected Concentrations

State (Reporting Threshold)	Source Water Type	Concentration Value of Detections (ppt)				
		Minimum	Median	90th Percentile	99th Percentile	Maximum
Alabama[1] (Not reported)	Ground Water	7.2	12.6	16.9	17.9	18
	Surface Water	0.5	2.10	6.40	6.48	6.5
	Total	**0.5**	**3.70**	**6.64**	**16.1**	**18**
Arizona (1.6 - 2 ppt)	Ground Water	4.1	4.1	4.1	4.1	4.1
	Surface Water	4.5	4.5	4.5	4.5	4.5
	Total	**4.1**	**4.30**	**4.46**	**4.50**	**4.5**
California (0.002 - 20 ppt)	Ground Water	0.23	2.40	3.00	7.24	8.3
	Surface Water	1.8	3.50	5.90	7.07	7.5
	Unknown	--	--	--	--	--
	Total	**0.23**	**3.20**	**4.26**	**7.72**	**8.3**
Colorado (2013-2017) (2 - 30 ppt)	Distribution (Finished)	9.2	78.0	160	178	180
	Surface water	--	--	--	--	--
	Total	**9.2**	**78.0**	**160**	**178**	**180**
Colorado (2020) (1.6 - 2.4 ppt)	Ground Water	1.9	2.20	5.20	6.28	6.4
	Surface Water	2.4	2.4	2.4	2.4	2.4
	Total	**1.9**	**2.40**	**4.80**	**6.24**	**6.4**
Georgia (20 ppt)	Ground Water	--	--	--	--	--
	Surface Water	--	--	--	--	--
	Total	**--**	**--**	**--**	**--**	**--**
Idaho (0.5 - 1 ppt)	Ground Water	--	--	--	--	--
	Surface Water	--	--	--	--	--
	Total	**--**	**--**	**--**	**--**	**--**
Illinois (1.7 - 2 ppt)	Ground Water	2.1	2.10	2.26	2.30	2.3
	Surface Water	2	2.70	3.06	3.55	3.6
	Total	**2**	**2.60**	**3.00**	**3.53**	**3.6**

State (Reporting Threshold)	Source Water Type	Concentration Value of Detections (ppt)				
		Minimum	Median	90th Percentile	99th Percentile	Maximum
Indiana (2 ppt)	Ground Water	--	--	--	--	--
	Surface Water	4.823	4.823	4.823	4.823	4.823
	Total	**4.823**	**4.823**	**4.823**	**4.823**	**4.823**
Iowa (1.7 - 4 ppt)	Ground Water	--	--	--	--	--
	Surface Water	--	--	--	--	--
	Total	**--**	**--**	**--**	**--**	**--**
Kentucky (3.24 ppt)	Ground Water	--	--	--	--	--
	Surface Water	0.99	1.29	1.52	1.57	1.58
	Total	**0.99**	**1.29**	**1.52**	**1.57**	**1.58**
Maine (PFAS Task Force)[2] (1.78 - 20 ppt)	Ground Water	--	--	--	--	--
	Surface Water	--	--	--	--	--
	Unknown	2.19	9.58	12.0	12.0	12
	Total	**2.19**	**9.58**	**12.0**	**12.0**	**12**
Maine (Compliance) (2 ppt)	Ground Water	2.05	5.84	62.5	116	127
	Surface Water	2.1	2.84	3.42	3.56	3.57
	Total	**2.05**	**5.65**	**50.5**	**115**	**127**
Maryland (Phase 1) (2 ppt)	Ground Water	2.09	2.59	2.98	3.07	3.08
	Surface Water	2.27	2.66	8.66	10.0	10.16
	Total	**2.09**	**2.66**	**7.33**	**9.88**	**10.16**
Maryland (Phase 2) (2 ppt)	Ground Water	2.03	2.03	2.03	2.03	2.03
	Surface Water	--	--	--	--	--
	Total	**2.03**	**2.03**	**2.03**	**2.03**	**2.03**
Maryland (Phase 3) (2 ppt)	Ground Water	2.43	3.50	4.35	4.54	4.56
	Surface Water	--	--	--	--	--
	Total	**2.43**	**3.50**	**4.35**	**4.54**	**4.56**
Massachusetts (0.43 - 10 ppt)	Ground Water	0.816	3.74	8.19	24.6	35.1
	Surface Water	1.83	2.57	8.62	9.22	9.3
	Total	**0.816**	**3.66**	**8.43**	**24.2**	**35.1**
Michigan (2 ppt)	Ground Water	2	4.00	9.70	32.7	34
	Surface Water	2	2	2	2	2
	Unknown	3	3	3	3	3
	Total	**2**	**4.00**	**9.50**	**32.7**	**34**
Missouri, 2022 - 2023 (Not reported)	Ground Water	--	--	--	--	--
	Surface Water	--	--	--	--	--
	Total	**--**	**--**	**--**	**--**	**--**
New Hampshire (Not reported)	Ground Water	0.51	3.49	43.8	88.8	94.2
	Surface Water	1.7	1.7	1.7	1.7	1.7
	Unknown	--	--	--	--	--
	Total	**0.51**	**3.21**	**43.2**	**88.7**	**94.2**

State (Reporting Threshold)	Source Water Type	Concentration Value of Detections (ppt)				
		Minimum	Median	90th Percentile	99th Percentile	Maximum
New Jersey (0.019 - 2,000 ppt)	Ground Water	0.24	3.23	10.0	31.3	57
	Surface Water	0.386	2.20	11.3	54.6	64
	Unknown	--	--	--	--	--
	Total	**0.24**	**2.83**	**10.0**	**40.9**	**64**
New Mexico (Not reported)	Ground Water	--	--	--	--	--
	Surface Water	--	--	--	--	--
	Total	**--**	**--**	**--**	**--**	**--**
New York (0.000000001-2,020 ppt)	Ground Water	0.41	2.20	9.76	22.3	330
	Surface Water	0.432	1.02	2.20	5.34	5.62
	Unknown	--	--	--	--	--
	Total	**0.41**	**2.10**	**9.23**	**21.2**	**330**
North Carolina[1] (Not Reported)	Unknown	0.22	40.0	40.0	79.3	80
	Total	**0.22**	**40.0**	**40.0**	**79.3**	**80**
North Dakota (2020) (Not reported)	Ground Water	--	--	--	--	--
	Surface Water	--	--	--	--	--
	Total	**--**	**--**	**--**	**--**	**--**
North Dakota (2021) (Not reported)	Ground Water	--	--	--	--	--
	Surface Water	--	--	--	--	--
	Total	**--**	**--**	**--**	**--**	**--**
Ohio (5 ppt)	Ground Water	5.6	6.61	23.1	23.9	24
	Surface Water	8.3	8.3	8.3	8.3	8.3
	Total	**5.6**	**7.46**	**22.9**	**23.9**	**24**
Oregon (10.1 - 12.4 ppt)	Ground Water	--	--	--	--	--
	Surface Water	--	--	--	--	--
	Total	**--**	**--**	**--**	**--**	**--**
Pennsylvania (2019) (1.9 ppt)	Ground Water	2.4	4.10	5.84	5.89	5.9
	Surface Water	4.3	9.15	13.0	13.9	14
	Total	**2.4**	**5.00**	**9.95**	**13.6**	**14**
Pennsylvania (2021) (1.7 - 4 ppt)	Ground Water	1.8	5.35	14.0	17.5	18.1
	Surface Water	2.1	5.90	11.1	14.6	15
	Total	**1.8**	**5.60**	**14.0**	**17.4**	**18.1**
South Carolina (2.1 ppt)	Ground Water	--	--	--	--	--
	Surface Water	2.5	2.5	2.5	2.5	2.5
	Total	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**
Tennessee (Not reported)	Ground Water	--	--	--	--	--
	Surface Water	--	--	--	--	--
	Total	**--**	**--**	**--**	**--**	**--**
Vermont (2 ppt)	Ground Water	2	4.97	19.9	31.6	36.2
	Surface Water	--	--	--	--	--

State (Reporting Threshold)	Source Water Type	Concentration Value of Detections (ppt)				
		Minimum	Median	90th Percentile	99th Percentile	Maximum
	Total	**2**	**4.97**	**19.9**	**31.6**	**36.2**
Virginia (3.5 ppt)	Ground Water	--	--	--	--	--
	Surface Water	--	--	--	--	--
	Total	**--**	**--**	**--**	**--**	**--**
Wisconsin (Not reported)	Ground Water	0.225	0.39	2.35	3.97	4.17
	Surface Water	0.3	0.33	0.338	0.340	0.34
	Total	**0.225**	**0.350**	**2.07**	**3.93**	**4.17**

Note: With limited exceptions, calculated concentration values (i.e., median, 90th percentile and 99th percentile concentrations) were rounded to three significant figures for consistent presentation across the datasets and may not indicate exact laboratory precision.
[1] Only reported detections were available in this state's dataset.
[2] Reported data from Maine may include results from public and private finished drinking water sources. Based on available state data information, the EPA could not verify PWSIDs for all included samples.

Exhibit 6-10: PFNA State Reported Drinking Water Occurrence Data - Summary of Systems with Finished Water Data

State (Reporting Threshold)	Source Water Type	Total Number of Systems	Systems with Detections		Systems with Detections > 10 ppt	
			Number	Percent	Number	Percent
Alabama[1] (Not reported)	Ground Water	--	2	--	1	--
	Surface Water	--	5	--	0	--
	Total	**--**	**7**	**--**	**1**	**--**
Arizona (1.6 - 2 ppt)	Ground Water	5	1	20.0%	0	0.0%
	Surface Water	1	1	100.0%	0	0.0%
	Total	**6**	**2**	**33.3%**	**0**	**0.0%**
California (0.002 - 20 ppt)	Ground Water	43	7	16.3%	0	0.0%
	Surface Water	78	11	14.1%	0	0.0%
	Unknown	1	0	0.0%	0	0.0%
	Total	**122**	**18**	**14.8%**	**0**	**0.0%**
Colorado (2013 - 2017) (2 - 30 ppt)	Distribution (Finished)	22	5	22.7%	4	18.2%
	Surface water (Finished)	5	0	0.0%	0	0.0%
	Total	**27**	**5**	**18.5%**	**4**	**14.8%**
Colorado (2020) (1.6 - 2.4 ppt)	Ground Water	221	3	1.4%	0	0.0%
	Surface Water	176	1	0.6%	0	0.0%
	Total	**397**	**4**	**1.0%**	**0**	**0.0%**
Georgia (20 ppt)	Ground Water	0	0	0.0%	0	0.0%
	Surface Water	1	0	0.0%	0	0.0%
	Total	**1**	**0**	**0.0%**	**0**	**0.0%**
Idaho	Ground Water	10	0	0.0%	0	0.0%

State (Reporting Threshold)	Source Water Type	Total Number of Systems	Systems with Detections		Systems with Detections > 10 ppt	
			Number	Percent	Number	Percent
(0.5 - 1 ppt)	Surface Water	0	0	0.0%	0	0.0%
	Total	**10**	**0**	**0.0%**	**0**	**0.0%**
Illinois (1.7 - 2 ppt)	Ground Water	899	2	0.2%	0	0.0%
	Surface Water	97	3	3.1%	0	0.0%
	Total	**996**	**5**	**0.5%**	**0**	**0.0%**
Indiana (2 ppt)	Ground Water	341	0	0.0%	0	0.0%
	Surface Water	31	1	3.2%	0	0.0%
	Total	**372**	**1**	**0.3%**	**0**	**0.0%**
Iowa (1.7 - 4 ppt)	Ground Water	89	0	0.0%	0	0.0%
	Surface Water	26	0	0.0%	0	0.0%
	Total	**115**	**0**	**0.0%**	**0**	**0.0%**
Kentucky (3.24 ppt)	Ground Water	30	0	0.0%	0	0.0%
	Surface Water	44	2	4.5%	0	0.0%
	Total	**74**	**2**	**2.7%**	**0**	**0.0%**
Maine (PFAS Task Force)[2] (1.78 - 20 ppt)	Ground Water	7	0	0.0%	0	0.0%
	Surface Water	1	0	0.0%	0	0.0%
	Unknown	10	2	20.0%	0	0.0%
	Total	**18**	**2**	**11.1%**	**0**	**0.0%**
Maine (Compliance) (2 ppt)	Ground Water	593	23	3.9%	3	0.5%
	Surface Water	53	2	3.8%	0	0.0%
	Total	**646**	**25**	**3.9%**	**3**	**0.5%**
Maine (All Systems)[3] (1.78 - 20 ppt)	Ground Water	593	23	3.9%	3	0.5%
	Surface Water	53	2	3.8%	0	0.0%
	Unknown	10	2	20.0%	0	0.0%
	Total	**656**	**27**	**4.1%**	**3**	**0.5%**
Maryland (Phase 1) (2 ppt)	Ground Water	30	1	3.3%	0	0.0%
	Surface Water	36	2	5.6%	0	0.0%
	Total	**66**	**3**	**4.5%**	**0**	**0.0%**
Maryland (Phase 2) (2 ppt)	Ground Water	6	1	16.7%	0	0.0%
	Surface Water	0	0	0.0%	0	0.0%
	Total	**6**	**1**	**16.7%**	**0**	**0.0%**
Maryland (Phase 3) (2 ppt)	Ground Water	63	2	3.2%	0	0.0%
	Surface Water	0	0	0.0%	0	0.0%
	Total	**63**	**2**	**3.2%**	**0**	**0.0%**
Maryland (All Systems)[3] (2 ppt)	Ground Water	99	4	4.0%	0	0.0%
	Surface Water	36	2	5.6%	0	0.0%
	Total	**135**	**6**	**4.4%**	**0**	**0.0%**
Massachusetts (0.43 - 10 ppt)	Ground Water	1,209	48	4.0%	4	0.3%
	Surface Water	122	10	8.2%	0	0.0%

State (Reporting Threshold)	Source Water Type	Total Number of Systems	Systems with Detections		Systems with Detections > 10 ppt	
			Number	Percent	Number	Percent
	Total	**1,331**	**58**	**4.4%**	**4**	**0.3%**
Michigan (2 ppt)	Ground Water	2,370	13	0.5%	1	0.0%
	Surface Water	84	1	1.2%	0	0.0%
	Unknown	54	1	1.9%	0	0.0%
	Total	**2,508**	**15**	**0.6%**	**1**	**0.0%**
Missouri, 2022 - 2023 (Not reported)	Ground Water	95	0	0.0%	0	0.0%
	Surface Water	18	0	0.0%	0	0.0%
	Total	**113**	**0**	**0.0%**	**0**	**0.0%**
New Hampshire (Not reported)	Ground Water	529	30	5.7%	5	0.9%
	Surface Water	30	1	3.3%	0	0.0%
	Unknown	1	0	0.0%	0	0.0%
	Total	**560**	**31**	**5.5%**	**5**	**0.9%**
New Jersey (0.019 - 2,000 ppt)	Ground Water	1,012	141	13.9%	15	1.5%
	Surface Water	107	44	41.1%	5	4.7%
	Unknown	5	0	0.0%	0	0.0%
	Total	**1,124**	**185**	**16.5%**	**20**	**1.8%**
New Mexico (Not reported)	Ground Water	2	0	0.0%	0	0.0%
	Surface Water	0	0	0.0%	0	0.0%
	Total	**2**	**0**	**0.0%**	**0**	**0.0%**
New York (0.000000001- 2,020 ppt)	Ground Water	565	58	10.3%	5	0.9%
	Surface Water	120	9	7.5%	0	0.0%
	Unknown	4	0	0.0%	0	0.0%
	Total	**689**	**67**	**9.7%**	**5**	**0.7%**
North Carolina[1] (Not Reported)	Unknown	--	5	--	5	--
	Total	**--**	**5**	**--**	**5**	**--**
North Dakota (2020) (Not reported)	Ground Water	41	0	0.0%	0	0.0%
	Surface Water	9	0	0.0%	0	0.0%
	Total	**50**	**0**	**0.0%**	**0**	**0.0%**
North Dakota (2021) (Not reported)	Ground Water	56	0	0.0%	0	0.0%
	Surface Water	7	0	0.0%	0	0.0%
	Total	**63**	**0**	**0.0%**	**0**	**0.0%**
North Dakota (All Systems)[3] (Not reported)	Ground Water	95	0	0.0%	0	0.0%
	Surface Water	16	0	0.0%	0	0.0%
	Total	**111**	**0**	**0.0%**	**0**	**0.0%**
Ohio (5 ppt)	Ground Water	1,372	3	0.2%	1	0.1%
	Surface Water	107	1	0.9%	0	0.0%
	Total	**1,479**	**4**	**0.3%**	**1**	**0.1%**
Oregon (10.1 - 12.4 ppt)	Ground Water	116	0	0.0%	0	0.0%
	Surface Water	27	0	0.0%	0	0.0%

State (Reporting Threshold)	Source Water Type	Total Number of Systems	Systems with Detections		Systems with Detections > 10 ppt	
			Number	Percent	Number	Percent
	Total	**143**	**0**	**0.0%**	**0**	**0.0%**
Pennsylvania (2019) (1.9 ppt)	Ground Water	71	4	5.6%	0	0.0%
	Surface Water	16	2	12.5%	0	0.0%
	Total	**87**	**6**	**6.9%**	**0**	**0.0%**
Pennsylvania (2021) (1.7 - 4 ppt)	Ground Water	269	14	5.2%	1	0.4%
	Surface Water	73	6	8.2%	1	1.4%
	Total	**342**	**20**	**5.8%**	**2**	**0.6%**
Pennsylvania (All Systems)[3] (1.7 - 4 ppt)	Ground Water	270	17	6.3%	1	0.4%
	Surface Water	73	6	8.2%	1	1.4%
	Total	**343**	**23**	**6.7%**	**2**	**0.6%**
South Carolina (2.1 ppt)	Ground Water	234	0	0.0%	0	0.0%
	Surface Water	64	1	1.6%	0	0.0%
	Total	**298**	**1**	**0.3%**	**0**	**0.0%**
Tennessee (Not reported)	Ground Water	0	0	0.0%	0	0.0%
	Surface Water	1	0	0.0%	0	0.0%
	Total	**1**	**0**	**0.0%**	**0**	**0.0%**
Vermont (2 ppt)	Ground Water	526	5	1.0%	1	0.2%
	Surface Water	38	0	0.0%	0	0.0%
	Total	**564**	**5**	**0.9%**	**1**	**0.2%**
Virginia (3.5 ppt)	Ground Water	5	0	0.0%	0	0.0%
	Surface Water	20	0	0.0%	0	0.0%
	Total	**25**	**0**	**0.0%**	**0**	**0.0%**
Wisconsin (Not reported)	Ground Water	213	6	2.8%	0	0.0%
	Surface Water	20	3	15.0%	0	0.0%
	Total	**233**	**9**	**3.9%**	**0**	**0.0%**

[1] Only reported detections were available in this state's dataset.
[2] Reported data from Maine may include results from public and private finished drinking water sources. Based on available state data information, the EPA could not verify PWSIDs for all included samples.
[3] The "All Systems" counts represent a summary of all unique systems across multiple sampling efforts within the state. For some states (e.g., CO), the EPA could not verify this number due to the sample site ID reporting.

Exhibit 6-11: PFNA State Reported Drinking Water Occurrence Data - Summary of Population Served by Systems with Finished Water Data

State (Reporting Threshold)	Source Water Type	Total Population Served by Systems	Total Population Served by Systems with Detections		Total Population Served by Systems with Detections > 10 ppt	
			Number	Percent	Number	Percent
Alabama[1] (Not reported)	Ground Water	--	73,311	--	13,827	--
	Surface Water	--	363,847	--	0	--

State (Reporting Threshold)	Source Water Type	Total Population Served by Systems	Total Population Served by Systems with Detections		Total Population Served by Systems with Detections > 10 ppt	
			Number	Percent	Number	Percent
	Total	**--**	**437,158**	**--**	**13,827**	**--**
Arizona (1.6 - 2 ppt)	Ground Water	94,569	50,770	53.7%	0	0.0%
	Surface Water	50,001	50,001	100.0%	0	0.0%
	Total	**144,570**	**100,771**	**69.7%**	**0**	**0.0%**
California (0.002 - 20 ppt)	Ground Water	1,098,122	360,254	32.8%	0	0.0%
	Surface Water	13,500,188	1,975,526	14.6%	0	0.0%
	Unknown	0	0	0.0%	0	0.0%
	Total	**14,598,310**	**2,335,780**	**16.0%**	**0**	**0.0%**
Colorado (2013 - 2017)[2] (2 - 30 ppt)	Distribution (Finished)	--	--	--	--	--
	Surface water (Finished)	--	--	--	--	--
	Total	**--**	**--**	**--**	**--**	**--**
Colorado (2020) (1.6 - 2.4 ppt)	Ground Water	261,162	765	0.3%	0	0.0%
	Surface Water	4,191,774	1,505	0.0%	0	0.0%
	Total	**4,452,936**	**2,270**	**0.1%**	**0**	**0.0%**
Georgia (20 ppt)	Ground Water	0	0	0.0%	0	0.0%
	Surface Water	9,993	0	0.0%	0	0.0%
	Total	**9,993**	**0**	**0.0%**	**0**	**0.0%**
Idaho (0.5 - 1 ppt)	Ground Water	81,985	0	0.0%	0	0.0%
	Surface Water	0	0	0.0%	0	0.0%
	Total	**81,985**	**0**	**0.0%**	**0**	**0.0%**
Illinois (1.7 - 2 ppt)	Ground Water	2,916,219	70,518	2.4%	0	0.0%
	Surface Water	4,628,949	4,740	0.1%	0	0.0%
	Total	**7,545,168**	**75,258**	**1.0%**	**0**	**0.0%**
Indiana (2 ppt)	Ground Water	545,838	0	0.0%	0	0.0%
	Surface Water	97,448	4,158	4.3%	0	0.0%
	Total	**643,286**	**4,158**	**0.6%**	**0**	**0.0%**
Iowa (1.7 - 4 ppt)	Ground Water	490,955	0	0.0%	0	0.0%
	Surface Water	987,522	0	0.0%	0	0.0%
	Total	**1,478,477**	**0**	**0.0%**	**0**	**0.0%**
Kentucky (3.24 ppt)	Ground Water	171,212	0	0.0%	0	0.0%
	Surface Water	1,922,023	55,135	2.9%	0	0.0%
	Total	**2,093,235**	**55,135**	**2.6%**	**0**	**0.0%**
Maine (PFAS Task Force)[2,3] (1.78 - 20 ppt)	Ground Water	3,995	0	0.0%	0	0.0%
	Surface Water	21,808	0	0.0%	0	0.0%
	Unknown	0	0	0.0%	0	0.0%
	Total	**25,803**	**0**	**0.0%**	**0**	**0.0%**
Maine (Compliance) (2 ppt)	Ground Water	274,866	6,369	2.3%	1,060	0.4%
	Surface Water	464,453	12,365	2.7%	0	0.0%
	Total	**739,319**	**18,734**	**2.5%**	**1,060**	**0.1%**

State (Reporting Threshold)	Source Water Type	Total Population Served by Systems	Total Population Served by Systems with Detections		Total Population Served by Systems with Detections > 10 ppt	
			Number	Percent	Number	Percent
Maine (All Systems)[2,4] (1.78 - 20 ppt)	Ground Water	274,866	6,369	2.3%	1,060	0.4%
	Surface Water	464,453	12,365	2.7%	0	0.0%
	Unknown	0	0	0.0%	0	0.0%
	Total	**739,319**	**18,734**	**2.5%**	**1,060**	**0.1%**
Maryland (Phase 1) (2 ppt)	Ground Water	384,007	6,600	1.7%	0	0.0%
	Surface Water	4,059,154	50,881	1.3%	0	0.0%
	Total	**4,443,161**	**57,481**	**1.3%**	**0**	**0.0%**
Maryland (Phase 2) (2 ppt)	Ground Water	3,896	50	1.3%	0	0.0%
	Surface Water	0	0	0.0%	0	0.0%
	Total	**3,896**	**50**	**1.3%**	**0**	**0.0%**
Maryland (Phase 3) (2 ppt)	Ground Water	41,063	145	0.4%	0	0.0%
	Surface Water	0	0	0.0%	0	0.0%
	Total	**41,063**	**145**	**0.4%**	**0**	**0.0%**
Maryland (All Systems)[4] (2 ppt)	Ground Water	428,966	6,795	1.6%	0	0.0%
	Surface Water	4,059,154	50,881	1.3%	0	0.0%
	Total	**4,488,120**	**57,676**	**1.3%**	**0**	**0.0%**
Massachusetts (0.43 - 10 ppt)	Ground Water	1,828,984	203,986	11.2%	6,927	0.4%
	Surface Water	5,860,701	315,115	5.4%	0	0.0%
	Total	**7,689,685**	**519,101**	**6.8%**	**6,927**	**0.1%**
Michigan[2] (2 ppt)	Ground Water	1,945,734	4,651	0.2%	385	0.0%
	Surface Water	1,314,601	36,542	2.8%	0	0.0%
	Unknown	0	0	0.0%	0	0.0%
	Total	**3,260,335**	**41,193**	**1.3%**	**385**	**0.0%**
Missouri, 2022 - 2023 (Not reported)	Ground Water	190,274	0	0.0%	0	0.0%
	Surface Water	405,045	0	0.0%	0	0.0%
	Total	**595,319**	**0**	**0.0%**	**0**	**0.0%**
New Hampshire (Not reported)	Ground Water	267,029	61,102	22.9%	1,198	0.4%
	Surface Water	476,367	2,450	0.5%	0	0.0%
	Unknown	10	0	0.0%	0	0.0%
	Total	**743,406**	**63,552**	**8.5%**	**1,198**	**0.2%**
New Jersey (0.019 - 2,000 ppt)	Ground Water	2,485,837	469,265	18.9%	46,687	1.9%
	Surface Water	5,794,947	2,097,046	36.2%	82,675	1.4%
	Unknown	0	0	0.0%	0	0.0%
	Total	**8,280,784**	**2,566,311**	**31.0%**	**129,362**	**1.6%**
New Mexico[2] (Not reported)	Ground Water	--	--	--	--	--
	Surface Water	--	--	--	--	--
	Total	**--**	**--**	**--**	**--**	**--**

State (Reporting Threshold)	Source Water Type	Total Population Served by Systems	Total Population Served by Systems with Detections		Total Population Served by Systems with Detections > 10 ppt	
			Number	Percent	Number	Percent
New York (0.000000001-2,020 ppt)	Ground Water	1,441,706	546,904	37.9%	3,762	0.3%
	Surface Water	2,845,715	104,478	3.7%	0	0.0%
	Unknown	1,024	0	0.0%	0	0.0%
	Total	**4,288,445**	**651,382**	**15.2%**	**3,762**	**0.1%**
North Carolina[1,2] (Not Reported)	Unknown	--	--	--	--	--
	Total	**--**	**--**	**--**	**--**	**--**
North Dakota (2020) (Not reported)	Ground Water	68,280	0	0.0%	0	0.0%
	Surface Water	57,469	0	0.0%	0	0.0%
	Total	**125,749**	**0**	**0.0%**	**0**	**0.0%**
North Dakota (2021) (Not reported)	Ground Water	113,623	0	0.0%	0	0.0%
	Surface Water	194,121	0	0.0%	0	0.0%
	Total	**307,744**	**0**	**0.0%**	**0**	**0.0%**
North Dakota (All Systems)[4] (Not reported)	Ground Water	181,514	0	0.0%	0	0.0%
	Surface Water	251,590	0	0.0%	0	0.0%
	Total	**433,104**	**0**	**0.0%**	**0**	**0.0%**
Ohio (5 ppt)	Ground Water	2,883,252	3,595	0.1%	2,830	0.1%
	Surface Water	6,215,644	7,425	0.1%	0	0.0%
	Total	**9,098,896**	**11,020**	**0.1%**	**2,830**	**0.0%**
Oregon (10.1 - 12.4 ppt)	Ground Water	114,194	0	0.0%	0	0.0%
	Surface Water	125,239	0	0.0%	0	0.0%
	Total	**239,433**	**0**	**0.0%**	**0**	**0.0%**
Pennsylvania (2019) (1.9 ppt)	Ground Water	162,825	6,393	3.9%	0	0.0%
	Surface Water	431,370	55,464	12.9%	0	0.0%
	Total	**594,195**	**61,857**	**10.4%**	**0**	**0.0%**
Pennsylvania (2021) (1.7 - 4 ppt)	Ground Water	471,651	70,381	14.9%	12,800	2.7%
	Surface Water	4,296,097	981,760	22.9%	4,464	0.1%
	Total	**4,767,748**	**1,052,141**	**22.1%**	**17,264**	**0.4%**
Pennsylvania (All Systems)[4] (1.7 - 4 ppt)	Ground Water	471,891	71,191	15.1%	12,800	2.7%
	Surface Water	4,296,097	981,760	22.9%	4,464	0.1%
	Total	**4,767,988**	**1,052,951**	**22.1%**	**17,264**	**0.4%**
South Carolina (2.1 ppt)	Ground Water	485,992	0	0.0%	0	0.0%
	Surface Water	2,246,954	9,070	0.4%	0	0.0%
	Total	**2,732,946**	**9,070**	**0.3%**	**0**	**0.0%**
Tennessee (Not reported)	Ground Water	0	0	0.0%	0	0.0%
	Surface Water	2,551	0	0.0%	0	0.0%
	Total	**2,551**	**0**	**0.0%**	**0**	**0.0%**
Vermont (2 ppt)	Ground Water	211,357	689	0.3%	50	0.0%
	Surface Water	174,473	0	0.0%	0	0.0%
	Total	**385,830**	**689**	**0.2%**	**50**	**0.0%**

State (Reporting Threshold)	Source Water Type	Total Population Served by Systems	Total Population Served by Systems with Detections		Total Population Served by Systems with Detections > 10 ppt	
			Number	Percent	Number	Percent
Virginia (3.5 ppt)	Ground Water	2,975	0	0.0%	0	0.0%
	Surface Water	4,839,373	0	0.0%	0	0.0%
	Total	**4,842,348**	**0**	**0.0%**	**0**	**0.0%**
Wisconsin (Not reported)	Ground Water	1,433,854	52,284	3.6%	0	0.0%
	Surface Water	1,297,605	266,275	20.5%	0	0.0%
	Total	**2,731,459**	**318,559**	**11.7%**	**0**	**0.0%**

[1] Only reported detections were available in this state's dataset.
[2] There were some instances where the population served by a system could not be identified. Thus, there are systems with detections but no associated population served by those systems with detections.
[3] Reported data from Maine may include results from public and private finished drinking water sources. Based on available state data information, the EPA could not verify PWSIDs for all included samples.
[3] The "All Systems" counts represent a summary of all unique systems across multiple sampling efforts within the state.

6.2.1.3 Additional Secondary Source Water and Drinking Water Studies

Boone et al. (2019) measured 17 PFAS in both source and treated water from 25 DWTPs in the United States. The results indicated that only five of the sampling locations demonstrated a significant difference in PFAS concentration between the source and treated water. The median concentration of PFNA in source water was 0.86 ng/L and 0.74 ng/L in treated water. PFNA was detected in 88 percent of treated drinking water samples (Boone et al., 2019).

Post et al. (2013) re-evaluated PFOA, PFOS, and PFC occurrence data in drinking water systems throughout New Jersey to update previous PFAS research in the area from 2006. PFCs were found in 70 percent of PWSs sampled at concentrations ranging from 5-174 ng/L. PFNA was detected in 30 percent of samples at a maximum concentration of 96 ng/L.

McMahon et al. (2022) collected samples from aquifer systems in the eastern United States in 2019 to evaluate PFAS occurrence in ground water used as a source of drinking water. The study found that 14 of the 24 analyzed PFAS were detected in ground water samples. Furthermore, at least one PFAS was detected in 54 percent of the ground water samples and two or more PFAS were detected in 47 percent of the ground water samples. In the public supply and domestic wells, 60 and 20 percent of the samples, respectively, had at least one PFAS detection. Two or more PFAS were detected in 53 percent of the public-supply wells and 10 percent of domestic wells. The six PFAS outlined in the EPA's UCMR 3 program (i.e., PFBS, PFHxS, PFOS, PFHpA, PFOA, and PFNA) were the most detected PFAS in the study's samples. PFNA was detected in 6 percent of the 254 samples (McMahon et al., 2022).

As part of a joint study by the EPA and USGS to assess human exposure to contaminants of emerging concern, water samples were collected from 25 DWTPs in 24 states (Glassmeyer et al., 2017). Participation in the study was voluntary, and candidate locations were selected based on nomination by the EPA and USGS regional personnel and DWTP self-nomination as well as consideration of high wastewater contribution and the availability of pharmaceutical concentration data. Final sample locations were chosen to represent a wide range of geography, diversity in disinfectant type used, and a range of production volumes. Phase I of the study (2007) analyzed a subset of contaminants and sites to test experimental design; PFNA was not included in Phase 1. During Phase II of the study (2010-2012), samples were collected from ground water and surface water sources and treated drinking water from 25 DWTPs and analyzed for PFNA occurrence. The LCMRL for PFNA was equal to 0.094 ng/L. PFHxS was detected in 96 percent of the 25 source water samples and 88 percent of the 25 treated drinking water samples. The maximum detected concentrations in source water and treated water were 41.4 ng/L and 38.6 ng/L, respectively.

Reyes (2021) conducted a ground water-quality study to describe the occurrence and distribution of PFAS in the Columbia aquifer public water-supply wells in the Delaware Coastal Plain region in 2018. One or more PFAS were detected in 16 of the sampled wells with as many as 8 different PFAS detected in a single sample. PFNA was not detected in any of the 30 public water-supply wells sampled in the study.

6.2.2 Other Data

6.2.2.1 Department of Defense (DoD) Drinking Water Sampling

The DoD conducted sampling of off-base drinking water located in “covered areas” (i.e., areas that are adjacent to and down gradient from a military installation) to identify potential impacts of PFAS resulting from DoD activities. Sampling was conducted for multiple PFAS, including PFNA. The EPA downloaded available DOD off-base sampling results in September 2023.

The EPA summarized off-base sampling results for PFNA collected “post treatment” from drinking water systems and private wells located in covered areas adjacent to 47 installations located in 22 states. Detected concentrations ranged from an estimated concentration of 0.457 ng/L to 27.8 ng/L. Sampling was conducted utilizing multiple analytical methods including EPA methods 533, 537, 537.1, 1633, and DoD Quality Systems Manual Table B-15 (DoD, 2023a). Results are based on DLs which vary between both sampling sites and across different PFAS. Results for PFNA are presented in Exhibit 6-11.

Exhibit 6-12: Summary of PFNA Drinking Water Sampling Results Collected Post-Treatment from Department of Defense Off-Base "Covered Areas"

State	Installation Name	Sampling Dates	Analysis Method	# Samples	# Detections	% Detections	Range of Detections (ng/L)
AK	Eielson AFB	11/3/2022	537	1	0	0.00%	NA
AZ	Luke AFB	3/31/2022	QSM_B15	2	0	0.00%	NA
AZ	YUMA AZ MCAS	5/26/2023	533	1	0	0.00%	NA
AR	Little Rock AFB	5/5/2022	537	3	0	0.00%	NA
AR	Little Rock AFB	6/16/2022 - 3/22/2023	QSM_B15	6	0	0.00%	NA
CA	Castle AFB	7/5/2022 - 4/5/2023	537	26	1	3.85%	0.5 (est)
CA	Castle AFB	11/17/2021 - 1/11/2022	QSM_B15	12	0	0.00%	NA
CA	George AFB	3/23/2023 - 4/20/2023	1633	3	0	0.00%	NA
CA	March AFB	1/3/2023 - 4/10/2023	533	3	0	0.00%	NA
CA	March AFB	1/3/2022 - 12/1/2022	537.1	11	0	0.00%	NA
CA	March AFB	9/1/2022	QSM_B15	1	0	0.00%	NA
CA	Mather AFB	7/28/2022	537	1	0	0.00%	NA
CA	Mather AFB	1/27/2022 - 4/26/2022	QSM_B15	3	0	0.00%	NA
CA	Travis AFB	1/25/2022 - 1/16/2023	QSM_B15	19	0	0.00%	NA
CO	Peterson Space Force Base	12/14/2021 - 2/7/2023	537.1	8	0	0.00%	NA
CO	Peterson Space Force Base	3/1/2022 - 9/14/2022	QSM_B15	16	0	0.00%	NA
DE	Dover AFB	1/22/2022 - 10/25/2022	QSM_B15	10	0	0.00%	NA
FL	Homestead Air Reserve Base	2/21/2022 - 3/30/2023	QSM_B15	13	0	0.00%	NA
FL	WHITING FLD FL NAS	9/1/2022	537.1	2	0	0.00%	NA
IL	Scott AFB	3/22/2022 - 3/28/2023	QSM_B15	3	0	0.00%	NA
ME	Loring AFB	7/25/2022	QSM_B15	1	0	0.00%	NA
ME	NCTAMSLANT DET CUTLER	4/20/2022 - 12/6/2022	537.1	66	2	3.03%	0.457 (est) - 1.18 (est)
MA	Otis ANG (Joint Base Cape Cod - Massachusetts Military Reservation)	2/28/2022 - 11/22/2022	QSM_B15	11	1	9.09%	1.5 (est)
MI	KI Sawyer AFB	7/13/2022	QSM_B15	2	0	0.00%	NA
MT	Great Falls International Airport	6/15/2022 - 7/7/2022	537	3	0	0.00%	NA
NH	Pease AFB	9/22/2021 - 3/30/2023	QSM_B15	16	5	31.25%	1.9 (est) - 3.6
NJ	Joint Base McGuire-Dix-Lakehurst	3/3/2022 - 5/25/2022	QSM_B15	2	0	0.00%	NA
NM	Cannon AFB	11/11/2021 - 12/13/2021	QSM_B15	2	0	0.00%	NA

State	Installation Name	Sampling Dates	Analysis Method	# Samples	# Detections	% Detections	Range of Detections (ng/L)
NY	Plattsburgh AFB	5/20/2022 - 8/10/2022	537	8	0	0.00%	NA
NY	Plattsburgh AFB	11/18/2021 - 9/15/2022	537.1	16	0	0.00%	NA
NY	Plattsburgh AFB	11/29/2021 - 6/27/2023	QSM_B15	15	0	0.00%	NA
OK	Tinker AFB	2/2/2023	QSM_B15	3	0	0.00%	NA
RI	NAVAL AUX LANDING FIELD	5/19/2022	537.1	2	0	0.00%	NA
RI	NAVAL AUX LANDING FIELD	10/17/2022 - 2/28/2023	QSM_B15	31	8	25.81%	0.545 (est) - 3.63
SD	Ellsworth AFB	3/14/2022	537	1	0	0.00%	NA
SD	Ellsworth AFB	6/9/2022 - 9/7/2022	537.1	2	0	0.00%	NA
SD	Ellsworth AFB	2/7/2022 - 6/23/2022	QSM_B15	36	2	5.56%	1.18 (est) - 10.4
TX	Goodfellow AFB	8/18/2022 - 11/15/2022	537	11	0	0.00%	NA
TX	Goodfellow AFB	12/6/2022 - 4/27/2023	QSM_B15	28	1	3.57%	27.8
TX	Reese AFB	9/14/2022 - 6/13/2023	1633	504	1	0.20%	1.3 (est)
TX	Reese AFB	9/28/2021 - 8/29/2022	QSM_B15	839	1	0.12%	7.9 (est)
VA	OCEANA VA NAS	10/19/2022 - 4/14/2023	537.1	13	0	0.00%	NA
WA	BREMERTON WA NAVBASE	10/11/2022 - 7/21/2023	537.1	3	2	66.67%	0.855 (est) - 0.872 (est)
WA	Fairchild AFB	9/19/2022 - 9/27/2022	537	87	1	1.15%	14.5
WA	Fairchild AFB	2/20/2023 - 3/6/2023	537.1	87	0	0.00%	NA
WA	Fairchild AFB	1/31/2022 - 7/21/2022	QSM_B15	187	0	0.00%	NA
WA	WHIDBEY IS WA NAS	4/21/2022 - 4/20/2023	537.1	11	0	0.00%	NA

Source: DOD, 2023a

6.2.3 Occurrence in Ambient Water

Lakes, rivers, and aquifers are the ambient sources of most drinking water. Contaminant occurrence in ambient water can provide useful information on the potential for contaminants to adversely affect drinking water supplies. Occurrence data for PFNA in ambient water are available from the USGS NWIS database and the EPA's legacy STORET data available through the WQP.

