

Silent Spring Institute PFAS water quality and health research

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SILENT SPRING INSTITUTE
Researching the Environment and Women's Health



PFAS-REACH
PFAS Research, Education,
and Action for Community Health



Sources, Transport, Exposure & Effects of PFASs
UNIVERSITY OF RHODE ISLAND SUPERFUND RESEARCH PROGRAM

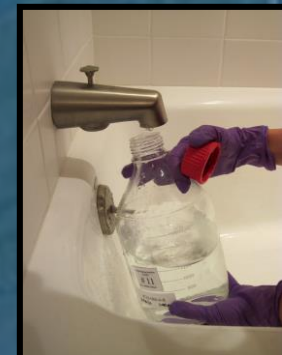
Outline

- PFAS in Cape Cod drinking water
- PFAS-REACH children's health study and PFAS Exchange online resource center
- Massachusetts PFAS and Your Health Study



Silent Spring Institute research on Cape Cod water quality

- EDCs in Cape wastewater and groundwater
Rudel et al. 1998. *Environ Sci Technol.* 32(7):861-9.
- EDC transport in Cape groundwater
Swartz et al. 2006. *Environ Sci Technol.* 40(16):4894-4902.
- Pharmaceutical and hormones in Cape Cod Ponds
Standley et al. 2008. *Environ Toxicol Chem.* 27(12): 2457-68
- CECs in Cape Cod public and private drinking water wells (including PFAS)
Schaidler et al. 2014 & 2016. *Sci Tot Env.* 468:384-93. *Sci Tot Env.* 547:470-81
- Systematic review of CECs in septic systems.
Schaidler et al. 2017. *Env Sci Technol.* 51(13):7304-17.



Silent Spring Institute's PFAS research

STEEP

- Studying how PFAS move in environment, exposures, and related health effects
- Measuring PFAS levels in Cape Cod private wells
- Community events and engagement

PFAS-REACH

- Studying how PFAS may affect immune system function in preschool age children
- PFAS Exchange online resource center
- Community experience interviews

MA PFAS and Your Health Study

- One of seven projects in a larger study funded by CDC/ATSDR
- Studying health effects from PFAS in drinking water in residents of Hyannis and Ayer



Potential sources of PFAS in Cape Cod groundwater

- AFFF firefighting foam
- Septic systems
- Sewage treatment plants
- Landfills
- Land-applied sludge



Silent Spring first found PFAS in public wells on Cape Cod in 2010 (Schaider et al. 2014. *Sci Tot Env*)

20 public wells in 9 districts tested for PFOS and PFOA

PFOS detected above 1 ppt in 8 of 20 wells

- Up to 97 ppt (Hyannis)

PFOA detected above 10 ppt in 2 of 20 wells

- Up to 22 ppt (Hyannis)

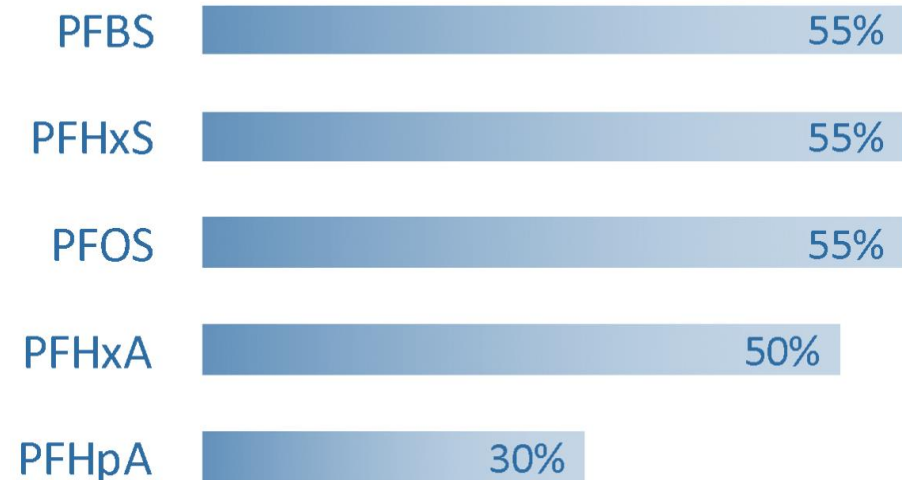
Water Department	Results for 20 wells		
Barnstable FD	●	●	
Brewster	●	●	
Buzzards Bay	●	●	
Chatham	●	●	
C-O-MM	●	●	●
Cotuit	●	●	
Dennis	●	●	
Falmouth	●	●	
Hyannis	●	●	●

Silent Spring's 2011 private wells study

(Schaider et al. 2016. *Sci Tot Env*)

- 20 wells in 7 towns
- Tested for 14 PFAS
- 70% of wells had at least 1 PFAS
- Wells with higher nitrate tended to have higher PFAS
- Septic systems are a likely source, additional sources unknown

Long-chain (older) and short-chain (newer) PFASs commonly detected



Predictors of PFAS and other emerging contaminants in private wells

	Nitrate	Boron	Resid. density	Ace-sulfame	Well depth
Number of detected CECs	0.59*	0.81***	0.48*	0.88***	-0.68**
Total conc. of pharmaceuticals	0.34	0.59**	0.43•	0.69***	-0.51*
Total conc. of PFAS	0.48*	0.75***	0.34	0.83***	-0.64**

Correlations between PFAS and wastewater indicators suggest septic systems are an important source

URI STEEP Superfund Research Program

(Sources, Transport, Exposure and Effects of PFAS)

Community Engagement Core

- Study of PFAS in private wells throughout Cape Cod
 - First round (2018): 101 wells
 - Sampling will resume Summer 2021
- Community engagement activities
 - Events, film screenings, webinars

