Legacy and alternative PFAS in private wells on Cape Cod, Massachusetts, USA

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

THE UNIVERSITY OF RHODE ISLAND

HARVARD T.H. CHAN
SCHOOL OF PUBLIC HEALTH
Department of Environmental Health

SILENT SPRING INSTITUTE
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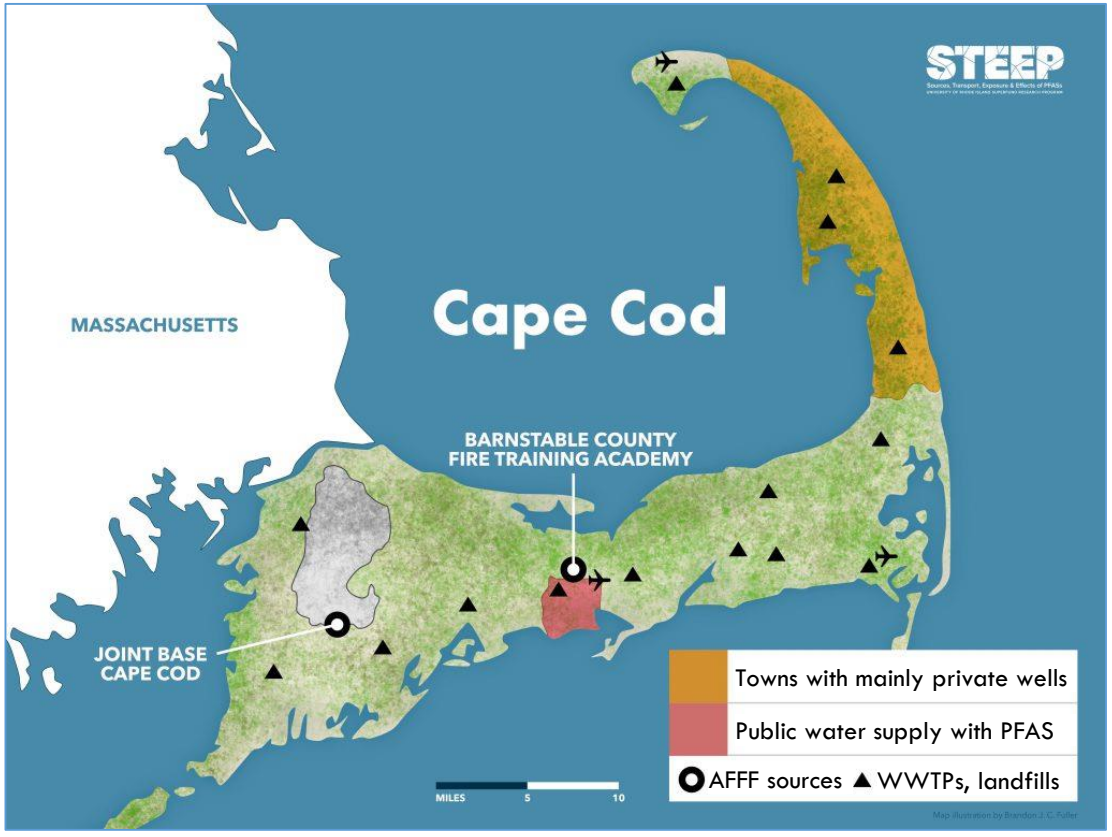
Presentation outline

- Study motivation and methods
- Results from preliminary testing
- Report-back to participants
- Focus groups and interviews
- Additional sample collection and next steps

Why study private wells on Cape Cod?