6.2.3.1 National Water Information System (NWIS) Data

The NWIS is the Nation's principal repository of water resources data USGS collects from more than 1.9 million sites (USGS, 2023). NWIS-Web is the general online interface to the USGS NWIS database. Discrete water-sample and time-series data are available from sites in all 50 States, including 5 million water samples with 90 million water-quality results. All USGS water quality and flow data are stored in NWIS, including site characteristics, streamflow, ground water level, precipitation, and chemical analyses of water, sediment, and biological media, though not all parameters are available for every site. NWIS houses the NAWQA data and includes other USGS data from unspecified projects. NWIS contains many more samples at many more sites than the NAWQA Program. Although NWIS is comprised of primarily ambient water data, some finished drinking water data are included as well. This section presents analyses of non-NAWQA data in NWIS, downloaded from the WQP in November 2023 (WQP, 2023).

The results of the non-NAWQA NWIS PFNA analysis are presented in Exhibit 6-12. NWIS data for PFNA were listed under the characteristic name "Perfluorononanoate." PFNA was detected in approximately 26 percent of samples (770 out of 2,950 samples) and at approximately 21 percent of sites (365 out of 1,759 sites). The median concentration based on detections was equal to 1.40 ng/L. (Note that the NWIS data are presented as downloaded; potential outliers were not evaluated or excluded from the analysis.)

Exhibit 6-13: PFNA NWIS Data

Site Type	Detection Frequency (detections are results ≥ reporting level)				Concentration Values (of detections, in ng/L)				
	No. of Samples	No. of Samples with Detections	No. of Sites	No. of Sites with Detections	Minimum	Median	90th Percentile	99th Percentile	Maximum
Ground Water	1,344	114	1,233	112	0.9	2.40	16.0	83.0	160
Surface Water	1,606	656	526	253	0.138	1.30	3.00	12.0	17
All Sites	**2,950**	**770**	**1,759**	**365**	**0.138**	**1.40**	**4.00**	**18.9**	**160**

Source: WQP, 2023

6.2.3.2 Storage and Retrieval (STORET) Data / Water Quality Portal (WQP)

From its launch in 1999 until it was decommissioned in June 2018, the EPA's STORET Data Warehouse was collaboratively populated with raw biological, chemical, and physical data from surface water and ground water sampling by federal, state and local agencies, Native American tribes, volunteer groups,

academics, and others. Legacy STORET data are accessible through the WQP: https://www.waterqualitydata.us/portal/.

STORET data are from monitoring locations in all 50 states as well as multiple territories and jurisdictions of the United States. Most data are from ambient waters, but in some cases finished drinking water data are included as well. STORET's data quality limitations include variations in the extent of national coverage and data completeness from parameter to parameter. Data may have been collected as part of targeted, rather than randomized, monitoring.

This section presents analyses of STORET data, downloaded from the WQP in November 2023 (WQP, 2023). The EPA reviewed STORET ground water data from wells and surface water data from lakes, rivers/streams, and reservoirs (WQP, 2023). STORET data for PFNA were listed under the characteristic name of "Perfluorononanoate" and "Perfluorononanoic acid." The results of the STORET analysis for PFNA are presented in Exhibit 6-13 and Exhibit 6-14. Nearly 700 PFNA samples were available for analysis. These PFNA samples were collected between 2006 and 2023. Of the 324 sites sampled, more than 7 percent reported detections of PFNA. Detected concentrations ranged from 0 to 13 ng/L. (Note: A minimum value of zero could represent a detection that was entered into the database as a non-numerical value (e.g., "Present").)

Exhibit 6-14: PFNA STORET Data - Summary of Detected Concentrations

Source Water Type	Concentration Value of Detections (ng/L)			
	Minimum[1]	Median	90th Percentile	Maximum
Ground Water	0.426	0.822	2.20	4.16
Surface Water	0.56502	2.10	4.77	13
Unknown	0	0	1.10	3.65
Total	**0**	**0.671**	**3.71**	**13**

Source: WQP, 2023
[1]A minimum value of zero may represent a detection that was entered into the database as a non-numerical value (e.g., "Present").

Exhibit 6-15: PFNA STORET Data - Summary of Samples and Sites

Source Water Type	Total Number of Samples	Samples with Detections		Total Number of Sites	Sites with Detections	
		Number	Percent		Number	Percent
Ground Water	102	10	9.80%	82	10	12.20%
Surface Water	88	10	11.36%	73	6	8.22%
Unknown	488	8	1.64%	169	8	4.73%
Total	**678**	**28**	**4.13%**	**324**	**24**	**7.41%**

Source: WQP, 2023

6.3 Analytical Methods

For the purposes of compliance with the PFAS NPDWR, the EPA has published two analytical methods that are available for the analysis of PFNA and other PFAS in drinking water. The performance metrics that are presented, including the DL, LCMRL, mean recoveries and RSDs are specific to PFNA for each of the listed analytical methods. Ranges of mean recoveries and RSDs are presented for the matrices listed; data from holding time studies are not included since these studies are designed to demonstrate a degradation in method performance over time and thus are not indicative of method performance that should be observed when holding times are not exceeded:

- EPA Method 537.1, Version 2.0, *Determination of Selected Per- and Polyfluorinated Alkyl Substances in Drinking Water by Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometry (LC/MS/MS)*. The DL and LCMRL generated by the laboratory that developed the method are 0.7 ng/L and 0.83 ng/L, respectively. Mean recoveries in fortified reagent water, tap water from a ground water source (TOC = 0.53 mg/L and hardness = 377 mg/L), tap water from a surface water source (TOC = 2.4 mg/L and hardness = 103 mg/L), and tap water from a private well (TOC = 0.56 mg/L and hardness = 394 mg/L) range from 92.4 to 110%, with RSDs of 1.3 to 6.9% (USEPA, 2020d).
- EPA Method 533, *Determination of Per- and Polyfluoroalkyl Substances in Drinking Water by Isotope Dilution Anion Exchange Solid Phase Extraction and Liquid Chromatography / Tandem Mass Spectrometry*. The LCMRL generated by the laboratory that developed the method is 4.8 ng/L (DLs were not calculated). Mean recoveries (excluding ^{13}C isotope analogue data) in fortified reagent water, finished drinking water from a ground water source (hardness = 320 mg/L, pH = 7.88 at 17^{o} C, free Cl_2 = 0.64 mg/L, and total Cl_2 = 0.74 mg/L) and clarified surface water (prior to GAC treatment and chlorinated in the laboratory; pH = 8.1 at 20 °C, free Cl_2 = 0.98 mg/L, total Cl_2 = 1.31 mg/L. and TOC = 3.8 mg/L) range from 89.7 to 109%, with RSDs of 2.8 to 9.5% (USEPA, 2019b).

Laboratories participating in UCMR 3 were required to use EPA Method 537 and were required to report PFNA values at or above the EPA-defined MRL of 20 ng/L (77 FR 26072; USEPA, 2012b). The MRL was set based on the capability of multiple laboratories at the time. EPA Method 537.1 was originally published in November 2018 as Version 1.0 as a more sensitive update to EPA Method 537 (with a slightly expanded target analyte list). Version 2.0 was published in March 2020 and contains minor editorial changes to Version 1.0. Use of EPA Method 537.1 is preferable to use of EPA Method 537 (it may not be feasible to reliably quantitate down to health levels of concern for certain PFAS when using EPA Method 537). For this reason, only EPA methods 533 and 537.1 are accepted for use in demonstrating compliance with this final rule.

7 Hexafluoropropylene Oxide Dimer Acid (HFPO-DA)

This chapter presents information and analysis specific to HFPO-DA, including background information on the contaminant, information on contaminant sources and environmental fate, an analysis of health effects, an analysis of occurrence in ambient and drinking water, and information about the availability of analytical methods and treatment technologies.

7.1 Contaminant Background, Chemical and Physical Properties

Synonyms for HFPO-DA include Perfluoro(2-methyl-3-oxahexanoic) acid; 2,3,3,3-Tetrafluoro-2-(heptafluoropropoxy)propanoic acid and Perfluoro-2-propoxypropionic acid, according to NCBI (2022e). The acronym HFPO-DA can also be used to refer to the deprotonated anionic form of the compound, 2,3,3,3-Tetrafluoro-2-(heptafluoropropoxy) propanoate also known as 2-(Heptafluoropropoxy)tetrafluoropropionic acid anion (NCBI, 2022e).

HFPO refers to hexafluoropropylene oxide, the compound used to manufacture HFPO-DA (USEPA, 2021d). HFPO-DA can react with HFPO to form HFPO trimer acid, HFPO tetramer acid and longer polymer fluorides (USEPA, 2021d). For the purposes of this document HFPO-DA will signify the ion, acid, or any salt of HFPO-DA.

HFPO-DA is a perfluoroalkyl ether carboxylic acid. Its predominant salt, HFPO-DA ammonium salt (NH_4^+HFPO-DA) differs from HFPO-DA by being associated with an ammonium ion. The technology used by Chemours Company for manufacturing HFPO-DA and NH_4^+HFPO-DA is referred to with the trade name GenX (USEPA, 2021d). GenX Chemicals include other perfluoroalkyl ether carboxylic acids that are used as a surfactant and polymerization aid in the processing of polytetrafluoroethylene. Chemours Company reports countless applications of GenX Chemicals and uses GenX Chemicals to produce four trademarked fluoropolymers Teflon™ polytetrafluoroethylene (PTFE), Teflon™ perfluoroalkoxy (PFA), Teflon™ fluorinated ethylene propylene (FEP), and Teflon™ amorphous fluoropolymer (AF) (Chemours, 2022; USEPA, 2022f).

HFPO-DA and NH_4^+HFPO-DA are used in the production of fluoropolymers as replacement chemicals for PFOA following the phase-out period of 2006 to 2015. Fluoropolymers have many uses due to their unique properties such as resistance to high and low temperatures, resistance to degradation and non-stick properties. Fluoropolymers are found in electrical, electronic and architectural applications and many manufacturing processes: fabrics, automotive, cable materials, food processing, electronics, pharmaceutical, biotech and semiconductors (USEPA, 2021d).

The diagram of Exhibit 7-1 shows the branched-chain chemical structure of HFPO-DA and NH_4^+HFPO-DA. The chemical and physical properties of HFPO-DA and its ammonium salt are listed in Exhibit 7-2.

Exhibit 7-1: Chemical Structure of HFPO-DA and its Ammonium Salt

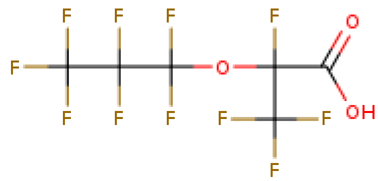


Figure 1 HFPO-DA Structure

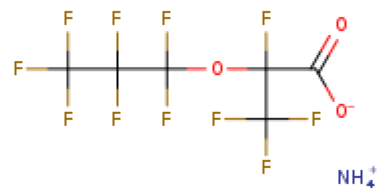


Figure 2 HFPO-DA Ammonium Salt Structure

Source: NCBI, 2022e and 2022f

DuPont reports a value of >751,000 mg/L for the solubility in water which represents the highest tested values, while the actual solubility is described as "infinite" (Dupont-24128, 2008). The uncertainty of the Henry's Law Constant builds upon the uncertainty of the measured water solubility. Log K_{ow} is not applicable or cannot be measured since HFPO-DA is expected to form multiple layers in octanol and water mixtures.

Where there are different conclusions in the literature for the properties of HFPO-DA, information is presented to highlight the range of uncertainty for this compound.

Exhibit 7-2: Physical and Chemical Properties of HFPO-DA & Its Ammonium Salt

Property	Data	
	HFPO-DA	NH_4^+HFPO-DA
Chemical Abstracts Service (CAS) Registry Number	13252-13-6 (NCBI, 2022e)	62037-80-3 (NCBI, 2022f)
EPA Pesticide Chemical Code	Not Applicable	--
Chemical Formula	$C_6HF_{11}O_3$ (NCBI, 2022e)	$C_6H_4F_{11}NO_3$ (NCBI, 2022f)
Molecular Weight	330.05 g/mol (NCBI, 2022e)	347.08 g/mol (NCBI, 2022f)
Color/Physical State	Clear, Colorless Liquid (DuPont-24698, 2008)	Solid (USEPA, 2021d)
Boiling Point	129 deg C (exp) (DuPont-24698, 2008) 143-145 deg C (exp) (ITRC, 2021)	108 deg C (exp) (DuPont-24637, 2008)
Melting Point	< -40.0 deg C (exp) (DuPont-24698, 2008) 27.8 deg C (est) (ITRC, 2021)	-21.0 deg C (as 86% salt solution in water) (exp) (DuPont-24637, 2008) No data available for salt form.
Density	1.69 g/mL (est) (ITRC, 2021) 1.85 g/mL (est) (ITRC, 2021)	--
Freundlich Adsorption Coefficient	--	--
Vapor Pressure	2.30 mm Hg (exp) (Dupont-24128, 2008; converted from 306 Pa) 2.9 mm Hg (est) (ITRC, 2021; converted from 2.59 log-Pa) 0.24 mm Hg at 25 deg C (est) (ITRC, 2021)	-1.49 ± 0.01 log (Pa) solid vapor pressure (est) (NCBI, 2022f) No measurement available[a] (exp) (DuPont-24129, 2008)

Property	Data	
	HFPO-DA	NH_4^+HFPO-DA
K_H	<2.5E-04 atm-m^3/mol[b] (est) (USEPA, 2021d) 1.8E-04 atm-m^3/mol (est) (ITRC, 2021; converted from - 2.13 log) 2.37E-10 atm-m^3/mol at 25 deg C (est) (ITRC, 2021)	--
Log K_{ow}	Not applicable[c]	Not applicable[c]
K_{oc}	11.2 (dimensionless) (est) (ITRC, 2021; Log K_{oc} 1.05) 83.2 (dimensionless) (est) (ITRC, 2021; Log K_{oc} 1.92)	Soil - 12 L/Kg (exp) (log 1.10) Sludge - 12.6 L/kg (exp) (log 1.08) (DuPont-17568-1675, 2008)
pK_a	2.84 (20 deg C) (exp) (DuPont-26349, 2008) -0.77 (est) (ITRC, 2021)	3.82 (20 deg C) (exp) (DuPont-26349, 2008)
Solubility in Water	>751,000 mg/L[d] (exp) (DuPont-24128, 2008) 7,059 mg/L (est) (ITRC, 2021; converted from -1.67 log-mol/L)	>739,000 mg/L[d] (exp) (DuPont-24129, 2008)
Other Solvents	--	--
Conversion Factors (at 25 deg C, 1 atm)	1 PPMV = 13.50 mg/m^3; 1 mg/m^3 = 0.074 PPMV (calculated)	N/A (salts do not volatilize)

Note: "--" indicates that no information was found.
[a] No experimental value was reported for the vapor pressure of NH_4^+HFPO-DA because the measured vapor pressure was reported to primarily be resultant of water and ammonia present in the substance.
[b] These values should not be used to estimate portioning between water and air. Estimated from measured vapor pressure and highest measured water solubility (Dupont-24128, 2008). The actual K_H is expected to be lower because the water solubility is reported to be infinite (USEPA, 2021d).
[c] Surfactants are surface acting agents that contain both a hydrophilic part and a hydrophobic part which causes them to accumulate at interfaces hampering the determination of their aqueous concentration. These surfactant properties present difficulties in applying existing methods for the experimental determination of log K_{ow} and produce unreliable results.
[d] Highest tested values. Actual solubility not determined but described as "infinite" (DuPont-24128, 2008; DuPont-24129, 2008).

7.1.1 Sources and Environmental Fate

7.1.1.1 Production, Use, and Release

Production data for HFPO-DA are available from the EPA's IUR and CDR programs and industrial release data are available from the EPA's TRI, as described below.

Inventory Update Reporting (IUR) / Chemical Data Reporting (CDR) Program

Under the authority of the TSCA, the EPA gathers information on production (including both manufacture and importation) of industrial chemicals. As a compound with a TSCA section 5(a)(2) SNUR, HFPO-DA and its ammonium salt is among those contaminants to which the 2,500-pound threshold applies. See Chapter 2 for further discussion.

Exhibit 7-3 presents the publicly available production data for HFPO-DA in the United States from 2016 to 2019 as reported under CDR. From 2016 to 2019, HFPO-DA production was less than 1 million pounds.

Exhibit 7-3: CDR Reported Annual Manufacture and Importation of HFPO-DA in the United States, 2016-2019 (pounds)

	Chemical Inventory Update Reporting Cycle				
	2016	**2017**	**2018**	**2019**	**2020**
Range of Production / Importation Volume	<1,000,000 lbs	<1,000,000 lbs	<1,000,000 lbs	<1,000,000 lbs	No Reports

Exhibit 7-4: CDR Reported Annual Manufacture and Importation of HFPO-DA Ammonium Salt in the United States, 2016-2019 (pounds)

	Chemical Inventory Update Reporting Cycle				
	2016	**2017**	**2018**	**2019**	**2020**
Range of Production / Importation Volume	<1,000,000 lbs	<1,000,000 lbs	<1,000,000 lbs	<1,000,000 lbs	No Reports

Toxics Release Inventory (TRI)

The EPA established TRI in 1987 in response to section 313 of the EPCRA. EPCRA section 313 requires the reporting of annual information on toxic chemical releases from facilities that meet specific criteria. This reported information is maintained in a database accessible through TRI Explorer (USEPA, 2023b).

Although TRI can provide a general idea of release trends, it has limitations. Not all facilities are required to report all releases. Facilities are required to report releases if they manufacture, process, or otherwise use a listed toxic chemical in quantities above the respective activity threshold. For HFPO-DA, the reporting threshold is 100 lbs. manufactured, processed, or otherwise used over the year. It should also be noted that, as of this publication, quantities of HFPO-DA at concentrations under 1.0 percent within mixtures may be exempt from TRI reporting requirements. Reporting requirements have changed over time (e.g., the chemical list has changed), so conclusions about temporal trends should be drawn with caution. TRI data are meant to reflect releases and other waste management activities and should not be used to estimate general public exposure to a chemical (USEPA, 2023b).

TRI data for HFPO-DA are available for 2020 through 2022 (USEPA, 2023b). As shown in Exhibit 7-5, there were 3,861 pounds of total on-site disposals and 314 pounds of total off-site disposals across all industries in 2020. In 2021, there were 3,252 pounds of total on-site disposals and 10,389 pounds of total off-site disposals across all industries. In 2022, there were 2,055 pounds of total on-site disposals and 1,347 pounds of total off-site disposals across all industries. A total of six facilities from six states reported releases of HFPO-DA in 2022 (USEPA, 2023b).

Exhibit 7-5: Environmental Releases of HFPO-DA in the United States, 2020-2022

Year	On-Site Releases (in pounds)				Total Off-Site Releases (in pounds)	Total On- and Off-Site Releases (in pounds)
	Air Emissions	Surface Water Discharges	Underground Injection	Releases to Land		
2020	61	12	3,788	0	314	4,176
2021	64	0	3,188	0	10,389	13,641
2022	59	0	1,596	400	1,347	3,402

Source: USEPA, 2023b

TRI data from 2020 through 2022 are also available for HFPO-DA ammonium salt (USEPA, 2023c). As shown in Exhibit 7-6, there were 624 pounds of total on-site disposals and no off-site disposals across all industries in 2020. Similarly, in 2021, all reported releases (820 pounds) were on-site releases. In 2022, a total of 171 on-site releases were reported and 56 off-site releases were reported. Releases were reported from one facility in West Virginia.

Exhibit 7-6: Environmental Releases of HFPO-DA Ammonium Salt in the United States, 2020-2022

Year	On-Site Releases (in pounds)				Total Off-Site Releases (in pounds)	Total On- and Off-Site Releases (in pounds)
	Air Emissions	Surface Water Discharges	Underground Injection	Releases to Land		
2020	218	406	0	0	0	624
2021	147	673	0	0	0	820
2022	46	126	0	0	56	227

Source: USEPA, 2023b

7.1.1.2 Environmental Fate

The primary measures used by the EPA to assess mobility include (where available) K_{oc}, log K_{ow}, K_H, water solubility and vapor pressure. For HFPO-DA, pK_a is also important. HFPO-DA is very stable chemically and is resistant to hydrolysis, photolysis, and biodegradation (USEPA, 2021d). HFPO-DA is considered persistent, having a half-life [t1/2] longer than six months in air, water, soil and sediments (USEPA, 2022f).

Findings from laboratory studies suggests a propensity for HFPO-DA to be infinitely soluble in water (DuPont-24128, 2008; DuPont-24129, 2008). In freshwater, HFPO-DA will dissociate to the HFPO carboxylate anion (USEPA, 2022f). With a pK_a of 2.84, HFPO-DA is expected to predominantly exist in its ionized form at typical environment pH ranges of natural waters (USEPA, 2021d). Based upon estimated Log K_{oc} 1.05 to 1.92 for HFPO-DA (ITRC, 2021) and Log K_{oc} of 1.10 for HFPO-DA ammonium salt, HFPO-DA would remain largely in ground water and surface water rather than to bind to suspended solids or sediments, although they can bind to the soil particle surfaces in areas of positive charge (USEPA, 2021d).

Based on the vapor pressure of 2.7 mm Hg (DuPont-24128, 2008), HFPO-DA could volatilize from dry soil. Also, volatilization from water at typical environment pH is possible (USEPA, 2021d).

Modeling of atmospheric behavior of HFPO-DA suggest that it will not exist solely as a vapor if released to the atmosphere based upon the HFPO-DA vapor pressure. HFPO-DA can very slowly react with photochemically produced hydroxyl radicals in the atmosphere to degrade (USEPA, 2021d). HFPO-DA is not expected to undergo direct photolysis (USEPA, 2021d).

Under CCL 3, the EPA created scales[12] to informally rank chemical contaminants' likely mobility (understood as their tendency to partition to water rather than other media) and persistence as "high," "moderate," or "low" based on physical and chemical properties (see USEPA, 2021b and USEPA, 2009). Based upon the chemical properties of HFPO-DA, infinite solubility, and relative low vapor pressure of 2.7 mm Hg predict a favorability of partitioning to water.

7.2 HFPO-DA Occurrence

This section presents data on the occurrence of HFPO-DA in drinking water in the United States. The EPA is finalizing an MCLG of 10 ppt for HFPO-DA. Under SDWA, the EPA must establish an enforceable MCL, the maximum concentration of a contaminant that is allowed in PWSs, as close to the MCLG as feasible, taking several factors into consideration, including analytical methods capable of measuring the contaminant, available treatment technologies to remove the contaminant, and costs. Based on these factors, the EPA is finalizing an MCL of 10 ppt for HFPO-DA. Occurrence data from various sources presented below are analyzed with respect to the MCL. When possible, estimates of the population exposed at concentrations above the MCL are presented. Also, when possible, studies that are meant to be representative and studies that are targeted at known or suspected sites of contamination are identified as such.

The drinking water analyses presented in this section were performed for select state data sources. In addition, this section presents HFPO-DA findings from occurrence analyses conducted by non-EPA researchers. For additional background information about data sources used to evaluate occurrence, please refer to Chapter 2.

The EPA is also finalizing an HI MCL for the regulation of PFHxS, PFNA, HFPO-DA, and PFBS when co-occurring in mixture combinations containing two or more of these four PFAS. Refer to Chapter 8 for more information on the HI MCL and chapter 9 for co-occurrence information.

7.2.1 Occurrence in Drinking Water

Data sources reviewed by the agency for information on HFPO-DA occurrence in drinking water included state drinking water monitoring programs, the DoD PFAS drinking water testing, and additional studies from the literature. The EPA notes that HFPO-DA were not monitored for a part of the UCMR 3. HFPO-

[12] See Exhibit A.8 here: https://www.epa.gov/sites/default/files/2014-05/documents/ccl3_pccltoccl_08-31-09_508.pdf

DA is being monitored for under UCMR 5 which is occurring from 2023 to 2025. Analysis of partial UCMR 5 results (the first three quarters of data that were made available as of February 2024) are discussed in section 11 of this document.

7.2.1.1 State Monitoring Data

Drinking water occurrence data from PWSs for HFPO-DA are available from several states, including Alabama, Arizona, California, Colorado, Idaho, Illinois, Indiana, Iowa, Kentucky, Maine, Maryland, Massachusetts, Michigan, Missouri, New Hampshire, New York, North Carolina, North Dakota, Ohio, Oregon, Pennsylvania, South Carolina, Vermont, Virginia, and Wisconsin. (Note: Some states reported monitoring for “GenX Chemicals” while other states reported monitoring for HFPO-DA.) The EPA downloaded publicly available monitoring data from state websites. Note that while some states did have available raw water data as indicated in Exhibit 7-7, for the subsequent analyses the EPA only evaluated finished water results.

Exhibit 7-7 provides a summary of the available state reported monitoring data for HFPO-DA, including date range and a description of coverage and representativeness (including whether monitoring was non-targeted or targeted (i.e., monitoring in areas of known or potential PFAS contamination)). A description of those studies is also included in Exhibit 7-7. State reporting thresholds are also provided, where available, in Exhibit 7-7. The EPA notes that different states utilized various reporting thresholds when analyzing and presenting their data, and for some states there were no clearly defined thresholds publicly provided; in these cases, minimum detected concentrations reported may be indicative of reporting thresholds used. Further, for some states, the thresholds varied when reporting results for the same analyte, as well as the laboratory analyzing the data. For those states, a range of thresholds is provided. As shown in Exhibit 7-7, some states reported at thresholds and/or presented data at concentrations below the EPA’s final MCL and/or PQL for HFPO-DA. However, to present the best available occurrence information, the EPA collected and evaluated the data based on the information as reported directly by the states and when conducting data analyses incorporated individual state-specific reporting thresholds where possible. Additionally, the EPA notes that the majority of the data were analyzed via an EPA-approved drinking water analytical method.

Exhibit 7-7: Summary of Available HFPO-DA State Reported Monitoring Data

State (Reference)	Date Range	Type of Water Tested	Reporting Threshold (ppt)	Notes on Coverage	Survey Type
Alabama (ADEM, 2023)	2020	Ground Water and Surface Water - Finished Water	Not reported	ADPH instructed water systems to carry out PFAS monitoring at all PWSs not previously sampled during UCMR 3. In 2022, water systems that had not been sampled since UCMR 3 were required to sample between January and June 2022 using current analytical methods . Only results that are above the MRL are posted online; thus, only reported detections were available for use in the occurrence analyses.	Non-Targeted
Arizona (ADEQ, 2023)	2021	Ground Water and Surface Water - Raw and Finished Water	1.6 - 2	ADEQ presents a PFAS Interactive Data Map that displays the results of testing conducted by ADEQ since 2018 at PWSs across Arizona.	Targeted
California (CADDW, 2023)	2019 - April 2023	Ground Water and Surface Water - Raw, Finished, and Unknown Water	0.002 - 17	The EPA reviewed the California HFPO-DA data available online through April 2023. Finished water data were available from approximately 100 PWSs. For this analysis, the EPA only included results that were explicitly marked as being from treated water. Sampling in California is ongoing.	Targeted
Colorado (CDPHE, 2020)	2020	Ground Water and Surface Water - Raw and Finished Water	1.6 - 3.7	The CDPHE offered free testing to PWSs serving communities, schools, and workplaces and also to fire districts with wells. Approximately 50% of PWSs in Colorado participated in the 2020 PFAS sampling project. Data included in this report were collected in March through May of 2020.	Non-Targeted
Idaho (Idaho DEQ, 2023)	2021 - April 2023	Ground Water - Finished and Unknown Water	0.5 - 1	Sampling of finished drinking water data between August 2016 and April 2023 that were available on the state's Drinking Water Watch website.	Not specified
Illinois (IL EPA, 2023)	2020 - May 2023	Ground Water and Surface Water - Raw and Finished Water	1.7 - 12	In 2020, the IL EPA initiated a statewide investigation into the prevalence and occurrence of PFAS in finished drinking water at 1,749 community water supplies across Illinois. The EPA reviewed finished drinking water data collected between September 2020 and May 2023 that were available on the state's Drinking Water Watch website. Sampling in Illinois is ongoing.	Non-Targeted
Indiana (IDEM, 2023)	2021 - January 2023	Ground Water and Surface Water - Raw, Finished, and Unknown Water	10	Beginning in February 2021, the IDEM facilitated PFAS monitoring at all CWSs throughout the state of Indiana. Samples were to be collected at all raw water (i.e., wells and intakes) and finished (after treatment) water points in a CWS's supply to evaluate the statewide occurrence of PFAS compounds in CWS across the state and determine the efficacy of conventional drinking water treatment for PFAS.	Non-Targeted

State (Reference)	Date Range	Type of Water Tested	Reporting Threshold (ppt)	Notes on Coverage	Survey Type
Iowa (IA DNR, 2023)	2021 - April 2023	Ground Water and Surface Water - Raw and Finished Water	1.7 - 5	In January 2020, the Iowa DNR developed an Action Plan to protect the health of Iowa residents and the environment from PFAS. Data were downloaded from the PFAS Sampling Interactive Dashboard and Map.	Targeted
Kentucky (KYDEP, 2019)	2019	Ground Water and Surface Water - Finished Water	3.96	Sampling of finished drinking water data between June and October 2019. Under this sampling effort, data are available from 81 community public DWTPs, representing 74 PWSs, and serving more than 2.4 million people.	Non-Targeted
Maine (Maine DEP, 2020)	2020	Drinking Water - Raw, Finished, and Unknown Water	3.69 - 4.31	In March 2019, the Maine PFAS Task Force was created to review the extent of PFAS contamination in Maine. Finished water results collected from 2013 through 2020 have been collected at 23 locations throughout the state. Data may include results from public and private finished drinking water sources. Sampling in Maine is ongoing.	Targeted
Maryland (MDE, 2021; MDE, 2022a; MDE, 2022b)	2020 - 2022	Ground Water and Surface Water - Raw and Finished Water	1	In 2020, MDE initiated a project to identify potential sources of PFAS in Maryland and to prioritize water sources for PFAS sampling. The EPA reviewed the finished water results from the first three phases of MDE's Public Water System study for the occurrence of PFAS in State drinking water sources. Under Phase 1 (September 2020 - February 2021), sites were selected for priority sampling based on MDE's evaluation of potential relative risk for PFAS exposure through drinking water. Under Phase 2 (March 2021 - May 2021), MDE conducted sampling at sites that were selected based on their geological setting and proximity to potential sources of PFAS. Under Phase 3 (August 2021- June 2022), MDE tested the remaining CWSs in the state.	Targeted (Phase 1, Phase 2); Non-Targeted (Phase 3)
Massachusetts (MA EEA, 2023)	2019 - April 2023	Ground Water and Surface Water - Raw and Finished Water	0.41 - 20	The EPA reviewed the finished water data available online through April 2023. Data were available from more than 1,300 PWSs. Sampling in Massachusetts is ongoing.	Targeted
Michigan (Michigan EGLE, 2023)	2020 - February 2023	Ground Water and Surface Water - Finished Water	2	The Michigan EGLE developed MCLs for seven PFAS compounds in Michigan, which took effect in August 2020. The EPA reviewed available finished compliance monitoring results through March 2023. Sampling in Michigan is ongoing.	Non-Targeted
Missouri (Missouri DNR, 2023)	2022 - 2023	Ground Water and Surface Water - Raw and Finished Water	Not reported	The EPA reviewed the finished water data available online from Missouri DNR's "PFAS Viewer Tool" which identifies the location of voluntary sampling for PFAS in public drinking water systems in Missouri. The EPA reviewed finished water data collected from approximately 125 PWSs from 2022 through 2023. Limited data were also available from 2013 through 2017.	Non-Targeted

State (Reference)	Date Range	Type of Water Tested	Reporting Threshold (ppt)	Notes on Coverage	Survey Type
New Hampshire (NHDES, 2021)	2019 - May 2021	Ground Water and Surface Water - Raw and Finished Water	Not reported	The EPA reviewed the New Hampshire HFPO-DA data available online through May 2021. Finished water data were available from more than 130 PWSs. Sampling in New Hampshire is ongoing.	Non-Targeted
New York (NYDOH, 2022)	2020 - 2022	Ground Water and Surface Water - Raw, Finished, and Unknown Water	0.000000001 - 2,020	The EPA reviewed finished water data voluntarily provided by the state to the EPA. Data were available from nearly 2,600 PWSs from 2020 through 2020.	Non-Targeted
North Carolina (NCDEQ, 2021; NCDEQ, 2023)	2017 - 2019	Finished and unknown water	Not reported	NCDEQ and the Department of Health and Human Services investigated the presence of HFPO-DA and other PFAS in the Cape Fear River in June 2017. Monthly results were also collected from five water treatment plants on the Cape Fear River. Data were available from June 2017 through October 2019. Only results above the DL were reported; thus, only reported detections were available for use in the occurrence analyses.	Targeted
	September 2022 - November 2022	Ground Water and Surface Water - Raw, Finished, and Unknown Water	Not reported	In late 2022, NCDEQ performed three months of sampling at 50 municipal and county water systems identified in the 2019 PFAS Testing Network study with PFOA/PFOS detections above the MRL indicated by the 2022 EPA interim health advisories.	Targeted
North Dakota (NDDEQ, date unknown; NDDEQ, date unknown)	2020, 2021	Ground Water and Surface Water - Raw and Finished Water	Not reported	NDDEQ published a 2020 and a 2021 survey report of North Dakota Statewide PFAS Presence/Absence results. The sampling effort in October of 2020 sought to determine if there was a PFAS presence in a representative portion of the state's public water supply. In 2021, sampling conducted as part of the third phase of the survey focused on drinking water sites not evaluated in the first two surveys.	Non-Targeted
Ohio (Ohio EPA, 2023)	December 2019 - December 2021	Ground Water and Surface Water - Raw and Finished Water	25	The Ohio EPA coordinated sampling of raw and finished drinking water from PWSs throughout the state. The EPA reviewed the finished water data available online through December 2021. During this timeframe, data were available from 1,479 PWSs.	Non-Targeted
Oregon (OHA-DWS, 2022)	2021 - July 2022	Ground Water and Surface Water - Finished Water	101 - 124	OHA conducted a PFAS drinking water monitoring project in 2021 at PWSs in Oregon identified as at risk due to their proximity to a known or suspected PFAS use or contamination site. The EPA reviewed the finished water data from more than 140 PWSs.	Targeted
Pennsylvania (PADEP, 2021)	2020 - March 2021	Ground Water and Surface Water - Finished Water	1.7 - 4	Beginning in 2020 and running through March of 2021, finished water data were collected by more than 340 PWSs.	Targeted

State (Reference)	Date Range	Type of Water Tested	Reporting Threshold (ppt)	Notes on Coverage	Survey Type
South Carolina (SCDHEC, 2020; SCDHEC, 2023)	2017 - March 2023	Ground Water and Surface Water - Raw and Finished Water	2.1	The EPA reviewed PFAS sampling results collected by the South Carolina Bureau of Water for community drinking water systems. Data were available from 300 PWSs.	Non-Targeted
Vermont (VT DEC, 2023)	2019 -April 2023	Ground Water and Surface Water - Finished Water	2	The Vermont Water Supply Rule required all CWSs and NTNCWSs to sample for PFAS. The EPA reviewed finished water data available online from July 2019 - April 2023 from approximately 560 PWSs. Sampling in Vermont is ongoing.	Non-Targeted
Virginia (VDH ODW, 2021)	2021	Ground Water and Surface Water - Raw and Finished Water	3.5	The Virginia ODW, in conjunction with VA PFAS work group, designed the sample study to prioritize sites for measuring PFAS concentrations in drinking water and major sources of water and generate statewide occurrence data.	Targeted / Non-Targeted
Wisconsin (WI DNR, 2023)	2022 - April 2023	Ground Water and Surface Water - Raw, Finished, and Unknown Water	Not reported	The EPA reviewed the finished water data available online from 2022 - 2023. Data were available from nearly 250 PWSs. Sampling in Wisconsin is ongoing.	Non-Targeted

A summary of state reported monitoring data from PWSs for HFPO-DA is presented in Exhibit 7-8 through Exhibit 7-10. As noted above, some of the monitoring data from each state are limited and may not be representative of occurrence in the state. In addition, states have varying reporting thresholds, as described earlier and indicated in the first column of Exhibit 7-8. For states with available reporting thresholds, only detected concentrations greater than the reporting thresholds were counted as detections. For states that did not provide reporting thresholds, the EPA included all detected concentrations reported in the count of detections. Overall, state reported detected concentrations ranged from 0.193 ppt (North Carolina) to 1,100 ppt (North Carolina). Note that for a small number of systems, population served information could not be identified. These systems were included in the counts and analysis presented in Exhibit 7-10; however, no associated population served was included in the counts and analysis presented in Exhibit 7-10.