STEEP partners

- University of Rhode Island (lead)
- Harvard School of Public Health
- Silent Spring Institute
- Local partners on Cape Cod
 - Mass. Breast Cancer Coalition
 - Sierra Club Cape Cod Group

STEEP Private wells study team

Project leaders:

- Laurel Schaidler, Silent Spring Institute
- Alyson McCann, University of Rhode Island

Harvard University:

- Elsie Sunderland, Heidi Pickard, Prentiss Balcom

Silent Spring Institute:

- Amanda Hernandez, Katie Boronow, Erik Haugsjaa

University of Rhode Island:

- Rainer Lohmann, Jitka Becanova, Lisa Philo, Amy Wengefeld

Massachusetts Breast Cancer Coalition:

- Cheryl Osimo

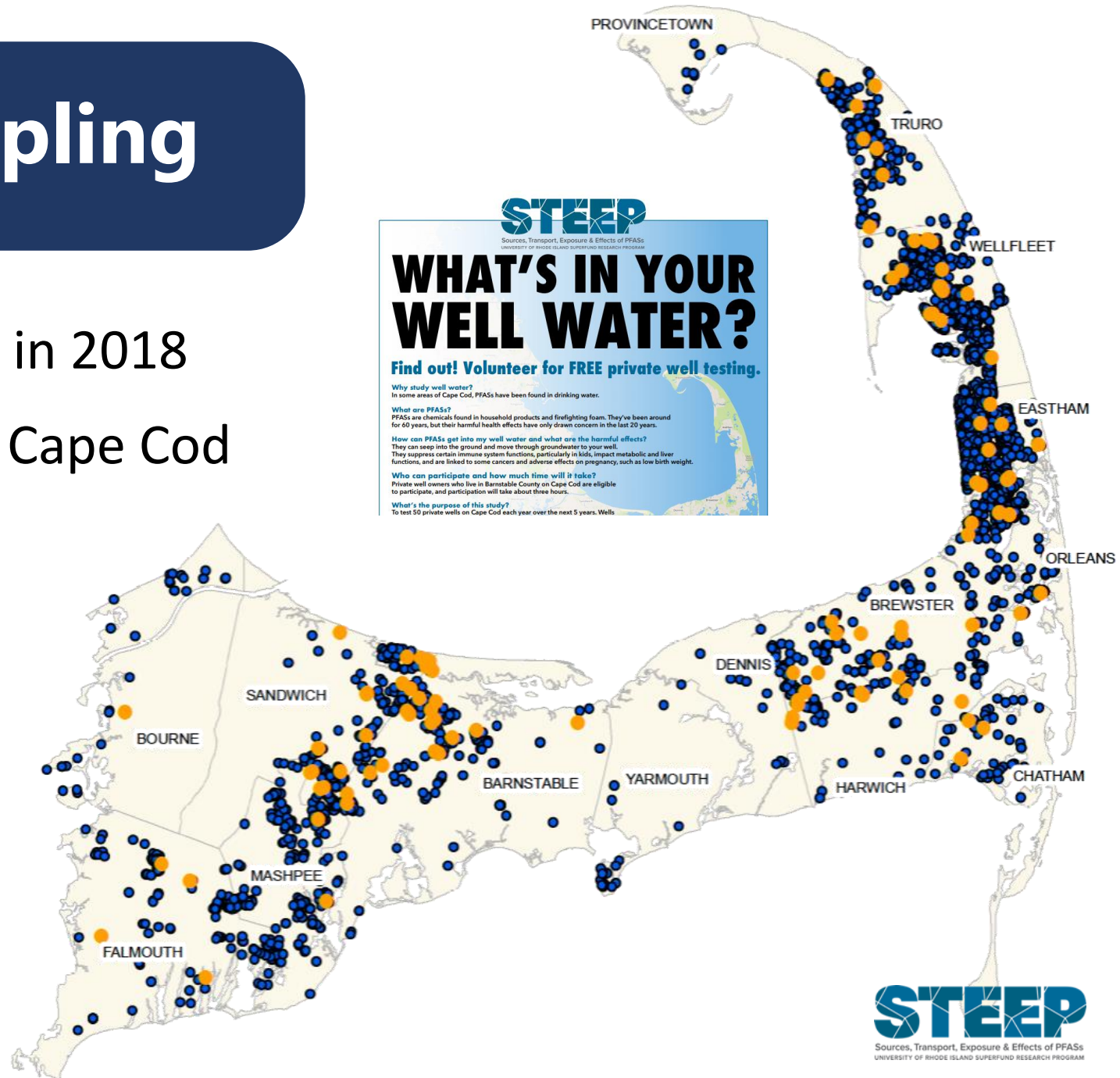


First round of sampling

- 101 volunteer wells sampled in 2018
- Locations of private wells on Cape Cod

Samples analyzed for:

- ✓ PFAS
- ✓ Nitrate
- ✓ Boron
- ✓ Trace metals



Initial findings

- No wells exceeded U.S. EPA guideline
- 3% of wells exceeded new Mass. standard of 20 ppt for 6 PFAS
- PFAS were detected in 46% of wells
- 28% of wells had 2 or more PFAS detected
- Both legacy and newer alternative PFAS
- Wells with higher nitrate were more likely to have PFAS

What's the quality of Cape Cod drinking water?