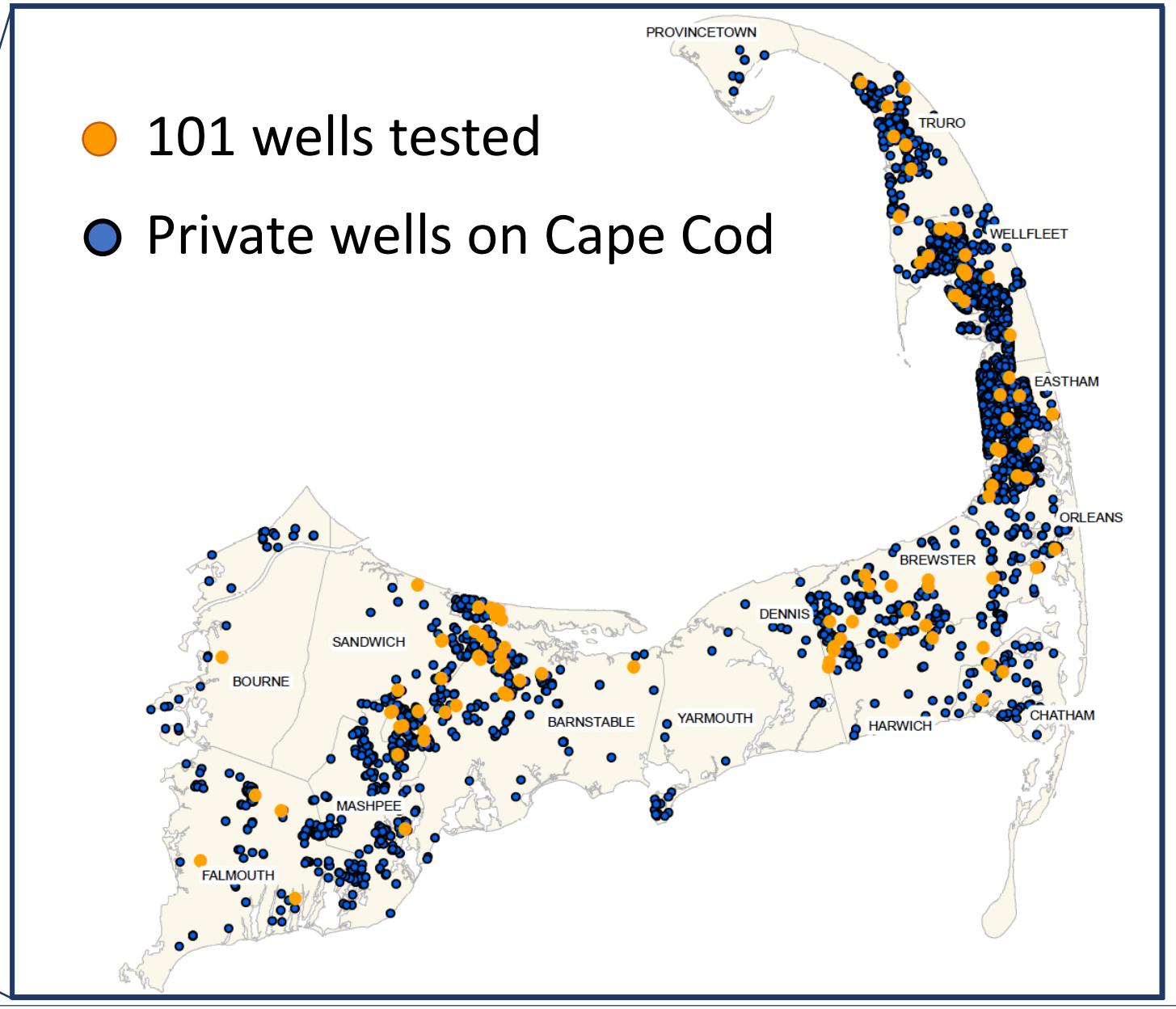
- Vulnerable sole-source aquifer
- AFFF contamination of groundwater
- 85% of residents on septic systems
- PFAS previously found in private wells (Schaider et al. 2016. STOTEN)
- Community concerns about water quality and health



Research questions

- How prevalent are PFAS in Cape Cod private wells?
- Are PFAS concentrations correlated with markers of septic system impact, such as nitrate and boron?
- Are PFAS concentrations associated with proximity to other potential sources, including landfills, fire stations, and car washes?