Exhibit 7-8: HFPO-DA State Reported Drinking Water Occurrence Data - Summary of Finished Water Samples

State (Reporting Threshold)	Source Water Type	Total Number of Samples	All Detections		All Detections > 10 ppt	
			Number	Percent	Number	Percent
Alabama[1] (Not reported)	Ground Water	--	1	--	0	--
	Surface Water	--	5	--	0	--
	Total	**--**	**6**	**--**	**0**	**--**
Arizona (1.6 - 2 ppt)	Ground Water	23	0	0.0%	0	0.0%
	Surface Water	2	0	0.0%	0	0.0%
	Total	**25**	**0**	**0.0%**	**0**	**0.0%**
California (0.002 - 17 ppt)	Ground Water	1,618	0	0.0%	0	0.0%
	Surface Water	3,844	0	0.0%	0	0.0%
	Unknown	4	0	0.0%	0	0.0%
	Total	**5,466**	**0**	**0.0%**	**0**	**0.0%**
Colorado (2020) (1.6 - 3.7 ppt)	Ground Water	339	0	0.0%	0	0.0%
	Surface Water	244	1	0.4%	0	0.0%
	Total	**583**	**1**	**0.2%**	**0**	**0.0%**
Idaho (0.5 - 1 ppt)	Ground Water	18	0	0.0%	0	0.0%
	Surface Water	0	0	0.0%	0	0.0%
	Total	**18**	**0**	**0.0%**	**0**	**0.0%**
Illinois (1.7 - 12 ppt)	Ground Water	1,666	0	0.0%	0	0.0%
	Surface Water	277	0	0.0%	0	0.0%
	Total	**1,943**	**0**	**0.0%**	**0**	**0.0%**
Indiana (10 ppt)	Ground Water	414	0	0.0%	0	0.0%
	Surface Water	56	0	0.0%	0	0.0%
	Total	**470**	**0**	**0.0%**	**0**	**0.0%**
Iowa (1.7 - 5 ppt)	Ground Water	152	5	3.3%	0	0.0%
	Surface Water	63	0	0.0%	0	0.0%
	Total	**215**	**5**	**2.3%**	**0**	**0.0%**

State (Reporting Threshold)	Source Water Type	Total Number of Samples	All Detections		All Detections > 10 ppt	
			Number	Percent	Number	Percent
Kentucky (3.96 ppt)	Ground Water	33	0	0.0%	0	0.0%
	Surface Water	48	11	22.9%	2	4.2%
	Total	**81**	**11**	**13.6%**	**2**	**2.5%**
Maine (PFAS Task Force)[2] (3.69 - 4.31 ppt)	Ground Water	0	0	0.0%	0	0.0%
	Surface Water	0	0	0.0%	0	0.0%
	Unknown	11	0	0.0%	0	0.0%
	Total	**11**	**0**	**0.0%**	**0**	**0.0%**
Maryland (Phase 1) (1 ppt)	Ground Water	70	0	0.0%	0	0.0%
	Surface Water	76	0	0.0%	0	0.0%
	Total	**146**	**0**	**0.0%**	**0**	**0.0%**
Maryland (Phase 2) (1 ppt)	Ground Water	9	0	0.0%	0	0.0%
	Surface Water	0	0	0.0%	0	0.0%
	Total	**9**	**0**	**0.0%**	**0**	**0.0%**
Maryland (Phase 3) (1 ppt)	Ground Water	88	0	0.0%	0	0.0%
	Surface Water	0	0	0.0%	0	0.0%
	Total	**88**	**0**	**0.0%**	**0**	**0.0%**
Massachusetts (0.41 - 20 ppt)	Ground Water	6,750	6	0.1%	0	0.0%
	Surface Water	1,888	0	0.0%	0	0.0%
	Total	**8,638**	**6**	**0.1%**	**0**	**0.0%**
Michigan (2 ppt)	Ground Water	10,007	8	0.1%	3	0.0%
	Surface Water	519	0	0.0%	0	0.0%
	Unknown	164	0	0.0%	0	0.0%
	Total	**10,690**	**8**	**0.1%**	**3**	**0.0%**
Missouri, 2022 - 2023 (Not reported)	Ground Water	190	0	0.0%	0	0.0%
	Surface Water	20	0	0.0%	0	0.0%
	Total	**210**	**0**	**0.0%**	**0**	**0.0%**
New Hampshire (Not reported)	Ground Water	191	8	4.2%	0	0.0%
	Surface Water	46	1	2.2%	0	0.0%
	Total	**237**	**9**	**3.8%**	**0**	**0.0%**
New York (0.000000001-2,020 ppt)	Ground Water	947	4	0.4%	0	0.0%
	Surface Water	252	4	1.6%	0	0.0%
	Unknown	9	0	0.0%	0	0.0%
	Total	**1,208**	**8**	**0.7%**	**0**	**0.0%**
North Carolina[1] (Not Reported)	Unknown	--	438	--	428	--
	Total	**--**	**438**	**--**	**428**	**--**

State (Reporting Threshold)	Source Water Type	Total Number of Samples	All Detections		All Detections > 10 ppt	
			Number	Percent	Number	Percent
North Carolina (2023)	Ground Water	21	3	14.3%	2	9.5%
	Surface Water	141	46	32.6%	0	0.0%
	Total	**162**	**49**	**30.2%**	**2**	**1.2%**
North Dakota (2020) (Not reported)	Ground Water	42	0	0.0%	0	0.0%
	Surface Water	9	0	0.0%	0	0.0%
	Total	**51**	**0**	**0.0%**	**0**	**0.0%**
North Dakota (2021) (Not reported)	Ground Water	56	0	0.0%	0	0.0%
	Surface Water	7	0	0.0%	0	0.0%
	Total	**63**	**0**	**0.0%**	**0**	**0.0%**
Ohio (25 ppt)	Ground Water	1,775	0	0.0%	0	0.0%
	Surface Water	170	1	0.6%	1	0.6%
	Total	**1,945**	**1**	**0.1%**	**1**	**0.1%**
Oregon (101 - 124 ppt)	Ground Water	131	0	0.0%	0	0.0%
	Surface Water	29	0	0.0%	0	0.0%
	Total	**160**	**0**	**0.0%**	**0**	**0.0%**
Pennsylvania (2021) (1.7 - 4 ppt)	Ground Water	314	0	0.0%	0	0.0%
	Surface Water	98	0	0.0%	0	0.0%
	Total	**412**	**0**	**0.0%**	**0**	**0.0%**
South Carolina (2.1 ppt)	Ground Water	572	0	0.0%	0	0.0%
	Surface Water	185	10	5.4%	0	0.0%
	Total	**757**	**10**	**1.3%**	**0**	**0.0%**
Vermont (2 ppt)	Ground Water	1,456	3	0.2%	0	0.0%
	Surface Water	102	0	0.0%	0	0.0%
	Total	**1,558**	**3**	**0.2%**	**0**	**0.0%**
Virginia (3.5 ppt)	Ground Water	5	0	0.0%	0	0.0%
	Surface Water	36	1	2.8%	1	2.8%
	Total	**41**	**1**	**2.4%**	**1**	**2.4%**
Wisconsin (Not reported)	Ground Water	683	0	0.0%	0	0.0%
	Surface Water	47	0	0.0%	0	0.0%
	Total	**730**	**0**	**0.0%**	**0**	**0.0%**

[1] Only reported detections were available in this state's dataset.
[2] Reported data from Maine may include results from public and private finished drinking water sources. Based on available state data information, the EPA could not verify PWSIDs for all included samples.

Exhibit 7-9: HFPO-DA State Reported Drinking Water Occurrence Data - Summary of Detected Concentrations

State (Reporting Threshold)	Source Water Type	Concentration Value of Detections (ppt)				
		Minimum	Median	90th Percentile	99th Percentile	Maximum
Alabama[1] (Not reported)	Ground Water	4.4	4.4	4.4	4.4	4.4
	Surface Water	2	2.40	3.70	3.88	3.9
	Total	**2**	**2.90**	**4.15**	**4.38**	**4.4**
Arizona (1.6 - 2 ppt)	Ground Water	--	--	--	--	--
	Surface Water	--	--	--	--	--
	Total	**--**	**--**	**--**	**--**	**--**
California (0.002 - 17 ppt)	Ground Water	--	--	--	--	--
	Surface Water	--	--	--	--	--
	Unknown	--	--	--	--	--
	Total	**--**	**--**	**--**	**--**	**--**
Colorado (2020) (1.6 - 3.7 ppt)	Ground Water	--	--	--	--	--
	Surface Water	2.2	2.2	2.2	2.2	2.2
	Total	**2.2**	**2.2**	**2.2**	**2.2**	**2.2**
Idaho (0.5 - 1 ppt)	Ground Water	--	--	--	--	--
	Surface Water	--	--	--	--	--
	Total	**--**	**--**	**--**	**--**	**--**
Illinois (1.7 - 12 ppt)	Ground Water	--	--	--	--	--
	Surface Water	--	--	--	--	--
	Total	**--**	**--**	**--**	**--**	**--**
Indiana (10 ppt)	Ground Water	--	--	--	--	--
	Surface Water	--	--	--	--	--
	Total	**--**	**--**	**--**	**--**	**--**
Iowa (1.7 - 5 ppt)	Ground Water	2.1	2.4	2.5	2.5	2.5
	Surface Water	--	--	--	--	--
	Total	**2.1**	**2.4**	**2.5**	**2.5**	**2.5**
Kentucky (3.96 ppt)	Ground Water	--	--	--	--	--
	Surface Water	3.57	5.75	18.3	28.6	29.7
	Total	**3.57**	**5.75**	**18.3**	**28.6**	**29.7**

State (Reporting Threshold)	Source Water Type	Concentration Value of Detections (ppt)				
		Minimum	Median	90th Percentile	99th Percentile	Maximum
Maine (PFAS Task Force)[2] (3.69 - 4.31 ppt)	Ground Water	--	--	--	--	--
	Surface Water	--	--	--	--	--
	Unknown	--	--	--	--	--
	Total	**--**	**--**	**--**	**--**	**--**
Maryland (Phase 1) (1 ppt)	Ground Water	--	--	--	--	--
	Surface Water	--	--	--	--	--
	Total	**--**	**--**	**--**	**--**	**--**
Maryland (Phase 2) (1 ppt)	Ground Water	--	--	--	--	--
	Surface Water	--	--	--	--	--
	Total	**--**	**--**	**--**	**--**	**--**
Maryland (Phase 3) (1 ppt)	Ground Water	--	--	--	--	--
	Surface Water	--	--	--	--	--
	Total	**--**	**--**	**--**	**--**	**--**
Massachusetts (0.41 - 20 ppt)	Ground Water	1.75	2.17	2.69	2.91	2.94
	Surface Water	--	--	--	--	--
	Total	**1.75**	**2.17**	**2.69**	**2.91**	**2.94**
Michigan (2 ppt)	Ground Water	2	7.25	95.1	99.5	100
	Surface Water	--	--	--	--	--
	Unknown	--	--	--	--	--
	Total	**2**	**7.25**	**95.1**	**99.5**	**100**
Missouri, 2022 - 2023 (Not reported)	Ground Water	--	--	--	--	--
	Surface Water	--	--	--	--	--
	Total	**--**	**--**	**--**	**--**	**--**
New Hampshire (Not reported)	Ground Water	1.7	1.75	1.93	1.99	2
	Surface Water	1.7	1.7	1.7	1.7	1.7
	Total	**1.7**	**1.70**	**1.92**	**1.99**	**2**
New York (0.000000001-2,020 ppt)	Ground Water	1.4	3.24	4.38	4.49	4.5
	Surface Water	0.722	1.50	3.28	3.93	4
	Unknown	--	--	--	--	--
	Total	**0.722**	**1.99**	**4.22**	**4.47**	**4.5**
North Carolina[1] (Not Reported)	Unknown	9.52	40.0	80.0	693	1100
	Total	**9.52**	**40.0**	**80.0**	**693**	**1100**

State (Reporting Threshold)	Source Water Type	Concentration Value of Detections (ppt)				
		Minimum	**Median**	**90th Percentile**	**99th Percentile**	**Maximum**
North Carolina (2023)	Ground Water	13.4	17.3	19.1	19.5	19.5
	Surface Water	0.193	0.715	4.98	10.5	11
	Total	**0.193**	**0.846**	**8.81**	**18.4**	**19.5**
North Dakota (2020) (Not reported)	Ground Water	--	--	--	--	--
	Surface Water	--	--	--	--	--
	Total	**--**	**--**	**--**	**--**	**--**
North Dakota (2021) (Not reported)	Ground Water	**--**	**--**	**--**	**--**	**--**
	Surface Water	**--**	**--**	**--**	**--**	**--**
	Total	**--**	**--**	**--**	**--**	**--**
Ohio (25 ppt)	Ground Water	--	--	--	--	--
	Surface Water	29.6	29.6	29.6	29.6	29.6
	Total	**29.6**	**29.6**	**29.6**	**29.6**	**29.6**
Oregon (101 - 124 ppt)	Ground Water	--	--	--	--	--
	Surface Water	--	--	--	--	--
	Total	**--**	**--**	**--**	**--**	**--**
Pennsylvania (2021) (1.7 - 4 ppt)	Ground Water	**--**	**--**	**--**	**--**	**--**
	Surface Water	**--**	**--**	**--**	**--**	**--**
	Total	**--**	**--**	**--**	**--**	**--**
South Carolina (2.1 ppt)	Ground Water	--	--	--	--	--
	Surface Water	2.2	4.65	6.15	6.56	6.6
	Total	**2.2**	**4.65**	**6.15**	**6.56**	**6.6**
Vermont (2 ppt)	Ground Water	2.5	3.1	3.1	3.1	3.1
	Surface Water	--	--	--	--	--
	Total	**2.5**	**3.1**	**3.1**	**3.1**	**3.1**
Virginia (3.5 ppt)	Ground Water	--	--	--	--	--
	Surface Water	54	54	54	54	54
	Total	**54**	**54**	**54**	**54**	**54**
Wisconsin (Not reported)	Ground Water	--	--	--	--	--
	Surface Water	--	--	--	--	--
	Total	**--**	**--**	**--**	**--**	**--**

Note: With limited exceptions, calculated concentration values (i.e., median, 90th percentile and 99th percentile concentrations) were rounded to three significant figures for consistent presentation across the datasets and may not indicate exact laboratory precision.
[1] Only reported detections were available in this state's dataset.
[2] Reported data from Maine may include results from public and private finished drinking water sources. Based on available state data information, the EPA could not verify PWSIDs for all included samples.

Exhibit 7-10: HFPO-DA State Reported Drinking Water Occurrence Data - Summary of Systems with Finished Water Data

State (Reporting Threshold)	Source Water Type	Total Number of Systems	Systems with Detections		Systems with Detections > 10 ppt	
			Number	Percent	Number	Percent
Alabama[1] (Not reported)	Ground Water	--	1	--	0	--
	Surface Water	--	3	--	0	--
	Total	**--**	**4**	**--**	**0**	**--**
Arizona (1.6 - 2 ppt)	Ground Water	5	0	0.0%	0	0.0%
	Surface Water	1	0	0.0%	0	0.0%
	Total	**6**	**0**	**0.0%**	**0**	**0.0%**
California (0.002 - 17 ppt)	Ground Water	39	0	0.0%	0	0.0%
	Surface Water	74	0	0.0%	0	0.0%
	Unknown	1	0	0.0%	0	0.0%
	Total	**114**	**0**	**0.0%**	**0**	**0.0%**
Colorado (2020) (1.6 - 3.7 ppt)	Ground Water	221	0	0.0%	0	0.0%
	Surface Water	176	1	0.6%	0	0.0%
	Total	**397**	**1**	**0.3%**	**0**	**0.0%**
Idaho (0.5 - 1 ppt)	Ground Water	10	0	0.0%	0	0.0%
	Surface Water	0	0	0.0%	0	0.0%
	Total	**10**	**0**	**0.0%**	**0**	**0.0%**
Illinois (1.7 - 12 ppt)	Ground Water	899	0	0.0%	0	0.0%
	Surface Water	97	0	0.0%	0	0.0%
	Total	**996**	**0**	**0.0%**	**0**	**0.0%**
Indiana (10 ppt)	Ground Water	333	0	0.0%	0	0.0%
	Surface Water	30	0	0.0%	0	0.0%
	Total	**363**	**0**	**0.0%**	**0**	**0.0%**
Iowa (1.7 - 5 ppt)	Ground Water	90	1	1.1%	0	0.0%
	Surface Water	26	0	0.0%	0	0.0%
	Total	**116**	**1**	**0.9%**	**0**	**0.0%**
Kentucky (3.96 ppt)	Ground Water	30	0	0.0%	0	0.0%
	Surface Water	44	9	20.5%	2	4.5%
	Total	**74**	**9**	**12.2%**	**2**	**2.7%**

State (Reporting Threshold)	Source Water Type	Total Number of Systems	Systems with Detections		Systems with Detections > 10 ppt	
			Number	Percent	Number	Percent
Maine (PFAS Task Force)[2] (3.69 - 4.31 ppt)	Ground Water	0	0	0.0%	0	0.0%
	Surface Water	0	0	0.0%	0	0.0%
	Unknown	2	0	0.0%	0	0.0%
	Total	**2**	**0**	**0.0%**	**0**	**0.0%**
Maryland (Phase 1) (1 ppt)	Ground Water	30	0	0.0%	0	0.0%
	Surface Water	36	0	0.0%	0	0.0%
	Total	**66**	**0**	**0.0%**	**0**	**0.0%**
Maryland (Phase 2) (1 ppt)	Ground Water	6	0	0.0%	0	0.0%
	Surface Water	0	0	0.0%	0	0.0%
	Total	**6**	**0**	**0.0%**	**0**	**0.0%**
Maryland (Phase 3) (1 ppt)	Ground Water	63	0	0.0%	0	0.0%
	Surface Water	0	0	0.0%	0	0.0%
	Total	**63**	**0**	**0.0%**	**0**	**0.0%**
Maryland (All Systems)[3] (1 ppt)	Ground Water	99	0	0.0%	0	0.0%
	Surface Water	36	0	0.0%	0	0.0%
	Total	**135**	**0**	**0.0%**	**0**	**0.0%**
Massachusetts (0.41 - 20 ppt)	Ground Water	1,192	4	0.3%	0	0.0%
	Surface Water	122	0	0.0%	0	0.0%
	Total	**1,314**	**4**	**0.3%**	**0**	**0.0%**
Michigan (2 ppt)	Ground Water	2,370	8	0.3%	3	0.1%
	Surface Water	84	0	0.0%	0	0.0%
	Unknown	54	0	0.0%	0	0.0%
	Total	**2,508**	**8**	**0.3%**	**3**	**0.1%**
Missouri, 2022 - 2023 (Not reported)	Ground Water	94	0	0.0%	0	0.0%
	Surface Water	16	0	0.0%	0	0.0%
	Total	**110**	**0**	**0.0%**	**0**	**0.0%**
New Hampshire (Not reported)	Ground Water	127	6	4.7%	0	0.0%
	Surface Water	11	1	9.1%	0	0.0%
	Total	**138**	**7**	**5.1%**	**0**	**0.0%**
New York (0.000000001- 2,020 ppt)	Ground Water	465	3	0.6%	0	0.0%
	Surface Water	94	3	3.2%	0	0.0%
	Unknown	4	0	0.0%	0	0.0%
	Total	**563**	**6**	**1.1%**	**0**	**0.0%**
North Carolina[1] (Not Reported)	Unknown	--	5	--	5	--
	Total	**--**	**5**	**--**	**5**	**--**

State (Reporting Threshold)	Source Water Type	Total Number of Systems	Systems with Detections		Systems with Detections > 10 ppt	
			Number	Percent	Number	Percent
North Carolina (2023)	Ground Water	7	1	14.3%	1	14.3%
	Surface Water	43	18	41.9%	0	0.0%
	Total	**50**	**19**	**38.0%**	**1**	**2.0%**
North Dakota (2020) (Not reported)	Ground Water	41	0	0.0%	0	0.0%
	Surface Water	9	0	0.0%	0	0.0%
	Total	**50**	**0**	**0.0%**	**0**	**0.0%**
North Dakota (2021) (Not reported)	Ground Water	56	0	0.0%	0	0.0%
	Surface Water	7	0	0.0%	0	0.0%
	Total	**63**	**0**	**0.0%**	**0**	**0.0%**
North Dakota (All Systems)[3] (Not reported)	Ground Water	95	0	0.0%	0	0.0%
	Surface Water	16	0	0.0%	0	0.0%
	Total	**111**	**0**	**0.0%**	**0**	**0.0%**
Ohio (25 ppt)	Ground Water	1,372	0	0.0%	0	0.0%
	Surface Water	107	1	0.9%	1	0.9%
	Total	**1,479**	**1**	**0.1%**	**1**	**0.1%**
Oregon (101 - 124 ppt)	Ground Water	116	0	0.0%	0	0.0%
	Surface Water	27	0	0.0%	0	0.0%
	Total	**143**	**0**	**0.0%**	**0**	**0.0%**
Pennsylvania (2021) (1.7 - 4 ppt)	Ground Water	269	0	0.0%	0	0.0%
	Surface Water	73	0	0.0%	0	0.0%
	Total	**342**	**0**	**0.0%**	**0**	**0.0%**
South Carolina (2.1 ppt)	Ground Water	234	0	0.0%	0	0.0%
	Surface Water	61	6	9.8%	0	0.0%
	Total	**295**	**6**	**2.0%**	**0**	**0.0%**
Vermont (2 ppt)	Ground Water	526	3	0.6%	0	0.0%
	Surface Water	38	0	0.0%	0	0.0%
	Total	**564**	**3**	**0.5%**	**0**	**0.0%**
Virginia (3.5 ppt)	Ground Water	5	0	0.0%	0	0.0%
	Surface Water	20	1	5.0%	1	5.0%
	Total	**25**	**1**	**4.0%**	**1**	**4.0%**
Wisconsin (Not reported)	Ground Water	213	0	0.0%	0	0.0%
	Surface Water	20	0	0.0%	0	0.0%
	Total	**233**	**0**	**0.0%**	**0**	**0.0%**

[1] Only reported detections were available in this state's dataset.
[2] Reported data from Maine may include results from public and private finished drinking water sources. Based on available state data information, the EPA could not verify PWSIDs for all included samples.
[3] The "All Systems" counts represent a summary of all unique systems across multiple sampling efforts within the state. For some states (e.g., NC), the EPA could not verify this number due to the sample site ID reporting.

Exhibit 7-11: HFPO-DA State Reported Drinking Water Occurrence Data - Summary of Population Served by Systems with Finished Water Data

State (Reporting Threshold)	Source Water Type	Total Population Served by Systems	Total Population Served by Systems with Detections		Total Population Served by Systems with Detections > 10 ppt	
			Number	Percent	Number	Percent
Alabama[1] (Not reported)	Ground Water	--	7,248	--	0	--
	Surface Water	--	57,905	--	0	--
	Total	**--**	**65,153**	**--**	**0**	**--**
Arizona (1.6 - 2 ppt)	Ground Water	94,569	0	0.0%	0	0.0%
	Surface Water	50,001	0	0.0%	0	0.0%
	Total	**144,570**	**0**	**0.0%**	**0**	**0.0%**
California (0.002 - 17 ppt)	Ground Water	1,086,727	0	0.0%	0	0.0%
	Surface Water	13,163,194	0	0.0%	0	0.0%
	Unknown	0	0	0.0%	0	0.0%
	Total	**14,249,921**	**0**	**0.0%**	**0**	**0.0%**
Colorado (2020) (1.6 - 3.7 ppt)	Ground Water	261,162	0	0.0%	0	0.0%
	Surface Water	4,191,774	1,505	0.0%	0	0.0%
	Total	**4,452,936**	**1,505**	**0.0%**	**0**	**0.0%**
Idaho (0.5 - 1 ppt)	Ground Water	81,985	0	0.0%	0	0.0%
	Surface Water	0	0	0.0%	0	0.0%
	Total	**81,985**	**0**	**0.0%**	**0**	**0.0%**
Illinois (1.7 - 12 ppt)	Ground Water	2,916,219	0	0.0%	0	0.0%
	Surface Water	4,628,949	0	0.0%	0	0.0%
	Total	**7,545,168**	**0**	**0.0%**	**0**	**0.0%**
Indiana (10 ppt)	Ground Water	505,212	0	0.0%	0	0.0%
	Surface Water	93,290	0	0.0%	0	0.0%
	Total	**598,502**	**0**	**0.0%**	**0**	**0.0%**
Iowa (1.7 - 5 ppt)	Ground Water	491,495	4,570	0.9%	0	0.0%
	Surface Water	987,522	0	0.0%	0	0.0%
	Total	**1,479,017**	**4,570**	**0.3%**	**0**	**0.0%**
Kentucky (3.96 ppt)	Ground Water	171,212	0	0.0%	0	0.0%
	Surface Water	1,922,023	1,130,006	58.8%	55,665	2.9%
	Total	**2,093,235**	**1,130,006**	**54.0%**	**55,665**	**2.7%**
Maine (PFAS Task Force)[2,3] (3.69 - 4.31 ppt)	Ground Water	0	0	0.0%	0	0.0%
	Surface Water	0	0	0.0%	0	0.0%
	Unknown	0	0	0.0%	0	0.0%
	Total	**0**	**0**	**0.0%**	**0**	**0.0%**
Maryland (Phase 1) (1 ppt)	Ground Water	384,007	0	0.0%	0	0.0%
	Surface Water	4,059,154	0	0.0%	0	0.0%

State (Reporting Threshold)	Source Water Type	Total Population Served by Systems	Total Population Served by Systems with Detections		Total Population Served by Systems with Detections > 10 ppt	
			Number	Percent	Number	Percent
	Total	**4,443,161**	**0**	**0.0%**	**0**	**0.0%**
Maryland (Phase 2) (1 ppt)	Ground Water	3,896	0	0.0%	0	0.0%
	Surface Water	0	0	0.0%	0	0.0%
	Total	**3,896**	**0**	**0.0%**	**0**	**0.0%**
Maryland (Phase 3) (1 ppt)	Ground Water	41,063	0	0.0%	0	0.0%
	Surface Water	0	0	0.0%	0	0.0%
	Total	**41,063**	**0**	**0.0%**	**0**	**0.0%**
Maryland (All Systems)[4] (1 ppt)	Ground Water	428,966	0	0.0%	0	0.0%
	Surface Water	4,059,154	0	0.0%	0	0.0%
	Total	**4,488,120**	**0**	**0.0%**	**0**	**0.0%**
Massachusetts (0.41 - 20 ppt)	Ground Water	1,777,376	45,470	2.6%	0	0.0%
	Surface Water	5,860,701	0	0.0%	0	0.0%
	Total	**7,638,077**	**45,470**	**0.6%**	**0**	**0.0%**
Michigan (2 ppt)	Ground Water	1,945,734	2,538	0.1%	966	0.0%
	Surface Water	1,314,601	0	0.0%	0	0.0%
	Unknown	0	0	0.0%	0	0.0%
	Total	**3,260,335**	**2,538**	**0.1%**	**966**	**0.0%**
Missouri, 2022 - 2023 (Not reported)	Ground Water	189,904	0	0.0%	0	0.0%
	Surface Water	347,928	0	0.0%	0	0.0%
	Total	**537,832**	**0**	**0.0%**	**0**	**0.0%**
New Hampshire (Not reported)	Ground Water	69,445	852	1.2%	0	0.0%
	Surface Water	237,720	2,450	1.0%	0	0.0%
	Total	**307,165**	**3,302**	**1.1%**	**0**	**0.0%**
New York (0.000000001-2,020 ppt)	Ground Water	464,701	9,250	2.0%	0	0.0%
	Surface Water	1,326,928	14,421	1.1%	0	0.0%
	Unknown	1,024	0	0.0%	0	0.0%
	Total	**1,792,653**	**23,671**	**1.3%**	**0**	**0.0%**
North Carolina[1,2] (Not Reported)	Unknown	--	--	--	--	--
	Total	**--**	**--**	**--**	**--**	**--**
North Carolina (2023)	Ground Water	26,914	3,889	14.4%	3,889	14.4%
	Surface Water	2,649,927	956,842	36.1%	0	0.0%
	Total	**2,676,841**	**960,731**	**35.9%**	**3,889**	**0.1%**
North Dakota (2020) (Not reported)	Ground Water	68,280	0	0.0%	0	0.0%
	Surface Water	57,469	0	0.0%	0	0.0%
	Total	**125,749**	**0**	**0.0%**	**0**	**0.0%**
North Dakota (2021) (Not reported)	Ground Water	113,623	0	0.0%	0	0.0%
	Surface Water	194,121	0	0.0%	0	0.0%
	Total	**307,744**	**0**	**0.0%**	**0**	**0.0%**

State (Reporting Threshold)	Source Water Type	Total Population Served by Systems	Total Population Served by Systems with Detections		Total Population Served by Systems with Detections > 10 ppt	
			Number	Percent	Number	Percent
North Dakota (All Systems)[4] (Not reported)	Ground Water	181,514	0	0.0%	0	0.0%
	Surface Water	251,590	0	0.0%	0	0.0%
	Total	**433,104**	**0**	**0.0%**	**0**	**0.0%**
Ohio (25 ppt)	Ground Water	2,883,252	0	0.0%	0	0.0%
	Surface Water	6,215,644	11,129	0.2%	11,129	0.2%
	Total	**9,098,896**	**11,129**	**0.1%**	**11,129**	**0.1%**
Oregon (101 - 124 ppt)	Ground Water	114,194	0	0.0%	0	0.0%
	Surface Water	125,239	0	0.0%	0	0.0%
	Total	**239,433**	**0**	**0.0%**	**0**	**0.0%**
Pennsylvania (2021) (1.7 - 4 ppt)	Ground Water	471,651	0	0.0%	0	0.0%
	Surface Water	4,296,097	0	0.0%	0	0.0%
	Total	**4,767,748**	**0**	**0.0%**	**0**	**0.0%**
South Carolina (2.1 ppt)	Ground Water	485,992	0	0.0%	0	0.0%
	Surface Water	2,200,008	138,147	6.3%	0	0.0%
	Total	**2,686,000**	**138,147**	**5.1%**	**0**	**0.0%**
Vermont (2 ppt)	Ground Water	211,357	305	0.1%	0	0.0%
	Surface Water	174,473	0	0.0%	0	0.0%
	Total	**385,830**	**305**	**0.1%**	**0**	**0.0%**
Virginia (3.5 ppt)	Ground Water	2,975	0	0.0%	0	0.0%
	Surface Water	4,839,373	155,000	3.2%	155,000	3.2%
	Total	**4,842,348**	**155,000**	**3.2%**	**155,000**	**3.2%**
Wisconsin (Not reported)	Ground Water	1,433,854	0	0.0%	0	0.0%
	Surface Water	1,297,605	0	0.0%	0	0.0%
	Total	**2,731,459**	**0**	**0.0%**	**0**	**0.0%**

[1] Only reported detections were available in this state's dataset.
[2] There were some instances where the population served by a system could not be identified. Thus, there are systems with detections but no associated population served by those systems with detections.
[3] Reported data from Maine may include results from public and private finished drinking water sources. Based on available state data information, the EPA could not verify PWSIDs for all included samples.
[4] The "All Systems" counts represent a summary of all unique systems across multiple sampling efforts within the state.

7.2.2 Other Data

7.2.2.1 Department of Defense (DoD) Drinking Water Sampling

The DoD conducted sampling of off-base drinking water located in "covered areas" (i.e., areas that are adjacent to and down gradient from a military installation) to identify potential impacts of PFAS resulting from DoD activities. Sampling was conducted for multiple PFAS, including HFPO-DA. The EPA downloaded available DOD off-base sampling results September 2023.

The EPA summarized off-base sampling results for HFPO-DA collected "post treatment" from drinking water systems and private wells located in covered areas adjacent to 18 installations located in 10 states. No detections were reported "post treatment." Sampling was conducted utilizing multiple analytical methods including EPA methods 533, 537, 537.1, 1633, and DoD Quality Systems Manual Table B-15 (DoD, 2023a). Results are based on DLs which vary between both sampling sites and across different PFAS. Results for HFPO-DA are presented in Exhibit 7-12.

Exhibit 7-12: Summary of HFPO-DA Drinking Water Sampling Results Collected Post-Treatment from Department of Defense Off-Base "Covered Areas"

State	Installation Name	Sampling Dates	Analysis Method	# Samples	# Detections	% Detections
AZ	YUMA AZ MCAS	5/26/2023	533	1	0	0.00%
CA	Castle AFB	7/5/2022 - 4/5/2023	537	26	0	0.00%
CA	Castle AFB	11/17/2021 - 1/11/2022	QSM_B15	12	0	0.00%
CA	George AFB	3/23/2023 - 4/20/2023	1633	3	0	0.00%
CA	March AFB	1/3/2023 - 4/10/2023	533	3	0	0.00%
CA	March AFB	1/3/2022 - 12/1/2022	537.1	11	0	0.00%
CA	March AFB	9/1/2022	QSM_B15	1	0	0.00%
DE	Dover AFB	1/22/2022	QSM_B15	6	0	0.00%
FL	WHITING FLD FL NAS	9/1/2022	537.1	2	0	0.00%
ME	NCTAMSLANT DET CUTLER	4/20/2022 - 12/6/2022	537.1	66	0	0.00%
NH	Pease AFB	6/23/2022	QSM_B15	2	0	0.00%
NY	Plattsburgh AFB	3/1/2022 - 9/15/2022	537.1	10	0	0.00%
NY	Plattsburgh AFB	11/29/2021 - 6/27/2023	QSM_B15	9	0	0.00%
RI	NAVAL AUX LANDING FIELD	5/19/2022	537.1	2	0	0.00%
RI	NAVAL AUX LANDING FIELD	10/17/2022 - 2/28/2023	QSM_B15	31	0	0.00%
VA	OCEANA VA NAS	10/19/2022 - 4/14/2023	537.1	13	0	0.00%
WA	BREMERTON WA NAVBASE	10/11/2022 - 7/21/2023	537.1	3	0	0.00%
WA	WHIDBEY IS WA NAS	4/21/2022 - 4/20/2023	537.1	11	0	0.00%

Source: DOD, 2023a

7.2.3 Occurrence in Ambient Water

Lakes, rivers, and aquifers are the ambient sources of most drinking water. Contaminant occurrence in ambient water can provide useful information on the potential for contaminants to adversely affect drinking water supplies. Occurrence data for HFPO-DA in ambient water are available from the USGS NWIS database and the EPA's legacy STORET data available through the WQP.

7.2.3.1 National Water Information System (NWIS) Data

The NWIS is the Nation's principal repository of water resources data USGS collects from more than 1.9 million sites (USGS, 2023). NWIS-Web is the general online interface to the USGS NWIS database. Discrete water-sample and time-series data are available from sites in all 50 States, including 5 million water samples with 90 million water-quality results. All USGS water quality and flow data are stored in NWIS, including site characteristics, streamflow, ground water level, precipitation, and chemical analyses of water, sediment, and biological media, though not all parameters are available for every site. NWIS houses the NAWQA data and includes other USGS data from unspecified projects. NWIS contains many more samples at many more sites than the NAWQA Program. Although NWIS is comprised of primarily ambient water data, some finished drinking water data are included as well. This section presents analyses of non-NAWQA data in NWIS, downloaded from the WQP in November 2023 (WQP, 2023).

The results of the non-NAWQA NWIS HFPO-DA analysis are presented in Exhibit 7-13. NWIS data for HFPO-DA were listed under the characteristic name "Hexafluoropropylene oxide dimer acid." HFPO-DA was not detected in any of the 170 samples collected from 60 sites. (Note that the NWIS data are presented as downloaded; potential outliers were not evaluated or excluded from the analysis.)

Exhibit 7-13: HFPO-DA NWIS Data

Site Type	Detection Frequency (detections are results ≥ reporting level)				Concentration Values (of detections, in ng/L)				
	No. of Samples	No. of Samples with Detections	No. of Sites	No. of Sites with Detections	Minimum	Median	90th Percentile	99th Percentile	Maximum
Ground Water	2	0	2	0	--	--	--	--	--
Surface Water	168	0	58	0	--	--	--	--	--
All Sites	**170**	**0**	**60**	**0**	--	--	--	--	--

Source: WQP, 2023

7.2.3.2 Storage and Retrieval (STORET) Data / Water Quality Portal (WQP)

From its launch in 1999 until it was decommissioned in June 2018, the EPA's STORET Data Warehouse was collaboratively populated with raw biological, chemical, and physical data from surface water and ground water sampling by federal, state and local agencies, Native American tribes, volunteer groups, academics, and others. Legacy STORET data are accessible through the WQP: https://www.waterqualitydata.us/portal/.

STORET data are from monitoring locations in all 50 states as well as multiple territories and jurisdictions of the United States. Most data are from ambient waters, but in some cases finished drinking water data are included as well. STORET's data quality limitations include variations in the extent of national coverage and data completeness from parameter to parameter. Data may have been collected as part of targeted, rather than randomized, monitoring.

This section presents analyses of STORET data, downloaded from the WQP in November 2023 (WQP, 2023). The EPA reviewed STORET ground water data from wells and springs and surface water data from lakes, rivers, streams, and reservoirs (WQP, 2023). STORET data for HFPO-DA were listed under the characteristic name of "Hexafluoropropylene oxide dimer acid" and "Perfluoro(2-propoxypropanoate)." The results of the STORET analysis for HFPO-DA are presented in Exhibit 7-14. More than 130 HFPO-DA samples were available for analysis. These HFPO-DA samples were collected between 2019 and 2023. Of the 118 sites sampled, less than 1 percent reported detections of HFPO-DA. One detected concentration was listed in the database as a non-numerical value (i.e., "Present Below Quantification Limit").

Exhibit 7-14: HFPO-DA STORET Data - Summary of Samples and Sites

Source Water Type	Total Number of Samples	Samples with Detections		Total Number of Sites	Sites with Detections	
		Number	Percent		Number	Percent
Ground Water	51	0	0.00%	48	0	0.00%
Surface Water	26	0	0.00%	26	0	0.00%
Unknown	59	1	1.69%	44	1	2.27%
Total	**136**	**1**	**0.74%**	**118**	**1**	**0.85%**

Source: WQP, 2023

7.3 Analytical Methods

For the purposes of compliance with the PFAS NPDWR, the EPA has published two analytical methods that are available for the analysis of HFPO-DA and other PFAS in drinking water. The performance metrics that are presented, including the DL, LCMRL, mean recoveries and RSDs are specific to HFPO-DA for each of the listed analytical methods. Ranges of mean recoveries and RSDs are presented for the matrices listed; data from holding time studies are not included since these studies are designed to demonstrate a degradation in method performance over time and thus are not indicative of method performance that should be observed when holding times are not exceeded:

- EPA Method 537.1, Version 2.0, *Determination of Selected Per- and Polyfluorinated Alkyl Substances in Drinking Water by Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometry (LC/MS/MS)*. The DL and LCMRL generated by the laboratory that developed the method are 1.9 ng/L and 4.3 ng/L, respectively. Mean recoveries in fortified reagent water, tap water from a ground water source (TOC = 0.53 mg/L and hardness = 377 mg/L), tap water from a surface water source (TOC = 2.4 mg/L and hardness = 103 mg/L), and tap water from a private well (TOC = 0.56 mg/L and hardness = 394 mg/L) range from 88.6 to 102%, with RSDs of 1.3 to 5.1% (USEPA, 2020d).
- EPA Method 533, *Determination of Per- and Polyfluoroalkyl Substances in Drinking Water by Isotope Dilution Anion Exchange Solid Phase Extraction and Liquid Chromatography / Tandem Mass Spectrometry*. The LCMRL generated by the laboratory that developed the method is 3.7 ng/L (DLs were not calculated). Mean recoveries (excluding ^{13}C isotope analogue data) in fortified reagent water, finished drinking water from a ground water source (hardness = 320 mg/L, pH = 7.88 at 17° C, free Cl_2 = 0.64 mg/L, and total Cl_2 = 0.74 mg/L) and clarified surface water (prior to GAC treatment and chlorinated in the laboratory; pH = 8.1 at 20 °C, free Cl_2 = 0.98 mg/L, total Cl_2 = 1.31 mg/L. and TOC = 3.8 mg/L) range from 102 to 109%, with RSDs of 4.7 to 9.7% (USEPA, 2019b).