PRELIMINARY FINDINGS FROM STEEP'S PRIVATE WELL STUDY ON CAPE COD

Key Findings

- STEEP tested water samples from 101 private wells in 12 towns across Cape Cod. About 46% of wells had detectable levels of at least 1 PFAS chemical, and 28% had 2 or more PFAS chemicals detected.
- The percentage of wells with detectable levels of 1 or more PFAS chemicals varied somewhat across different parts of the Cape, with the highest percentage in the Mid Cape and the lowest percentage in the Lower Cape.
- Wells with higher levels of nitrate had higher PFAS concentrations. Since nitrate is an indicator of septic system impact, this suggests that septic systems could be a source of PFAS in private wells.
- None of the wells exceeded current federal or state health guidelines for PFAS. Massachusetts has proposed a stricter groundwater standard, and around 3% of wells exceeded this proposed state standard.

What are PFAS?

PFAS (per- and polyfluoroalkyl substances) are a large family of chemicals commonly added to nonstick, stain-resistant, and waterproof consumer products such as carpets and upholstery, waterproof clothing, cookware, food packaging, and even some dental floss. They are also added to some firefighting foams used at military bases, airports, and fire training areas. Due to their extreme persistence in the environment, PFAS are often referred to as "forever chemicals."

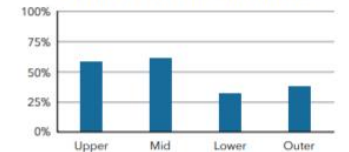
PFAS chemicals have been found in public water supplies across the U.S., including in Hyannis and Mashpee. A prior study by Silent Spring Institute in 2011 found PFAS in a majority of private wells tested on Cape Cod. Potential sources of PFAS contamination to Cape groundwater include septic systems, firefighting foams, and discharges from sewage treatment plants and landfills.

What did STEEP do?

STEPP tested untreated water samples from 101 private wells in 12 towns across Cape Cod. Water samples were analyzed for 25 PFAS chemicals, including the 5 PFAS chemicals in the Massachusetts drinking water guideline. Also measured were nitrate and boron, which indicate potential septic system influence, and some metals, such as lead and iron.

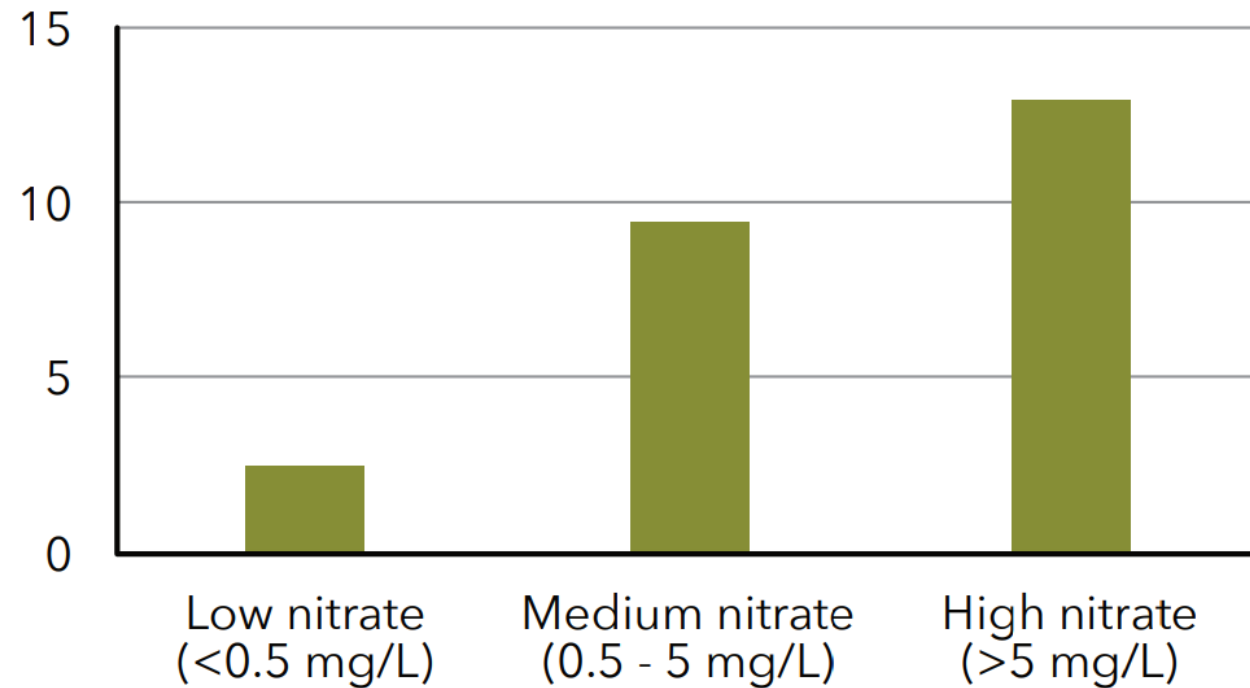
The U.S. Environmental Protection Agency (EPA) issued a health guideline of 70 parts per trillion (ppt) for PFOA and PFOS (combined), two PFAS chemicals frequently found in the environment and in people. In 2018, the Massachusetts Department of Environmental Protection (MassDEP) issued a health guideline of 70 ppt for the total amount of 5 PFAS chemicals (PFOA, PFOS, PFNA, PFHpA, and PFHxS) in public water supplies. In 2019, MassDEP proposed a stricter guideline for groundwater of 20 ppt for the total amount of these 5 PFAS chemicals plus a sixth (PFDA), and is working to develop a revised drinking water standard. Exposures to PFAS have been associated with higher cholesterol, effects on the liver and thyroid, decreased vaccine response in children, testicular and kidney cancer, changes in breast development, and other effects on growth and development.

Percent of wells with detectable PFAS



Higher nitrate wells had higher PFAS

**Average total
PFAS
concentration
(parts per
trillion)**



Note:

EPA's standard for nitrate is 10 mg/L.
2% of wells exceeded this standard.