Well locations (2018)
Cape Cod, MA



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Sample collection and analysis

- Raw samples from 101 private wells in fall 2018
- 25 PFAS by LC-MS/MS with direct injection (Sunderland lab, Harvard)
  - MDLs mostly 1-6 ng/L
  - PFCAs (C4 - C14)
  - PFSAs (C4 - C10)
  - FtS (4:2, 6:2, 8:2)
  - N-EtFOSAA, MeFOSAA
  - FOSA
  - NaDONA
- Nitrate, boron, and trace metals
- Quality assurance/quality control
  - Field and lab blanks, field and lab duplicates
- Participant survey of well depth, age, water quality

Overall findings

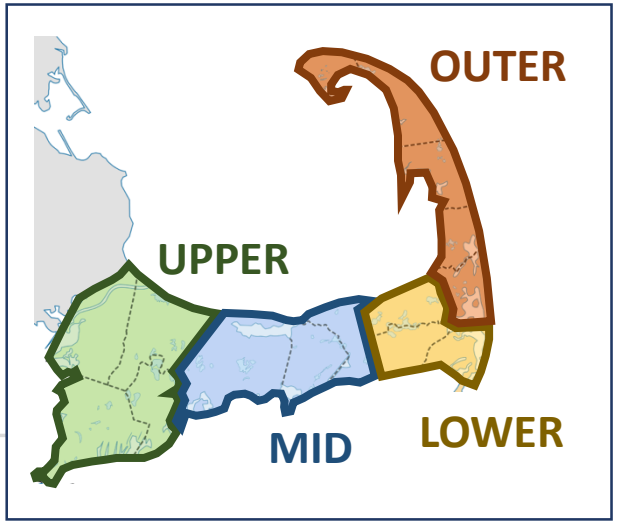
- 46% of wells had at least one PFAS detected and 28% had ≥2 PFAS detected
- 9 PFAS compounds detected, mostly PFCAs and PFSAs, both long-chain and short-chain
- No wells exceeded EPA LHA, 3% exceeded Massachusetts MCL of 20 ng/L for PFAS6