8 Hazard Index MCL Analyses

The EPA is making a final regulatory determination and finalizing an HI NPDWR for the regulation of mixture combinations containing two or more of PFHxS, PFNA, HFPO-DA, and PFBS (collectively referred to as “HI PFAS”). As such, the EPA is finalizing to calculate the HI as the sum total of component four PFAS hazard quotients (HQs), calculated by dividing the measured component PFAS concentration in water by the relevant Health Based Water Concentration (HBWC). The EPA is finalizing the HBWCs to be 10 ppt for PFHxS; 10 ppt for PFNA; 10 ppt for HFPO-DA; and 2,000 ppt for PFBS. The EPA notes these HBWCs are identical to the final individual MCLs for PFHxS, PFNA, and HFPO-DA. Exhibit 8-1 below presents the sample-level results of the HI analysis for mixtures containing two or more of PFHxS, PFNA, HFPO-DA, and PFBS using available finished water data from the state reported data sets. The EPA notes that while nearly all states included in Exhibit 8-1 conducted monitoring of all four PFAS as a part of their overall PFAS sampling effort, in a subset of those states (e.g., California, Massachusetts) some samples did not include reported data on all four HI PFAS (i.e., values of one or more of the HI PFAS were not reported as non-detect, rather no value was reported). Therefore, for that subset of states, to fully conduct the HI analysis, the EPA also analyzed samples even if those samples did not contain reported values (including non-detects) of all four HI PFAS (i.e., exceeding the HI based on only two or three HI PFAS with reported values included within a sample). Accordingly, for water samples with a reported result of all four analytes included, an HQ is calculated for each analyte and the resulting ratios are summed and compared to the HI of 1 (unitless). For water samples with fewer than all four analytes (as indicated in the first column of Exhibit 8-1), the HQs for any of the four PFAS with available results are also calculated and then summed and compared to the HI of 1 (unitless). The HI MCL equation is calculated as follows:

$$HI\ MCL = \left(\frac{[HFPO-DA_{water}]}{[10\ ppt]}\right) + \left(\frac{[PFBS_{water}]}{[2{,}000\ ppt]}\right) + \left(\frac{[PFNA_{water}]}{[10\ ppt]}\right) + \left(\frac{[PFHxS_{water}]}{[10\ ppt]}\right)$$

Where $HFPO\text{-}DA_{water}$ = monitored ppt concentration of HFPO-DA;
$PFBS_{water}$ = monitored ppt concentration of PFBS;
$PFNA_{water}$= monitored ppt concentration of PFNA; and
$PFHxS_{water}$ = monitored ppt concentration of PFHxS

Exhibit 8-1. Hazard Index Analysis, Summary of Samples

Samples with "X" number of analytes	State	Source Water Type	Total # Samples Hazard Index (HI) Calculation	# Samples with HI > 1	% of Samples with HI > 1
4	Arizona	Ground Water	23	5	21.74%
4		Surface Water	2	0	0.00%
4		**Total**	**25**	**5**	**20.00%**
4	California	Ground Water	1,601	63	3.94%

Samples with "X" number of analytes	State	Source Water Type	Total # Samples Hazard Index (HI) Calculation	# Samples with HI > 1	% of Samples with HI > 1
4		Surface Water	3,803	82	2.16%
4		Unknown	4	0	0.00%
4		**Total**	**5,408**	**145**	**2.68%**
3	California	Ground Water	267	115	43.07%
3		Surface Water	117	12	10.26%
3		**Total**	**384**	**127**	**33.07%**
2	California	Ground Water	1	0	0.00%
2		Surface Water	0	0	0.00%
2		**Total**	**1**	**0**	**0.00%**
3	Colorado (2013-2017)	Distribution (Finished)	66	27	40.91%
3		Surface Water (Finished)	11	0	0.00%
3		**Total**	**77**	**27**	**35.06%**
4	Colorado (2020)	Ground Water	339	1	0.29%
4		Surface Water	244	1	0.41%
4		**Total**	**583**	**2**	**0.34%**
3	Georgia	Ground Water	0	0	0.00%
3		Surface Water	2	0	0.00%
3		**Total**	**2**	**0**	**0.00%**
4	Idaho	Ground Water	18	0	0.00%
4		Surface Water	0	0	0.00%
4		**Total**	**18**	**0**	**0.00%**
4	Illinois	Ground Water	1,666	13	0.78%
4		Surface Water	277	0	0.00%
4		**Total**	**1,943**	**13**	**0.67%**
3	Illinois	Ground Water	157	3	1.91%
3		Surface Water	25	0	0.00%
3		**Total**	**182**	**3**	**1.65%**
4	Indiana	Ground Water	414	0	0.00%
4		Surface Water	56	0	0.00%
4		**Total**	**470**	**0**	**0.00%**
3	Indiana	Ground Water	8	0	0.00%
3		Surface Water	3	0	0.00%
3		**Total**	**11**	**0**	**0.00%**
4	Iowa	Ground Water	151	3	1.99%
4		Surface Water	63	4	6.35%
4		**Total**	**214**	**7**	**3.27%**
3	Iowa	Ground Water	1	0	0.00%
3		Surface Water	0	0	0.00%

Samples with "X" number of analytes	State	Source Water Type	Total # Samples Hazard Index (HI) Calculation	# Samples with HI > 1	% of Samples with HI > 1
3		**Total**	**1**	**0**	**0.00%**
4	Kentucky	Ground Water	33	0	0.00%
4		Surface Water	48	2	4.17%
4		**Total**	**81**	**2**	**2.47%**
4	Maine	Ground Water	0	0	0.00%
4		Surface Water	0	0	0.00%
4		Unknown	9	0	0.00%
4		**Total**	**9**	**0**	**0.00%**
3	Maine	Ground Water	7	0	0.00%
3		Surface Water	2	0	0.00%
3		Unknown	45	3	6.67%
3		**Total**	**54**	**3**	**5.56%**
3	Maine (Compliance)	Ground Water	640	3	0.47%
3		Surface Water	62	0	0.00%
3		**Total**	**702**	**3**	**0.43%**
2	Maine (Compliance)	Ground Water	6	1	16.67%
2		Surface Water	0	0	0.00%
2		**Total**	**6**	**1**	**16.67%**
4	Maryland (Phase 1)	Ground Water	70	3	4.29%
4		Surface Water	76	3	3.95%
4		**Total**	**146**	**6**	**4.11%**
4	Maryland (Phase 2)	Ground Water	9	1	11.11%
4		Surface Water	0	0	0.00%
4		**Total**	**9**	**1**	**11.11%**
4	Maryland (Phase 3)	Ground Water	88	3	3.41%
4		Surface Water	0	0	0.00%
4		**Total**	**88**	**3**	**3.41%**
4	Massachusetts	Ground Water	6,522	85	1.30%
4		Surface Water	1,751	7	0.40%
4		**Total**	**8,273**	**92**	**1.11%**
3	Massachusetts	Ground Water	238	34	14.29%
3		Surface Water	130	4	3.08%
3		**Total**	**368**	**38**	**10.33%**
2	Massachusetts	Ground Water	192	6	3.13%
2		Surface Water	93	0	0.00%
2		**Total**	**285**	**6**	**2.11%**
4	Michigan	Ground Water	9,973	62	0.62%
4		Surface Water	516	0	0.00%
4		Unknown	164	3	1.83%

Samples with "X" number of analytes	State	Source Water Type	Total # Samples Hazard Index (HI) Calculation	# Samples with HI > 1	% of Samples with HI > 1
4		**Total**	**10,653**	**65**	**0.61%**
4	Missouri, 2022 - 2023	Ground Water	190	1	0.53%
4		Surface Water	20	0	0.00%
4		**Total**	**210**	**1**	**0.48%**
3	Missouri, 2022 - 2023	Ground Water	19	0	0.00%
3		Surface Water	23	0	0.00%
3		**Total**	**42**	**0**	**0.00%**
4	New Hampshire	Ground Water	181	4	2.21%
4		Surface Water	45	0	0.00%
4		**Total**	**226**	**4**	**1.77%**
3	New Hampshire	Ground Water	338	11	3.25%
3		Surface Water	14	0	0.00%
3		**Total**	**352**	**11**	**3.13%**
2	New Hampshire	Ground Water	1,107	25	2.26%
2		Surface Water	92	0	0.00%
2		Unknown	1	0	0.00%
2		**Total**	**1,200**	**25**	**2.08%**
3	New Jersey	Ground Water	5,344	119	2.23%
3		Surface Water	1,769	20	1.13%
3		Unknown	3	0	0.00%
3		**Total**	**7,116**	**139**	**1.95%**
2	New Jersey	Ground Water	2	0	0.00%
2		Surface Water	1	0	0.00%
2		**Total**	**3**	**0**	**0.00%**
3	New Mexico	Ground Water	2	0	0.00%
3		Surface Water	0	0	0.00%
3		**Total**	**2**	**0**	**0.00%**
4	New York	Ground Water	874	6	0.69%
4		Surface Water	239	2	0.84%
4		Unknown	4	0	0.00%
4		**Total**	**1,117**	**8**	**0.72%**
3	New York	Ground Water	822	19	2.31%
3		Surface Water	115	0	0.00%
3		**Total**	**937**	**19**	**2.03%**
2	New York	Ground Water	16	0	0.00%
2		Surface Water	5	0	0.00%
2		**Total**	**21**	**0**	**0.00%**
3	North Dakota (2020)	Ground Water	42	0	0.00%
3		Surface Water	8	0	0.00%

Samples with "X" number of analytes	State	Source Water Type	Total # Samples Hazard Index (HI) Calculation	# Samples with HI > 1	% of Samples with HI > 1
3		**Total**	**50**	**0**	**0.00%**
2	North Dakota (2020)	Ground Water	0	0	0.00%
2		Surface Water	1	0	0.00%
2		**Total**	**1**	**0**	**0.00%**
4	North Dakota (2021)	Ground Water	56	0	0.00%
4		Surface Water	7	0	0.00%
4		**Total**	**63**	**0**	**0.00%**
4	Ohio	Ground Water	1,775	57	3.21%
4		Surface Water	170	1	0.59%
4		**Total**	**1,945**	**58**	**2.98%**
4	Oregon	Ground Water	113	1	0.88%
4		Surface Water	27	0	0.00%
4		**Total**	**140**	**1**	**0.71%**
3	Oregon	Ground Water	18	0	0.00%
3		Surface Water	2	0	0.00%
3		**Total**	**20**	**0**	**0.00%**
3	Pennsylvania (2019)	Ground Water	75	1	1.33%
3		Surface Water	21	1	4.76%
3		**Total**	**96**	**2**	**2.08%**
4	Pennsylvania (2021)	Ground Water	314	9	2.87%
4		Surface Water	98	1	1.02%
4		**Total**	**412**	**10**	**2.43%**
4	South Carolina	Ground Water	572	2	0.35%
4		Surface Water	185	0	0.00%
4		**Total**	**757**	**2**	**0.26%**
3	South Carolina	Ground Water	0	0	0.00%
3		Surface Water	3	0	0.00%
3		**Total**	**3**	**0**	**0.00%**
2	South Carolina	Ground Water	0	0	0.00%
2		Surface Water	6	0	0.00%
2		**Total**	**6**	**0**	**0.00%**
3	Tennessee	Ground Water	0	0	0.00%
3		Surface Water	2	0	0.00%
3		**Total**	**2**	**0**	**0.00%**
4	Vermont	Ground Water	1,456	20	1.37%
4		Surface Water	101	0	0.00%
4		**Total**	**1,557**	**20**	**1.28%**
3	Vermont	Ground Water	1	0	0.00%
3		Surface Water	0	0	0.00%

Samples with "X" number of analytes	State	Source Water Type	Total # Samples Hazard Index (HI) Calculation	# Samples with HI > 1	% of Samples with HI > 1
3		**Total**	**1**	**0**	**0.00%**
2	Vermont	Ground Water	6	0	0.00%
2		Surface Water	1	0	0.00%
2		**Total**	**7**	**0**	**0.00%**
4	Virginia	Ground Water	5	0	0.00%
4		Surface Water	34	1	2.94%
4		**Total**	**39**	**1**	**2.56%**
4	Wisconsin	Ground Water	675	14	2.07%
4		Surface Water	47	0	0.00%
4		**Total**	**722**	**14**	**1.94%**
3	Wisconsin	Ground Water	9	0	0.00%
3		Surface Water	0	0	0.00%
3		**Total**	**9**	**0**	**0.00%**
2	Wisconsin	Ground Water	36	0	0.00%
2		Surface Water	7	0	0.00%
2		**Total**	**43**	**0**	**0.00%**

[1] New Jersey only conducted monitoring for PFHxS, PFNA, and PFBS.

The EPA notes that there are other states (e.g., Alabama, North Carolina) that conducted monitoring of all four PFAS; however, for the entirety of their results, only detections were reported. Thus, conducting the HI analysis for those states may not be fully representative. An analysis of the HI data for those two states showed the following results: 5 percent of Alabama samples including two or more PFAS had an HI > 1 (4 of 80 samples) and 99 percent of North Carolina samples including two or more PFAS had an HI > 1 (367 of 372 samples).

Exhibit 8-2 presents similar results to Exhibit 8-1 but at the system-level, including population served estimates. For the states with a varying number of analytes included in the HI calculation, a summary of the unique count of systems with data is also presented (e.g., California, Massachusetts, etc.).

Exhibit 8-2. Hazard Index Analysis, Summary of Systems and Population Served by Systems

Samples with "X" number of analytes	State	Source Water Type	Total # Systems with Data for the HI Calculation	# Systems with HI >1	% of Systems with HI > 1	Total Pop. Served by Systems with Data for the HI Calculation[1]	Pop. Served by Systems with HI >1	% of Systems with HI > 1
4	Arizona	Ground Water	5	2	40.00%	94,569	55,535	58.72%
		Surface Water	1	0	0.00%	50,001	0	0.00%
		Total	**6**	**2**	**33.33%**	**144,570**	**55,535**	**38.41%**
4	California	Ground Water	37	6	16.22%	1,085,674	132,539	12.21%
		Surface Water	74	11	14.86%	13,163,194	2,491,347	18.93%
		Unknown	1	0	0.00%	0	0	0.00%
		Total	**112**	**17**	**15.18%**	**14,248,868**	**2,623,886**	**18.41%**
3	California	Ground Water	12	3	25.00%	122,333	84,840	69.35%
		Surface Water	22	5	22.73%	3,319,040	754,159	22.72%
		Total	**34**	**8**	**23.53%**	**3,441,373**	**838,999**	**24.38%**
2	California	Ground Water	1	0	0.00%	26,355	0	0.00%
		Surface Water	0	0	0.00%	0	0	0.00%
		Total	**1**	**0**	**0.00%**	**26,355**	**0**	**0.00%**
Unique System Count	California	Ground Water	43	7	16.28%	1,098,122	134,039	12.21%
		Surface Water	78	12	15.38%	13,500,188	2,665,573	19.74%
		Unknown	1	0	0.00%	0	0	0.00%
		Total	**122**	**19**	**15.57%**	**14,598,310**	**2,799,612**	**19.18%**
3	Colorado (2013-2017)	Distribution (Finished)	22	11	50.00%	--	--	--
		Surface Water (Finished)	5	0	0.00%	--	--	--
		Total	**27**	**11**	**40.74%**	**--**	**--**	**--**
4	Colorado (2020)	Ground Water	221	1	0.45%	261,162	70	0.03%
		Surface Water	176	1	0.57%	4,191,774	4,495	0.11%
		Total	**397**	**2**	**0.50%**	**4,452,936**	**4,565**	**0.10%**
3	Georgia[2]	Ground Water	0	0	0.00%	0	0	0.00%

Samples with "X" number of analytes	State	Source Water Type	Total # Systems with Data for the HI Calculation	# Systems with HI >1	% of Systems with HI > 1	Total Pop. Served by Systems with Data for the HI Calculation[1]	Pop. Served by Systems with HI >1	% of Systems with HI > 1
		Surface Water	1	0	0.00%	9,993	0	0.00%
		Total	**1**	**0**	**0.00%**	**9,993**	**0**	**0.00%**
4	Idaho	Ground Water	10	0	0.00%	81,985	0	0.00%
		Surface Water	0	0	0.00%	0	0	0.00%
		Total	**10**	**0**	**0.00%**	**81,985**	**0**	**0.00%**
4	Illinois	Ground Water	899	7	0.78%	2,916,219	83,168	2.85%
		Surface Water	97	0	0.00%	4,628,949	0	0.00%
		Total	**996**	**7**	**0.70%**	**7,545,168**	**83,168**	**1.10%**
3	Illinois	Ground Water	26	1	3.85%	531,087	3,000	0.56%
		Surface Water	13	0	0.00%	315,395	0	0.00%
		Total	**39**	**1**	**2.56%**	**846,482**	**3,000**	**0.35%**
Unique System Count	Illinois	Ground Water	899	7	0.78%	2,916,219	83,168	2.85%
		Surface Water	97	0	0.00%	4,628,949	0	0.00%
		Total	**996**	**7**	**0.70%**	**7,545,168**	**83,168**	**1.10%**
4	Indiana	Ground Water	333	0	0.00%	505,212	0	0.00%
		Surface Water	30	0	0.00%	93,290	0	0.00%
		Total	**363**	**0**	**0.00%**	**598,502**	**0**	**0.00%**
3	Indiana	Ground Water	8	0	0.00%	40,626	0	0.00%
		Surface Water	1	0	0.00%	4,158	0	0.00%
		Total	**9**	**0**	**0.00%**	**44,784**	**0**	**0.00%**
Unique System Count	Indiana	Ground Water	341	0	0.00%	545,838	0	0.00%
		Surface Water	31	0	0.00%	97,448	0	0.00%
		Total	**372**	**0**	**0.00%**	**643,286**	**0**	**0.00%**
4	Iowa	Ground Water	89	2	2.25%	490,955	5,834	1.19%
		Surface Water	26	1	3.85%	987,522	85,797	8.69%
		Total	**115**	**3**	**2.61%**	**1,478,477**	**91,631**	**6.20%**

Samples with "X" number of analytes	State	Source Water Type	Total # Systems with Data for the HI Calculation	# Systems with HI >1	% of Systems with HI > 1	Total Pop. Served by Systems with Data for the HI Calculation[1]	Pop. Served by Systems with HI >1	% of Systems with HI > 1
3	Iowa	Ground Water	1	0	0.00%	540	0	0.00%
		Surface Water	0	0	0.00%	0	0	0.00%
		Total	**1**	**0**	**0.00%**	**540**	**0**	**0.00%**
Unique	Iowa	Ground Water	90	2	2.22%	491,495	5,834	1.19%
		Surface Water	26	1	3.85%	987,522	85,797	8.69%
		Total	**116**	**3**	**2.59%**	**1,479,017**	**91,631**	**6.20%**
4	Kentucky	Ground Water	30	0	0.00%	171,212	0	0.00%
		Surface Water	44	2	4.55%	1,922,023	55,665	2.90%
		Total	**74**	**2**	**2.70%**	**2,093,235**	**55,665**	**2.66%**
4	Maine	Ground Water	0	0	0.00%	0	0	0.00%
		Surface Water	0	0	0.00%	0	0	0.00%
		Unknown	2	0	0.00%	0	0	0.00%
		Total	**2**	**0**	**0.00%**	**0**	**0**	**0.00%**
3	Maine	Ground Water	7	0	0.00%	3,995	0	0.00%
		Surface Water	1	0	0.00%	21,808	0	0.00%
		Unknown	10	3	30.00%	0	0	0.00%
		Total	**18**	**3**	**16.67%**	**25,803**	**0**	**0.00%**
Unique System Count	Maine	Ground Water	7	0	0.00%	3,995	0	0.00%
		Surface Water	1	0	0.00%	21,808	0	0.00%
		Unknown	10	3	0.00%	0	0	0.00%
		Total	**18**	**3**	**16.67%**	**25,803**	**0**	**0.00%**
3	Maine (Compliance)	Ground Water	588	3	0.51%	274,216	1,060	0.39%
		Surface Water	53	0	0.00%	464,453	0	0.00%
		Total	**641**	**3**	**0.47%**	**738,669**	**1,060**	**0.14%**
2	Maine (Compliance)	Ground Water	5	1	20.00%	650	140	21.54%
		Surface Water	0	0	0.00%	0	0	0.00%

Samples with "X" number of analytes	State	Source Water Type	Total # Systems with Data for the HI Calculation	# Systems with HI >1	% of Systems with HI > 1	Total Pop. Served by Systems with Data for the HI Calculation[1]	Pop. Served by Systems with HI >1	% of Systems with HI > 1
		Total	**5**	**1**	**20.00%**	**650**	**140**	**21.54%**
Unique System Count	Maine (Compliance)	Ground Water	593	4	0.67%	274,866	1,200	0.44%
		Surface Water	53	0	0.00%	464,453	0	0.00%
		Total	**646**	**4**	**0.62%**	**739,319**	**1,200**	**0.16%**
Unique System Count	Maine (All)	Ground Water	593	4	0.67%	274,866	1,200	0.44%
		Surface Water	53	0	0.00%	464,453	0	0.00%
		Unknown	10	3	0.00%	0	0	0.00%
		Total	**656**	**7**	**1.07%**	**739,319**	**1,200**	**0.16%**
4	Maryland (Phase 1)	Ground Water	30	2	6.67%	384,007	7,000	1.82%
		Surface Water	36	2	5.56%	4,059,154	40,656	1.00%
		Total	**66**	**4**	**6.06%**	**4,443,161**	**47,656**	**1.07%**
4	Maryland (Phase 2)	Ground Water	6	1	16.67%	3,896	180	4.62%
		Surface Water	0	0	0.00%	0	0	0.00%
		Total	**6**	**1**	**16.67%**	**3,896**	**180**	**4.62%**
4	Maryland (Phase 3)	Ground Water	63	2	3.17%	41,063	295	0.72%
		Surface Water	0	0	0.00%	0	0	0.00%
		Total	**63**	**2**	**3.17%**	**41,063**	**295**	**0.72%**
Unique System Count	Maryland (All)	Ground Water	99	5	5.05%	428,966	7,475	1.74%
		Surface Water	36	2	0.00%	4,059,154	40,656	1.00%
		Total	**135**	**7**	**5.19%**	**4,488,120**	**48,131**	**1.07%**
4	Massachusetts	Ground Water	1,187	21	1.77%	1,776,646	129,909	7.31%
		Surface Water	122	2	1.64%	5,860,701	56,285	0.96%
		Total	**1,309**	**23**	**1.76%**	**7,637,347**	**186,194**	**2.44%**
3	Massachusetts	Ground Water	69	7	10.14%	386,252	86,397	22.37%
		Surface Water	24	2	8.33%	1,007,330	119,500	11.86%
		Total	**93**	**9**	**9.68%**	**1,393,582**	**205,897**	**14.77%**

Samples with "X" number of analytes	State	Source Water Type	Total # Systems with Data for the HI Calculation	# Systems with HI >1	% of Systems with HI > 1	Total Pop. Served by Systems with Data for the HI Calculation[1]	Pop. Served by Systems with HI >1	% of Systems with HI > 1
2	Massachusetts	Ground Water	93	5	5.38%	541,579	73,361	13.55%
		Surface Water	31	0	0.00%	3,681,189	0	0.00%
		Total	**124**	**5**	**4.03%**	**4,222,768**	**73,361**	**1.74%**
Unique System Count	Massachusetts	Ground Water	1,204	27	2.24%	1,828,254	216,323	11.83%
		Surface Water	122	4	3.28%	5,860,701	175,785	3.00%
		Total	**1,326**	**31**	**2.34%**	**7,688,955**	**392,108**	**5.10%**
4	Michigan	Ground Water	2,370	16	0.68%	1,945,734	222,360	11.43%
		Surface Water	84	0	0.00%	1,314,601	0	0.00%
		Unknown	54	1	1.85%	0	0	0.00%
		Total	**2,508**	**17**	**0.68%**	**3,260,335**	**222,360**	**6.82%**
4	Missouri	Ground Water	94	1	1.06%	189,904	1,963	1.03%
		Surface Water	16	0	0.00%	347,928	0	0.00%
		Total	**110**	**1**	**0.91%**	**537,832**	**1,963**	**0.36%**
3	Missouri	Ground Water	3	0	0.00%	23,470	0	0.00%
		Surface Water	4	0	0.00%	384,959	0	0.00%
		Total	**7**	**0**	**0.00%**	**408,429**	**0**	**0.00%**
Unique System Count	Missouri	Ground Water	96	1	1.04%	212,274	1,963	0.92%
		Surface Water	19	0	0.00%	417,202	0	0.00%
		Total	**115**	**1**	**0.87%**	**629,476**	**1,963**	**0.31%**
4	New Hampshire	Ground Water	127	3	2.36%	69,445	4,145	5.97%
		Surface Water	11	0	0.00%	237,720	0	0.00%
		Total	**138**	**3**	**2.17%**	**307,165**	**4,145**	**1.35%**
3	New Hampshire	Ground Water	121	8	6.61%	122,407	29,486	24.09%
		Surface Water	10	0	0.00%	302,520	0	0.00%
		Total	**131**	**8**	**6.11%**	**424,927**	**29,486**	**6.94%**
2	New Hampshire	Ground Water	434	10	2.30%	225,885	2,368	1.05%

Samples with "X" number of analytes	State	Source Water Type	Total # Systems with Data for the HI Calculation	# Systems with HI >1	% of Systems with HI > 1	Total Pop. Served by Systems with Data for the HI Calculation[1]	Pop. Served by Systems with HI >1	% of Systems with HI > 1
		Surface Water	20	0	0.00%	149,742	0	0.00%
		Unknown	1	0	0.00%	10	0	0.00%
		Total	**455**	**10**	**2.20%**	**375,637**	**2,368**	**0.63%**
Unique System Count	New Hampshire	Ground Water	529	17	3.21%	267,029	34,736	13.01%
		Surface Water	30	0	0.00%	476,367	0	0.00%
		Unknown	1	0	0.00%	10	0	0.00%
		Total	**560**	**17**	**3.04%**	**743,406**	**34,736**	**4.67%**
3	New Jersey[2]	Ground Water	598	22	3.68%	1,520,663	181,605	11.94%
		Surface Water	65	5	7.69%	4,783,734	216,145	4.52%
		Unknown	1	0	0.00%	0	0	0.00%
		Total	**664**	**27**	**4.07%**	**6,304,397**	**397,750**	**6.31%**
2	New Jersey[2]	Ground Water	2	0	0.00%	2,520	0	0.00%
		Surface Water	1	0	0.00%	335,449	0	0.00%
		Total	**3**	0	0.00%	**337,969**	0	0.00%
Unique System Count	New Jersey[2]	Ground Water	599	22	0.00%	1,520,763	181,605	11.94%
		Surface Water	65	5	7.69%	4,783,734	216,145	4.52%
		Unknown	1	0	0.00%	0	0	0.00%
		Total	**665**	**27**	**4.06%**	**6,304,497**	**397,750**	**6.31%**
3	New Mexico[2]	Ground Water	1	0	0.00%	--	--	--
		Surface Water	0	0	0.00%	--	--	--
		Total	**1**	**0**	**0.00%**	**--**	**--**	**--**
4	New York	Ground Water	452	5	1.11%	459,067	3,643	0.79%
		Surface Water	91	2	2.20%	1,280,497	11,200	0.87%
		Unknown	3	0	0.00%	1,024	0	0.00%
		Total	**546**	**7**	**1.28%**	**1,740,588**	**14,843**	**0.85%**
3	New York	Ground Water	153	13	8.50%	1,195,261	154,077	12.89%

Samples with "X" number of analytes	State	Source Water Type	Total # Systems with Data for the HI Calculation	# Systems with HI >1	% of Systems with HI > 1	Total Pop. Served by Systems with Data for the HI Calculation[1]	Pop. Served by Systems with HI >1	% of Systems with HI > 1
		Surface Water	35	0	0.00%	1,818,235	0	0.00%
		Total	**188**	**13**	**6.91%**	**3,013,496**	**154,077**	**5.11%**
2	New York	Ground Water	13	0	0.00%	30,296	0	0.00%
		Surface Water	4	0	0.00%	5,251	0	0.00%
		Total	**17**	**0**	**0.00%**	**35,547**	**0**	**0.00%**
Unique System Count	New York	Ground Water	550	16	2.91%	1,451,812	157,170	10.83%
		Surface Water	120	2	1.67%	2,805,924	11,200	0.40%
		Unknown	3	0	0.00%	1,024	0	0.00%
		Total	**673**	**18**	**2.67%**	**4,258,760**	**168,370**	**3.95%**
4	North Dakota (2021)	Ground Water	56	0	0.00%	113,623	0	0.00%
		Surface Water	7	0	0.00%	194,121	0	0.00%
		Total	**63**	**0**	**0.00%**	**307,744**	**0**	**0.00%**
3	North Dakota (2020)	Ground Water	41	0	0.00%	68,280	0	0.00%
		Surface Water	8	0	0.00%	56,016	0	0.00%
		Total	**49**	**0**	**0.00%**	**124,296**	**0**	**0.00%**
2	North Dakota (2020)	Ground Water	0	0	0.00%	0	0	0.00%
		Surface Water	1	0	0.00%	1,453	0	0.00%
		Total	**1**	**0**	**0.00%**	**1,453**	**0**	**0.00%**
Unique System Count	North Dakota (2020)	Ground Water	41	0	0.00%	68,280	0	0.00%
		Surface Water	9	0	0.00%	57,469	0	0.00%
		Total	**50**	**0**	**0.00%**	**125,749**	**0**	**0.00%**
Unique System Count	North Dakota (All)	Ground Water	95	0	0.00%	181,514	0	0.00%
		Surface Water	16	0	0.00%	251,590	0	0.00%
		Total	111	0	0.00%	433,104	0	0.00%
4	Ohio	Ground Water	1,372	15	1.09%	2,883,252	66,341	2.30%
		Surface Water	107	1	0.93%	6,215,644	11,129	0.18%

Samples with "X" number of analytes	State	Source Water Type	Total # Systems with Data for the HI Calculation	# Systems with HI >1	% of Systems with HI > 1	Total Pop. Served by Systems with Data for the HI Calculation[1]	Pop. Served by Systems with HI >1	% of Systems with HI > 1
		Total	**1,479**	**16**	**1.08%**	**9,098,896**	**77,470**	**0.85%**
4	Oregon	Ground Water	100	1	1.00%	100,162	289	0.29%
		Surface Water	25	0	0.00%	106,912	0	0.00%
		Total	**125**	**1**	**0.80%**	**207,074**	**289**	**0.14%**
3	Oregon	Ground Water	16	0	0.00%	14,032	0	0.00%
		Surface Water	2	0	0.00%	18,327	0	0.00%
		Total	**18**	**0**	**0.00%**	**32,359**	**0**	**0.00%**
Unique System Count	Oregon	Ground Water	116	1	0.86%	114,194	289	0.25%
		Surface Water	27	0	0.00%	125,239	0	0.00%
		Total	**143**	**1**	**0.70%**	**239,433**	**289**	**0.12%**
3	Pennsylvania (2019)	Ground Water	71	1	1.41%	162,825	110	0.07%
		Surface Water	16	1	6.25%	431,370	51,000	11.82%
		Total	**87**	**2**	**2.30%**	**594,195**	**51,110**	**8.60%**
4	Pennsylvania (2021)	Ground Water	269	9	3.35%	471,651	37,553	7.96%
		Surface Water	73	1	1.37%	4,296,097	4,464	0.10%
		Total	**342**	**10**	**2.92%**	**4,767,748**	**42,017**	**0.88%**
Unique	Pennsylvania	Ground Water	270	9	3.33%	471,891	37,553	7.96%
		Surface Water	73	2	2.74%	4,296,097	55,464	1.29%
		Total	**343**	**11**	**3.21%**	**4,767,988**	**93,017**	**1.95%**
4	South Carolina	Ground Water	234	2	0.85%	485,992	709	0.15%
		Surface Water	61	0	0.00%	2,200,008	0	0.00%
		Total	**295**	**2**	**0.68%**	**2,686,000**	**709**	**0.03%**
3	South Carolina	Ground Water	0	0	0.00%	0	0	0.00%
		Surface Water	3	0	0.00%	46,946	0	0.00%
		Total	**3**	**0**	**0.00%**	**46,946**	**0**	**0.00%**
2	South Carolina	Ground Water	0	0	0.00%	0	0	0.00%

Samples with "X" number of analytes	State	Source Water Type	Total # Systems with Data for the HI Calculation	# Systems with HI >1	% of Systems with HI > 1	Total Pop. Served by Systems with Data for the HI Calculation[1]	Pop. Served by Systems with HI >1	% of Systems with HI > 1
		Surface Water	1	0	0.00%	242,397	0	0.00%
		Total	**1**	**0**	**0.00%**	**242,397**	**0**	**0.00%**
Unique System Count	South Carolina	Ground Water	234	2	0.85%	485,992	709	0.15%
		Surface Water	65	0	0.00%	2,489,351	0	0.00%
		Total	**299**	**2**	**0.67%**	**2,975,343**	**709**	**0.02%**
3	Tennessee[2]	Ground Water	0	0	0.00%	0	0	0.00%
		Surface Water	1	0	0.00%	2,551	0	0.00%
		Total	**1**	**0**	**0.00%**	**2,551**	**0**	**0.00%**
4	Vermont	Ground Water	526	2	0.38%	211,357	170	0.08%
		Surface Water	38	0	0.00%	174,473	0	0.00%
		Total	**564**	**2**	**0.35%**	**385,830**	**170**	**0.04%**
3	Vermont	Ground Water	1	0	0.00%	302	0	0.00%
		Surface Water	0	0	0.00%	0	0	0.00%
		Total	**1**	**0**	**0.00%**	**302**	**0**	**0.00%**
2	Vermont	Ground Water	6	0	0.00%	1,722	0	0.00%
		Surface Water	1	0	0.00%	64	0	0.00%
		Total	**7**	**0**	**0.00%**	**1,786**	**0**	**0.00%**
Unique System Count	Vermont	Ground Water	526	2	0.38%	211,357	170	0.08%
		Surface Water	38	0	0.00%	174,473	0	0.00%
		Total	**564**	**2**	**0.35%**	**385,830**	**170**	**0.04%**
4	Virginia	Ground Water	5	0	0.00%	2,975	0	0.00%
		Surface Water	19	1	5.26%	4,680,173	155,000	3.31%
		Total	**24**	**1**	**4.17%**	**4,683,148**	**155,000**	**3.31%**
4	Wisconsin	Ground Water	211	7	3.32%	1,407,629	56,862	4.04%
		Surface Water	20	0	0.00%	1,297,605	0	0.00%
		Total	**231**	**7**	**3.03%**	**2,705,234**	**56,862**	**2.10%**

Samples with "X" number of analytes	State	Source Water Type	Total # Systems with Data for the HI Calculation	# Systems with HI >1	% of Systems with HI > 1	Total Pop. Served by Systems with Data for the HI Calculation[1]	Pop. Served by Systems with HI >1	% of Systems with HI > 1
3	Wisconsin	Ground Water	7	0	0.00%	10,058	0	0.00%
		Surface Water	0	0	0.00%	0	0	0.00%
		Total	**7**	**0**	**0.00%**	**10,058**	**0**	**0.00%**
2	Wisconsin	Ground Water	11	0	0.00%	480,084	0	0.00%
		Surface Water	7	0	0.00%	361,347	0	0.00%
		Total	**18**	**0**	**0.00%**	**841,431**	**0**	**0.00%**
Unique System Count	Wisconsin	Ground Water	215	7	3.26%	1,488,212	56,862	3.82%
		Surface Water	22	0	0.00%	1,333,737	0	0.00%
		Total	**237**	**7**	**2.95%**	**2,821,949**	**56,862**	**2.01%**

[1] There were some instances where the population served by a system could not be identified. Thus, there are systems with detections but no associated population served by those systems with detections.
[2] The following states only conducted monitoring for PFHxS, PFNA, and PFBS: Georgia, New Jersey, New Mexico, and Tennessee. These states did not conduct monitoring for HFPO-DA.

9 Co-Occurrence Analyses

This chapter presents co-occurrence analysis of PFAS data in the UCMR 3 as well as in non-targeted supplemental state datasets. The UCMR 3 included monitoring for PFOA, PFOS, PFBS, PFHxS, PFHpA, and PFNA. The EPA notes that PFHpA is not included as a part of the final regulation and HFPO-DA was not monitored for under the UCMR 3. The state datasets included monitoring for a broader suite of PFAS but the analysis presented here is limited to PFAS included in the final regulation: PFOA, PFOS, HFPO-DA, PFBS, PFHxS, and PFNA. Since reporting thresholds differed both across chemicals (for both the UCMR 3 dataset and the aggregated state datasets) and within chemicals (in the aggregated state datasets) continuous approaches relying on relationships between chemical concentrations were not used. Instead, the reported absence or presence of chemicals were used to conduct categorical analyses. Co-occurrence was assessed both groupwise and pairwise.

9.1 UCMR 3

The UCMR 3 dataset included 36,965 complete sample sets (i.e., sample sets where results were reported for all six PFAS analytes included in UCMR 3). Co-occurrence for these sample sets was assessed using groupwise methods as well as counting instances of the occurrence of specific combinations of PFAS chemicals reported to be present.

9.1.1 Groupwise Co-occurrence

The six UCMR 3 PFAS were separated into two groups. The first group consisted of PFOA and PFOS. The second group consisted of the remaining UCMR 3 PFAS (PFHpA, PFHxS, PFNA, and PFBS). The second group is collectively referred to in this section as “Other PFAS.” Exhibit 9-1 provides the counts and percentages of UCMR 3 samples and systems according to whether a) they reported the presence of PFOS or PFOA and b) they reported the presence of Other PFAS.

Exhibit 9-1: UCMR 3 - Samples and Systems Binned According to Whether PFOS or PFOA were Reported by States and Whether Additional Other PFAS were Reported

Type	No PFOS or PFOA Reported		PFOS or PFOA Reported		Total Count
	No Other PFAS Reported	Other PFAS Reported	No Other PFAS Reported	Other PFAS Reported	
Samples	36,368 (98.4%)	91 (0.2%)	255 (0.7%)	251 (0.7%)	36,965
Systems	4,722 (96.0%)	36 (0.7%)	80 (1.6%)	82 (1.7%)	4,920

Exhibit 9-2 further examines systems and samples that detected both PFOS and/or PFOA and Other PFAS according to how many Other PFAS were reported above the MRL.

Exhibit 9-2: UCMR 3 - Counts of Systems and Samples Where PFOA/PFOS and Other PFAS Were Reported Above the MRL According to the Number of Other PFAS Reported Above the UCMR 3 MRL

Additional PFAS Reported	Samples	Systems
1	127 (50.6%)	44 (53.7%)
2	113 (45.0%)	32 (39.0%)
3	11 (4.4%)	6 (7.3%)
Total	251	82

Results of a pairwise PFAS co-occurrence analysis conducted using UCMR 3 data can be found in the discussion of Guelfo and Adamson (2018) in Section 9.3.

9.1.2 Unique Chemical Combinations

Exhibit 9-3 provides the unique combinations of PFAS that were observed at or above the MRL in the UCMR 3 dataset. Also presented is the percentage contribution of each unique combination of PFAS to the total number of sample sets that had any PFAS reported at or above the respective UCMR 3 MRL.

Exhibit 9-3: UCMR 3 - Counts of Unique Combinations of PFAS Chemicals At or Above the UCMR 3 MRL at the Sample Level

Chemicals Reported Present	Number of Occurrences	Percentage Among All Samples with a PFAS Reported At or Above MRL
PFOA	149	25.0%
PFOS/PFOA/PFHxS/PFHpA	76	12.7%
PFOS	75	12.6%
PFHpA	48	8.0%
PFOA/PFHpA	41	6.9%
PFOS/PFHxS	33	5.5%
PFOS/PFOA	31	5.2%
PFHxS	27	4.5%
PFOS/PFOA/PFHxS	19	3.2%
PFOS/PFOA/PFHpA	18	3.0%
PFOS/PFHxS/PFHpA	17	2.8%
PFOA/PFHxS	11	1.8%
PFNA	11	1.8%
PFOA/PFHxS/PFHpA	10	1.7%
PFOS/PFOA/PFHxS/PFHpA/PFBS	7	1.2%
PFOS/PFOA/PFHpA/PFBS	7	1.2%
PFOS/PFOA/PFNA/PFHxS/PFHpA	4	0.7%

Chemicals Reported Present	Number of Occurrences	Percentage Among All Samples with a PFAS Reported At or Above MRL
PFOS/PFHpA	3	0.5%
PFBS	3	0.5%
PFOA/PFNA/PFHpA	2	0.3%
PFOA/PFBS	2	0.3%
PFOS/PFOA/PFNA/PFHxS	1	0.2%
PFHxS/PFHpA	1	0.2%
PFNA/PFHpA	1	0.2%

9.2 State Datasets

The aggregated state monitoring dataset used to conduct these analyses includes data from Colorado, Illinois, Indiana, Kentucky, Maine, Maryland, Massachusetts, Michigan, Missouri, New Hampshire, New Jersey, New York, North Dakota, Ohio, South Carolina, Tennessee, Vermont, and Wisconsin and consists of 54,198 sample sets. System-level data were also included for Minnesota. As noted previously, states utilized various reporting thresholds both across and within chemicals. Co-occurrence was assessed with groupwise and pairwise methods.

9.2.1 Groupwise Co-occurrence

The six chemicals the EPA is finalizing regulation of individually and/or as part of the HI were separated into two groups. The first group consisted of PFOA and PFOS. The second group consisted of HFPO-DA, PFBS, PFHxS, and PFNA (collectively referred to in this section as "HI PFAS"). Different state data collection efforts included different numbers of HI PFAS. Exhibit 9-4 below shows the number of systems and samples according to the number of HI PFAS that were sampled at the sample and system levels.