“Let’s Talk About PFAS” webinar series

- February 3: How Can I Tell if PFAS Are in My Drinking Water?
- March 11: Taking Action to Protect Your Health
- April 14: Don’t Need It, Don’t Use It (PFAS in consumer products)
- June 23: The Case of the Missing Contaminants (PFAS in Cape watersheds)



To access recordings of past webinars:

<http://web.uri.edu/STEEP/>

PFAS-REACH: Research, Education, and Action for Community Health

Study components



- Study of PFAS effects on children's immune systems



- PFAS Exchange:
Online resource center



- Analysis of experiences of affected communities

Study partners

- Silent Spring Institute (lead)
- Northeastern University
- Michigan State University
- Mass. Breast Cancer Coalition
- Testing for Pease
- Community Action Works

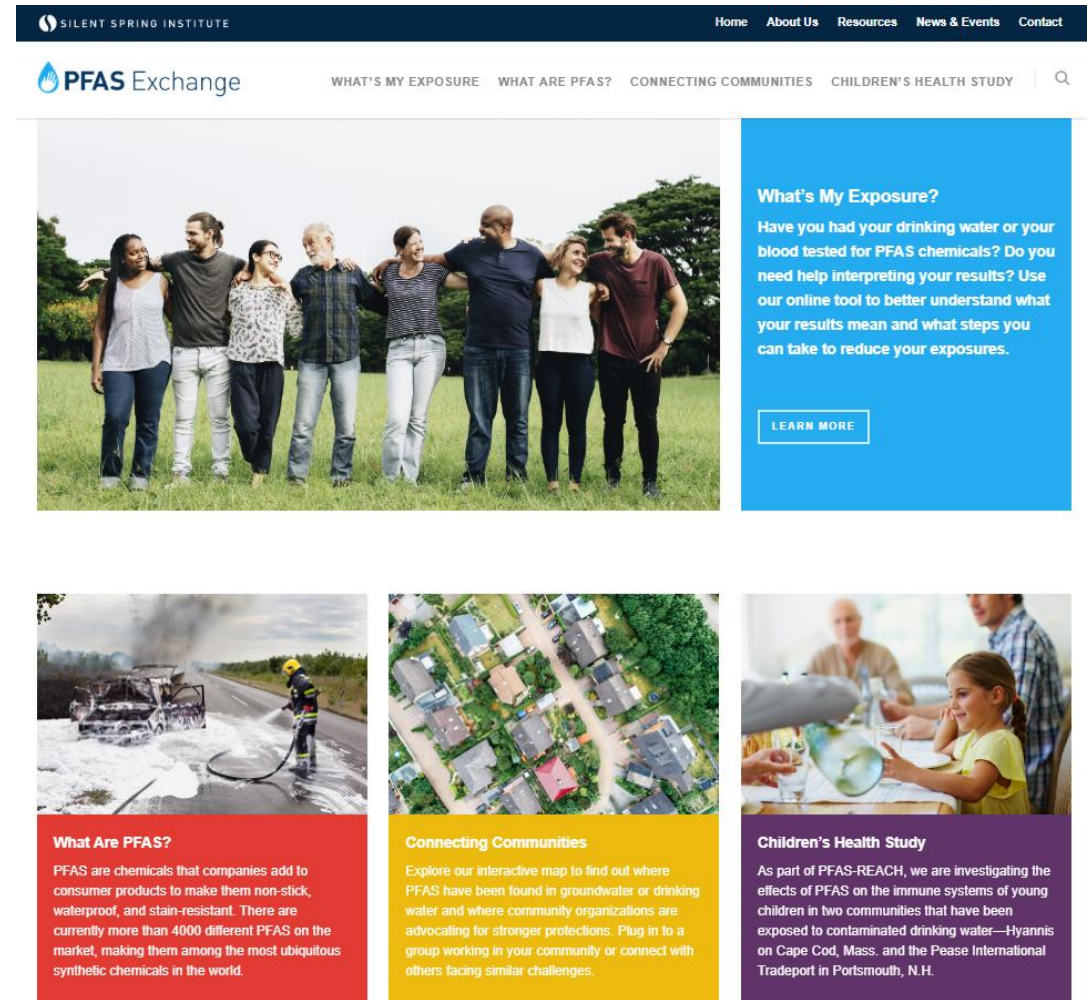
PFAS-REACH Children's Health Study

- Study links between PFAS exposure and immune system effects, including potential decreased antibody response to routine vaccinations (diphtheria, tetanus)
- Now enrolling preschool age children in Hyannis potentially exposed to Hyannis water prior to 2016 (directly or indirectly)
- Also including children from Pease Tradeport, Portsmouth, NH
- Study components
 - Collection of blood and urine samples
 - Completion of questionnaires and text message survey

PFAS Exchange online resource center

www.pfas-exchange.org

- Resources for residents, water and health officials, medical professionals, firefighters
- Supporting connections and knowledge sharing among communities
- Data interpretation for blood and water test results



The screenshot shows the homepage of the PFAS Exchange website. At the top, there is a navigation bar with the Silent Spring Institute logo and links for Home, About Us, Resources, News & Events, and Contact. Below this is the PFAS Exchange logo and a search bar. The main content area features a large image of a diverse group of people standing in a field. To the right of this image is a blue box with the heading "What's My Exposure?" and a call to action "LEARN MORE". Below the main image are three smaller images with corresponding text boxes: "What Are PFAS?" (a firefighter cleaning a car), "Connecting Communities" (an aerial view of a residential neighborhood), and "Children's Health Study" (a child looking at a globe).