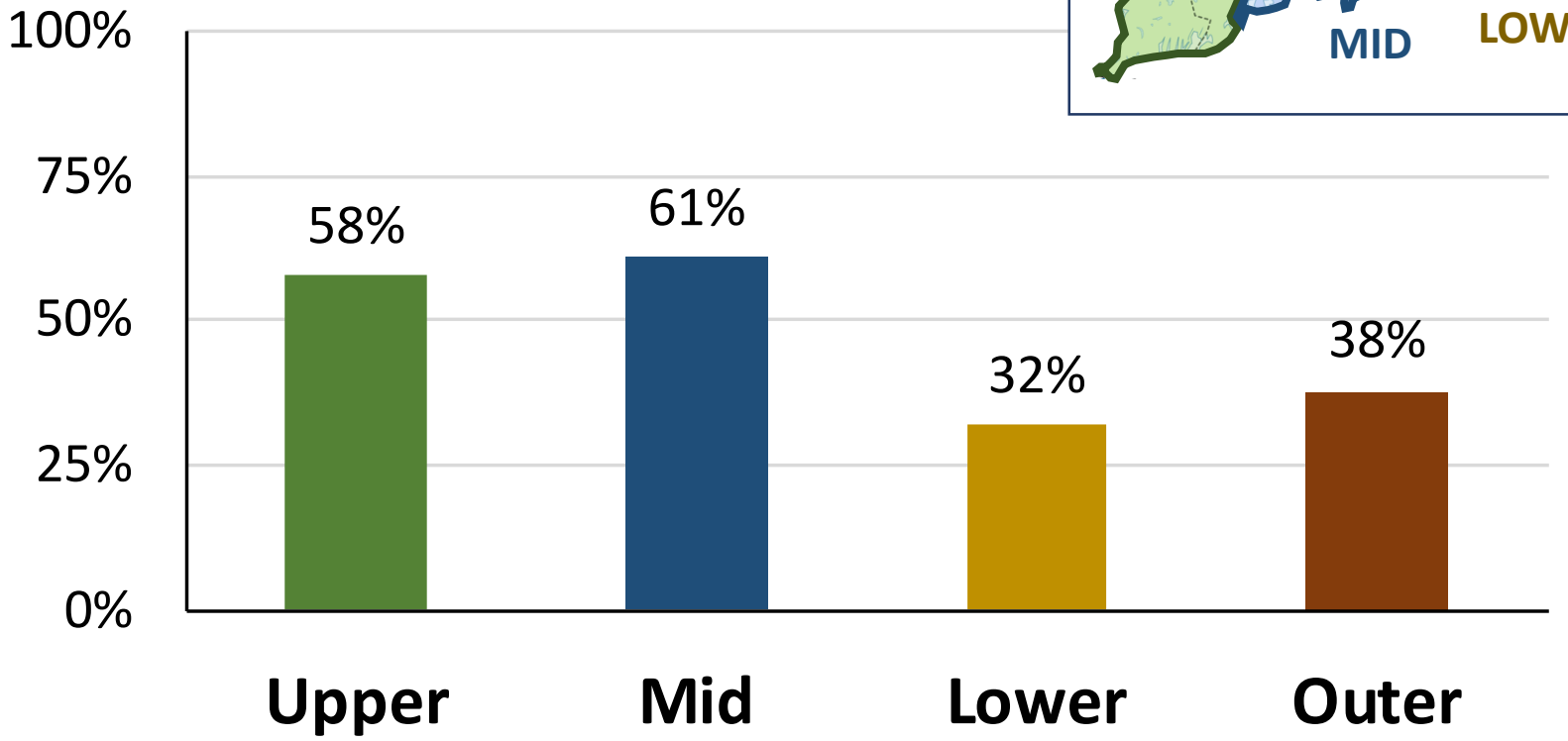
9 PFAS detected in Cape Cod private wells

	Compound	% of wells	Maximum (ng/L)	MDL (ng/L)
PFCAs	PFBA	3%	8.0	3.3
	PFPeA	24%	15	1.3
	PFHxA	13%	13	3.3
	PFHpA	4%	11	2.6
	PFOA	19%	25	3.9
PFSAs	PFBS	13%	43	2.2
	PFHxS	7%	8.7	3.1
	PFOS	17%	10	3.0
FTSs	4:2 FtS	11%	16	3.4