Exhibit 9-4: Counts of Systems and Samples According to the Number of HI PFAS Analyzed

Number of HI PFAS Analyzed	Samples	Systems
0	4,826	1,202
1	9,231	466
2	1,609	934
3	9,739	1,554
4	28,793	9,198
Total	54,198	13,354

Among these, 48,889 samples and 12,145 systems included analysis for at least one HI PFAS as well as sufficient analysis to examine whether PFOS or PFOA were present. Exhibit 9-5 provides the counts and percentages of these samples and systems according to whether: a) they reported the presence of PFOS or PFOA, and b) they reported the presence of HI chemicals.

Exhibit 9-5: Non-Targeted State PFAS Finished Water Data - Samples and Systems Binned According to Whether PFOS or PFOA were Reported by States and Whether Additional HI PFAS were Reported

Type	No PFOS or PFOA Reported		PFOS or PFOA Reported		Total Count
	No Other PFAS Reported	HI PFAS Reported	No HI PFAS Reported	HI PFAS Reported	
Samples	28,249 (57.8%)	1,321 (2.7%)	7,365 (15.1%)	11,954 (24.5%)	48,889
Systems	8,576 (70.6%)	401 (3.3%)	1,079 (8.9%)	2,089 (17.2%)	12,145

The number of HI that were analyzed for may impact whether any HI PFAS were reported as present as well as how many HI PFAS were reported present. Exhibit 9-6 through Exhibit 9-9 present the HI PFAS reported according to how many HI PFAS were analyzed for and whether PFOS or PFOA were detected at the system and sample level.

Exhibit 9-6: Sample counts according to HI PFAS analyzed and reported present for samples where PFOS and PFOA were <u>not</u> reported present by the state

HI PFAS Analyzed	HI PFAS Reported Present					
	0	1	2	3	4	Total
1	4,629 (99.8%)	8 (0.2%)	-	-	-	4,637
2	640 (97.3%)	12 (1.8%)	6 (0.9%)	-	-	658
3	4,435 (97.2%)	116 (2.5%)	13 (0.3%)	0 (0.0%)	-	4,564
4	18,545 (94.1%)	939 (4.8%)	226 (1.1%)	1 (0.0%)	0 (0.0%)	19,711
Total	28,249	1,075	245	1	0	

Exhibit 9-7: System counts according to HI PFAS analyzed and reported present for systems where PFOS and PFOA were <u>not</u> reported present by the state

HI PFAS Analyzed	HI PFAS Reported Present					
	0	1	2	3	4	Total
1	235 (99.2%)	2 (0.8%)	-	-	-	237
2	626 (96.6%)	17 (2.6%)	5 (0.8%)	-	-	648
3	-799 (97.3%)	21 (2.6%)	1 (0.1%)	0 (0.0%)	-	821

HI PFAS Analyzed	HI PFAS Reported Present					
	0	1	2	3	4	Total
4	6,916 (95.1%)	285 (3.9%)	69 (0.9%)	1 (0.0%)	0 (0.0%)	7,271
Total	8,576	325	75	1	0	

Exhibit 9-8: Sample counts according to HI PFAS analyzed and reported present for samples where PFOS and PFOA were reported present by the state

HI PFAS Analyzed	HI PFAS Reported Present					
	0	1	2	3	4	Total
1	3,383 (81.2%)	785 (18.8%)	-	-	-	4,168
2	483 (53.0%)	294 (32.3%)	134 (14.7%)	-	-	911
3	1,829 (35.4%)	1,670 (32.4%)	1,424 (27.6%)	239 (4.6%)	-	5,162
4	1,670 (18.4%)	1,750 (19.3%)	3,947 (43.5%)	1,680 (18.5%)	31 (0.3%)	9,078
Total	7,365	4,499	5,505	1,919	31	

Exhibit 9-9: System counts according to HI PFAS analyzed and reported present for systems where PFOS and PFOA were reported present by the state

HI PFAS Analyzed	HI PFAS Reported Present					
	0	1	2	3	4	Total
1	148 (65.5%)	78 (34.5%)	-	-	-	226
2	138 (48.6%)	85 (29.9%)	61 (21.5%)	-	-	284
3	282 (38.5%)	183 (25.0%)	183 (25.0%)	84 (11.5%)	-	732
4	511 (26.5%)	449 (23.3%)	668 (34.7%)	278 (14.4%)	20 (1.0%)	1,926
Total	1,079	795	912	362	20	

Exhibit 9-10 and Exhibit 9-11 provide categorical results similar to Exhibit 9-5; however these results are broken down by state and restricted to systems and samples that included data for at least three of the HI PFAS.

Exhibit 9-10: Non-Targeted State PFAS Finished Water Data - Samples that Included Three or Four HI PFAS Binned According to Whether PFOS or PFOA were Reported and Whether Any Additional HI PFAS were Reported by State

State	No PFOS or PFOA Reported	PFOS or PFOA Reported	Total Sample Count

	No HI PFAS detected	HI PFAS detected	No HI PFAS detected	HI PFAS detected	
CO	422 (72.4%)	30 (5.1%)	14 (2.4%)	117 (20.1%)	583
IL	1,531 (72.0%)	199 (9.4%)	112 (5.3%)	283 (13.3%)	2,125
IN	435 (92.4%)	22 (4.7%)	7 (1.5%)	7 (1.5%)	471
KY	40 (49.4%)	4 (4.9%)	20 (24.7%)	17 (21.0%)	81
MA	2,041 (23.6%)	158 (1.8%)	716 (8.3%)	5,740 (66.3%)	8,655
MD	66 (75.0%)	0 (0.0%)	3 (3.4%)	19 (21.6%)	88
ME	517 (73.6%)	14 (2.0%)	89 (12.7%)	82 (11.7%)	702
MI	9,422 (88.2%)	516 (4.8%)	287 (2.7%)	458 (4.3%)	10,683
MO	191 (89.3%)	2 (0.9%)	10 (4.7%)	11 (5.1%)	214
ND	102 (89.5%)	9 (7.9%)	0 (0.0%)	3 (2.6%)	114
NH	148 (26.2%)	18 (3.2%)	225 (39.8%)	174 (30.8%)	565
NJ	2,940 (41.3%)	57 (0.8%)	1,450 (20.4%)	2,669 (37.5%)	7,116
NY	1,109 (52.3%)	64 (3.0%)	283 (13.3%)	666 (31.4%)	2,122
OH	1,658 (85.2%)	97 (5.0%)	99 (5.1%)	91 (4.7%)	1,945
SC	574 (75.5%)	23 (3.0%)	51 (6.7%)	112 (14.7%)	760
TN	2 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	2
VT	1,274 (81.8%)	26 (1.7%)	105 (6.7%)	153 (9.8%)	1,558
WI	508 (69.5%)	56 (7.7%)	28 (3.8%)	139 (19.0%)	731

Exhibit 9-11: Non-Targeted State PFAS Finished Water Data - Systems that Sampled for Three or Four HI PFAS Binned According to Whether PFOS or PFOA were Reported and Whether Any Additional HI PFAS were Reported by State

State	No PFOS or PFOA Reported		PFOS or PFOA Reported		Total Sample Count
	No HI PFAS detected	HI PFAS detected	No HI PFAS detected	HI PFAS detected	
CO	270 (68.0%)	26 (6.5%)	11 (2.8%)	90 (22.7%)	397
IL	880 (88.4%)	28 (2.8%)	25 (2.5%)	63 (6.3%)	996
IN	339 (91.4%)	19 (5.1%)	6 (1.6%)	7 (1.9%)	371

KY	38 (51.4%)	3 (4.1%)	17 (23.0%)	16 (21.6%)	74
MA	479 (36.5%)	33 (2.5%)	146 (11.1%)	655 (49.9%)	1,313
MD	51 (81.0%)	0 (0.0%)	3 (4.8%)	9 (14.3%)	63
ME	469 (73.2%)	12 (1.9%)	84 (13.1%)	76 (11.9%)	641
MI	2,205 (87.9%)	130 (5.2%)	66 (2.6%)	107 (4.3%)	2,508
MO	102 (90.3%)	2 (1.8%)	4 (3.5%)	5 (4.4%)	113
ND	99 (89.2%)	9 (8.1%)	0 (0.0%)	3 (2.7%)	111
NH	64 (27.0%)	13 (5.5%)	68 (28.7%)	92 (38.8%)	237
NJ	227 (34.1%)	7 (1.1%)	142 (21.4%)	289 (43.5%)	665
NY	275 (40.1%)	15 (2.2%)	132 (19.2%)	264 (38.5%)	686
OH	1,397 (94.5%)	31 (2.1%)	25 (1.7%)	26 (1.8%)	1,479
SC	187 (62.8%)	11 (3.7%)	28 (9.4%)	72 (24.2%)	298
TN	1 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1
VT	492 (87.2%)	14 (2.5%)	26 (4.6%)	32 (5.7%)	564
WI	140 (60.1%)	24 (10.3%)	10 (4.3%)	59 (25.3%)	233

9.2.2 Pairwise Co-occurrence

To examine pairwise relationships among PFAS, odds ratios were calculated. In this analysis, odds ratios represent the change in the odds of observing a first chemical given that a second chemical is known to be present relative to the odds of observing the first chemical given that the second chemical is not present. For example, an odds ratio of 2 would indicate that the presence of the second chemical would be expected to double the odds of the first chemical being reported present. Odds ratios were calculated as follows.

$$OR_{AB} = \frac{n_{AB} * n_{!A!B}}{n_{A!B} * \ n_{B!A}}$$

Where n indicates the number of samples that fell into a given bin. Subscript AB indicates both chemicals were detected while A!B, for example, indicates that chemical A was detected but chemical B was not. Since this equation is symmetrical, chemical A and chemical B are interchangeable (as long as it is the same pair of chemicals, it does not matter which is A and which is B). Exhibit 9-12 and Exhibit 9-13 below present the calculated odds ratios for each unique pair of PFAS chemicals among the six included in the final rule, as well as the lower and upper limits for the approximate 95% confidence intervals (CI) for the odds ratios determined based on the score statistic.

Exhibit 9-12: Sample-level counts of pairwise chemical occurrence and odds ratios calculated from aggregated state dataset PFAS samples for PFOS, PFOA, and HI PFAS

Chem A	Chem B	Chems A and B Reported	Only Chem B Reported	Only Chem A Reported	Neither Chem Reported	Odds Ratio [95% CI]
HFPO-DA	PFBS	54	7,708	26	21,055	5.7 [3.6-9.0]
HFPO-DA	PFHxS	41	6,458	39	22,280	3.6 [2.3-5.6]
HFPO-DA	PFNA	31	1,885	49	26,869	9.0 [5.8-14.1]
HFPO-DA	PFOA	61	8,319	20	20,428	7.5 [4.5-12.4]
HFPO-DA	PFOS	61	7,678	20	21,070	8.4 [5.1-13.8]
PFBS	PFHxS	7,330	1,555	2,989	26,693	42.1 [38.3-46.3]
PFBS	PFNA	2,059	354	8,206	27,897	19.8 [17.6-22.2]
PFBS	PFOA	9,105	4,280	1,228	23,967	41.5 [37.7-45.7]
PFBS	PFOS	8,488	3,262	1,842	24,986	35.3 [32.1-38.8]
PFHxS	PFNA	2,192	308	7,003	30,503	31.0 [27.4-35.0]
PFHxS	PFOA	8,413	5,780	853	25,026	42.7 [38.8-47.0]
PFHxS	PFOS	8,226	4,074	1,036	26,733	52.1 [47.4-57.3]
PFNA	PFOA	3,190	14,983	74	30,542	87.9 [69.7-110.7]
PFNA	PFOS	3,086	12,380	182	33,136	45.4 [39.0-52.8]
PFOA	PFOS	15,024	1,203	3,974	33,324	104.7 [95.2-115.2]

Exhibit 9-13: System-level counts of pairwise chemical occurrence and odds ratios calculated from aggregated state dataset PFAS samples for PFOS, PFOA, and HI PFAS

Chem A	Chem B	Chems A and B Reported	Only Chem B Reported	Only Chem A Reported	Neither Chem Reported	Odds Ratio [95% CI]
HFPO-DA	PFBS	33	1,532	21	7,614	7.8 [4.5-13.5]
HFPO-DA	PFHxS	23	1,137	31	8,007	5.2 [3.1-8.9]
HFPO-DA	PFNA	20	327	34	8,818	15.9 [9.1-27.7]
HFPO-DA	PFOA	39	1,665	16	7,480	11.0 [6.2-19.5]
HFPO-DA	PFOS	37	1,530	18	7,613	10.2 [5.9-17.9]

Chem A	Chem B	Chems A and B Reported	Only Chem B Reported	Only Chem A Reported	Neither Chem Reported	Odds Ratio [95% CI]
PFBS	PFHxS	1,282	245	721	9,093	66.0 [56.4-77.2]
PFBS	PFNA	423	85	1,510	8,735	28.8 [22.7-36.6]
PFBS	PFOA	1,605	852	401	8,485	39.9 [35.0-45.4]
PFBS	PFOS	1,497	692	509	8,645	36.7 [32.4-41.7]
PFHxS	PFNA	415	108	1,115	9,455	32.6 [26.1-40.7]
PFHxS	PFOA	1,374	1,259	230	8,820	41.9 [35.9-48.7]
PFHxS	PFOS	1,369	939	235	9,140	56.7 [48.6-66.2]
PFNA	PFOA	575	2,190	23	8,764	100.1 [65.9-151.8]
PFNA	PFOS	555	1,864	43	9,089	62.9 [46.0-86.1]
PFOA	PFOS	2,304	341	729	9,972	92.4 [80.6-106.0]

Estimates of correlation between system-level means across chemicals modeled in the national occurrence model can be found in Section 10.1.

9.3 Additional UCMR 3 Analyses from Published Studies

Adamson et al. (2017) and Guelfo and Adamson (2018) conducted independent analyses of UCMR 3 data for six PFASs (PFOA and PFOS, PFHpA, PFNA, PFBS, and PFHxS) and other contaminants. Some care should be taken when comparing their UCMR 3 occurrence findings with results presented elsewhere in this document. Note, for example, that these researchers appeared to have been working with a "near-final" data set of 36,139 samples (Guelfo and Adamson, 2018), whereas the final UCMR 3 data set included 36,972 samples for most PFAS.

Guelfo and Adamson (2018) examined PFAS results from UCMR 3 in detail, addressing co-occurrence among the six PFAS compounds, relationships to sources, and temporal trends over the UCMR 3 sampling period. They found that approximately 50 percent of samples with reportable levels of one or more PFAS detections contained at least two PFAS and 72 percent of detections occurred in ground water. Large PWSs (>10,000 customers) were 5.6 times more likely than small PWSs (≤10,000 customers) to exhibit PFAS detections; however, when detected, median total PFAS concentrations were higher in small PWSs (0.12 µg/L) than in large (0.053 µg/L). The authors performed pairwise co-occurrence analyses using both a categorical (chi square) analysis based on sample detections and a calculation of odds ratios for co-occurring pairs also based on sample detections. All of the pairwise categorical results showed statistically significant co-occurrence, with the exception of PFBS and PFNA for which there was no observed co-occurrence. The odds ratio results, presented in Exhibit 9-14, also showed a strong likelihood of co-occurrence between all PFAS pairs other than PFNA and PFBS. (Odds ratios > 1 suggest co-occurrence greater than that expected by chance; odds ratios of 0 to <1 indicate co-occurrence less than that expected by chance. While the magnitude of the values shown in Exhibit

9-14 suggest the odds ratios are likely to be statistically significant given the sample size, the authors did not specifically present p value results for these odds ratios.)

Exhibit 9-14: Co-Occurrence Matrix (Odds Ratios for Association Between PFAS Pairs)

	PFOS	PFOA	PFHxS	PFHpA	PFBS	PFNA
PFOS	--	216	876	295	371	46
PFOA	216	--	242	407	538	57
PFHxS	876	242	--	389	107	65
PFHpA	295	407	389	--	463	94
PFBS	371	538	107	463	--	0
PFNA	46	57	65	94	0	--

Guelfo and Adamson (2018) also conducted a cluster analysis for assessing co-occurrence relationships between PFAS based on both detection and concentration. The authors identified two notable clusters among co-occurring PFAS, one involving PFOA and PFHpA and the other involving PFOS and PFHxS. The authors also noted that the lack of co-occurrence between PFNA and PFBS could have been an artifact of low individual detection rates but also could be attributed to factors related to use and environmental transport for these two compounds.

With respect to sources, the authors observed that perfluoroalkyl sulfonates, PFSAs (i.e., PFOS, PFHxS, PFBS) tended to dominate over perfluoroalkyl carboxylates, or PFCAs (i.e., PFOA, PFHpA, PFNA) in ground water, while PFCAs tended to dominate over PFSAs in surface water. PFSAs tend to be associated with uses such as fire-fighting foam, mist suppressants, and surface protection products, while PFCA releases tend to be associated with fluoropolymer manufacturing, landfills, and water treatment plant effluent.

Guelfo and Adamson (2018) evaluated temporal trends using two different methodologies: linear regression and a Mann-Kendall test. In an examination of quarterly detection rates for all six PFAS together, both analyses showed an increasing trend over twelve quarters; however, only the Mann-Kendall results were statistically significant ($p = 0.03$). Further analysis (apparently using the Mann-Kendall test alone) showed increasing trends as well for PFOA alone (statistically significant; $p = 0.01$) and PFOS alone (not statistically significant; $p = 0.1$).

In an earlier related study, Adamson et al. (2017) calculated odds ratios to examine co-occurrence between 1,4-dioxane and other UCMR 3 contaminants, including PFOS and PFOA. Statistically significant (at a 95 percent confidence level) co-occurrence was observed with both PFOS and PFOA. Based on calculated odds ratios, samples with a 1,4-dioxane detection were 14.2 times more likely to occur with a PFOS detection than without a PFOS detection when adjusted for system size. Similarly, samples with a 1,4-dioxane detection were 13.4 times more likely to occur with a PFOA detection than without a PFOA detection when adjusted for system size.

Hu et al. (2016) presented a spatial analysis of PFAS concentrations under UCMR 3 and found that the number of industrial sites that manufacture or use these compounds, the number of military fire training areas, and the number of wastewater treatment plants are all significant predictors of PFAS detection frequencies and concentrations in public water supplies. The authors found that for PFAS monitored under UCMR 3, the detection frequency in drinking water sourced from ground water was more than twice that from surface water. Additionally, PFOA and PFOS were more frequently detected in ground water whereas UCMR 3 PFAS compounds with shorter chain lengths were detected more frequently in surface waters. Hu et al. (2016) noted that this observation could be due to the original mode of environmental release (aerosol, application to soil, and aqueous discharge).

10 Model Estimates and Extrapolation

10.1 Model Data and Correlation Output

A Bayesian hierarchical model was developed to estimate national occurrence of four PFAS that were included in the UCMR 3 monitoring effort. These PFAS were PFOA, PFOS, PFHxS, and PFHpA. While PFNA and PFBS were also monitored for in UCMR 3, each chemical was limited to 19 results (among nearly 37,000 samples per chemical) that were reported as concentrations over the MRL. The limited number of reported concentrations for these two chemicals was insufficient for these chemicals to be included in the Bayesian model. The EPA also notes that while PFHpA was included in the model because of its UCMR 3 data availability; however, the EPA is not including it in this final regulation. A total of 65,537 samples from 28 state datasets were included to supplement the UCMR 3 dataset. State datasets were generally collected more recently than the UCMR 3 dataset with improved analytical methods capable of measuring PFOA, PFOS, PFHxS, and/or PFHpA at concentrations lower than the UCMR 3 MRLs. These data provided valuable information regarding the occurrence of PFAS at sub-UCMR 3 MRL concentrations to the model. From the state datasets, only samples that were collected at systems that monitored as part of UCMR 3 were incorporated in the model fitting. This decision was made because the UCMR sampling program selects a set of systems to monitor that is statistically representative of PWS in the United States as a whole (i.e., a nationally representative set of PWS). The inclusion of non-UCMR 3 systems would have biased model results towards states which had subsequent state datasets available. Additional information on the model design, including detailed discussion of the model's methods, can be found in Cadwallader et al. (2022) which is included in the docket for this final regulation and incorporated by reference into this document.

The fitted model was examined to assess the correlation of system-level means across the four chemicals. The median estimates for the Pearson correlation coefficients (which indicate the strength of a linear relationship) between untransformed system-level means are shown in Exhibit 10-1.

Exhibit 10-1: National Occurrence Model Estimate - Median Estimated Pearson Correlation Coefficient and 90% Credible Interval Among System-level Means

Chemical Pair	Pearson Correlation Coefficient [90% CI]
PFOS-PFOA	0.73 [0.63-0.80]
PFOS-PFHpA	0.67 [0.56-0.75]
PFOS-PFHxS	0.82 [0.72-0.89]
PFOA-PFHpA	0.83 [0.79-0.87]
PFOA-PFHxS	0.51 [0.39-0.60]
PFHpA-PFHxS	0.58 [0.44-0.67]

The fitted model produced high-level distributions of system-level means as well as within and between-system standard deviations for each chemical included. These high-level distributions were sampled to perform extrapolation to a national inventory of active CWSs and NTNCWSs. This inventory was extracted from SDWIS and included 66,782 systems.

10.2 Extrapolation of System-level Means

Exhibit 10-2 shows the median estimate of the number of systems anticipated to have system-level means above various thresholds for the four modeled PFAS contaminants. Exhibit 10-3 shows the median estimate of the total population served by systems that were estimated to have system-level means over the respective thresholds.

Exhibit 10-2: National Occurrence Model Estimate - Estimated Number of Systems With System-level Means At or Above Various Concentrations

Concentration (ppt)	PFHpA [90% CI]	PFHxS [90% CI]	PFOA [90% CI]	PFOS [90% CI]
4.0	466 [299-735]	1,828 [1,226-2,689]	3,260 [2,416-4,349]	3,368 [2,461-4,566]
5.0	264 [166-429]	1,252 [823-1,888]	2,194 [1,588-2,994]	2,447 [1,757-3,386]
10.0	41 [24-69]	340 [209-555]	523 [354-771]	793 [537-1,166]

Exhibit 10-3: National Occurrence Model Estimate - Estimated Total Population Served By Systems With System-level Means At or Above Various Concentrations

Concentrations (ppt)	PFHpA [90% CI]	PFHxS [90% CI]	PFOA [90% CI]	PFOS [90% CI]
4.0	8,660,000 [7,111,000-10,209,000]	20,386,000 [17,436,000-24,351,000]	34,343,000 [30,897,000-40,600,000]	34,313,000 [30,703,000-41,110,000]
5.0	6,082,000 [3,614,000-7,002,000]	15,436,000 [12,524,000-18,458,000]	24,287,000 [21,551,000-28,222,000]	26,594,000 [23,793,000-31,240,000]
10.0	713,000 [507,000-2,933,000]	4,645,000 [3,557,000-7,205,000]	7,132,000 [4,871,000-8,987,000]	10,205,000 [7,552,000-12,232,000]

10.3 National Estimate of Systems Exceeding Individual MCLs or HI MCL

The model output for PFOS, PFOA, and PFHxS was combined with characteristics observed in the state datasets for the three remaining HI PFAS to generate estimates of the national counts of systems (CWS and NTNCWS) anticipated to exceed either the MCL for PFOS, the MCL for PFOA, or the HI MCL for HFPO-DA, PFBS, PFHxS and PFNA.

10.3.1 Handling of Model Output

The extrapolation results in Section 10.2 are shown at the system mean level. In order to account for within-system variability, each entry point concentration was simulated using the system-level mean and within-system standard deviation of the log transformed, normal distribution (i.e., with the assumption of lognormality). Here all within-system variability was assumed to be attributable to differences across entry points (rather than temporal variations within entry points) (USEPA, 2023c).

Thus, for each system included in the extrapolation, a concentration was simulated for each entry point. The maximum entry point concentration of PFOA or PFOS was selected to examine whether the system would exceed a final MCL. The maximum value of PFHxS was also selected for each system for subsequent combination with PFNA, PFBS, and HFPO-DA data. Finally, the highest sum value of the four modeled PFAS (PFOA, PFOS, PFHxS, and PFHpA) was retained for probabilistic weighting of which systems to assign additional PFAS concentrations to (described in Section 10.3.2).

10.3.2 Combination of State Data with Modeled Estimates

The aggregated non-targeted state monitoring dataset was used to extract information regarding the occurrence of HFPO-DA, PFBS, and PFNA. This information included the fraction of systems with data for the individual chemicals that reported any measurement of the chemical at or above its respective UCMR 5 MRL. The MRLs for HFPO-DA, PFBS, and PFNA in UCMR 5 are equivalent to 5.0 ppt, 3.0 ppt, and 4.0 ppt, respectively (USEPA, 2021e). For each of these systems, the system-level maximum concentration observed of the chemical of interest was selected, providing a list (an empirical cumulative distribution function or eCDF) of system-level maximums for PFNA, PFBS, and HFPO-DA. These eCDFs were used to superimpose PFNA, PFBS, and HFPO-DA concentrations onto the model output for each iteration.

Given potential uncertainty of extrapolating the aggregated state datasets to the nation, multiple methods were examined. Common elements across these methods included randomly sampling each chemical's eCDF for concentrations to apply to a fraction of national systems equivalent to the fraction of systems that observed the presence of the chemical in the aggregated state dataset. In most cases, this fraction of systems was selected from systems that were not already exceeding the MCLs for PFOS or PFOA.

Systems were selected using the following methods:

- Among systems not already exceeding an MCL for PFOS or PFOA, add chemical concentration to the remaining systems with the highest maximum sum of modeled PFAS (PFOA, PFOS, PFHxS, PFHpA)
- Among systems not already exceeding an MCL for PFOS or PFOA, select systems randomly but with probability of selection proportionate to the system's maximum sum of modeled PFAS
- Among systems not already exceeding an MCL for PFOS or PFOA that had sum of modeled PFAS at or above 2.0 ppt, select systems randomly but with probability of selection proportionate to the system's maximum sum of modeled PFAS
- Select systems randomly with a probability proportionate to the system's maximum sum of modeled PFAS (including systems already exceeding an MCL for PFOA or PFOS)
- Select equal percentages of systems among systems that a) are already exceeding an MCL for PFOA or PFOS and b) are not exceeding an MCL for PFOA or PFOS. Within a group, probability of being selected is proportionate to the system's maximum sum of modeled PFAS

Systems were selected separately for each chemical and were assigned a concentration that was randomly sampled from that chemical's eCDF. This concentration was added to the modeled concentration for PFHxS at the selected system. After this was completed for PFBS, PFNA, and HFPO-DA, a simulated value of the system's maximum HI could be produced. The output from this analysis was used to anticipate how many systems would either exceed an MCL for PFOA, an MCL for PFOS, or the HI

MCL for PFHxS, PFBS, PFNA, and HFPO-DA. This approach requires the assumption that a system's maximum concentration for each chemical would occur at the same location. This assumption was deemed reasonable given the extensive co-occurrence among PFAS observed in state data and the UCMR 3 dataset and that systems selected using a probability weight and were not necessarily the same across the 3 additional HI chemicals.

Because the approach used to generate national estimates of systems exceeding the HI MCL included multiple methods for comparison, strict quantiles and central estimates are not provided. Instead, the "Low" estimate indicates the results of the lowest 5th percentile estimate across methods, rounded down, while the "High" estimate indicates the highest 95th percentile estimate across methods, rounded up. Since PFOA and PFOS were included in the model, output related to systems exceeding PFOA or PFOS MCLs did not vary by method. Exhibit 10-4 provides estimates for the number of systems anticipated to be in exceedance of the PFOS or PFOA MCLs of 4.0 ppt, as well as the total population served by these systems. Exhibit 7-5 provides estimates for the number of systems estimated to exceed the HI MCL, as well as the total population served. The systems counts and population totals provided in Exhibit 10-4 and Exhibit 10-5 are not mutually exclusive and thus cannot be added to estimate total systems exceeding either the HI MCL or the MCLs for PFOS or PFOA. Instead, Exhibit 10-6 presents the number of systems estimated to be exceeding either the HI MCL, the MCL for PFOA, or the MCL for PFOS. Among systems not exceeding the MCLs for PFOA or PFOS, approximately 100-300 are anticipated to exceed the HI MCL.

Exhibit 10-4: National Occurrence Estimate - Estimated Systems and Total Population Served By Systems in Exceedance of the MCL for PFOS or PFOA

Estimate	Low	High
Systems Exceeding MCLs for PFOS or PFOA	4,000	6,500
Population Served by Systems Exceeding MCLs for PFOS or PFOA	82,000,000	103,000,000

Exhibit 10-5: National Occurrence Estimate - Estimated Systems and Total Population Served By Systems in Exceedance of the HI MCL

Estimate	Low	High
Systems Exceeding the HI MCL	300	700
Population Served by Systems Exceeding the HI MCL	9,000,000	18,000,000

Exhibit 10-6: National Occurrence Estimate - Estimated Systems and Total Population Served By Systems in Exceedance of an MCL for PFOS or PFOA or the HI MCL

Estimate	Low	High
Systems Exceeding MCLs	4,100	6,700
Population Served by Systems Exceeding MCLs	83,000,000	105,000,000

11 UCMR 5 Results

This chapter presents the preliminary sampling results from the fifth Unregulated Contaminant Monitoring Rule (UCMR 5) as of February 2024 (USEPA, 2024c). The UCMR 5 data collection effort will run from January 2023 through December 2025, with the final dataset anticipated to be available in 2026. The results described here account for approximately 24 percent of the results anticipated to be available in the final dataset. Since the UCMR 5 dataset is currently incomplete, it does not serve as the basis for informing the agency's decisions for the regulatory determinations and NPDWRs. While 29 PFAS chemicals are being monitored under UCMR 5, only results for the six PFAS included in the final NPDWRs are shown. Most summaries are presented at the sample, entry point, and system levels. Exhibit 11-1 shows the sample counts, entry point counts, system counts, and the percentages of samples, entry points, and systems that had concentrations at or above the minimum reporting levels for UCMR 5.

Exhibit 11-1: Preliminary UCMR 5 Dataset[1] – Summary of Sample, Entry Point, and System Counts as of February 2024

Chemical	Samples Collected	Sample Results At or Above Minimum Reporting Level	Entry Points With Results	Entry Points With Results At or Above Minimum Reporting Level	Systems with Results	Systems With Results At or Above Minimum Reporting Level
PFOA	16,772	1,076 (6.4%)	9,536	744 (7.8%)	3,720	429 (11.5%)
PFOS	16,768	1,149 (6.9%)	9,535	796 (8.3%)	3,720	477 (12.8%)
PFHxS	16,768	933 (5.6%)	9,534	670 (7.0%)	3,721	374 (10.1%)
PFNA	16,778	48 (0.3%)	9,539	35 (0.4%)	3,722	26 (0.7%)
PFBS	16,766	1,443 (8.6%)	9,534	981 (10.3%)	3,720	570 (15.3%)
HFPO-DA	16,777	24 (0.1%)	9,538	17 (0.2%)	3,722	17 (0.5%)

Notes:

[1] The preliminary UCMR 5 dataset contains approximately 24 percent of the samples anticipated to be available once the dataset is complete.

These data combined for a total of 100,629 analytical results from 9,539 entry points at 3,722 PWS. These included 16,743 completed sample sets where an analytical result was available for each of the six PFAS and 9,528 entry points and 3,719 PWS that provided at least one analytical result for each of the six PFAS and had at least one sample set for which the HI could be calculated. Among these 16,743 sample sets, 9,528 entry points, and 3,719 PWS, Exhibit 11-2 shows the count of individual samples that exceeded numerical thresholds for the PFOA, PFOS, PFHxS, PFNA, HFPO-DA, and/or HI MCLs as well as the count of entry points and systems with such samples. Note that MCL violations under the final rule are based on running annual average MCL exceedance rather than a single sample MCL exceedance (see section XIII of the final rule preamble for monitoring and compliance requirements).

Exhibit 11-2: Preliminary UCMR 5 Dataset[1] – Summary of Single Samples, Entry Points with Single Samples, and Systems with Single Samples Exceeding MCL Thresholds

MCL Threshold[2]	Samples Exceeding	Entry Points With At Least One Sample Exceeding	Systems With At Least One Sample Exceeding
PFOA (4.0 ng/L)	1,024 (6.1%)	719 (7.5%)	415 (11.2%)
PFOS (4.0 ng/L)	1,100 (6.6%)	766 (8.0%)	462 (12.4%)
PFHxS (10 ng/L)	66 (0.4%)	53 (0.6%)	42 (1.1%)
PFNA (10 ng/L)	5 (<0.1%)	5 (<0.1)	5 (0.1%)
HFPO-DA (10 ng/L)	2 (<0.1%)	1 (<0.1%)	1 (<0.1%)
HI (1)	76 (0.5%)	60 (0.6%)	48 (1.3%)
Any	1,504 (9.0%)	1,043 (10.9%)	589 (15.8%)

Notes:

[1] The preliminary UCMR 5 dataset contains approximately 24 percent of the samples anticipated to be available once the dataset is complete.

[2] MCL thresholds for PFOA and PFOS were assessed to two significant figures while MCL thresholds for PFHxS, PFNA, HFPO-DA, and the HI were assessed with one significant figure. Analytical results had to be equal to or exceed the following values to be treated as exceeding an MCL: 4.05 for PFOA and PFOS; 15 for PFHxS, PFNA, and HFPO-DA; 1.5 for the HI. See Section V of the final rule preamble for more information.

Entry points with means and systems with entry point-level mean concentrations exceeding MCL thresholds were also assessed. For this analysis, only sample sets with analytical results for all six PFAS were included when calculating entry point-level means. Further, only entry points at which multiple complete sample sets were available were included. Results meeting these criteria were available for 5,269 entry points and 2,498 systems. When calculating entry point mean concentrations, analytical results below the respective minimum reporting limits were treated as zero to maximize consistency with the NPDWR. Exhibit 11-3 shows the count and percentages of entry points and systems with data meeting the described criteria that had an observed entry point mean concentration exceeding an MCL threshold.

Exhibit 11-3: Preliminary UCMR 5 Dataset[1] – Summary of Systems with Entry Point Mean Concentrations Exceeding MCL Thresholds

MCL Threshold[2]	Entry Points With Mean Exceeding	Systems With At Least One Entry Point Mean Exceeding
PFOA (4.0 ng/L)	253 (4.8%)	149 (6.0%)
PFOS (4.0 ng/L)	278 (5.3%)	179 (7.2%)
PFHxS (10 ng/L)	15 (0.3%)	11 (0.4%)
PFNA (10 ng/L)	1 (<0.1%)	1 (<0.1%)
HFPO-DA (10 ng/L)	1 (<0..1%)	1 (<0.1%)
HI (1)	18 (0.3%)	14 (0.6%)
Any	381 (7.2%)	235 (9.4%)

Notes:

[1] The preliminary UCMR 5 dataset contains approximately 24 percent of the samples anticipated to be available once the dataset is complete.

[2] MCL thresholds for PFOA and PFOS were assessed to two significant figures while MCL thresholds for PFHxS, PFNA, HFPO-DA, and the HI were assessed with one significant figure. Calculated means had to be equal to or exceed the following values to be treated as exceeding an MCL: 4.05 for PFOA and PFOS; 15 for PFHxS, PFNA, and HFPO-DA; 1.5 for the HI. See Section V of the final rule preamble for more information.

PFAS co-occurrence was also examined in the partial UCMR 5 dataset. Exhibit 11-4 shows sample, entry point, and system counts according to how many PFAS were reported at or above their minimum reporting levels for the 16,743 samples for which all six analytes had results and 9,529 entry points and 3,719 systems which had at least one analytical result for each analyte.

Exhibit 11-4: Preliminary UCMR 5 Dataset[1] – Samples, Entry Points, and Systems Binned According to Number of PFAS Among PFOA, PFOS, PFHxS, PFNA, HFPO-DA and PFBS That Were Reported at or Above the Minimum Reporting Level

PFAS Observed	Samples	Entry Points	Systems
0	14,408 (86.1%)	7,954 (83.5%)	2,877 (77.4%)
1	1,077 (6.4%)	676 (7.1%)	313 (8.4%)
2	541 (3.2%)	379 (4.0%)	191 (5.1%)

PFAS Observed	Samples	Entry Points	Systems
3	393 (2.3%)	289 (3.0%)	172 (4.6%)
4	303 (1.8%)	215 (2.3%)	148 (4.0%)
5	21 (0.1%)	16 (0.2%)	18 (0.5%)
6	0 (0.0%)	0 (0.0%)	0 (0.0%)

Notes:

[1] The preliminary UCMR 5 dataset contains approximately 24 percent of the samples anticipated to be available once the dataset is complete.

The partial UCMR 5 dataset was also separated for groupwise analysis using the same approach described in subsection 9.2.1. Exhibit 11-5 provides the counts and percentages of samples, entry points, and systems according to whether: a) they reported the presence of PFOS or PFOA, and b) they reported the presence of HI chemicals.

Exhibit 11-5: Preliminary UCMR 5 Dataset[1] – Samples, Entry Points, and Systems Binned According to Whether PFOS or PFOA and Additional HI PFAS were Reported At or Above their Minimum Reporting Levels

Type	No PFOS or PFOA Reported		PFOS or PFOA Reported		Total Count
	No Other PFAS Reported	HI PFAS Reported	No HI PFAS Reported	HI PFAS Reported	
Samples	14,408 (86.1%)	786 (4.7%)	498 (3.0%)	1,051 (6.3%)	16,743
Entry Points	7,954 (83.5%)	508 (5.3%)	317 (3.3%)	750 (7.9%)	9,529
Systems	2,877 (77.4%)	242 (6.5%)	145 (3.9%)	455 (12.2%)	3,719

Notes:

[1] The preliminary UCMR 5 dataset contains approximately 24 percent of the samples anticipated to be available once the dataset is complete.

Samples, entry points, and systems were also separated according to how many HI PFAS were reported at or above the minimum reporting level. Exhibit 11-6 and Exhibit 11-7 present these results when PFOA or PFOS were not reported present and for when they were reported present, respectively.

Exhibit 11-6: Preliminary UCMR 5 Dataset[1] – Sample, Entry Points, and System Counts According the Number of HI PFAS Reported At or Above their Minimum Reporting Levels for Samples, Entry Points, and Systems Where PFOS and PFOA Were Below their Minimum Reporting Levels

HI PFAS Observed	Samples	Entry Points	Systems
0	14,408 (94.8%)	7,954 (94.0%)	2,877 (92.2%)
1	686 (4.5%)	429 (5.1%)	202 (6.5%)
2	100 (0.7%)	79 (0.9%)	40 (1.3%)
3	0 (0.0%)	0 (0.0%)	0 (0.0%)
4	0 (0.0%)	0 (0.0%)	0 (0.0%)
Total	15,194	8,462	3,119

Notes:

[1] The preliminary UCMR 5 dataset contains approximately 24 percent of the samples anticipated to be available once the dataset is complete.

Exhibit 11-7: Preliminary UCMR 5 Dataset[1] – Sample, Entry Points, and System Counts According to the Number of HI PFAS Reported At or Above their Minimum Reporting Levels for Samples and Systems Where PFOS and/or PFOA Were At or Above the Minimum Reporting Level

HI PFAS Observed	Samples	Entry Points	Systems
0	498 (32.2%)	317 (29.7%)	145 (24.2%)
1	573 (37.0%)	403 (37.8%)	223 (37.2%)
2	453 (29.2%)	329 (30.8%)	214 (35.7%)
3	25 (1.6%)	18 (1.7%)	18 (3.0%)
4	0 (0.0%)	0 (0.0%)	0 (0.0%)
Total	1,549	1,067	600

Notes:

[1] The preliminary UCMR 5 dataset contains approximately 24 percent of the samples anticipated to be available once the dataset is complete.

Pairwise co-occurrence was also assessed through odds ratios, as seen in subsection 9.2.2. The results are shown at the sample level and the system level in Exhibit 11-8 and Exhibit 11-9, respectively.