SILENT SPRING INSTITUTE Home About Us Resources News & Events Contact

PFAS Exchange WHAT'S MY EXPOSURE WHAT ARE PFAS? CONNECTING COMMUNITIES CHILDREN'S HEALTH STUDY

What's My Exposure?
Have you had your drinking water or your blood tested for PFAS chemicals? Do you need help interpreting your results? Use our online tool to better understand what your results mean and what steps you can take to reduce your exposures.

[LEARN MORE](#)

What Are PFAS?
PFAS are chemicals that companies add to consumer products to make them non-stick, waterproof, and stain-resistant. There are currently more than 4000 different PFAS on the market, making them among the most ubiquitous synthetic chemicals in the world.

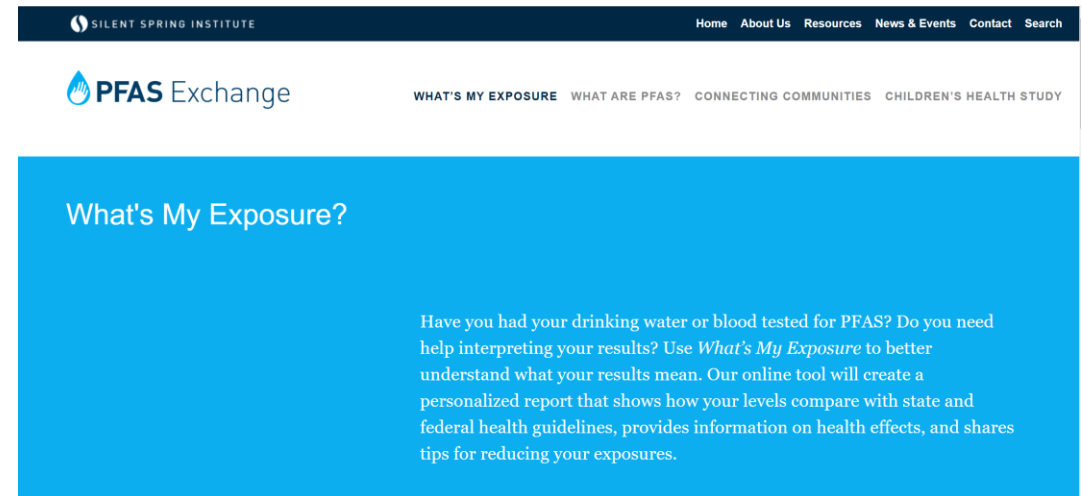
Connecting Communities
Explore our interactive map to find out where PFAS have been found in groundwater or drinking water and where community organizations are advocating for stronger protections. Plug in to a group working in your community or connect with others facing similar challenges.

Children's Health Study
As part of PFAS-REACH, we are investigating the effects of PFAS on the immune systems of young children in two communities that have been exposed to contaminated drinking water—Hyannis on Cape Cod, Mass. and the Pease International Tradeport in Portsmouth, N.H.

What's My Exposure?

Data interpretation tool

- Interactive online tool to instantly provide information to interpret blood and water PFAS test results
- Results of blood and water testing can be difficult to understand
- Having information to understand and contextualize results can be empowering
- Builds on Silent Spring Institute's extensive experience in report-back of personal chemical exposure results



Enter blood and/or water test results

[How to use this tool](#)[Enter your test results](#)[FAQ](#)[Share your feedback](#)

Enter your test results

Enter your test results on this page to generate your personalized exposure report. Remember to enter all results on your report! You may not have data from all the PFAS chemicals in the drop-down list; if so, don't worry, you will be able to create a report from the data you have. Please visit the [FAQ tab](#) to see answers to common questions. You can also contact the PFAS Exchange team at 617-332-4288, ext. 230 or email us at pfas-reach@silentspring.org.

Information from your water report

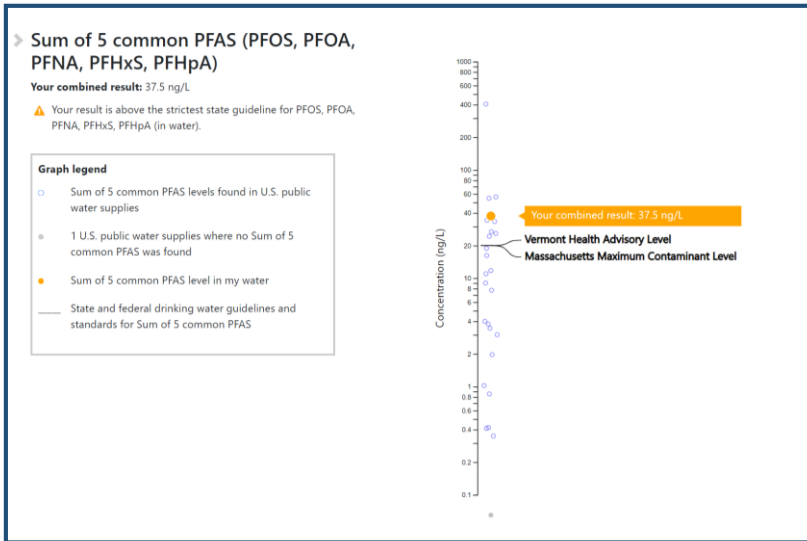
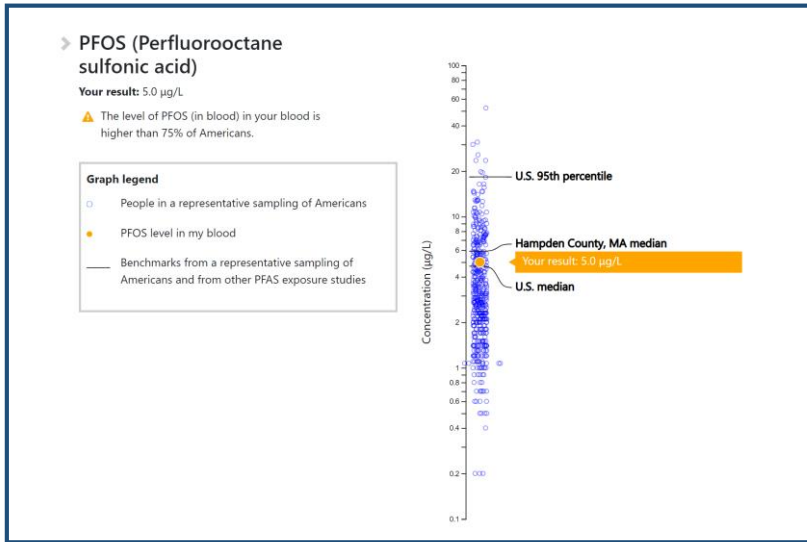
PFOA (in water) -- Perfluorooctanoic acid	Value 25	Unit ng/L (n)	
PFOS (in water) -- Perfluorooctane sulfonic acid	Value 10	Unit ng/L (n)	
PFHxS (in water) -- Perfluorohexane sulfonic acid	Value 2	Unit ng/L (n)	
PFNA (in water) -- Perfluorononanoic acid	Value ND	Detection Limit 1	Unit ng/L (n)
PFBS (in water) -- Perfluorobutane sulfonic acid	Value 0.1	Unit ng/L (n)	
PFHpA (in water) -- Perfluoroheptanoic acid	Value 0.5	Unit ng/L (n)	