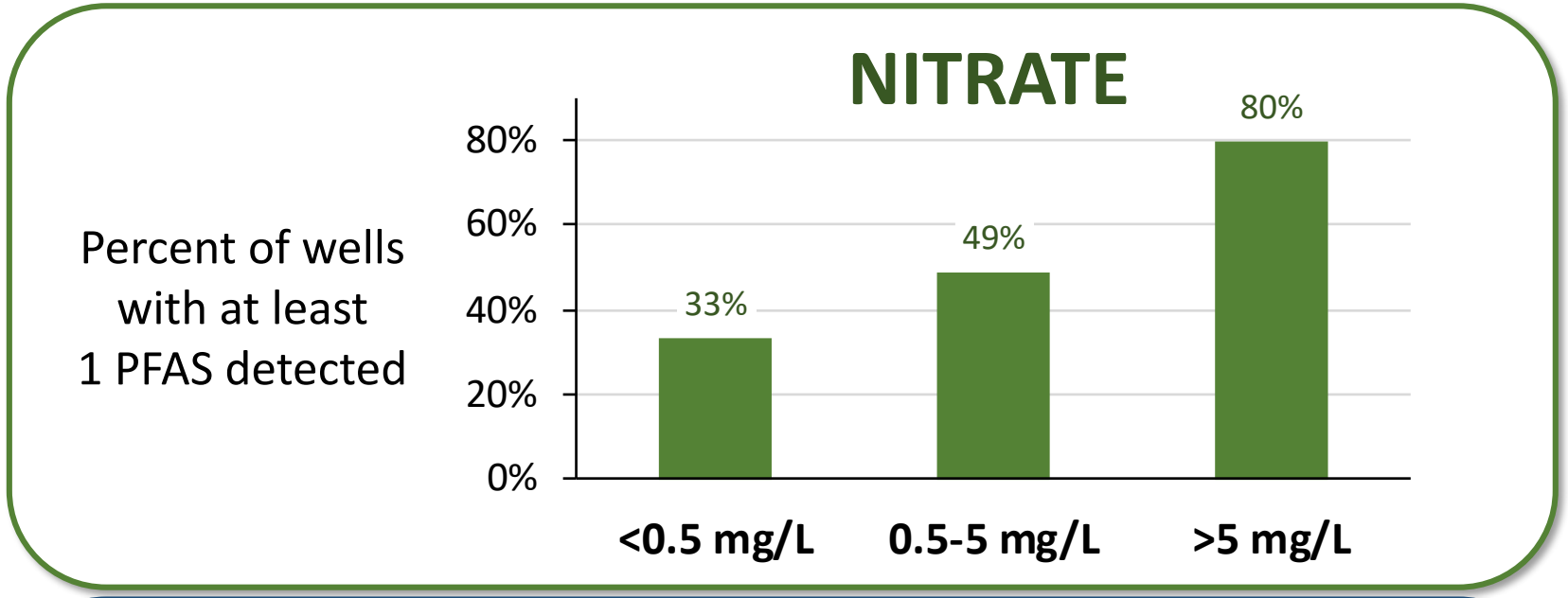
Detection frequency varied by region around Cape Cod