Exhibit 11-8: Preliminary UCMR 5 Dataset[1] – Sample-level Counts of Pairwise Chemical Occurrence and Calculated Odds Ratios

Chem A	Chem B	Chems A and B Reported	Only Chem B Reported	Only Chem A Reported	Neither Chem Reported	Odds Ratio [95% CI]
HFPO-DA	PFBS	12	1,427	12	15,309	10.7 [4.9-23.5]
HFPO-DA	PFHxS	4	925	20	15,812	3.4 [1.2-9.6]
HFPO-DA	PFNA	0	48	24	16,704	0.0 [0.0-56.2]
HFPO-DA	PFOA	16	1,057	8	15,686	29.7 [13.0-67.9]
HFPO-DA	PFOS	15	1,128	9	15,608	23.1 [10.3-51.7]
PFBS	PFHxS	559	373	882	14,938	25.4 [21.9-29.4]
PFBS	PFNA	30	18	1,409	15,305	18.1 [10.2-32.3]
PFBS	PFOA	626	450	816	14,872	25.4 [22.0-29.2]
PFBS	PFOS	714	433	728	14,882	33.7 [29.3-38.8]
PFHxS	PFNA	25	23	905	15,810	19.0 [10.8-33.4]
PFHxS	PFOA	432	642	500	15,186	20.4 [17.6-23.8]
PFHxS	PFOS	594	553	339	15,270	48.4 [41.3-56.7]
PFNA	PFOA	36	1,037	12	15,684	45.4 [23.8-86.6]
PFNA	PFOS	33	1,111	15	15,603	30.9 [16.9-56.6]
PFOA	PFOS	669	478	407	15,209	52.3 [44.9-61.0]

Notes:

[1] The preliminary UCMR 5 dataset contains approximately 24 percent of the samples anticipated to be available once the dataset is complete.

Exhibit 11-9: Preliminary UCMR 5 Dataset[1] – System-level Counts of Pairwise Chemical Occurrence and Calculated Odds Ratios

Chem A	Chem B	Chems A and B Reported	Only Chem B Reported	Only Chem A Reported	Neither Chem Reported	Odds Ratio [95% CI]
HFPO-DA	PFBS	10	560	7	3,143	8.0 [3.1-20.5]

Chem A	Chem B	Chems A and B Reported	Only Chem B Reported	Only Chem A Reported	Neither Chem Reported	Odds Ratio [95% CI]
HFPO-DA	PFHxS	3	371	14	3,333	1.9 [0.6-6.3]
HFPO-DA	PFNA	0	26	17	3,679	0.0 [0.0-32.6]
HFPO-DA	PFOA	12	417	5	3,286	18.9 [6.9-51.8]
HFPO-DA	PFOS	13	464	4	3,239	22.7 [7.7-66.4]
PFBS	PFHxS	259	115	311	3,034	22.0 [17.1-28.2]
PFBS	PFNA	19	7	551	3,143	15.5 [6.6-36.1]
PFBS	PFOA	290	139	280	3,011	22.4 [17.7-28.4]
PFBS	PFOS	327	150	243	2,999	26.9 [21.3-34.0]
PFHxS	PFNA	17	9	357	3,338	17.7 [8.0-39.2]
PFHxS	PFOA	204	225	170	3,120	16.6 [13.0-21.2]
PFHxS	PFOS	273	204	101	3,142	41.6 [31.8-54.5]
PFNA	PFOA	22	407	4	3,287	44.4 [15.9-123.9]
PFNA	PFOS	20	457	6	3,237	23.6 [9.7-57.4]
PFOA	PFOS	306	171	123	3,119	45.4 [35.0-58.9]

Notes:

[1] The preliminary UCMR 5 dataset contains approximately 24 percent of the samples anticipated to be available once the dataset is complete.

12 References

3M. 1999. The science of organic fluorochemistry. U.S. Environmental Protection Agency. OPPT-2002-0043-0006. http://www.fluoridealert.org/pesticides/pfos.fr.final.docket.0006.pdf. July 08, 2008.

3M. 2008. Screening level human exposure assessment report. 3M Decatur, Alabama facility PFOA site-related environmental monitoring program. St. Paul, MN: 3M Company.

Adamson, D.T., E.A. Piña, A.E. Cartwright, S.R. Rauch, R.H. Anderson, T. Mohr, and J.A. Connor. 2017. 1,4-Dioxane drinking water occurrence data from the third unregulated contaminant monitoring rule. *Science of the Total Environment* vol. 596, pp. 236-245.

Alabama Department of Environmental Management (ADEM). 2023. Per- and Polyfluoroalkyl Substances (PFAS) in Drinking Water. Available on the Internet at: https://adem.alabama.gov/programs/water/drinkingwater/files/AllPFASResults.pdf. Accessed May 3, 2023.

Agency for Toxic Substances and Disease Registry (ATSDR). 2021. *Toxicological Profile for Perfluoroalkyls.* Department of Health and Human Services, Public Health Service. Available on the Internet at https://www.atsdr.cdc.gov/ToxProfiles/tp200.pdf

Arizona Department of Environmental Quality (ADEQ). 2021. Public Water System PFAS Data (Luke Air Force Base Area) | PFAS Resources. Available on the Internet at: https://www.azdeq.gov/node/7941.

ADEQ. 2023. PFAS Interactive Map. Available on the Internet at: https://experience.arcgis.com/experience/9a4b9734d7134b5e8e4820a996eb3191. Accessed May 16, 2023.

Boone, J.S., C. Vigo, T. Boone, C. Byrne, J. Ferrario, R. Benson, J. Donohue, J.E. Simmons, D.W. Kolpin, E.T. Furlong, and S.T. Glassmeyer. 2019. Per-and polyfluoroalkyl substances in source and treated drinking waters of the United States. *Science of the Total Environment*. 653:359-369.

Buck, R.C., J. Franklin, U. Berger, J.M. Conder, I.T. Cousins, P. de Voogt, A.A. Jensen, K. Kannan, S.A. Mabury and S.P.J. van Leeuwen. 2011. Perfluoroalkyl and polyfluoroalkyl substances in the environment: Terminology, classification, and origins. *Society of Environmental Toxicology and Chemistry* 7(4):513-541. Available on the Internet at: https://setac.onlinelibrary.wiley.com/doi/full/10.1002/ieam.258.

Cadwallader, A., A. Greene, H. Holsinger, A. Lan, M. Messner, M. Simic, and R. Albert. 2022. A Bayesian hierarchical model for estimating national PFAS drinking water occurrence. AWWA Water Science, e1284. https://doi.org/10.1002/aws2.1284.

California Division of Drinking Water (CADDW). 2023. EDT Library and Water Quality Analyses Data and Download Page. Available on the Internet at: https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/EDTlibrary.html. Accessed May 1, 2023.

Centers for Disease Control (CDC). 2022. *National Report on Human Exposure to Environmental Chemicals, Biomonitoring Data Tables for Environmental Chemicals.* Department of Health and Human Services, Centers for Disease Control and Prevention. Available on the Internet at: https://www.cdc.gov/exposurereport/data_tables.html. Last updated March 24, 2022.

Colorado Department of Public Health and Environment (CDPHE). 2018. Perfluorinated compound levels in environmental water samples. Updated August 7, 2018.

CDPHE. 2020. 2020 PFAS Sampling Project, Downloadable Data. Available on the Internet at: https://cohealthviz.dphe.state.co.us/t/EnvironmentalEpidemiologyPublic/views/PFAS_results_DRAFT/Download?%3AshowAppBanner=false&%3Adisplay_count=n&%3AshowVizHome=n&%3Aorigin=viz_share_link&%3AisGuestRedirectFromVizportal=y&%3Aembed=y

Chemours (The Chemours Company). 2022. *Product Selection Guide*. Accessed August 2022. https://www.teflon.com/en/products/product-selection-guide.

Delaware Office of Drinking Water (DE ODW). 2021. Delaware Drinking Water Watch Data. Available on the Internet at: https://drinkingwater.dhss.delaware.gov/. Accessed on January 25, 2021.

Department of Defense (DoD). 2020. Department of Defense Perfluorooctane Sulfonate and Perfluorooctanoic Acid on Military Installations Report to Congress. April 2020. Available on the Internet at: https://media.defense.gov/2021/May/27/2002730765/-1/-1/0/DOD-PFOS-AND-PFOA-ON-MILITARY-INSTALLATIONS-RTC-APRIL-2020.PDF.

DoD. 2023a. Public Disclosure of Results of Department of Defense (DoD) Testing of Off-Base Drinking Water in a Covered Area for Per- and Polyfluoroalkyl Substances (PFAS). Available on the Internet at: https://www.acq.osd.mil/eie/eer/ecc/pfas/map/pfasmap.html. Accessed September 4, 2023.

DoD. 2023b. PFAS Data: On-Base Water Data (Military Installations). Available on the Internet at: https://www.acq.osd.mil/eie/eer/ecc/pfas/data/onbase-drinking-water.html.

DuPont-17568-1675: E.I. du Pont de Nemours and Company. 2008. Estimation of the Adsorption Coefficient (Koc) of the HFPO Dimer Acid Ammonium Salt on Soil and Sludge. OECD Test Guideline 121. Study conducted by DuPont Haskell Global Centers for Health and Environmental Sciences (Study Completion Date: September 11, 2008), Newark, DE.

DuPont-24128: E.I. du Pont de Nemours and Company. 2008. Determination of the Water Solubility and Vapor Pressure of H-28307. U.S. EPA OPPTS 830.7840 and 830.7950; OECD Test Guidelines 104 and 105. Study conducted by Wildlife International, Ltd. (Study Completion Date: March 27, 2008), Easton, MD.

DuPont-24129: E.I. du Pont de Nemours and Company. 2008. Determination of the Water Solubility and Vapor Pressure of H-28308. U.S. EPA OPPTS 830.7840 and 830.7950; OECD Test Guidelines 104 and 105. Study conducted by Wildlife International, Ltd. (Study Completion Date: March 27, 2008), Easton, MD.

DuPont-24637: DuPont Haskell Global Centers for Health and Environmental Sciences. 2008. Physical and Chemical Characteristics of FRD-902: State of the Substance, Melting/Freezing Point, Boiling Point, Relative Density, Surface Tension, Flash Point, Auto-Ignition Temperature and Viscosity. OECD Test Guidelines 102 and 115; ASTM Methods D 92, 445, 446, 891, and 1120; ASTM Method E 659-78. Study conducted by Case Consulting Laboratories, Inc. (Study Completion Date: May 5, 2008), Whippany, NJ.

DuPont-24698: DuPont Haskell Global Centers for Health and Environmental Sciences. 2008. Physical and Chemical Characteristics of FRD-903: State of the Substance, Melting/Freezing Point, Boiling Point, Relative Density, Surface Tension, Flash Point, Auto-Ignition Temperature and Viscosity. OECD Test Guidelines 102 and 115; ASTM Methods D 92, 445, 446, 891, and 1120; ASTM Method E 659-78. Study conducted by Case Consulting Laboratories, Inc. (Study Completion Date: May 5, 2008), Whippany, NJ

DuPont-26349: E.I. du Pont de Nemours and Company. 2008. Determination of the Dissociation Constant and UV-VIS Absorption Spectra of H-28307. U.S. EPA OPPTS 830.7370; OECD Test Guidelines 101 and 112. Study conducted by Wildlife International, Ltd. (Study Completion Date: September 17, 2008), Easton, MD.

ECHA (European Chemical Agency). 2015. *Support Document for Identification of Perfluorononan-1-oic acid and its Sodium and Ammonium Salts as Substances of Very High Concern Because of Their Toxic for Reproduction and PBT Properties*. Adopted on 30 November 2015. Accessed August 2022. https://echa.europa.eu/documents/10162/deb7e1e1-d993-4d60-b3d5-25ba0621a11a.

ECHA. 2019. *Support Document for Identification of Perfluorobutane Sulfonic Acid and its Salts as Substances of Very High Concern Because of Their Hazardous Properties Which Cause Probable Serious Effects to Human Health and the Environment Which Give Rise to An Equivalent Level of Concern to Those of CMR and PBT/vPvB Substances (Article 57F)*. Adopted on 11 December 2019. Accessed August 2022. https://echa.europa.eu/documents/10162/891ab33d-d263-cc4b-0f2d-d84cfb7f424a.

Georgia Environmental Protection Division (GA EPD). 2020. “FINAL Analytical Report Project: 20-0169, GAEPD Summerville PFAS Screening”. Available on the Internet at: https://gaepd.maps.arcgis.com/apps/MapSeries/index.html?appid=e8f2c6a51c1c41088002350f1eabe598.

Glassmeyer, S.T., E.T. Furlong, D.W. Kolpin, A.L. Batt, R. Benson, J. S. Boone, O. Conerly, M.J. Donohue, D.N. King, M.S. Kostich, H.E. Mash, S.L. Pfaller, K.M. Schenck, J.E. Simmons, E.A. Varughese, S.J. Vesper, E.N. Villegas, and V.S. Wilson. 2017. Nationwide Reconnaissance of Contaminants of Emerging Concern in Source and Treated Drinking Waters of the United States. *Science of the Total Environment* (581-582):909-922.

Guelfo, J.L. and D.T. Adamson. 2018. Evaluation of a national data set for insights into sources, composition, and concentrations of per- and polyfluoroalkyl substances (PFASs) in U.S. drinking water. *Environmental Pollution* vol. 236 (May), pp.505-513.

Hu X.C., D.Q. Andrews, A.B. Lindstrom, T.A. Bruton, L.A. Schaider, P. Grandjean, et al. 2016. Detection of poly- and perfluoroalkyl substances (PFASs) in U.S. drinking water linked to industrial sites, military fire training areas, and wastewater treatment plants. *Environ Sci Technol Lett* 3(10):344-350.

Idaho Department of Environmental Quality (Idaho DEQ). 2023. Idaho Drinking Water Watch. Available on the Internet at: http://dww.deq.idaho.gov/IDPDWW/. Accessed May 17, 2023.

Illinois Environmental Protection Agency (IL EPA). 2023. Illinois Drinking Water Watch. Available on the Internet at: http://water.epa.state.il.us/dww/index.jsp. . Accessed May 18, 2023.

Indiana Department of Environmental Management (IDEM). 2023. PFAS Sampling Project for Community Public Water Systems. Available on the Internet at: https://www.in.gov/idem/resources/nonrule-policies/per-and-polyfluoroalkyl-substances-pfas/#sampling. Accessed May 12, 2023.

Interstate Technology & Regulatory Council (ITRC). 2020a. Naming Conventions and Physical and Chemical Properties of Per- and Polyfluoroalkyl Substances (PFAS). Available on the Internet at: https://pfas-1.itrcweb.org/fact_sheets_page/PFAS_Fact_Sheet_Naming_Conventions_April2020.pdf.

Iowa Department of Natural Resources (Iowa DNR). 2023. PFAS Sampling Interactive Dashboard and Map. Available on the Internet at: https://www.iowadnr.gov/Environmental-Protection/PFAS. Accessed May 16, 2023.

ITRC. 2020b. References for Naming Conventions and Physical and Chemical Properties of Per- and Polyfluoroalkyl Substances (PFAS). Available on the Internet at: https://pfas-1.itrcweb.org/references/. Accessed September 2020.

ITRC. 2021. *PFAS - Per and Polyfluoroalkyls Substances; Table 4.1*. Available on the Internet at https://pfas-1.itrcweb.org/wp-content/uploads/2022/03/PFAS-Full-PDF-December-2021-Update.pdf

Jarvis, A.L., J.R. Justice, M.C. Elias, B. Schnitker, and K. Gallagher. 2021. Perfluorooctane Sulfonate in US Ambient Surface Waters: A Review of Occurrence in Aquatic Environments and Comparison to Global Concentrations. *Environmental Toxicology and Chemistry*. 40(9):2425-2442.

Kentucky Department for Environmental Protection (KYDEP). 2019. Evaluation of Kentucky Community Drinking Water for Per- & Poly-Fluoroalkyl Substances. Available on the Internet at: https://eec.ky.gov/Documents%20for%20URLs/PFAS%20Drinking%20Water%20Report%20Final.pdf.

Lange, F.T., C. Schmidt, and H.J. Brauch. 2006. Perfluoroalkyl carboxylates and sulfonates, Rhine Water Works, The Netherlands, Association of River Waterworks - RIWA.

Li, Y., D.P Oliver and R.S. Kookana. 2018. A Critical Analysis of Published Data to Discern the Role of Soil and Sediment Properties in Determining Sorption of Per and Polyfluoroalkyl Substances (PFAS). *Science of the Total Environment*. 628-629:110-120.

Maine Department of Environmental Protection (Maine DEP). 2020. Maine PFAS Data (2007 - 2020). Available on the Internet at: https://www1.maine.gov/dep/spills/topics/pfas/PFAS-current-results-10262020.pdf

Maine Department of Health and Human Services (Maine DHHS). 2023. Maine PFAS Data (2007 - 2020). Available on the Internet at: https://www.maine.gov/dhhs/mecdc/environmental-health/dwp/cet/documents/PFASallResults.pdf. Accessed May 1, 2023.

Martin, J.W., B.J. Asher, S. Beesoon, J.P. Benskin, and M.S. Ross. 2010. PFOS or PreFOS? Are perfluorooctane sulfonate precursors (PreFOS) important determinants of human and environmental perfluorooctane sulfonate (PFOS) exposure? *Journal of Environmental Monitoring* 12(11):1979–2004.

Maryland Department of the Environment (MDE). 2021. Phase 1 of MDE's Public Water System (PWS) study for the occurrence of PFAS in State drinking water sources. Available on the Internet at: https://mde.maryland.gov/programs/Water/water_supply/Pages/PFAS_Home.aspx.

MDE. 2022a. Phase 2 Results Table. April 2022. Available on the Internet at: https://mde.maryland.gov/programs/Water/water_supply/Pages/PFAS_Home.asp.

MDE. 2022b. Public Water System Study PFAS Phase 3 Report Table. September 2022. Available on the Internet at: https://mde.maryland.gov/programs/Water/water_supply/Pages/PFAS_Home.asp.

Massachusetts Department of Energy and Environmental Affairs (MA EEA). 2023. Energy and Environmental Affairs Data Portal. Available on the Internet at: https://eeaonline.eea.state.ma.us/portal#!/search/drinking-water. Accessed May 4, 2023.

McMahon, P.B., A.K. Tokranov, L.M. Bexfield, B.D. Lindsey, T.D. Johnson, M.A. Lombard, and E. Watson. 2022. Perfluoroalkyl and Polyfluoroalkyl Substances in Groundwater Used as a Source of Drinking Water in the Eastern United States. *Environmental Science and Technology*. 56(4):2279-2288.

Michigan Department of Environment, Great Lakes and Energy (Michigan EGLE). 2023. Michigan Public Water Supply Sampling Results, April 2018 - March 2023. Available on the Internet at: https://www.michigan.gov/pfasresponse/0,9038,7-365-95571_95577_106298---,00.html. .

Minnesota Department of Health (MDH). 2023. PFAS Testing of Minnesota Community Water Systems. Available on the Internet at: https://mdh.maps.arcgis.com/apps/MapSeries/index.html?appid=63515695237f425ea7120d1aac1fd09a. Accessed May 18, 2023.

Missouri Department of Natural Resources (Missouri DNR). 2018. PFOS and PFOA in Missouri, Targeted Sampling Done for Public Drinking Water Systems. Available on the Internet at: https://regform.org/wp-content/uploads/2018/09/Medlock_E_-10am_-PFOS-and-PFOA-in-Missouri_REGFORM_091218-1.pdf.

Missouri DNR. 2023. Missouri PFAS Viewer Tool. Available on the Internet at: https://modnr.maps.arcgis.com/apps/webappviewer/index.html?id=386c71927569476ebd2d0e6910424d17. Accessed May 4, 2023.

National Center for Biotechnology Information (NCBI). 2022a. *PubChem Compound Summary for CID 9554, Perfluorooctanoic acid.* Available on the Internet at https://pubchem.ncbi.nlm.nih.gov/compound/Perfluorooctanoic-acid. Accessed September 27, 2022.

NCBI. 2022b. *PubChem Compound Summary for CID 74483, Perfluorooctanesulfonic acid.* Available on the Internet at https://pubchem.ncbi.nlm.nih.gov/compound/Perfluorooctanesulfonic-acid. Accessed September 27, 2022.

NCBI. 2022c. *PubChem Compound Summary for CID 67734, Perfluorohexanesulfonic acid.* Available on the Internet at https://pubchem.ncbi.nlm.nih.gov/compound/67734. Accessed July 28, 2022.

NCBI. 2022d. *PubChem Compound Summary for CID 67821, Perfluorononanoic acid.* Available on the Internet at https://pubchem.ncbi.nlm.nih.gov/compound/67821. Accessed July 28, 2022

NCBI. 2022e. *PubChem Compound Summary for CID 114481, 2,3,3,3-Tetrafluoro-2-(heptafluoropropoxy)propanoic acid*. Available on the Internet at https://pubchem.ncbi.nlm.nih.gov/compound/114481. Accessed September 27, 2022.

NCBI. 2022f. *PubChem Compound Summary for CID 51342034, Ammonium 2,3,3,3-tetrafluoro-2-(heptafluoropropoxy)propanoate*. Available on the Internet at https://pubchem.ncbi.nlm.nih.gov/compound/51342034. Accessed September 27, 2022.

NCBI. 2022g. *PubChem Compound Summary for CID 67815, Perfluorobutanesulfonic acid.* Available on the Internet at: https://pubchem.ncbi.nlm.nih.gov/compound/67815. Accessed September 27, 2022.

New Hampshire Department of Environmental Services (NHDES). 2021. PFOA/PFOS Sampling Results for Public Water Systems in New Hampshire.

New Jersey Department of Environmental Protection (NJDEP). 2023. New Jersey Drinking Water Watch. Available on the Internet at: https://www9.state.nj.us/DEP_WaterWatch_public/. Accessed May 17, 2023.

New Mexico Environment Department (NMED). 2019. Data from public drinking water supplies, private wells on and around Cannon Air Force Base. Available on the Internet at: https://www.env.nm.gov/wp-content/uploads/sites/21/2019/04/CAFB-PFAS-sample-results.pdf. Accessed April 2021.

New York Department of Health (NYDOH). 2022. PFAS Sampling Results for Public Water Systems in New York. Available in public docket at: https://www.regulations.gov/docket/EPA-HQ-OW-2022-0114.

Nguyen, T.M.H., J. Bräunig, K. Thompson, J. Thompson, S. Kabiri, D.A. Navarro, R.S. Kookana, C. Grimison, C.M. Barnes, C.P. Higgins, M.J. McLaughlin and J.F. Mueller. 2020. Influences of Chemical Properties, Soil Properties, and Solution pH on Soil–Water Partitioning Coefficients of Per- and Polyfluoroalkyl Substances (PFASs). *Environmental Science & Technology*. 54:15883-15892.

North Carolina Department of Environmental Quality (NCDEQ). 2021. Gen X Surface Water Sampling Sites. Available on the Internet at: https://deq.nc.gov/news/key-issues/genx-investigation/genx-surface-water-sampling-sites. Accessed May 4, 2021.

NCDEQ. 2023. 2022 DEQ Sampling of 50 Water Systems. Available on the Internet at: https://www.deq.nc.gov/key-issues/2022-pfas-data-pfoa-pfospdf/download?attachment. Accessed May 1, 2023.

North Dakota Department of Environmental Quality (NDDEQ). 2019. North Dakota Statewide 2018 Per- and Polyfluoroalkyl Substances (PFAS) Presence/Absence Survey. Available on the Internet at: https://deq.nd.gov/Publications/MF/PFAS_Report.pdf.

NDDEQ. Date Unknown. North Dakota Statewide 2020 Per- and Polyfluoroalkyl Substances (PFAS) Presence/Absence Survey. Available on the Internet at: https://deq.nd.gov/Publications/MF/PFAS_Report_2020.pdf?v=1.

NDDEQ. Date Unknown. North Dakota Statewide 2021 Per- and Polyfluoroalkyl Substances (PFAS) Presence/Absence Survey. Available on the Internet at: https://deq.nd.gov/Publications/MF/PFAS_Report_2021.pdf?v=1.

Ohio Environmental Protection Agency (Ohio EPA). 2023. Per- and Polyfluoroalkyl Substances (PFAS). Available on the Internet at: https://data-oepa.opendata.arcgis.com/datasets/pfas-sampling-results. Accessed May 17, 2023.

Oregon Health Authority - Drinking Water Services (OHA-DWS). 2022. PFAS Screening and Assessment Project Results. Available on the Internet at: https://yourwater.oregon.gov/pfascounty.php. Accessed January 23, 2023.

Pennsylvania Department of Environmental Protection (PADEP). 2019. Statewide Sampling Plan: October 2019 Summary of Results. Available on the Internet at: http://files.dep.state.pa.us/Water/DrinkingWater/Perfluorinated%20Chemicals/SamplingResults/PFASPhase1ResultsSummary.pdf.

PADEP. 2021. Statewide Sampling Plan: Final Results. Available on the Internet at: https://files.dep.state.pa.us/Water/DrinkingWater/Perfluorinated%20Chemicals/SamplingResults/PFAS_Sampling_Final_Results_May_2021.pdf.

Post, G.B., J.B. Louis, R.L. Lippincott, and N.A. Procopio. 2013. Occurrence of perfluorinated compounds in raw water from New Jersey public drinking water systems. *Environmental Science and Technology.* 47(23):13266-13275.

Prevedouros, K., I.T. Cousins, R.C. Buck, and S.H. Korzeniowski. 2006. Sources, Fate and Transport of Perfluorocarboxylates. *Environmental Science and Technology.* 40(1):32-44.

Reyes, B. 2021. Occurrence and distribution of PFAS in sampled source water of public drinking-water supplies in the surficial aquifer in Delaware, 2018; PFAS and groundwater age-dating results. U.S. Geological Survey, Open-File Report 2021-1109, 27 p. Available on the Internet at: https://doi.org/10.3133/ofr20211109.

South Carolina Department of Health and Environmental Control (SCDHEC). 2020. PFAS Sampling Results: Surface Water-Sourced Community Drinking Water Systems. Available on the Internet at: https://scdhec.gov/BOW/pfas-sampling-results.

SCDHEC. 2023. PFAS Sampling Results: Ground Water-Sourced Community Drinking Water. Available on the Internet at: https://scdhec.gov/sites/default/files/media/document/Raw%20Data_0.pdf. Accessed May 1, 2023.

Tennessee Department of Environment and Conservation. 2023. Metro Nashville PFAS Sampling Data. Available on the Internet at: https://www.tn.gov/environment/policy/pfas/non-tdec-sampling.html. Accessed May 17, 2023.

United Nations Environment Programme (UNEP) 2017. Proposal to list Perfluorohexane sulfonic acid, its salts and PFHxS-related compounds in Annexes A, B and/or C to the Stockholm Convention on Persistent Organic Pollutants. UNEO/POPS/POPRC.13/4*. June 2017. Available on Internet: http://chm.pops.int/TheConvention/POPsReviewCommittee/Meetings/POPRC13/MeetingDocuments/tabid/6024/Default.aspx

UNEP. 2019. *Report of the Persistent Organics Review Committee on the work of its fifteenth meeting, Risk management evaluation on Perfluorohexane sulfonic acid, its salts and PFHxS-related compounds.* Stockholm Convention on Persistent Organic Pollutants. UNEO/POPS/POPRC.15/7/Add.1. October 2019. Available on Internet: http://www.pops.int/TheConvention/POPsReviewCommittee/Meetings/POPRC15/Overview/tabid/8052/Default.aspx

UNEP. 2021 *Proposal to list long-chain perfluorocarboxylic acids, their salts and related compounds in Annexes A, B and/or C to the Stockholm Convention.* UNEP/POPS/POPRC.17/7. June 2021.

United States Environmental Protection Agency (USEPA). 2000. EPA and 3M Announce Phase Out of PFOS. News Release. May 16, 2000. Available on the Internet at: https://archive.epa.gov/epapages/newsroom_archive/newsreleases/33aa946e6cb11f35852568e1005246b4.html

USEPA. 2003. *How are the Toxics Release Inventory Data Used?* EPA 260-R-002-004. May 2003. Available on the Internet at: https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=900B0I00.TXT.

USEPA. 2008. Using the 2006 Inventory Update Reporting (IUR) Public Data: Background Document. Office of Pollution Prevention and Toxics. December. Available on the Internet at: https://www.epa.gov/sites/production/files/documents/iurdbbackground_0.pdf.

USEPA. 2009. *Final Contaminant Candidate List 3 Chemicals: Classification of the PCCL to CCL.* Office of Water. EPA 815-R-09-008. Available on the Internet at: https://www.epa.gov/sites/production/files/2014-05/documents/ccl3_pccltoccl_08-31-09_508.pdf

USEPA. 2012a. Estimation Program Interface (EPI Suite^{TM}) Program Modification & New Features in v4.11 (November 2012). Available on the Internet at: https://19january2017snapshot.epa.gov/tsca-screening-tools/estimation-program-interface-epi-suite-tm-program-modifications-new-features_.html

USEPA. 2012b. Revisions to the Unregulated Contaminant Monitoring Regulation (UCMR 3) for Public Water Systems. *Federal Register* Vol. 77, No. 85, p. 26072, May 2, 2012.

USEPA. 2017. Technical Fact Sheet - Perfluorooctane Sulfonate (PFOS) and Perfluorooctanoic Acid (PFOA). EPA 505-F-17-001. Available on the Internet at: https://19january2021snapshot.epa.gov/sites/static/files/2017-12/documents/ffrrofactsheet_contaminants_pfos_pfoa_11-20-17_508_0.pdf.

USEPA. 2019a. *Occurrence Data from the Third Unregulated Contaminant Monitoring Rule (UCMR 3)*. EPA 815-R-19-007.

USEPA. 2019b. Method 533: Determination of Per- and Polyfluoroalkyl Substances in Drinking Water by Isotope Dilution Anion Exchange Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometry. EPA Document No. 815-B-19-020, November 2019. Office of Water, Office of Ground Water and Drinking Water, Standards and Risk Management Division, Technical Support Center, Cincinnati, OH. Available on the Internet at: https://www.epa.gov/dwanalyticalmethods/method-533-determination-and-polyfluoroalkyl-substances-drinking-water-isotope

USEPA. 2020a. Announcement of Preliminary Regulatory Determinations for Contaminants on the Fourth Drinking Water Contaminant Candidate List. *Federal Register.* Vol. 85, No. 47, p. 14098, March 10, 2020.

USEPA. 2020b. 2020 Chemical Data Reporting Frequent Questions. Available on the Internet at: https://www.epa.gov/chemical-data-reporting/2020-chemical-data-reporting-frequent-questions. Last updated November 10, 2020.

USEPA. 2020c. *TSCA Chemical Data Reporting Fact Sheet: Chemical Substances which are the Subject of Certain TSCA Actions.* May 2020. Available on the Internet at: https://www.epa.gov/sites/default/files/2020-05/documents/fact_sheet_chemical_substances_subject_tsca_actions_05.08.20.pdf.

USEPA. 2020d. Method 537.1: Determination of Selected Per- and Polyfluorinated Alkyl Substances in Drinking Water by Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometry (LC/MS/MS). Version 2.0, EPA/600/R-20/006, March 2020. Center for Environmental Solutions & Emergency Response, Office of Research and Development, Cincinnati, OH. Available on the Internet at:

https://cfpub.epa.gov/si/si_public_record_report.cfm?dirEntryId=348508&Lab=CESER&simpleSearch=0&showCriteria=2&searchAll=537.1&TIMSType=&dateBeginPublishedPresented=03%2F24%2F2018.

USEPA. 2021a. Announcement of Final Regulatory Determinations for Contaminants on the Fourth Drinking Water Contaminant Candidate List. *Federal Register.* Vol. 86, No. 40, p. 12272, March 3, 2021.

USEPA. 2021b. *Final Regulatory Determination 4 Support Document.* EPA 815-R-21-001. January 2021.

USEPA. 2021c. EPA's Analytical Chemistry Branch PFAS Testing - Rinses from Selected Fluorinated and Non-Fluorinated HDPE Containers. March 4, 2021. https://www.epa.gov/sites/default/files/2021-03/documents/results-of-rinsates-samples_03042021.pdf.

USEPA. 2021d. Human Health Toxicity Values for Hexafluoropropylene Oxide (HFPO) Dimer Acid and Its Ammonium Salt , EPA/822/R-21/010. Oct., 2021. https://www.epa.gov/system/files/documents/2021-10/genx-chemicals-toxicity-assessment_tech-edited_oct-21-508.pdf

USEPA. 2021e. Revisions to the Unregulated Contaminant Monitoring Rule (UCMR 5) for Public Water Systems and Announcement of Public Meetings. *Federal Register*. Vol. 86, No. 245, p. 73131, December 27, 2021.

USEPA. 2021f. Human Health Toxicity Values for Perfluorobutane Sulfonic Acid and Related Compound Potassium Perfluorobutane Sulfonate, EPA/600/R-20/345F. April, 2021. https://cfpub.epa.gov/ncea/risk/recordisplay.cfm?deid=350888

USEPA. 2022a. *About the TSCA Chemical Substance Inventory*. Available on the Internet at: https://www.epa.gov/tsca-inventory/about-tsca-chemical-substance-inventory. Accessed September 27, 2022.

USEPA. 2022b. *Factors to Consider When Using Toxics Release Inventory Data.* Available on the Internet at: https://www.epa.gov/toxics-release-inventory-tri-program/factors-consider-when-using-toxics-release-inventory-data.

USEPA. 2022c*. List of PFAS Added to the TRI by the NDAA*. Available on the Internet at: https://www.epa.gov/toxics-release-inventory-tri-program/list-pfas-added-tri-ndaa

USEPA. 2022d. Fact Sheet: 2010/2015 PFOA Stewardship Program. Available on the Internet at: https://www.epa.gov/assessing-and-managing-chemicals-under-tsca/fact-sheet-20102015-pfoa-stewardship-program. Last updated April 26, 2022.

USEPA. 2022e. 2020 CDR Data. Available on the Internet at: https://www.epa.gov/chemical-data-reporting/access-cdr-data#2020. Accessed May 24, 2022.

USEPA. 2022f. Drinking Water Health Advisory: Hexafluoropropylene Oxide (HFPO) Dimer Acid (CASRN 13252-13-6) and HFPO Dimer Acid Ammonium Salt (CASRN 62037-80-3), Also Known as "GenX

Chemicals." EPA/822/R-22/005, June 2022, Health and Ecological Criteria Division, Office of Science and Technology, Office of Water, Washington, DC. Available on the internet at: https://www.epa.gov/system/files/documents/2022-06/drinking-water-genx-2022.pdf.

USEPA. 2022g. Drinking Water Health Advisory: Perfluorobutane Sulfonic Acid (CASRN 375-73-5) and Related Compound Potassium Perfluorobutane Sulfonate (CASRN 294209-49-3). EPA 822/R-22/006, June 2022, Health and Ecological Criteria Division, Office of Science and Technology, Office of Water, Washington, DC. Available on the internet at: https://www.epa.gov/system/files/documents/2022-06/drinking-water-pfbs-2022.pdf

USEPA. 2023a. PFAS National Primary Drinking Water Regulation Rulemaking. *Federal Register*. Vol. 88, No. 60, p. 18638, March 29, 2023.

USEPA. 2023b. TRI Explorer: Trends. Available on the Internet at: https://enviro.epa.gov/triexplorer/tri_release.trends. Accessed November 2023.

USEPA. 2023c. *Economic Analysis of the Proposed National Primary Drinking Water Regulation for Per- and Polyfluoroalkyl Substances.* EPA-822-P-22-001. March 2023.

USEPA. 2024a. Final National Primary Drinking Water Regulation for Per- and Polyfluoroalkyl Substances.

USEPA. 2024b. Economic Analysis of the Final National Primary Drinking Water Regulation for Per- and Polyfluoroalkyl Substances. EPA-815-R-24-001.

USEPA. 2024c. Fifth Unregulated Contaminant Monitoring Rule: Occurrence Data. Available on the internet at: https://www.epa.gov/dwucmr/occurrence-data-unregulated-contaminant-monitoring-rule#5

USGS. 2023. National Water Information System (NWIS) Water-Quality Web Services. https://waterdata.usgs.gov/nwis. Last modified August 2023.

Vermont Department of Environmental Conservation (VT DEC). 2023. State PFAS Monitoring Results Received. Available on the Internet at: https://dec.vermont.gov/water/drinking-water/water-quality-monitoring/pfas. Accessed May 17, 2023.

Virginia Department of Health Office of Drinking Water (VDH ODW). 2021. Virginia Per and Polyfluoroalkyl Substances (PFAS) in Drinking Water Sample Study. Available on the Internet at: https://www.vdh.virginia.gov/content/uploads/sites/14/2021/09/VA-PFAS-Sample-Study-Summary.pdf.

Wang, Y., G. Arsenault, N. Riddell, R. McCrindle, A. McAlees, and J.W. Martin. 2009. Perfluorooctane sulfonate (PFOS) precursors can be metabolized enantioselectively: Principle for a new PFOS source tracking tool. *Environmental Science and Technology*. 43(21):8283−8289.

Washington, J.W., H. Yoo, J.J. Jackson, T.M. Jenkins, and E.L. Libelo. 2010. Concentrations, distribution and persistence of perfluoroalkylates in sludge-applied soils near Decatur, Alabama, USA. *Environmental Science and Technology* 44(22):8390-8396.

Washington, J.W., T.M. Jenkins, K. Rankin, and J.F. Naile. 2014. Decades-Scale Degradation of Commercial, Side-Chain, Fluorotelomer-Based Polymers in Soils and Water. *Environmental Science and Technology* 49(2):915−923.

Washington, J.W., T.M. Jenkins, and E.J. Weber. 2015. Identification of unsaturated and 2H polyfluorocarboxylate homologous aeries and their detection in environmental samples and as polymer degradation products. *Environmental Science and Technology* 49(22):13256−13263.

Water Quality Portal (WQP). 2023. Water Quality Portal Data Warehouse. Available on the Internet at: https://www.waterqualitydata.us/. Data Warehouse consulted November 2023.

West Virginia Department of Health and Human Resources (WV DHHR). 2023. Drinking Water Viewer Data. Available on the Internet at: https://wvdwv.gecsws.com/.

Wisconsin Department of Natural Resources (WI DNR). 2023. Drinking Water System Portal. Available on the Internet at: https://dnr.wi.gov/dwsviewer/ContamResult/Search. Accessed May 3, 2023.

Yoo, H., J.W. Washington, T.M. Jenkins, and J.J. Ellington. 2011. Quantitative Determination of Perfluorochemicals and Fluorotelomer Alcohols in Plants from Biosolid-Amended Fields using LC/MS/MS and GC/MS. *Environ. Sci. Technol*. 45(19):7985−7990.

Zareitalabad, P., J. Siemens, M. Hamer, and W. Amelung. 2013. Perfluorooctanoic Acid (PFOA) and Perfluorooctanesulfonic Acid (PFOS) in Surface Waters, Sediments, Soils, and Wastewater - A Review on Concentrations and Distribution Coefficients. *Chemosphere* 91:725-732.

Appendix A: Perfluorobutane Sulfonic Acid (PFBS)

This appendix presents information and analysis specific to PFBS, including background information on the contaminant, information on contaminant sources and environmental fate, an analysis of health effects, an analysis of occurrence in ambient and drinking water, and information about the availability of analytical methods and treatment technologies.

A.1 Contaminant Background, Chemical and Physical Properties

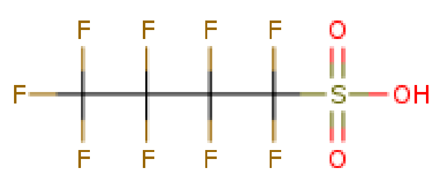
Synonyms for PFBS include nonafluorobutanesulfonic acid and 1-perfluorobutanesulfonic acid, according to NCBI (2022g). The acronym PFBS is also used to refer to the deprotonated anionic form of the compound, perfluorobutane sulfonate (NCBI, 2022g) also known as pentyl perfluorobutanoate (ATSDR, 2021).