Information from your blood report

PFOA (in blood) -- Perfluorooctanoic acid	Value 2	Unit ppb (p)
PFOS (in blood) -- Perfluorooctane sulfonic acid	Value 5	Unit ppb (p)
PFHxS (in blood) -- Perfluorohexane sulfonic acid	Value 6	Unit ppb (p)
PFNA (in blood) -- Perfluorononanoic acid	Value 1.1	Unit ppb (p)

[Generate report](#)

Graphs & headlines



Tips and additional info

Drinking water guidelines vary state-to-state

There are no federal U.S. drinking water standards for any PFAS chemicals. Some states have proposed or adopted their own guidelines or enforceable standards. Some of these are based on the levels of individual PFAS chemicals, while others are based on certain combinations of PFAS.

This table summarizes these standards and guidelines:

Drinking water standards and guidelines (parts per trillion or nanograms per liter)

	Included as individual chemicals or in combination						Total (number of chemicals)	Included as individual chemicals			
	PFOA	PFOS	PFNA	PFHxS	PFHpA	PFDA		PFBA	PFHxA	PFBS	GenX (HPFO-DA)
EPA	70	70					70 (2)				
CA	10	40									
CT	70	70	70	70	70		70 (5)				
MA	20	20	20	20	20	20	20 (6)			2,000	
MI	8	16	6	51					400,000	420	370
MN	35	15		47				7,000		2,000	
NH	12	15	11	18							
NJ	14	13									
NY	10	10									
NC											140
OH	70	70	21	140			70 (2)			140,000	700
VT	20	20	20	20	20		20 (5)				
WA	10	15	14	70						1,300	

Adapted from [Post 2020](#).

What are the sources of PFAS?

PFAS (per- and polyfluoroalkyl substances) are a class of water-, heat-, and oil-resistant chemicals. There are currently more than 4,700 different PFAS chemicals on the global market, making them among the most ubiquitous synthetic chemicals in the world. They are found in a wide range of consumer products including stain-resistant carpets and upholstery, waterproof clothing, floor waxes, nonstick cookware, greaseproof food packaging, and even some dental floss. They are also found in certain firefighting foams that are commonly used at military bases, airports, and other fire training areas. Potential sources of PFAS in the environment include firefighting foams, industrial discharges, wastewater from homes and businesses, landfills, and land disposal of sewage sludge.

How are PFAS regulated in drinking water?

Currently, there are no federal drinking water standards for any PFAS chemicals. This means that public water supplies do not have to test or treat their water for PFAS under federal law. The EPA has issued a non-enforceable guideline for two of the most common PFAS chemicals, PFOS and PFOA. Some states have issued health guidelines that are stricter than the EPA guideline, and some states have proposed or established enforceable standards. For more information about drinking water guidelines, read the [fact sheet](#) in our Resources center. And for up-to-date information on the rapidly changing landscape of state guidelines and standards, check out the [Safer States bill tracker](#).

Why are PFAS a health concern?

Over 99% of Americans have PFAS in their blood. Because of their strong chemical bonds, the synthetic chemicals persist in our bodies and in the environment and don't break down easily. Some PFAS chemicals are difficult to excrete and can stay in the body for years. Because of their persistence and because exposures are so widespread, scientists are concerned about potential health impacts.

Studies in animals and humans have linked exposure to PFAS with numerous health effects including high cholesterol, liver damage, decreased vaccine response in children, various cancers (testicular, kidney, liver, and pancreatic), delayed mammary gland development, thyroid disruption, and effects on growth and development. PFOA and PFOS are the two most well-studied PFAS chemicals. However, new research suggests other types of PFAS have similar health effects. Scientists' understanding of PFAS is expanding rapidly as these chemicals are the target of significant new research and regulation.

How can I reduce my exposure to PFAS?