PFBS is a short-chain perfluorinated aliphatic sulfonic acid (ITRC, 2021). Its predominant salt K^+PFBS differs from PFBS by being associated with a potassium ion. For the purposes of this document PFBS will signify the ion, acid, or any salt of PFBS (USEPA, 2022g).

PFBS is a replacement chemical for PFOS. It has been used as a surfactant in alkaline cleaners, paints and water- and stain-repellant products (USEPA, 2021f). It has also been found in semiconductor waste streams (ITRC, 2021), floor wax, firefighting foam, and carpeting (USEPA, 2021f; USEPA, 2022g). While PFBS is not authorized for use in food packaging, it has been detected in grease-proofing agents in other countries (USEPA, 2022g). It is possible that some of these compounds, notably the potassium salt, potassium perfluorobutane sulfonate, used as a flame retardant for polycarbonate resin may result in the presence of PFBS in the environment (ITRC, 2021).

The diagram of Exhibit A-1 shows the straight-chain chemical structure of PFBS. Currently PFBS is not known to exist as branched-chain isomers. As more analytical standards become available, PFBS may be reported as either linear or branched in the future (ITRC, 2021). The chemical and physical properties of PFBS are listed in Exhibit A-2 and would represent mixtures of branched and linear isomers, if present, rather than any particular isomer.

Exhibit A-1: Chemical Structure of PFBS - Straight-Chain Isomer



Source: NCBI, 2022g

NCBI (2022g) reports a value of 1.82 for the log octanol/water partitioning coefficient (log K_{ow}) that is estimated using the EPA's EPISuite™, while ATSDR (2021) indicated that log K_{ow} is not applicable or cannot be measured since PFBS is expected to form multiple layers in octanol and water mixtures. PFBS is charged/ionized and at typical environmental pH can be moderately to very soluble in water (NCBI, 2022g; ITRC, 2021). ATSDR reports no data available for Henry's Law Constant while ITRC and NCBI present a value for K_H. The K_H value presented by NCBI was estimated from vapor pressure and water solubility using EPISuite™.

Where there are different conclusions in the literature for the properties of PFBS, information is presented to highlight the range of uncertainty for this compound.

Exhibit A-2: Physical and Chemical Properties of PFBS

Property	Data
	PFBS
Chemical Abstracts Service (CAS) Registry Number	375-73-5 (NCBI, 2022g)
EPA Pesticide Chemical Code	Not Applicable
Chemical Formula	$C_4HF_9O_3S$ (ATSDR, 2021)
Molecular Weight	300.1 g/mol (ATSDR, 2021)
Color/Physical State	Colorless Liquid (NCBI, 2022g)
Boiling Point	210-212 deg C (NCBI, 2022g) 80-211 deg C (ITRC, 2021) 152 deg C (USEPA, 2021f)
Melting Point	20.4-70.4 deg C (est) (ITRC, 2021) No data (ATSDR, 2021)
Density	1.811 g/mL at 25 deg C (NCBI, 2022g)
Freundlich Adsorption Coefficient	--
Vapor Pressure	1.0 mm Hg at 25 deg C (ITRC, 2021; converted from 2.12 log-Pa) 0.0268 mm Hg at 25 deg C (est) (NCBI, 2022g) 0.104 mm Hg (est) (USEPA, 2021f)
K_H	0.26 atm-m^3/mol at 25 deg C (ITRC, 2021; converted from 1.02 log) 1.44E-05 atm-m^3/mol at 25 deg C (est) (NCBI, 2022g)[a] No data (ATSDR, 2021)
Log K_{ow}	1.82 (est) (dimensionless) (NCBI, 2022g)[b] Not applicable (ATSDR, 2021)
K_{oc}	<1 - 1.6E02 soil (dimensionless) (ITRC, 2021 :Log K_{oc} -0.7 to 2.2) 6.3 - 3.2E03 sediment (dimensionless) (ITRC, 2021; Log K_{oc} 0.8 to 3.5) 1.15E02 (ATSDR, 2021; Log K_{oc} 2.06 avg (n=7)) 180 (dimensionless) (est) (NCBI, 2022g)
pK_a	-3.31 (est) (NCBI, 2022g) 0.14 (est) (ATSDR, 2021)
Solubility in Water	6,875 mg/L (ITRC, 2021; converted from -1.64 log-mol/L) 344 mg/L at 25 deg C (est) (NCBI, 2022g)
Other Solvents	--

Property	Data
	PFBS
Conversion Factors (at 25 deg C, 1 atm)	1 PPM = 12.27 mg/m^3; 1 mg/m^3 = 0.081 PPM (ATSDR, 2021)

Note: "--" indicates that no information was found.
[a]These values should not be used to estimate portioning between water and air.
[b]Surfactants are surface acting agents that contain both a hydrophilic part and a hydrophobic part which causes them to accumulate at interfaces hampering the determination of their aqueous concentration. These surfactant properties present difficulties in applying existing methods for the experimental determination of log K_{ow} and produce unreliable results.

A.1.1 Sources and Environmental Fate

A.1.1.1 Production, Use, and Release

No production data for PFBS are available from the EPA's IUR and CDR programs.[13] Industrial release data are available from the EPA's TRI, as described below.

Toxics Release Inventory (TRI)

The EPA established TRI in 1987 in response to section 313 of the EPCRA. EPCRA section 313 requires the reporting of annual information on toxic chemical releases from facilities that meet specific criteria. This reported information is maintained in a database accessible through TRI Explorer (USEPA, 2023b).

Although TRI can provide a general idea of release trends, it has limitations. Not all facilities are required to report all releases. Facilities are required to report releases if they manufacture, process, or otherwise use a listed toxic chemical in quantities above the respective activity threshold. For PFOA, the reporting threshold is 100 pounds manufactured, processed, or otherwise used over the year. It should also be noted that, as of this publication, quantities of PFOA at concentrations under 1.0 percent within mixtures may be exempt from TRI reporting requirements. Reporting requirements have changed over time (e.g., the chemical list has changed), so conclusions about temporal trends should be drawn with caution. TRI data are meant to reflect releases and other waste management activities and should not be used to estimate general public exposure to a chemical (USEPA, 2023b).

TRI data for PFBS are available for 2022 (USEPA, 2023b). As shown in Exhibit A-3, there were 40 pounds of total on-site disposals and 4 pounds of total off-site disposals reported across all industries in 2022. Releases were reported by one facility in Alabama (USEPA, 2023b).

[13] Note that there are 2020 CDR data listed for "Perfluoro compounds, C5-18." Those data are not summarized in this report.

Exhibit A-3: Environmental Releases of PFBS in the United States, 2022

Year	On-Site Releases (in pounds)				Total Off-Site Releases (in pounds)	Total On- and Off-Site Releases (in pounds)
	Air Emissions	Surface Water Discharges	Underground Injection	Releases to Land		
2022	10	30	0	0	4	44

Source: USEPA, 2023b

A.1.1.2 Environmental Fate

The primary measures used by the EPA to assess mobility include (where available) K_{oc}, log K_{ow}, K_H, water solubility and vapor pressure. For PFBS, pK_a is also important.

PFBS is expected to be stable to oxidation, hydrolysis, photodegradation in the atmosphere and abiotic degradation under environmental conditions (ECHA, 2019; USEPA, 2022g).

Modeling of atmospheric behavior of PFBS suggest that PFBS will be present as a vapor if released to the atmosphere (NCBI, 2022g). PFBS can react with photochemically produced hydroxyl radicals in the atmosphere to degrade (NCBI, 2022g), although PFBS has the potential for long range transport (ECHA, 2019). A half-life for this reaction in air is estimated to be 115 days (NCBI, 2022g) and 76.4 days (ECHA, 2019) based upon EPISuite™ models. Caution should be applied while interpreting these results since half-life estimation is based on “reaction with N, S and OH-“ and does not fully cover perfluoroalkyl substances (ECHA, 2019). Note that radical reactions typically proceed more rapidly than chemically- or microbially-mediated degradation reactions in other environmental media such as water, soil, and/or sediment. PFBS is not expected to undergo direct photolysis (NCBI, 2022g).

Log K_{oc} suggests a propensity for PFBS to be mobilized to ground water and surface water rather than to bind to soil. The relative hydrophobicity of PFAS control their sorption to soils, with PFBS exhibiting lower sorption affinity than PFOS and PFOA, due to PFBS of relative low value of log K_{OW} and its shorter carbon chain. PFBS is expected to have moderate mobility to sediment as K_{oc} was found to range up to Log K_{oc} 3.2 ±0.3, equivalent to 790 - 3160 in sediment (dimensionless) (ITRC, 2021).

PFBS is considered hydrolytically stable having a hydrolytic half-life or more than 1 year based upon a study of K^+PFBS hydrolysis at varying pHs of 4.0, 7.0 and 9.0 (ECHA, 2019). PFBS is also not expected to undergo photolysis in water based upon testing of PFOS and structural similarities between PFBS and PFOS (ECHA, 2019).

PFBS was modelled by ECHA using the seven separate models of EPISuite™ BIOWIN v4.10 to estimate the probability of aerobic and anaerobic biodegradation in water. Although the models provide varying biodegradation results based upon varying methods of structural carbon stability, all of the methods found that PFBS would not biodegrade fast, having results below the screening criteria for being “readily biodegradable” (ECHA, 2019). This finding is corroborated by a 28-day test of PFBS inoculated surface water which biodegraded less than 3 percent (NCBI, 2022g).

No significant oxidation of PFBS by abiotic degradation is expected based on a study using various advanced oxidation methods (ultraviolet radiation, hydrogen peroxide and both methods combined) (ECHA, 2019).

Based on the vapor pressure, PFBS is not expected to volatilize from dry soil (NCBI, 2022g). With a pK_a of less than 1.0, PFBS is expected to exist in its ionized form at typical environment pH ranges of natural waters (NCBI, 2022g). Thus, volatilization from water at typical environment pH is not expected (NCBI, 2022g).

Under CCL 3, the EPA created scales[14] to informally rank chemical contaminants' likely mobility (understood as their tendency to partition to water rather than other media) and persistence as "high," "moderate," or "low" based on physical and chemical properties (see USEPA, 2021b and USEPA, 2009). For PFBS, a log K_{ow} of 1.82, and a water solubility of more than 300 mg/L at 25 degrees C predict a moderate favorability of partitioning to water. The water solubility of the potassium salt of PFBS, 2.7E05 mg/L, which may be more indicative of the anionic form that occurs at typical environmental pH, predicts a high likelihood of partitioning to water. The experimental value of K_H of 0.26 atm-m^3/mol (ITRC, 2021) predicts a high likelihood of partitioning to water. NCBI (2022g) lists a K_H of 1.44E-05 atm-m^3/mol, but this value was estimated from vapor pressure and water solubility using EPISuite™.

PFBS is very stable chemically and is resistant to hydrolysis, photolysis, and biodegradation (NCBI, 2022g). A resistance to essentially all forms of degradation other than recalcitrant atmospheric processes indicates high persistence.

A.2 PFBS Occurrence

In this action, the EPA is deferring the final determination to individually regulate PFBS for further evaluation under the SDWA statutory criteria. The EPA is making a final determination to regulate PFBS as part of an HI approach when co-occurring in mixture combinations containing two or more of PFHxS, PFNA, HFPO-DA, and PFBS. Refer to chapter 8 for more information on the HI and chapter 9 for co-occurrence information. For reference only, this appendix presents data on the individual occurrence of PFBS in drinking water and ambient water in the United States. The drinking water analyses presented in this section were performed for UCMR 3 and select state data sources. For additional background information about data sources used to evaluate occurrence, please refer to Chapter 2.

A.2.1 Occurrence in Drinking Water

Data sources reviewed by the agency for information on PFBS occurrence in drinking water included UCMR 3, more recent state drinking water monitoring programs, and the DoD PFAS drinking water testing, as well as additional studies from the literature. Note that there may be some overlap, as sources with different purposes and audiences may have reported the same underlying data. UCMR 3 is a nationally representative data source. Other data sources profiled in this section are considered "supplemental" sources. Also note that PFBS is being monitored for under UCMR 5, which is occurring from 2023 to 2025. Analysis of partial UCMR 5 results (the first three quarters of data that were made available as of February 2024) are discussed in section 11 of this document. Additionally, the EPA notes

[14] See Exhibit A.8 here: https://www.epa.gov/sites/default/files/2014-05/documents/ccl3_pccltoccl_08-31-09_508.pdf

that the UCMR 3 MRL for PFBS is higher than that utilized within the majority of state monitoring data and for the UCMR 5.

A.2.1.1 UCMR 3 Data

PFBS was included as part of the nationally representative UCMR 3 monitoring from 2013 through 2015. UCMR 3 Assessment Monitoring occurrence data are available for PFBS from all large and very large PWSs (serving between 10,001 and 100,000 people and serving more than 100,000 people, respectively), plus a statistically representative national sample of 800 small PWSs (serving 10,000 people or fewer).[15] Surface water and GWUDI sampling points were monitored four times during the applicable year of monitoring, and ground water sample points were monitored twice during the applicable year of monitoring. See USEPA (2012b) and USEPA (2019a) for more information on the UCMR 3 study design and data analysis.

Exhibit A-4 through Exhibit A-6 provide an overview of PFBS occurrence results from the UCMR 3 Assessment Monitoring. Laboratories participating in UCMR 3 were required to report values at or above MRLs defined by the EPA. The UCMR MRLs are not intended to represent the lowest achievable measurement level an individual laboratory may achieve. Rather, the MRLs are established to ensure reliable and consistent results from the array of laboratories needed for a national monitoring program and are set based on the quantitation level capability of multiple commercial laboratories prior to beginning each UCMR round. The MRL used for PFBS in the UCMR 3 survey was 90 ng/L (77 FR 26072; USEPA, 2012b). Exhibit A-4 presents a sample-level summary of the results. Exhibit A-5 shows a statistical summary of PFBS concentrations by system size and source water type (including the minimum, 25th percentile, median, 75th percentile, 90th percentile, 99th percentile, and maximum). Exhibit A-6 shows system-level results for detections greater than or equal to the MRL.

A total of 36,972 finished water samples for PFBS were collected from 4,920 PWSs. PFBS was reported ≥ MRL of 90 ng/L in 0.05 percent of UCMR 3 samples. Reported PFBS concentrations for these results ranged from 90 ng/L (the MRL) to 370 ng/L. Of 4,920 systems, 8 (0.16 percent of systems, serving 0.15 percent of the PWS-served population) reported at least one detection.

Exhibit A-4: PFBS National Occurrence Measures Based on UCMR 3 Assessment Monitoring Data - Summary of Samples

Source Water Type	Total # of Samples	Samples with Detections ≥ MRL of 90 ng/L	
		Number	Percent
Small Systems (serving ≤ 10,000 people)			
Ground Water	1,853	0	0.00%
Surface Water	1,421	0	0.00%
All Small Systems	**3,274**	**0**	**0.00%**
Large Systems (serving 10,001 - 100,000 people) -- CENSUS			
Ground Water	11,707	0	0.00%
Surface Water	14,860	19	0.13%

[15] A total of 799 small systems submitted Assessment Monitoring results.

Source Water Type	Total # of Samples	Samples with Detections ≥ MRL of 90 ng/L	
		Number	Percent
All Large Systems	**26,567**	**19**	**0.07%**
Very Large Systems (serving > 100,000 people) -- CENSUS			
Ground Water	2,020	0	0.00%
Surface Water	5,111	0	0.00%
All Very Large Systems	**7,131**	**0**	**0.00%**
All Systems			
All Water Systems	**36,972**	**19**	**0.05%**

Exhibit A-5: PFBS Occurrence Data from UCMR 3 Assessment Monitoring - Summary of Reported Concentrations

Source Water Type	Concentration Value of Detections (in ng/L) ≥ MRL of 90 ng/L						
	Minimum	25th percentile	Median	75th percentile	90th Percentile	99th Percentile	Maximum
Small Systems (serving ≤ 10,000 people)							
Ground Water	--	--	--	--	--	--	--
Surface Water	--	--	--	--	--	--	--
All Small Systems	**--**	**--**	**--**	**--**	**--**	**--**	**--**
Large Systems (serving 10,001 - 100,000 people) -- CENSUS							
Ground Water	--	--	--	--	--	--	--
Surface Water	90	115	170	205	336	368.2	370
All Large Systems	**90**	**115**	**170**	**205**	**336**	**368.2**	**370**
Very Large Systems (serving > 100,000 people) -- CENSUS							
Ground Water	--	--	--	--	--	--	--
Surface Water	--	--	--	--	--	--	--
All Very Large Systems	**--**	**--**	**--**	**--**	**--**	**--**	**--**
All Systems							
All Water Systems	**90**	**115**	**170**	**205**	**336**	**368.2**	**370**

Exhibit A-6: PFBS National Occurrence Measures Based on UCMR 3 Assessment Monitoring Data - Summary of System and Population Served Data - Reported Detections

Source Water Type	UCMR 3 Samples		Number With At Least One Detection ≥ MRL of 90 ng/L		Percent With At Least One Detection ≥ MRL of 90 ng/L		National Inventory		Percent of National Inventory Included	
	Systems	Population	Systems	Population	Systems	Population	Systems	Population	Systems	Population
Small Systems (serving ≤ 10,000 people)										
Ground Water	527	1,498,845	0	0	0.00%	0.00%	55,700	38,730,597	0.95%	3.87%
Surface Water	272	1,250,215	0	0	0.00%	0.00%	9,728	20,007,917	2.80%	6.25%
All Small Systems	**799**	**2,749,060**	**0**	**0**	**0.00%**	**0.00%**	**65,428**	**58,738,514**	**1.22%**	**4.68%**
Large Systems (serving 10,001 - 100,000 people) -- CENSUS										
Ground Water	1,453	37,141,418	0	0	0.00%	0.00%	1,470	37,540,614	98.84%	98.94%
Surface Water	2,260	69,619,878	8	349,933	0.35%	0.50%	2,310	70,791,005	97.84%	98.35%
All Large Systems	**3,713**	**106,761,296**	**8**	**349,933**	**0.22%**	**0.33%**	**3,780**	**108,331,619**	**98.23%**	**98.55%**
Very Large Systems (serving > 100,000 people) -- CENSUS										
Ground Water	68	16,355,951	0	0	0.00%	0.00%	68	16,355,951	100.00%	100.00%
Surface Water	340	115,158,260	0	0	0.00%	0.00%	343	120,785,622	99.13%	95.34%
All Very Large Systems	**408**	**131,514,211**	**0**	**0**	**0.00%**	**0.00%**	**411**	**137,141,573**	**99.27%**	**95.90%**
All Systems										
All Water Systems	**4,920**	**241,024,567**	**8**	**349,933**	**0.16%**	**0.15%**	**69,619**	**304,211,706**	**7.07%**	**79.23%**

A.2.1.2 State Monitoring Data

In the development of the proposed and final NPDWR, the agency supplemented its UCMR 3 data with more recent publicly available data collected by states. In general, these more recent state data were collected using newer analytical methods and state results reflect lower reporting and detection limits than those in the UCMR 3. Drinking water occurrence data from PWSs for PFBS were available from several states, including Alabama, Arizona, California, Colorado, Georgia, Idaho, Illinois, Indiana, Iowa, Kentucky, Maine, Maryland, Massachusetts, Michigan, Minnesota, Missouri, New Hampshire, New Jersey, New Mexico, New York, North Carolina, North Dakota, Ohio, Oregon, Pennsylvania, South Carolina, Tennessee, Vermont, Virginia, and Wisconsin. The EPA downloaded publicly available monitoring data from state websites. Note that while some states did have available raw water data as indicated in Exhibit A-7, for the subsequent analyses the EPA only evaluated finished water results.

Exhibit A-7 provides a summary of the available state reported monitoring data for PFBS, including date range and a description of coverage and representativeness (including whether monitoring was non-targeted or targeted (i.e., monitoring in areas of known or potential PFAS contamination)). A description of those studies is also included in Exhibit A-7. State reporting thresholds are also provided, where available, in Exhibit A-7. The EPA notes that different states utilized various reporting thresholds when analyzing and presenting their data, and for some states there were no clearly defined thresholds publicly provided; in these cases, minimum detected concentrations reported may be indicative of reporting thresholds used. Further, for some states, the thresholds varied when reporting results for the same analyte, as well as the laboratory analyzing the data. For those states, a range of thresholds is provided. As shown in Exhibit A-7, some states reported at thresholds and/or presented data at concentrations below the EPA's final HBWC and/or PQL for PFBS. However, to present the best available occurrence information, the EPA collected and evaluated the data based on the information as reported directly by the states and when conducting data analyses incorporated individual state-specific reporting thresholds where possible. Additionally, the EPA notes that the majority of the data were analyzed via an EPA-approved drinking water analytical method.

Exhibit A-7: Summary of Available PFBS State Reported Monitoring Data

State (Reference)	Date Range	Type of Water Tested	Reporting Threshold (ppt)	Notes on Coverage	Survey Type
Alabama (ADEM, 2023)	2013 - 2022	Ground Water and Surface Water - Finished Water	Not reported	ADPH instructed water systems to carry out PFAS monitoring at all PWSs not previously sampled during UCMR 3. In 2022, water systems that had not been sampled since UCMR 3 were required to sample between January and June 2022 using current analytical methods. Only results that are above the MRL are posted online; thus, only reported detections were available for use in the occurrence analyses.	Non-Targeted
Arizona (ADEQ, 2023)	2021	Ground Water and Surface Water - Raw and Finished Water	1.6 - 2	ADEQ presents a PFAS Interactive Data Map that displays the results of testing conducted by ADEQ since 2018 at PWSs across Arizona.	Targeted
California (CADDW, 2023)	2016 - April 2023	Ground Water and Surface Water - Raw, Finished, and Unknown Water	0.002 - 90	The EPA reviewed the California PFBS data available online through April 2023. Finished water data were available from approximately 120 PWSs. For this analysis, the EPA only included results that were explicitly marked as being from treated water. Sampling in California is ongoing.	Targeted
Colorado (CDPHE, 2018;CDPHE, 2020)	2013 - 2017	Surface Water (Finished Water) and Drinking Water Distribution Samples	2 - 90	Data available from 28 “drinking water distribution zones” (one or more per PWS) in targeted sampling efforts at a known contaminated aquifer region. Data were collected by El Paso County Public Health, local water districts and utilities, and the CDPHE.	Targeted
	2020	Ground Water and Surface Water - Raw and Finished Water	1.6 - 2.4	CDPHE offered free testing to PWSs serving communities, schools, and workplaces and also to fire districts with wells. Approximately 50% of PWSs in Colorado participated in the 2020 PFAS sampling project. Data included in this report were collected in March through May of 2020.	Non-Targeted
Georgia (GA EPD, 2020)	2020	Surface Water - Raw, Finished, and Unknown Water	18	The EPA and the GA EPD conducted joint sampling of the City of Summerville’s drinking water sources and finished drinking water in January 2020.	Targeted
Idaho (Idaho DEQ, 2023)	2021 - April 2023	Ground Water - Finished and Unknown Water	0.5 - 1	Sampling of finished drinking water data between September 2021 and April 2023 that were available on the state’s Drinking Water Watch website.	Not specified
Illinois (IL EPA, 2023)	2020 - May 2023	Ground Water and Surface Water - Raw and Finished Water	1.7 - 5	In 2020, the IL EPA initiated a statewide investigation into the prevalence and occurrence of PFAS in finished drinking water at 1,749 community water supplies across Illinois. The EPA reviewed finished drinking water data	Non-Targeted

State (Reference)	Date Range	Type of Water Tested	Reporting Threshold (ppt)	Notes on Coverage	Survey Type
				collected between September 2020 and May 2023 that were available on the state's Drinking Water Watch website. Sampling in Illinois is ongoing.	
Indiana (IDEM, 2023)	2021 - January 2023	Ground Water and Surface Water - Raw, Finished, and Unknown Water	2	Beginning in February 2021, the IDEM facilitated PFAS monitoring at all CWSs throughout the state of Indiana. Samples were to be collected at all raw water (i.e., wells and intakes) and finished (after treatment) water points in a CWS's supply to evaluate the statewide occurrence of PFAS compounds in CWS across the state and determine the efficacy of conventional drinking water treatment for PFAS.	Non-Targeted
Iowa (IA DNR, 2023)	2021 - April 2023	Ground Water and Surface Water - Raw and Finished Water	1.7 - 3	In January 2020, the Iowa DNR developed an Action Plan to protect the health of Iowa residents and the environment from PFAS. Data were downloaded from the PFAS Sampling Interactive Dashboard and Map.	Targeted
Kentucky (KYDEP, 2019)	2019	Ground Water and Surface Water - Finished Water	3.96	Sampling of finished drinking water data between June and October 2019. Under this sampling effort, data are available from 81 community public DWTPs, representing 74 PWSs, and serving more than 2.4 million people.	Non-Targeted
Maine (Maine DEP, 2020; Maine DHHS, 2023)	2013 - 2020	Drinking Water - Raw, Finished, and Unknown Water	1.78 - 90	In March 2019, the Maine PFAS Task Force was created to review the extent of PFAS contamination in Maine. Finished water results collected from 2013 through 2020 have been collected at 23 locations throughout the state. Data may include results from public and private finished drinking water sources. Sampling in Maine is ongoing.	Targeted
	2021 - January 2023	Ground Water and Surface Water - Finished Water	2	The EPA reviewed the finished water data reported to the Maine CDC Drinking Water Program as compliance samples since June 2021 and processed in the database as of 3/10/2023. Sampling in Maine is ongoing.	Non-Targeted
Maryland (MDE, 2021; MDE, 2022a; MDE, 2022b)	2020 - 2022	Raw and Finished Water	1	In 2020, MDE initiated a project to identify potential sources of PFAS in Maryland and to prioritize water sources for PFAS sampling. The EPA reviewed the finished water results from the first three phases of MDE's Public Water System study for the occurrence of PFAS in State drinking water sources. Under Phase 1 (September 2020 - February 2021), sites were selected for priority sampling based on MDE's evaluation of potential relative risk for PFAS exposure through drinking water. Under Phase 2 (March 2021 - May 2021), MDE conducted sampling at sites that were selected based on their geological setting and proximity to potential sources of PFAS. Under Phase 3 (August 2021- June 2022), MDE tested the remaining CWSs in the state.	Targeted (Phase 1, Phase 2); Non-Targeted (Phase 3)

State (Reference)	Date Range	Type of Water Tested	Reporting Threshold (ppt)	Notes on Coverage	Survey Type
Massachusetts (MA EEA, 2023)	2016 - April 2023	Ground Water and Surface Water - Raw and Finished Water	0.26 - 42	The EPA reviewed the finished water data available online through April 2023. Data were available from 1,319 PWSs. Sampling in Massachusetts is ongoing.	Targeted
Michigan (Michigan EGLE, 2023)	2020 - March 2023	Ground Water and Surface Water - Finished Water	2	The Michigan EGLE developed MCLs for seven PFAS compounds in Michigan, which took effect in August 2020. The EPA reviewed available finished compliance monitoring results through March 2023. Sampling in Michigan is ongoing.	Non-Targeted
Minnesota (MDH, 2023)	2020 - 2023	Ground Water and Surface Water - Finished Water	Not reported	Through the Statewide PFAS Monitoring Project, MDH is testing CWSs across the state for PFAS. The EPA reviewed finished water data through MDH's Interactive Dashboard for PFAS Testing in Drinking Water.	Non-Targeted
Missouri (Missouri DNR, 2023)	2022 - 2023	Ground Water and Surface Water - Raw and Finished Water	Not reported	The EPA reviewed the finished water data available online from Missouri DNR's "PFAS Viewer Tool" which identifies the location of voluntary sampling for PFAS in public drinking water systems in Missouri. The EPA reviewed finished water data collected from approximately 113 PWSs from 2022 through 2023. Limited data were also available from 2013 through 2017.	Non-Targeted
New Hampshire (NHDES, 2021)	2016 – May 2021	Ground Water and Surface Water – Raw and Finished Water	Not reported	The EPA reviewed the New Hampshire PFBS data available online through May 2021. Finished water data were available from more than 200 PWSs. Sampling in New Hampshire is ongoing.	Non-Targeted
New Jersey (NJDEP, 2023)	2019 - May 2023	Ground Water and Surface Water - Raw, Finished, and Unknown Water	0.43 - 44	Statewide sampling of finished drinking water data was available from 2019-2023. The EPA reviewed data available online through May 2023 from more than 660 PWSs. Sampling in New Jersey is ongoing.	Non-Targeted
New Mexico (NMED, 2019)	2016	Ground Water - Raw and Finished Water	Not reported	NMED, Department of Health and the U.S. Air Force conducted testing at public drinking water supplies at or around Cannon Air Force Base up to 2019.	Targeted
New York (NYDOH, 2022)	2017 - 2022	Ground Water and Surface Water - Raw, Finished, and Unknown Water	0.000000001 - 1,790	The EPA reviewed finished water data voluntarily provided by the state to the EPA. Data were available from nearly 2,600 PWSs from 2017 through 2022. Limited data were also available from 2016.	Non-Targeted
North Carolina (NCDEQ, 2021)	2017 - 2019	Finished and unknown water	Not reported	NCDEQ and the Department of Health and Human Services investigated the presence of HFPO-DA and other PFAS in the Cape Fear River in June 2017. Monthly results were also collected from five water treatment plants on the Cape Fear River. Data were available from June 2017 through October 2019. Only results above the DL were reported; thus, only reported detections were available for use in the occurrence analyses.	Targeted

State (Reference)	Date Range	Type of Water Tested	Reporting Threshold (ppt)	Notes on Coverage	Survey Type
North Dakota (NDDEQ, date unknown; NDDEQ, date unknown)	2020, 2021	Ground Water and Surface Water - Raw and Finished Water	Not reported	NDDEQ published a 2020 and a 2021 survey report of North Dakota Statewide PFAS Presence/Absence results. The sampling effort in October of 2020 sought to determine if there was a PFAS presence in a representative portion of the state's public water supply. In 2021, sampling conducted as part of the third phase of the survey focused on drinking water sites not evaluated in the first two surveys.	Non-Targeted
Ohio (Ohio EPA, 2023)	December 2019 - December 2021	Ground Water and Surface Water - Raw and Finished Water	5	The Ohio EPA coordinated sampling of raw and finished drinking water from PWSs throughout the state. The EPA reviewed the finished water data available online through December 2021. During this timeframe, data were available from 1,479 PWSs.	Non-Targeted
Oregon (OHA-DWS, 2022)	2021 - July 2022	Ground Water and Surface Water - Finished Water	40.2 - 49.6	OHA conducted a PFAS drinking water monitoring project in 2021 at PWSs in Oregon identified as at risk due to their proximity to a known or suspected PFAS use or contamination site. The EPA reviewed the finished water data from more than 140 PWSs.	Targeted
Pennsylvania (PADEP, 2019)	2019	Ground Water and Surface Water - Finished Water	1.9	A PFAS Sampling Plan was developed to test PWSs across the state. Finished water data were collected for 87 PWSs in 2019.	Targeted
Pennsylvania (PADEP, 2021)	2020 - March 2021	Ground Water and Surface Water - Finished Water	1.7 - 4	Beginning in 2020 and running through March of 2021, finished water data were collected by more than 340 PWSs.	Targeted
South Carolina (SCDHEC, 2020; SCDHEC, 2023)	2017 - March 2023	Ground Water and Surface Water - Raw and Finished Water	2.1	The EPA reviewed PFAS sampling results collected by the South Carolina Bureau of Water for community drinking water systems . Data were available from 300 PWSs.	Non-Targeted
Tennessee (TDEC, 2023)	2019	Surface Water - Raw and Finished Water	Not reported	In 2019, Metro Water Services conducted a voluntary sampling of Nashville's drinking water systems for PFAS. Their stated goal was to go above and beyond current federal and state monitoring requirements to understand the potential presence of PFAS in Nashville's drinking water.	Non-Targeted
Vermont (VT DEC, 2023)	2019 -April 2023	Ground Water and Surface Water - Raw, Finished, and Unknown Water	2	The Vermont Water Supply Rule required all CWSs and NTNCWSs to sample for PFAS. The EPA reviewed finished water data available online from July 2019 - April 2023 from approximately 560 PWSs. Sampling in Vermont is ongoing.	Non-Targeted

State (Reference)	Date Range	Type of Water Tested	Reporting Threshold (ppt)	Notes on Coverage	Survey Type
Virginia (VDH ODW, 2021)	2021	Ground Water and Surface Water - Raw and Finished Water	3.5	The Virginia ODW, in conjunction with VA PFAS work group, designed the sample study to prioritize sites for measuring PFAS concentrations in drinking water and major sources of water and generate statewide occurrence data.	Targeted / Non-Targeted
Wisconsin (WI DNR, 2023)	2022 - April 2023	Ground Water and Surface Water - Raw, Finished, and Unknown Water	Not reported	The EPA reviewed the finished water data available online from 2022 - 2023. Data were available from nearly 250 PWSs. Sampling in Wisconsin is ongoing.	Non-Targeted

A summary of state reported monitoring data from PWSs for PFBS is presented in Exhibit A-8 through Exhibit A-10. As noted above, some of the monitoring data from each state are limited and may not be representative of occurrence in the state. In addition, states have varying reporting thresholds, as indicated in the first column of Exhibit A-8. For states with available reporting thresholds, only detected concentrations greater than the reporting thresholds were counted as detections. For states that did not provide reporting thresholds, the EPA included all detected concentrations reported in the count of detections. Overall, state reported detected concentrations ranged from 0.22 ppt (North Carolina) to 720 ppt (Alabama). Note that for a small number of systems, population served information could not be identified. These systems were included in the counts and analysis presented in Exhibit A-10; however, no associated population served was included in the counts and analysis presented in Exhibit A-10.

Exhibit A-8: PFBS State Reported Drinking Water Occurrence Data - Summary of Finished Water Samples

State (Reporting Threshold)	Source Water Type	Total Number of Samples	All Detections	
			Number	Percent
Alabama[1] (Not reported)	Ground Water	--	29	--
	Surface Water	--	171	--
	Total	**--**	**200**	**--**
Arizona (1.6 - 2 ppt)	Ground Water	23	15	65.22%
	Surface Water	2	0	0.00%
	Total	**25**	**15**	**60.00%**
California (0.002 - 90 ppt)	Ground Water	1,882	448	23.80%
	Surface Water	3,950	735	18.61%
	Unknown	4	0	0.00%
	Total	**5,836**	**1,183**	**20.27%**
Colorado (2013-2017) (2 - 90 ppt)	Distribution (Finished)	94	26	27.66%
	Surface water (Finished)	11	0	0.00%
	Total	**105**	**26**	**24.76%**
Colorado (2020) (1.6 - 2.4 ppt)	Ground Water	339	43	12.68%
	Surface Water	244	21	8.61%
	Total	**583**	**64**	**10.98%**
Georgia (18 ppt)	Ground Water	0	0	0.00%
	Surface Water	2	0	0.00%
	Total	**2**	**0**	**0.00%**
Idaho (0.5 - 1 ppt)	Ground Water	18	1	5.56%
	Surface Water	0	0	0.00%
	Total	**18**	**1**	**5.56%**
Illinois (1.7 - 5 ppt)	Ground Water	1,823	298	16.35%
	Surface Water	302	75	24.83%
	Total	**2,125**	**373**	**17.55%**

State (Reporting Threshold)	Source Water Type	Total Number of Samples	All Detections	
			Number	Percent
Indiana (2 ppt)	Ground Water	422	25	5.92%
	Surface Water	59	2	3.39%
	Total	**481**	**27**	**5.61%**
Iowa (1.7 - 3 ppt)	Ground Water	153	40	26.14%
	Surface Water	64	14	21.88%
	Total	**217**	**54**	**24.88%**
Kentucky (3.96 ppt)	Ground Water	33	4	12.12%
	Surface Water	48	6	12.50%
	Total	**81**	**10**	**12.35%**
Maine (PFAS Task Force)[2] (1.78 - 90 ppt)	Ground Water	9	0	0.00%
	Surface Water	3	0	0.00%
	Unknown	75	3	4.00%
	Total	**87**	**3**	**3.45%**
Maine (Compliance) (2 ppt)	Ground Water	640	70	10.94%
	Surface Water	62	1	1.61%
	Total	**702**	**71**	**10.11%**
Maryland (Phase 1) (1 ppt)	Ground Water	70	45	64.29%
	Surface Water	76	47	61.84%
	Total	**146**	**92**	**63.01%**
Maryland (Phase 2) (1 ppt)	Ground Water	9	2	22.22%
	Surface Water	0	0	0.00%
	Total	**9**	**2**	**22.22%**
Maryland (Phase 3) (1 ppt)	Ground Water	88	17	19.32%
	Surface Water	0	0	0.00%
	Total	**88**	**17**	**19.32%**
Massachusetts (0.26 - 42 ppt)	Ground Water	7,013	2,734	38.98%
	Surface Water	2,014	863	42.85%
	Total	**9,027**	**3,597**	**39.85%**
Michigan (2 ppt)	Ground Water	10,007	775	7.74%
	Surface Water	519	20	3.85%
	Unknown	164	6	3.66%
	Total	**10,690**	**801**	**7.49%**
Missouri (Not reported)	Ground Water	192	12	6.25%
	Surface Water	22	1	4.55%
	Total	**214**	**13**	**6.07%**
New Hampshire (Not reported)	Ground Water	539	184	34.14%
	Surface Water	60	8	13.33%
	Total	**599**	**192**	**32.05%**
New Jersey (0.43 - 44 ppt)	Ground Water	5,345	1,529	28.61%
	Surface Water	1,770	471	26.61%

State (Reporting Threshold)	Source Water Type	Total Number of Samples	All Detections	
			Number	Percent
	Unknown	3	0	0.00%
	Total	**7,118**	**2,000**	**28.10%**
New Mexico (Not reported)	Ground Water	2	1	50.00%
	Surface Water	0	0	0.00%
	Total	**2**	**1**	**50.00%**
New York (0.000000001-1,790 ppt)	Ground Water	1,843	565	30.66%
	Surface Water	400	83	20.75%
	Unknown	10	0	0.00%
	Total	**2,253**	**648**	**28.76%**
North Carolina[1] (Not Reported)	Unknown	--	372	--
	Total	**--**	**372**	**--**
North Dakota (2020) (Not reported)	Ground Water	42	0	0.00%
	Surface Water	9	0	0.00%
	Total	**51**	**0**	**0.00%**
North Dakota (2021) (Not reported)	Ground Water	56	8	14.29%
	Surface Water	7	2	28.57%
	Total	**63**	**10**	**15.87%**
Ohio (5 ppt)	Ground Water	1,775	93	5.24%
	Surface Water	170	5	2.94%
	Total	**1,945**	**98**	**5.04%**
Oregon (40.2 - 49.6 ppt)	Ground Water	131	0	0.00%
	Surface Water	29	0	0.00%
	Total	**160**	**0**	**0.00%**
Pennsylvania (2019) (1.9 ppt)	Ground Water	75	12	16.00%
	Surface Water	21	8	38.10%
	Total	**96**	**20**	**20.83%**
Pennsylvania (2021) (1.7 - 4 ppt)	Ground Water	314	46	14.65%
	Surface Water	98	20	20.41%
	Total	**412**	**66**	**16.02%**
South Carolina (2.1 ppt)	Ground Water	572	48	8.39%
	Surface Water	194	57	29.38%
	Total	**766**	**105**	**13.71%**
Tennessee (Not reported)	Ground Water	0	0	0.00%
	Surface Water	2	0	0.00%
	Total	**2**	**0**	**0.00%**
Vermont (2 ppt)	Ground Water	1,457	108	7.41%
	Surface Water	102	3	2.94%
	Total	**1,559**	**111**	**7.12%**
Virginia (3.5 ppt)	Ground Water	5	0	0.00%
	Surface Water	36	3	8.33%

State (Reporting Threshold)	Source Water Type	Total Number of Samples	All Detections	
			Number	Percent
	Total	**41**	**3**	**7.32%**
Wisconsin (Not reported)	Ground Water	728	193	26.51%
	Surface Water	54	26	48.15%
	Total	**782**	**219**	**28.01%**

[1] Only reported detections were available in this state's dataset.
[2] Reported data from Maine may include results from public and private finished drinking water sources. Based on available state data information, the EPA could not verify PWSIDs for all included samples.