Treat your water

If your water has elevated levels of PFAS, you may want to consider home water treatment. There are two types of common home water treatment systems that can remove PFAS from drinking water. Activated carbon filters are effective at removing PFOA, PFOS, and some other PFAS chemicals. Activated carbon systems include solid carbon block filters (typically a filter under your sink) and granular activated carbon filters (as in a filter pitcher). Another option is a reverse osmosis system, which can remove a wider range of PFAS chemicals. However, reverse osmosis is the more expensive option and produces a significant amount of waste water. When choosing a filtering system, look for one that is NSF P473 certified, or meets the NSF/ANSI 53 standard for activated carbon filters and the NSF/ANSI 58 standard for reverse osmosis. Be sure to follow the manufacturer's instructions and replace the cartridges or membranes as recommended.

Avoid products with PFAS

PFAS Exchange fact sheets

**New medical
screening guidance**

PFAS: A Word About Drinking Water Guidelines



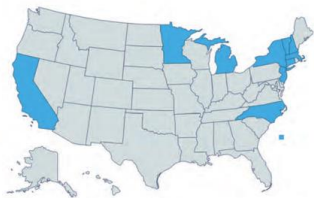
Are PFAS regulated in drinking water?

PFAS (per- and polyfluoroalkyl substances) are currently not regulated under the Safe Drinking Water Act. This means there are no federal drinking water standards and public water supplies do not have to test or treat their water for PFAS under federal law.

The U.S. Environmental Protection Agency (EPA) has set a non-enforceable health-based guideline level of 70 parts per trillion (ppt) for PFOA and PFOS, individually or combined.

However, many scientists and regulators believe this guideline is not protective enough of human health. As a result, some states have developed their own guideline levels for PFAS that are stricter than EPA's, and some have set, or are in the process of setting, enforceable standards.

Although guideline levels are not enforceable, meaning water utilities are not required to test or treat the water, they do offer some protection.



10 states with drinking water guidelines that are more restrictive than EPA's.



Why do guidelines vary?

Guideline levels are created when regulators, after reviewing the science, calculate a level of exposure below which health effects are not expected to occur. Regulators consider different types of evidence and factors when developing guideline levels:

- Studies linking exposure to PFAS with various health effects (for instance, effects on the immune system, liver, or mammary gland development).
- The impact on vulnerable populations such as infants or pregnant women.
- How much water people drink in a day.
- How much exposure likely comes from drinking water versus diet and consumer products.
- Molecular studies that show what happens to PFAS after the chemicals enter the body.

Although some variation is expected among the different state guideline levels, more recent guidelines are being set at similarly lower levels.

Learn more: www.pfas-exchange.org

How Can PFAS Affect Your Health?



PFAS (per- and polyfluoroalkyl substances) are among the most ubiquitous synthetic chemicals in the world. Approximately 98 percent of Americans have PFAS in their bodies. People can be exposed to these chemicals in many different ways—through the water they drink, the products they use, the air they breathe, and the food they eat. During pregnancy, PFAS can pass from the mother to the fetus through the umbilical cord, and babies can be exposed through breast milk or formula made with contaminated water.



Their strong chemical bonds and unique structures make them very effective at repelling water and oil even at high temperatures. These same characteristics also make PFAS extremely persistent, meaning they don't break down in the environment. Even more concerning, some PFAS can remain in the body for years, and people continue to be exposed to the chemicals.

Because of their persistence and because exposures are so widespread, scientists are concerned about the potential health impacts. Most health studies have looked at PFOA and PFOS, the two most commonly found PFAS. However, new research suggests other types of PFAS have similar health effects.

Learn more: www.pfas-exchange.org

Although the science on health effects is still evolving, scientists are increasingly concerned about low-dose exposures, as they continue to find health effects at lower and lower levels. More research is needed on other PFAS chemicals, in particular ones that companies have developed to replace PFOA and PFOS. Because people are exposed to multiple PFAS from multiple sources, researchers are beginning to investigate the effects of mixtures of PFAS on human health.

Scientific studies have linked exposure to PFAS with:

Human studies

- High cholesterol
- Ulcerative colitis
- Cancer (testicular, kidney)
- Preeclampsia
- Liver damage
- Thyroid disease
- Decreased vaccine response
- Asthma
- Decreased fertility
- Lower birth weight

Animal studies

- Cancer (testicular, liver, pancreatic)
- Liver damage
- Delayed mammary gland development
- Developmental problems
- Effects on brain development
- Immune system effects
- Changes in cholesterol levels
- Changes in thyroid hormones
- Low birth weight



PFAS-REACH is a five-year project funded by the National Institute of Environmental Health Sciences (NIEHS) under grant R01ES028311.

PFAS-REACH is led by Silent Spring Institute in collaboration with Northeastern University and Michigan State University. Community partners include Testing for Pease, Massachusetts Breast Cancer Coalition, and Toxics Action Center.



PFAS Exposure: Information for patients and guidance for clinicians to inform patient and clinician decision making

For clinicians

About this guidance document

The guidance summarized here is to help inform discussion and decision making for physicians and their patients. Many of the tests and screenings noted are part of basic primary care annual appointments. In 2019, the American Medical Association (AMA) resolved to support research and policy to address the effects of PFAS exposure.

We based the following suggestions for medical screening tests on those previously developed and implemented for a PFAS-impacted community as well as peer-reviewed research and scientific assessments using weight of evidence approaches from:

- Agency for Toxic Substances and Disease Registry (2021)
- Centers for Disease Control and Prevention (2019)
- CB Science and Medical Panels (2005-2013)
- European Environment Agency (2019)
- International Agency for Research on Cancer (2017)
- National Toxicology Program (2016)

These recommendations are for those living in communities with contaminated water or who are exposed to other sources of PFAS that substantially increases their internal burden of PFAS. These recommendations are not targeted to those with average levels of PFAS exposure.