Exhibit A-9: PFBS State Reported Drinking Water Occurrence Data - Summary of Detected Concentrations

State (Reporting Threshold)	Source Water Type	Concentration Value of Detections (ppt)				
		Minimum	Median	90th Percentile	99th Percentile	Maximum
Alabama[1] (Not reported)	Ground Water	1.1	3.80	5.30	17.4	22
	Surface Water	0.7	4.50	81.0	154	720
	Total	**0.7**	**4.30**	**71.5**	**131**	**720**
Arizona (1.6 - 2 ppt)	Ground Water	1.6	3.70	9.88	13.4	14
	Surface Water	--	--	--	--	--
	Total	**1.6**	**3.70**	**9.88**	**13.4**	**14**
California (0.002 - 90 ppt)	Ground Water	1	4.90	10.0	31.5	45
	Surface Water	1.7	3.60	15.0	36.0	47
	Unknown	--	--	--	--	--
	Total	**1**	**4.10**	**12.9**	**35.2**	**47**
Colorado (2013-2017) (2 - 90 ppt)	Distribution (Finished)	2.9	46.5	86.0	138	150
	Surface water (Finished)	--	--	--	--	--
	Total	**2.9**	**46.5**	**86.0**	**138**	**150**
Colorado (2020) (1.6 - 2.4 ppt)	Ground Water	1.8	3.70	7.72	9.54	10
	Surface Water	1.7	3.60	9.00	14.7	16
	Total	**1.7**	**3.65**	**7.87**	**12.2**	**16**
Georgia (18 ppt)	Ground Water	--	--	--	--	--
	Surface Water	--	--	--	--	--
	Total	**--**	**--**	**--**	**--**	**--**
Idaho (0.5 - 1 ppt)	Ground Water	2.47	2.47	2.47	2.47	2.47
	Surface Water	--	--	--	--	--
	Total	**2.47**	**2.47**	**2.47**	**2.47**	**2.47**
Illinois (1.7 - 5 ppt)	Ground Water	1.8	3.50	9.48	34.0	37
	Surface Water	2.1	2.70	4.08	6.20	6.2
	Total	**1.8**	**3.30**	**8.46**	**25.4**	**37**

State (Reporting Threshold)	Source Water Type	Concentration Value of Detections (ppt)				
		Minimum	Median	90th Percentile	99th Percentile	Maximum
Indiana (2 ppt)	Ground Water	2	3.20	6.14	12.4	14
	Surface Water	2.3	7.75	12.1	13.1	13.2
	Total	**2**	**3.20**	**7.10**	**13.8**	**14**
Iowa (1.7 - 3 ppt)	Ground Water	2	6.35	14.9	46.2	47
	Surface Water	1.9	4.95	24.7	27.6	28
	Total	**1.9**	**6.10**	**24.7**	**45.9**	**47**
Kentucky (3.96 ppt)	Ground Water	1.39	1.99	6.62	8.36	8.55
	Surface Water	1.35	1.85	2.62	2.72	2.73
	Total	**1.35**	**1.99**	**3.31**	**8.03**	**8.55**
Maine (PFAS Task Force)[2] (1.78 - 90 ppt)	Ground Water	--	--	--	--	--
	Surface Water	--	--	--	--	--
	Unknown	19	44	44	44	44
	Total	**19**	**44**	**44**	**44**	**44**
Maine (Compliance) (2 ppt)	Ground Water	2.01	3.71	9.78	34.9	72.8
	Surface Water	2.8	2.8	2.8	2.8	2.8
	Total	**2.01**	**3.70**	**9.72**	**34.4**	**72.8**
Maryland (Phase 1) (1 ppt)	Ground Water	1.08	3.59	8.97	18.7	21.29
	Surface Water	1.08	2.57	6.60	10.3	11.32
	Total	**1.08**	**2.77**	**7.63**	**15.9**	**21.29**
Maryland (Phase 2) (1 ppt)	Ground Water	3.32	5.68	7.56	7.98	8.03
	Surface Water	--	--	--	--	--
	Total	**3.32**	**5.68**	**7.56**	**7.98**	**8.03**
Maryland (Phase 3) (1 ppt)	Ground Water	1.22	3.31	10.2	12.7	12.9
	Surface Water	--	--	--	--	--
	Total	**1.22**	**3.31**	**10.2**	**12.7**	**12.9**
Massachusetts (0.26 - 42 ppt)	Ground Water	1.15	3.24	7.57	43.3	414
	Surface Water	1.68	2.80	5.34	9.04	11.1
	Total	**1.15**	**3.11**	**6.90**	**27.0**	**414**
Michigan (2 ppt)	Ground Water	2	3.80	15.0	53.0	110
	Surface Water	2	3.45	4.17	6.35	6.5
	Unknown	2	2.5	5	5	5
	Total	**2**	**3.70**	**15.0**	**52.0**	**110**
Minnesota (Not reported)	Ground Water	0.76	--	--	--	11
	Surface Water	--	--	--	--	--
	Total	**0.76**	**--**	**--**	**--**	**11**
Missouri (Not reported)	Ground Water	2	4.75	6.95	7.62	7.7
	Surface Water	2.3	2.3	2.3	2.3	2.3
	Total	**2**	**4.60**	**6.90**	**7.62**	**7.7**
New Hampshire	Ground Water	1.6	2.80	7.12	16.3	26.8

State (Reporting Threshold)	Source Water Type	Concentration Value of Detections (ppt)				
		Minimum	Median	90th Percentile	99th Percentile	Maximum
(Not reported)	Surface Water	1.7	2.78	17.3	18.1	18.2
	Total	**1.6**	**2.80**	**7.20**	**18.0**	**26.8**
New Jersey (0.43 - 44 ppt)	Ground Water	0.47	3.30	7.66	17.7	310
	Surface Water	0.68	2.80	5.30	11.2	18.8
	Unknown	--	--	--	--	--
	Total	**0.47**	**3.20**	**7.19**	**15.8**	**310**
New Mexico (Not reported)	Ground Water	4.1	4.1	4.1	4.1	4.1
	Surface Water	--	--	--	--	--
	Total	**4.1**	**4.1**	**4.1**	**4.1**	**4.1**
New York (0.000000001-1,790 ppt)	Ground Water	0.25	2.99	8.05	33.6	126
	Surface Water	0.36	1.97	4.58	9.76	12.1
	Unknown	--	--	--	--	--
	Total	**0.25**	**2.80**	**7.81**	**33.4**	**126**
North Carolina[1] (Not Reported)	Unknown	0.22	40.0	40.0	79.3	80
	Total	**0.22**	**40.0**	**40.0**	**79.3**	**80**
North Dakota (2020) (Not reported)	Ground Water	--	--	--	--	--
	Surface Water	--	--	--	--	--
	Total	**--**	**--**	**--**	**--**	**--**
North Dakota (2021) (Not reported)	Ground Water	0.499	0.741	1.46	1.51	1.51
	Surface Water	0.522	1.02	1.42	1.51	1.52
	Total	**0.499**	**0.741**	**1.51**	**1.52**	**1.52**
Ohio (5 ppt)	Ground Water	5.08	7.14	16.0	21.9	28.2
	Surface Water	5.1	117	165	183	185
	Total	**5.08**	**7.39**	**17.3**	**136**	**185**
Oregon (40.2 - 49.6 ppt)	Ground Water	--	--	--	--	--
	Surface Water	--	--	--	--	--
	Total	**--**	**--**	**--**	**--**	**--**
Pennsylvania (2019) (1.9 ppt)	Ground Water	2.2	3.10	6.93	7.6	7.7
	Surface Water	2	4.00	7.89	12.5	13
	Total	**2**	**3.75**	**7.25**	**12.0**	**13**
Pennsylvania (2021) (1.7 - 4 ppt)	Ground Water	1.7	4.40	14.9	49.2	64
	Surface Water	1.8	3.90	8.12	11.8	12
	Total	**1.7**	**4.15**	**10.4**	**42.6**	**64**
South Carolina (2.1 ppt)	Ground Water	2.1	4.00	7.45	12.1	14
	Surface Water	2.1	3.10	4.23	9.50	10
	Total	**2.1**	**3.20**	**6.28**	**10.0**	**14**
Tennessee (Not reported)	Ground Water	--	--	--	--	--
	Surface Water	--	--	--	--	--
	Total	**--**	**--**	**--**	**--**	**--**

State (Reporting Threshold)	Source Water Type	Concentration Value of Detections (ppt)				
		Minimum	Median	90th Percentile	99th Percentile	Maximum
Vermont (2 ppt)	Ground Water	2	3.17	6.18	17.8	19.2
	Surface Water	2.44	2.56	3.33	3.50	3.52
	Total	**2**	**3.14**	**6.18**	**17.8**	**19.2**
Virginia (3.5 ppt)	Ground Water	--	--	--	--	--
	Surface Water	4.2	4.80	5.44	5.58	5.6
	Total	**4.2**	**4.80**	**5.44**	**5.58**	**5.6**
Wisconsin (Not reported)	Ground Water	0.251	1.50	5.11	18.2	25.4
	Surface Water	0.32	0.400	0.785	2.61	3.2
	Total	**0.251**	**1.30**	**4.73**	**17.6**	**25.4**

Note: With limited exceptions, calculated concentration values (i.e., median, 90th percentile and 99th percentile concentrations) were rounded to three significant figures for consistent presentation across the datasets and may not indicate exact laboratory precision.
[1] Only reported detections were available in this state's dataset.
[2] Reported data from Maine may include results from public and private finished drinking water sources. Based on available state data information, the EPA could not verify PWSIDs for all included samples.

Exhibit A-10: PFBS State Reported Drinking Water Occurrence Data - Summary of Systems and Population Served by Systems with Finished Water Data

State (Reporting Threshold)	Source Water Type	Total Number of Systems	Systems with Detections		Total Population Served by Systems	Total Population Served by Systems with Detections	
			Number	Percent		Number	Percent
Alabama[1] (Not reported)	Ground Water	--	18	--	--	203,924	--
	Surface Water	--	54	--	--	2,437,360	--
	Total	**--**	**72**	**--**	**--**	**2,641,284**	**--**
Arizona (1.6 - 2 ppt)	Ground Water	5	2	40.00%	94,569	55,535	58.72%
	Surface Water	1	0	0.00%	50,001	0	0.00%
	Total	**6**	**2**	**33.33%**	**144,570**	**55,535**	**38.41%**
California (0.002 - 90 ppt)	Ground Water	43	12	27.91%	1,098,122	647,605	58.97%
	Surface Water	78	32	41.03%	13,500,188	4,468,482	33.10%
	Unknown	1	0	0.00%	0	0	0.00%
	Total	**122**	**44**	**36.07%**	**14,598,310**	**5,116,087**	**35.05%**
Colorado (2013 - 2017)[2] (2 - 90 ppt)	Distribution (Finished)	22	9	40.91%	--	--	--
	Surface water (Finished)	5	0	0.00%	--	--	--
	Total	**27**	**9**	**33.33%**	**--**	**--**	**--**
Colorado (2020) (1.6 - 2.4 ppt)	Ground Water	221	35	15.84%	261,162	91,478	35.03%
	Surface Water	176	18	10.23%	4,191,774	926,253	22.10%
	Total	**397**	**53**	**13.35%**	**4,452,936**	**1,017,731**	**22.86%**

State (Reporting Threshold)	Source Water Type	Total Number of Systems	Systems with Detections		Total Population Served by Systems	Total Population Served by Systems with Detections	
			Number	Percent		Number	Percent
Georgia (18 ppt)	Ground Water	0	0	0.00%	0	0	0.00%
	Surface Water	1	0	0.00%	9,993	0	0.00%
	Total	**1**	**0**	**0.00%**	**9,993**	**0**	**0.00%**
Idaho (0.5 - 1 ppt)	Ground Water	10	1	10.00%	81,985	150	0.18%
	Surface Water	0	0	0.00%	0	0	0.00%
	Total	**10**	**1**	**10.00%**	**81,985**	**150**	**0.18%**
Illinois (1.7 - 5 ppt)	Ground Water	899	66	7.34%	2,916,219	787,544	27.01%
	Surface Water	97	14	14.43%	4,628,949	823,327	17.79%
	Total	**996**	**80**	**8.03%**	**7,545,168**	**1,610,871**	**21.35%**
Indiana (2 ppt)	Ground Water	341	22	6.45%	545,838	53,136	9.73%
	Surface Water	31	2	6.45%	97,448	5,050	5.18%
	Total	**372**	**24**	**6.45%**	**643,286**	**58,186**	**9.05%**
Iowa (1.7 - 3 ppt)	Ground Water	90	12	13.33%	491,495	107,099	21.79%
	Surface Water	26	5	19.23%	987,522	338,155	34.24%
	Total	**116**	**17**	**14.66%**	**1,479,017**	**445,254**	**30.10%**
Kentucky (3.96 ppt)	Ground Water	30	4	13.33%	171,212	13,041	7.62%
	Surface Water	44	6	13.64%	1,922,023	433,845	22.57%
	Total	**74**	**10**	**13.51%**	**2,093,235**	**446,886**	**21.35%**
Maine (PFAS Task Force)[2,3] (1.78 - 90 ppt)	Ground Water	7	0	0.00%	3,995	0	0.00%
	Surface Water	1	0	0.00%	21,808	0	0.00%
	Unknown	10	3	30.00%	0	0	0.00%
	Total	**18**	**3**	**16.67%**	**25,803**	**0**	**0.00%**
Maine (Compliance) (2 ppt)	Ground Water	588	65	11.05%	274,216	34,345	12.52%
	Surface Water	53	1	1.89%	464,453	3,115	0.67%
	Total	**641**	**66**	**10.30%**	**738,669**	**37,460**	**5.07%**
Maine (All Systems)[2,4] (1.78 - 90 ppt)	Ground Water	588	65	11.05%	274,216	34,345	12.52%
	Surface Water	53	1	1.89%	464,453	3,115	0.67%
	Unknown	10	3	30.00%	0	0	0.00%
	Total	**651**	**69**	**10.60%**	**738,669**	**37,460**	**5.07%**
Maryland (Phase 1) (1 ppt)	Ground Water	30	16	53.33%	384,007	73,237	19.07%
	Surface Water	36	18	50.00%	4,059,154	3,834,319	94.46%
	Total	**66**	**34**	**51.52%**	**4,443,161**	**3,907,556**	**87.95%**
Maryland (Phase 2) (1 ppt)	Ground Water	6	2	33.33%	3,896	135	3.47%
	Surface Water	0	0	0.00%	0	0	0.00%
	Total	**6**	**2**	**33.33%**	**3,896**	**135**	**3.47%**
Maryland (Phase 3) (1 ppt)	Ground Water	63	8	12.70%	41,063	2,940	7.16%
	Surface Water	0	0	0.00%	0	0	0.00%
	Total	**63**	**8**	**12.70%**	**41,063**	**2,940**	**7.16%**

State (Reporting Threshold)	Source Water Type	Total Number of Systems	Systems with Detections		Total Population Served by Systems	Total Population Served by Systems with Detections	
			Number	Percent		Number	Percent
Maryland (All Systems)[4] (1 ppt)	Ground Water	99	26	26.26%	428,966	76,312	17.79%
	Surface Water	36	18	50.00%	4,059,154	3,834,319	94.46%
	Total	**135**	**44**	**32.59%**	**4,488,120**	**3,910,631**	**87.13%**
Massachusetts (0.26 - 42 ppt)	Ground Water	1,197	308	25.73%	1,828,117	1,200,412	65.66%
	Surface Water	122	59	48.36%	5,860,701	1,694,183	28.91%
	Total	**1,319**	**367**	**27.82%**	**7,688,818**	**2,894,595**	**37.65%**
Michigan[2] (2 ppt)	Ground Water	2,370	187	7.89%	1,945,734	500,134	25.70%
	Surface Water	84	6	7.14%	1,314,601	185,162	14.09%
	Unknown	54	4	7.41%	0	0	0.00%
	Total	**2,508**	**197**	**7.85%**	**3,260,335**	**685,296**	**21.02%**
Minnesota (Not reported)	Ground Water	561	60	10.7%	2,752,594	869,034	31.6%
	Surface Water	16	0	0.0%	1,106,268	0	0.0%
	Total	**577**	**60**	**10.4%**	**3,858,862**	**869,034**	**22.5%**
Missouri (Not reported)	Ground Water	95	6	6.32%	190,274	9,825	5.16%
	Surface Water	18	1	5.56%	405,045	1,000	0.25%
	Total	**113**	**7**	**6.19%**	**595,319**	**10,825**	**1.82%**
New Hampshire (Not reported)	Ground Water	223	87	39.01%	156,573	93,968	60.02%
	Surface Water	16	4	25.00%	393,475	45,090	11.46%
	Total	**239**	**91**	**38.08%**	**550,048**	**139,058**	**25.28%**
New Jersey (0.43 - 44 ppt)	Ground Water	599	200	33.39%	1,520,763	515,709	33.91%
	Surface Water	65	34	52.31%	4,783,734	3,728,587	77.94%
	Unknown	1	0	0.00%	0	0	0.00%
	Total	**665**	**234**	**35.19%**	**6,304,497**	**4,244,296**	**67.32%**
New Mexico[2] (Not reported)	Ground Water	2	1	50.00%	--	--	--
	Surface Water	0	0	0.00%	--	--	--
	Total	**2**	**1**	**50.00%**	**--**	**--**	**--**
New York (0.000000001-1,790 ppt)	Ground Water	570	221	38.77%	1,458,927	308,051	21.11%
	Surface Water	123	35	28.46%	2,850,536	792,304	27.79%
	Unknown	5	0	0.00%	1,024	0	0.00%
	Total	**698**	**256**	**36.68%**	**4,310,487**	**1,100,355**	**25.53%**
North Carolina[1,2] (Not Reported)	Unknown	--	5	--	--	--	--
	Total	**--**	**5**	**--**	**--**	**--**	**--**
North Dakota (2020) (Not reported)	Ground Water	41	0	0.00%	68,280	0	0.00%
	Surface Water	9	0	0.00%	57,469	0	0.00%
	Total	**50**	**0**	**0.00%**	**125,749**	**0**	**0.00%**
North Dakota (2021) (Not reported)	Ground Water	56	8	14.29%	113,623	69,449	61.12%
	Surface Water	7	2	28.57%	194,121	5,530	2.85%
	Total	**63**	**10**	**15.87%**	**307,744**	**74,979**	**24.36%**

State (Reporting Threshold)	Source Water Type	Total Number of Systems	Systems with Detections		Total Population Served by Systems	Total Population Served by Systems with Detections	
			Number	Percent		Number	Percent
North Dakota (All Systems)[4] (Not reported)	Ground Water	95	8	8.42%	181,514	69,449	38.26%
	Surface Water	16	2	12.50%	251,590	5,530	2.20%
	Total	**111**	**10**	**9.01%**	**433,104**	**74,979**	**17.31%**
Ohio (5 ppt)	Ground Water	1,372	34	2.48%	2,883,252	131,013	4.54%
	Surface Water	107	2	1.87%	6,215,644	7,600	0.12%
	Total	**1,479**	**36**	**2.43%**	**9,098,896**	**138,613**	**1.52%**
Oregon (40.2 - 49.6 ppt)	Ground Water	116	0	0.00%	114,194	0	0.00%
	Surface Water	27	0	0.00%	125,239	0	0.00%
	Total	**143**	**0**	**0.00%**	**239,433**	**0**	**0.00%**
Pennsylvania (2019) (1.9 ppt)	Ground Water	71	10	14.08%	162,825	56,541	34.73%
	Surface Water	16	6	37.50%	431,370	138,966	32.22%
	Total	**87**	**16**	**18.39%**	**594,195**	**195,507**	**32.90%**
Pennsylvania (2021) (1.7 - 4 ppt)	Ground Water	269	42	15.61%	471,651	161,556	34.25%
	Surface Water	73	14	19.18%	4,296,097	1,300,279	30.27%
	Total	**342**	**56**	**16.37%**	**4,767,748**	**1,461,835**	**30.66%**
Pennsylvania (All Systems)[4] (1.7 - 4 ppt)	Ground Water	270	45	16.67%	471,891	161,766	34.28%
	Surface Water	73	15	20.55%	4,296,097	1,351,279	31.45%
	Total	**343**	**60**	**17.49%**	**4,767,988**	**1,513,045**	**31.73%**
South Carolina (2.1 ppt)	Ground Water	234	38	16.24%	485,992	9,485	1.95%
	Surface Water	65	28	43.08%	2,489,351	1,322,343	53.12%
	Total	**299**	**66**	**22.07%**	**2,975,343**	**1,331,828**	**44.76%**
Tennessee (Not reported)	Ground Water	0	0	0.00%	0	0	0.00%
	Surface Water	1	0	0.00%	2,551	0	0.00%
	Total	**1**	**0**	**0.00%**	**2,551**	**0**	**0.00%**
Vermont (2 ppt)	Ground Water	526	32	6.08%	211,357	16,254	7.69%
	Surface Water	38	2	5.26%	174,473	4,598	2.64%
	Total	**564**	**34**	**6.03%**	**385,830**	**20,852**	**5.40%**
Virginia (3.5 ppt)	Ground Water	5	0	0.00%	2,975	0	0.00%
	Surface Water	20	3	15.00%	4,839,373	1,433,813	29.63%
	Total	**25**	**3**	**12.00%**	**4,842,348**	**1,433,813**	**29.61%**
Wisconsin (Not reported)	Ground Water	217	66	30.41%	1,514,437	1,002,980	66.23%
	Surface Water	22	15	68.18%	1,333,737	660,373	49.51%
	Total	**239**	**81**	**33.89%**	**2,848,174**	**1,663,353**	**58.40%**

[1] Only reported detections were available in this state's dataset.
[2] There were some instances where the population served by a system could not be identified. Thus, there are systems with detections but no associated population served by those systems with detections.
[3] Reported data from Maine may include results from public and private finished drinking water sources. Based on available state data information, the EPA could not verify PWSIDs for all included samples.
[4] The "All Systems" counts represent a summary of all unique systems across multiple sampling efforts within the state. For some states (e.g., CO), the EPA could not verify this number due to the sample site ID reporting.

A.2.1.3 Additional Secondary Source Water and Drinking Water Studies

Boone et al. (2019) measured 17 PFAS in both source and treated water from 25 DWTPs in the United States. The results indicated that only five of the sampling locations demonstrated a significant difference in PFAS concentration between the source and treated water. The median concentration of PFBS in source water was 1.12 ng/L and 1.17 ng/L in treated water. PFBS was detected in 96 percent of treated drinking water samples (Boone et al., 2019).

Post et al. (2013) re-evaluated PFOA, PFOS, and PFC occurrence data in drinking water systems throughout New Jersey to update previous PFAS research in the area from 2006. PFCs were found in 70 percent of PWSs sampled at concentrations ranging from 5-174 ng/L. PFBS was detected in 10 percent of samples at a maximum concentration of 6 ng/L.

McMahon et al. (2022) collected samples from aquifer systems in the eastern United States in 2019 to evaluate PFAS occurrence in ground water used as a source of drinking water. The study found that 14 of the 24 analyzed PFAS were detected in ground water samples. Furthermore, at least one PFAS was detected in 54 percent of the ground water samples and two or more PFAS were detected in 47 percent of the ground water samples. In the public supply and domestic wells, 60 and 20 percent of the samples, respectively, had at least one PFAS detection. Two or more PFAS were detected in 53 percent of the public-supply wells and 10 percent of domestic wells. The six PFAS outlined in the EPA's UCMR 3 program (i.e., PFBS, PFHxS, PFOS, PFHpA, PFOA, and PFNA) were the most detected PFAS in the study's samples. PFBS was detected in 22 percent of the 254 samples (McMahon et al., 2022).

As part of a joint study by the EPA and USGS to assess human exposure to contaminants of emerging concern, water samples were collected from 25 DWTPs in 24 states (Glassmeyer et al., 2017). Participation in the study was voluntary, and candidate locations were selected based on nomination by the EPA and USGS regional personnel and DWTP self-nomination as well as consideration of high wastewater contribution and the availability of pharmaceutical concentration data. Final sample locations were chosen to represent a wide range of geography, diversity in disinfectant type used, and a range of production volumes. Phase I of the study (2007) analyzed a subset of contaminants and sites to test experimental design; PFBS was not included in Phase 1. During Phase II of the study (2010-2012), samples were collected from ground water and surface water sources and treated drinking water from 25 DWTPs and analyzed for PFBS occurrence. The LCMRL for PFBS was equal to 0.032 ng/L. PFBS was detected in 96 percent of the 25 source water samples and 96 percent of the 25 treated drinking water samples. The maximum detected concentrations in source water and treated water were 11.1 ng/L and 11.9 ng/L, respectively.

Reyes (2021) conducted a ground water-quality study to describe the occurrence and distribution of PFAS in the Columbia aquifer public water-supply wells in the Delaware Coastal Plain region in 2018. One or more PFAS were detected in 16 of the sampled wells with as many as 8 different PFAS detected in a single sample. PFBS was detected in 6 of the 30 public water-supply wells sampled in the study. The maximum PFBS concentration detected was 100 ng/L.

A.2.2 Other Data

A.2.2.1 Department of Defense (DoD) Drinking Water Sampling

The DoD conducted sampling of off-base drinking water located in "covered areas" (i.e., areas that are adjacent to and down gradient from a military installation) to identify potential impacts of PFAS resulting from DoD activities. Sampling was conducted for multiple PFAS, including PFBS. The EPA downloaded available DoD off-base sampling results in September 2023.

The EPA summarized off-base sampling results for PFBS collected "post treatment" from drinking water systems and private wells located in covered areas adjacent to 47 installations located in 22 states. Detected concentrations ranged from an estimated concentration of 0.18 ng/L to 476 ng/L. Sampling was conducted utilizing multiple analytical methods including EPA methods 533, 537, 537.1, 1633, and DoD Quality Systems Manual Table B-15 (DoD, 2023a). Results are based on DLs which vary between both sampling sites and across different PFAS. Results for PFBS are presented Exhibit A-11.

Exhibit A-11: Summary of PFBS Drinking Water Sampling Results Collected Post-Treatment from Department of Defense Off-Base "Covered Areas"

State	Installation Name	Sampling Dates	Analysis Method	# Samples	# Detections	% Detections	Range of Detections (ng/L)
AK	Eielson AFB	11/3/2022	537	1	0	0.00%	NA
AZ	Luke AFB	3/31/2022	QSM_B15	2	0	0.00%	NA
AZ	YUMA AZ MCAS	5/26/2023	533	1	0	0.00%	NA
AR	Little Rock AFB	5/5/2022	537	3	2	66.67%	9.9 - 10.2
AR	Little Rock AFB	6/16/2022 - 3/22/2023	QSM_B15	6	0	0.00%	NA
CA	Castle AFB	7/5/2022 - 4/5/2023	537	26	4	15.38%	0.331 (est) - 2.41
CA	Castle AFB	11/17/2021 - 1/11/2022	QSM_B15	12	2	16.67%	1.05 (est) - 1.6 (est)
CA	George AFB	3/23/2023 - 4/20/2023	1633	3	0	0.00%	NA
CA	March AFB	1/3/2023 - 4/10/2023	533	3	2	66.67%	6.9 - 13
CA	March AFB	1/3/2022 - 12/1/2022	537.1	11	7	63.64%	4 - 35
CA	March AFB	9/1/2022	QSM_B15	1	1	100.00%	10
CA	Mather AFB	7/28/2022	537	1	1	100.00%	1.4 (est)
CA	Mather AFB	1/27/2022 - 4/26/2022	QSM_B15	3	0	0.00%	NA
CA	Travis AFB	1/25/2022 - 1/16/2023	QSM_B15	19	0	0.00%	NA
CO	Peterson Space Force Base	12/14/2021 - 2/7/2023	537.1	8	0	0.00%	NA
CO	Peterson Space Force Base	3/1/2022 - 9/14/2022	QSM_B15	16	0	0.00%	NA
DE	Dover AFB	1/22/2022 - 10/25/2022	QSM_B15	10	0	0.00%	NA
FL	Homestead Air Reserve Base	2/21/2022 - 3/30/2023	QSM_B15	13	0	0.00%	NA
FL	WHITING FLD FL NAS	9/1/2022	537.1	2	0	0.00%	NA
IL	Scott AFB	3/22/2022 - 3/28/2023	QSM_B15	3	0	0.00%	NA
ME	Loring AFB	7/25/2022	QSM_B15	1	0	0.00%	NA
ME	NCTAMSLANT DET CUTLER	4/20/2022 - 12/6/2022	537.1	66	2	3.03%	10.4 (est) - 17.2 (est)
MA	Otis ANG (Joint Base Cape Cod - Massachusetts Military Reservation)	2/28/2022 - 11/22/2022	QSM_B15	11	6	54.55%	0.33 (est) - 1.7 (est)
MI	KI Sawyer AFB	7/13/2022	QSM_B15	2	0	0.00%	NA
MT	Great Falls International Airport	6/15/2022 - 7/7/2022	537	3	0	0.00%	NA
NH	Pease AFB	9/22/2021 - 3/30/2023	QSM_B15	16	7	43.75%	1.7 (est) - 13
NJ	Joint Base McGuire-Dix-Lakehurst	3/3/2022 - 5/25/2022	QSM_B15	2	0	0.00%	NA
NM	Cannon AFB	11/11/2021 - 12/13/2021	QSM_B15	2	0	0.00%	NA

State	Installation Name	Sampling Dates	Analysis Method	# Samples	# Detections	% Detections	Range of Detections (ng/L)
NY	Plattsburgh AFB	5/20/2022 - 8/10/2022	537	8	0	0.00%	NA
NY	Plattsburgh AFB	11/18/2021 - 9/15/2022	537.1	16	0	0.00%	NA
NY	Plattsburgh AFB	11/29/2021 - 6/27/2023	QSM_B15	15	2	13.33%	1 (est) - 1 (est)
OK	Tinker AFB	2/2/2023	QSM_B15	3	0	0.00%	NA
RI	NAVAL AUX LANDING FIELD	5/19/2022	537.1	2	0	0.00%	NA
RI	NAVAL AUX LANDING FIELD	10/17/2022 - 2/28/2023	QSM_B15	31	22	70.97%	0.326 (est) - 13.4
SD	Ellsworth AFB	3/14/2022	537	1	0	0.00%	NA
SD	Ellsworth AFB	6/9/2022 - 9/7/2022	537.1	2	0	0.00%	NA
SD	Ellsworth AFB	2/7/2022 - 6/23/2022	QSM_B15	36	4	11.11%	20.7 - 273
TX	Goodfellow AFB	8/18/2022 - 11/15/2022	537	11	0	0.00%	NA
TX	Goodfellow AFB	12/6/2022 - 4/27/2023	QSM_B15	28	1	3.57%	476
TX	Reese AFB	9/14/2022 - 6/13/2023	1633	504	27	5.36%	0.52 (est) - 24.8
TX	Reese AFB	9/28/2021 - 8/29/2022	QSM_B15	839	39	4.65%	2 (est) - 71.3
VA	OCEANA VA NAS	10/19/2022 - 4/14/2023	537.1	13	0	0.00%	NA
WA	BREMERTON WA NAVBASE	10/11/2022 - 7/21/2023	537.1	3	2	66.67%	11 - 11.3
WA	Fairchild AFB	9/19/2022 - 9/27/2022	537	87	2	2.30%	7 (est) - 14.1
WA	Fairchild AFB	2/20/2023 - 3/6/2023	537.1	87	2	2.30%	0.18 (est) - 0.2 (est)
WA	Fairchild AFB	1/31/2022 - 7/21/2022	QSM_B15	187	5	2.67%	3 (est) - 5.5 (est)
WA	WHIDBEY IS WA NAS	4/21/2022 - 4/20/2023	537.1	11	2	18.18%	9.14 - 12.7

Source: DOD, 2023a

A.2.3 Occurrence in Ambient Water

Lakes, rivers, and aquifers are the ambient sources of most drinking water. Contaminant occurrence in ambient water provides information on the potential for contaminants to adversely affect drinking water supplies. Occurrence data for PFBS in ambient water are available from the USGS NWIS database and the EPA's legacy STORET data available through the WQP.

A.2.3.1 National Water Information System (NWIS) Data

The NWIS is the Nation's principal repository of water resources data USGS collects from more than 1.9 million sites (USGS, 2023). NWIS-Web is the general online interface to the USGS NWIS database. Discrete water-sample and time-series data are available from sites in all 50 States, including 5 million water samples with 90 million water-quality results. All USGS water quality and flow data are stored in NWIS, including site characteristics, streamflow, ground water level, precipitation, and chemical analyses of water, sediment, and biological media, though not all parameters are available for every site. NWIS houses the NAWQA data and includes other USGS data from unspecified projects. NWIS contains many more samples at many more sites than the NAWQA Program. Although NWIS is comprised of primarily ambient water data, some finished drinking water data are included as well. This section presents analyses of non-NAWQA data in NWIS, downloaded from the WQP in November 2023 (WQP, 2023).

The results of the non-NAWQA NWIS PFBS analysis are presented in Exhibit A-12. NWIS data for PFBS were listed under the characteristic name of "Perfluorobutanesulfonate." PFBS was detected in approximately 47 percent of samples (1,385 out of 2,952 samples) and at approximately 38 percent of sites (676 out of 1,759 sites). The median concentration based on detections was equal to 3.60 ng/L. (Note that the NWIS data are presented as downloaded; potential outliers were not evaluated or excluded from the analysis.)

Exhibit A-12: PFBS NWIS Data

Site Type	Detection Frequency (detections are results ≥ reporting level)				Concentration Values (of detections, in ng/L)				
	No. of Samples	No. of Samples with Detections	No. of Sites	No. of Sites with Detections	Minimum	Median	90th Percentile	99th Percentile	Maximum
Ground Water	1,344	321	1,233	315	0	2.50	10.0	64.4	370
Surface Water	1,608	1,064	526	361	0	3.82	12.0	87.1	460
All Sites	**2,952**	**1,385**	**1,759**	**676**	**0**	**3.60**	**12.0**	**86.8**	**460**

Source: WQP, 2023

A.2.3.2 Storage and Retrieval (STORET) Data / Water Quality Portal (WQP)

From its launch in 1999 until it was decommissioned in June 2018, the EPA's STORET Data Warehouse was collaboratively populated with raw biological, chemical, and physical data from surface water and ground water sampling by federal, state and local agencies, Native American tribes, volunteer groups,

academics, and others. Legacy STORET data are accessible through the WQP: https://www.waterqualitydata.us/portal/.

STORET data are from monitoring locations in all 50 states as well as multiple territories and jurisdictions of the United States. Most data are from ambient waters, but in some cases finished drinking water data are included as well. STORET's data quality limitations include variations in the extent of national coverage and data completeness from parameter to parameter. Data may have been collected as part of targeted, rather than randomized, monitoring.

This section presents analyses of STORET data, downloaded from the WQP in November 2023 (WQP, 2023). The EPA reviewed STORET ground water data from wells and surface water data from lakes, rivers/streams, and reservoirs (WQP, 2023). STORET data for PFBS were listed under the characteristic name of "1-Butanesulfonic acid, 1,1,2,2,3,3,4,4,4-nonafluoro-, potassium salt (1:1)", "Perfluorobutanesulfonate", and "Perfluorobutanesulfonic acid." The results of the STORET analysis for PFBS are presented in Exhibit A-13 and Exhibit A-14. Nearly 900 PFBS samples were available for analysis. These PFBS samples were collected between 2006 and 2023. Of the 628 sites sampled, approximately 76 percent reported detections of PFBS. Detected concentrations ranged from 0 to 68 ng/L. (Note: A minimum value of zero could represent a detection that was entered into the database as a non-numerical value (e.g., "Present").)

Exhibit A-13: PFBS STORET Data - Summary of Detected Concentrations

Source Water Type	Concentration Value of Detections (ng/L)			
	Minimum[1]	Median	90th Percentile	Maximum
Ground Water	0	0	0	50
Surface Water	0.93	2.05	61.2	68
Unknown	0	0	2.09	4.25
Total	**0**	**0**	**0**	**68**

Source: WQP, 2023
[1]A minimum value of zero may represent a detection that was entered into the database as a non-numerical value (e.g., "Present").

Exhibit A-14: PFBS STORET Data - Summary of Samples and Sites

Source Water Type	Total Number of Samples	Samples with Detections		Total Number of Sites	Sites with Detections	
		Number	Percent		Number	Percent
Ground Water	729	654	89.71%	495	450	90.91%
Surface Water	88	16	18.18%	73	11	15.07%
Unknown	76	21	27.63%	60	16	26.67%
Total	**893**	**691**	**77.38%**	**628**	**477**	**75.96%**

Source: WQP, 2023

A.3 Analytical Methods

The EPA has published two analytical methods that are available for the analysis of PFBS and other PFAS in drinking water. The performance metrics that are presented, including the DL, LCMRL, mean recoveries and RSDs are specific to PFBS for each of the listed analytical methods. Ranges of mean recoveries and RSDs are presented for the matrices listed; data from holding time studies are not included since these studies are designed to demonstrate a degradation in method performance over time and thus are not indicative of method performance that should be observed when holding times are not exceeded:

- EPA Method 537.1, Version 2.0, *Determination of Selected Per- and Polyfluorinated Alkyl Substances in Drinking Water by Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometry (LC/MS/MS)*. The DL and LCMRL generated by the laboratory that developed the method are 1.8 ng/L and 6.3 ng/L, respectively. Mean recoveries in fortified reagent water, tap water from a ground water source (TOC = 0.53 mg/L and hardness = 377 mg/L), tap water from a surface water source (TOC = 2.4 mg/L and hardness = 103 mg/L), and tap water from a private well (TOC = 0.56 mg/L and hardness = 394 mg/L) range from 85.1 to 104%, with RSDs of 2.1 to 7.1% (USEPA, 2020d).
- EPA Method 533, *Determination of Per- and Polyfluoroalkyl Substances in Drinking Water by Isotope Dilution Anion Exchange Solid Phase Extraction and Liquid Chromatography / Tandem Mass Spectrometry*. The LCMRL generated by the laboratory that developed the method is 3.5 ng/L (DLs were not calculated). Mean recoveries (excluding ^{13}C isotope analogue data) in fortified reagent water, finished drinking water from a ground water source (hardness = 320 mg/L, pH = 7.88 at 17° C, free Cl_2 = 0.64 mg/L, and total Cl_2 = 0.74 mg/L) and clarified surface water (prior to GAC treatment and chlorinated in the laboratory; pH = 8.1 at 20 °C, free Cl_2 = 0.98 mg/L, total Cl_2 = 1.31 mg/L. and TOC = 3.8 mg/L) range from 96.2 to 111%, with RSDs of 2.7 to 17% (USEPA, 2019b).

Laboratories participating in UCMR 3 were required to use EPA Method 537 and were required to report PFBS values at or above the EPA-defined MRL of 90 ng/L (77 FR 26072; USEPA, 2012b). The MRL was set based on the capability of multiple laboratories at the time. The EPA Method 537.1 was originally published in November 2018 as Version 1.0 as a more sensitive update to EPA Method 537 (with a slightly expanded target analyte list). Version 2.0 was published in March 2020 and contains minor editorial changes to Version 1.0. Use of EPA Method 537.1 is preferable to use of EPA Method 537 (it may not be feasible to reliably quantitate down to health levels of concern for certain PFAS when using EPA Method 537).