Guidance for adult patients

Laboratory tests

- **Lipid panel (cholesterol, LDL, HDL, triglycerides).** PFAS exposure has been associated with higher total and LDL cholesterol and fatty liver.
- **Liver function tests,** such as ALT, AST, and GGT. PFAS exposure has been associated with higher-than-normal liver function tests, as well as hepatotoxicity, including hepatocyte and liver architecture damage.
- **Serum creatinine and urine protein and urine albumin.** PFAS exposure is associated with chronic kidney disease and kidney cancer. An important note for researchers is that there is enhanced excretion of PFAS in moderate-to-severe kidney disease, especially if there is albuminuria. Reduced serum PFAS concentrations for those individuals introduces a bias towards the null if not controlled for in epidemiologic studies.
- **Thyroid tests,** such as TSH with or without FT4. PFAS exposure has been associated with thyroid disease.

Clinical examinations

- **Regular testicular examinations.** Exposure to high levels of PFAS has been associated with increased risk of testicular cancer.

Counseling topics

- **Vaccine response.** There is currently no consensus on revaccinating patients with low vaccine titer when tested a month following vaccination (i.e., Tdap, MMR); more research is needed.
- **Home blood pressure monitoring during pregnancy.** PFAS are associated with elevated blood pressure during pregnancy and with preeclampsia.
- **Breastfeeding.** Babies can be exposed to PFAS during pregnancy since PFAS can cross the placenta. PFAS chemicals also accumulate in breast milk. However, the benefits of breastfeeding are clear, and include benefits to maternal as well as child health. There is insufficient evidence to recommend against breastfeeding based on maternal PFAS exposure.



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PFAS-REACH is led by Silent Spring Institute in collaboration with Northeastern University and Michigan State University. Community partners include Testing for Pease, Massachusetts Breast Cancer Coalition, and Toxics Action Center.

CDC/ATSDR Multi-Site Study

- Multi-site Health Study funded by Centers for Disease Control and Prevention (CDC) and Agency for Toxic Substances and Disease Registry (ATSDR)
- Silent Spring is leading 1 of 7 funded studies across the U.S. to look at health effects of PFAS exposure from drinking water

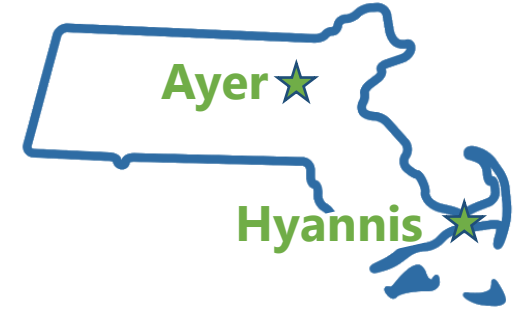
Communities in 7 states included in ATSDR study



**California
Colorado
Massachusetts
Michigan**

**New Jersey
New York
Pennsylvania**

MA PFAS and Your Health Study

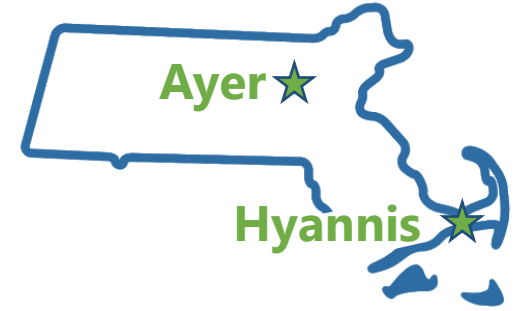


- Hyannis and Ayer, MA
 - Public water supplies contaminated by AFFF and other sources
- Target study population
 - 1000 adults, 300 children (4-17)
 - 2/3 Hyannis, 1/3 Ayer
- Core protocol (all sites) and additional components (only MA)

Study partners

- Silent Spring Institute (lead)
- Harvard School of Public Health
- Eastern Research Group
- Mass. Breast Cancer Coalition
- People of Ayer Concerned about the Environment (PACE)

Study scope



- Data collection
 - Blood and urine samples
 - Body measurements
 - Questionnaires (health, residential history, water consumption)
 - Neurobehavioral testing (children)
- Reconstructing past exposures
 - Estimating past PFAS levels in drinking water
 - Calculating cumulative exposures

Study outcomes



- Evaluate associations between PFAS exposure and effects:
 - Thyroid hormones
 - Cholesterol and other lipids, and markers of liver function
 - Antibody levels, including vaccine response in children
 - Neurobehavioral test outcomes
 - Disease prevalence
- Additional exposure and effects evaluations
 - Non-targeted PFAS and extractable organofluorine
 - Metabolomics and measurements of COVID-19 antibodies and cholesterol subfractions

Timeline



Summer 2021	Training field staff in Hyannis, finalizing protocols
August 2021	Begin data collection in Hyannis
Early 2022	Complete data collection in Hyannis Transition to Ayer
Spring 2022	Begin data collection in Ayer
Fall 2022	Wrap up data collection in Ayer

A few additional thoughts

- Blood testing for PFAS-impacted communities addresses concerns of residents to learn about their exposures and can be used in future studies
- Longitudinal studies, as well as cross-sectional studies, would provide new insight on early life exposures
- Contributions of diet and consumer products to overall PFAS exposures are poorly characterized
- A class-based approach that considers the entire life cycle of products is important for preventing new contamination moving forward

Contact information:

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twitter: @laurelschaider

RESOURCES:

- ▶ Silent Spring Institute: www.silentspring.org
- ▶ PFAS Exchange: www.pfas-exchange.org
- ▶ URI STEEP Superfund Research Program: web.uri.edu/stEEP
- ▶ MA PFAS and Your Health Study: bit.ly/ma-pfas