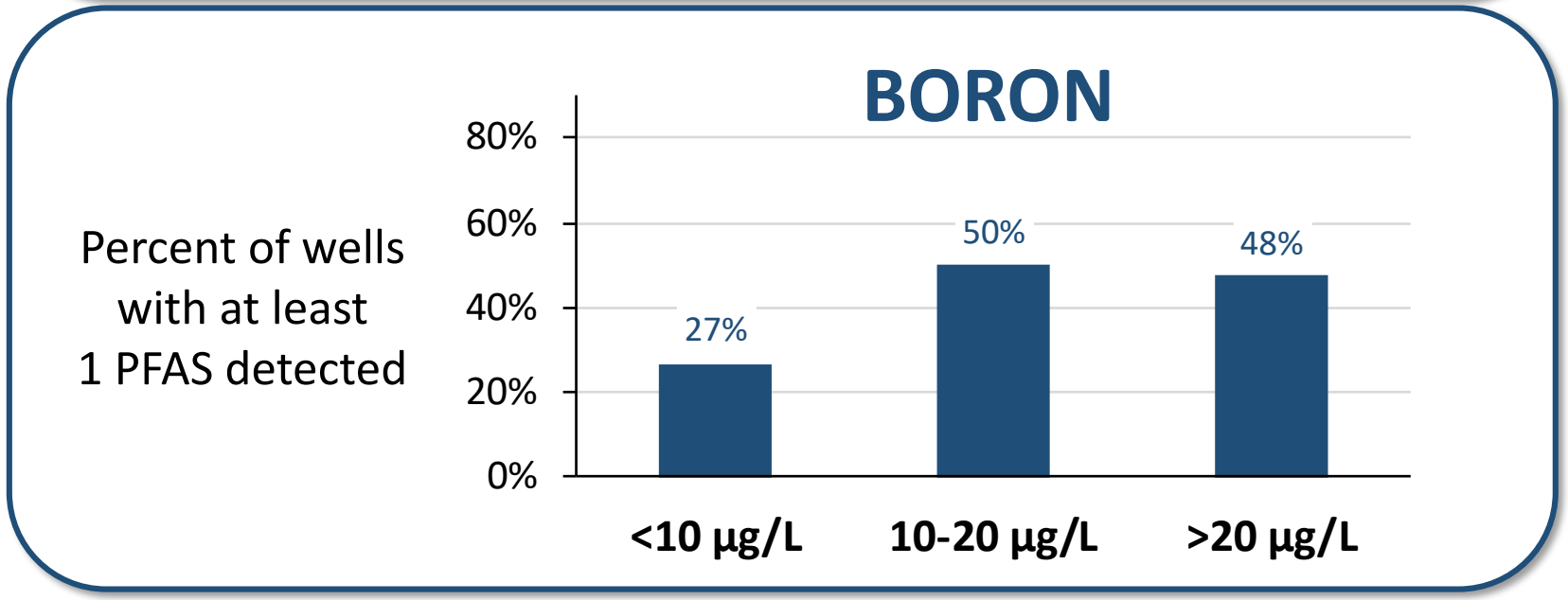
Percent of wells with detectable PFAS





Nitrate more closely associated with PFAS detections than boron



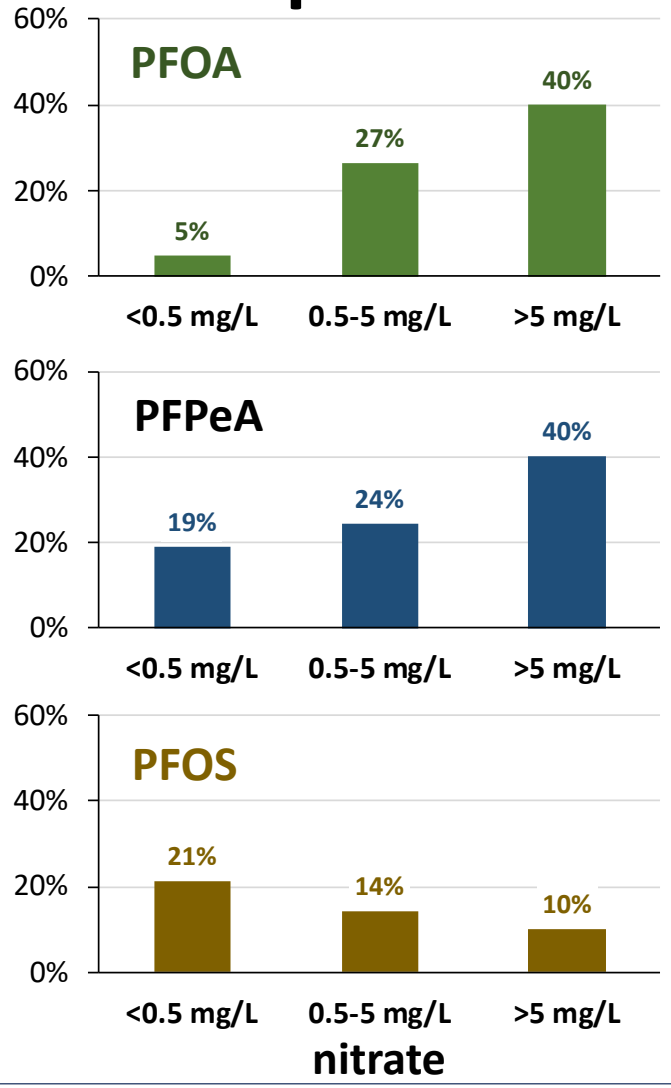


Strength of associations with nitrate vary by compound

Spearman rho correlation coefficients

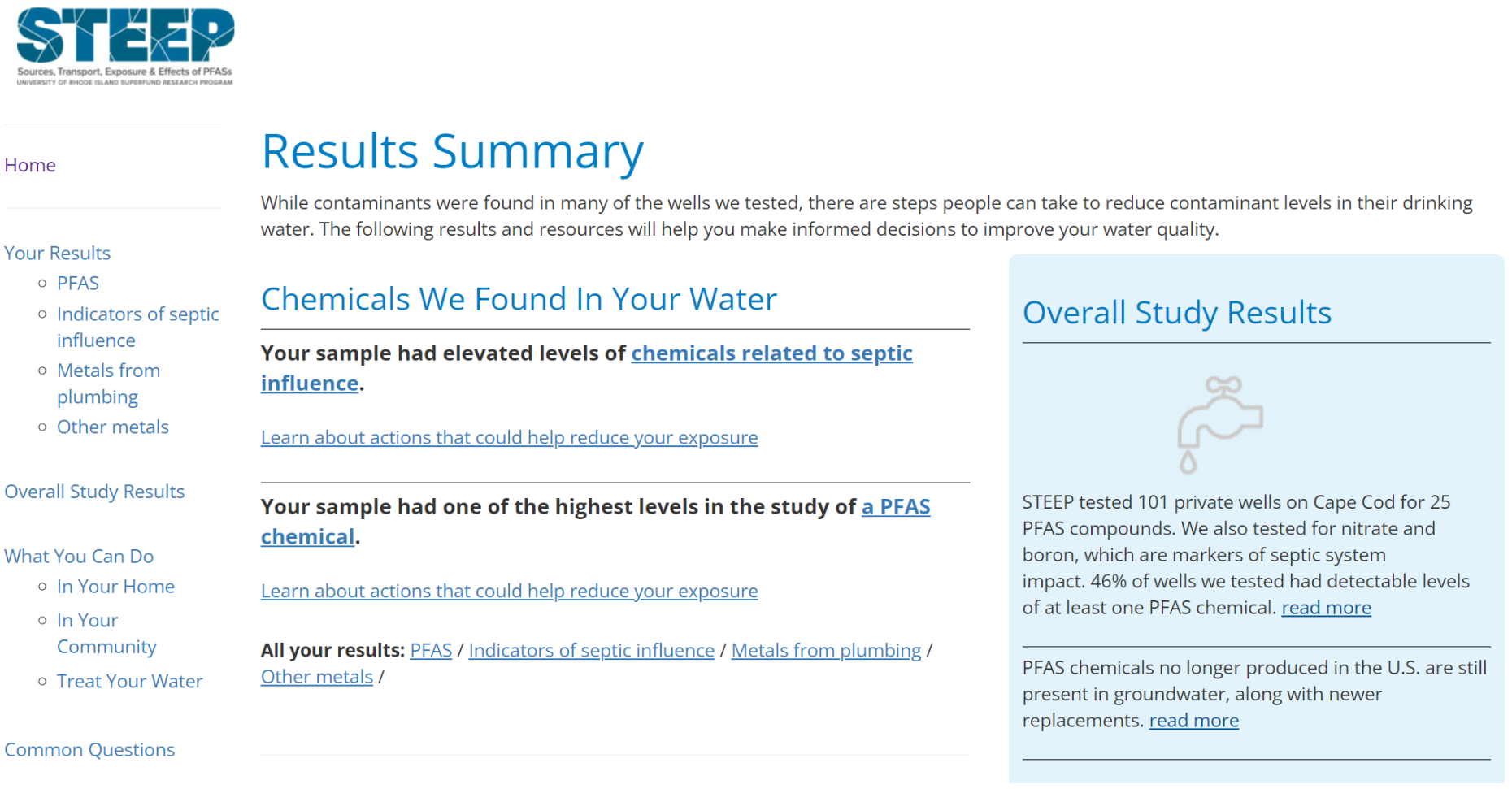
PFBA	**0.11**
PFPeA	**0.25***
PFHxA	**0.39*****
PFHpA	0.05
PFOA	**0.38*****
PFBS	**0.26****
PFHxS	**0.23***
PFOS	-0.04
4:2 FtS	**0.27****
Any PFAS	**0.34*****

Detection frequencies



Participant report-back

- Silent Spring Institute's DERBI (Digital Exposure Report-back Interface)



View a sample report: https://steep.reportback.org/r/report/demo

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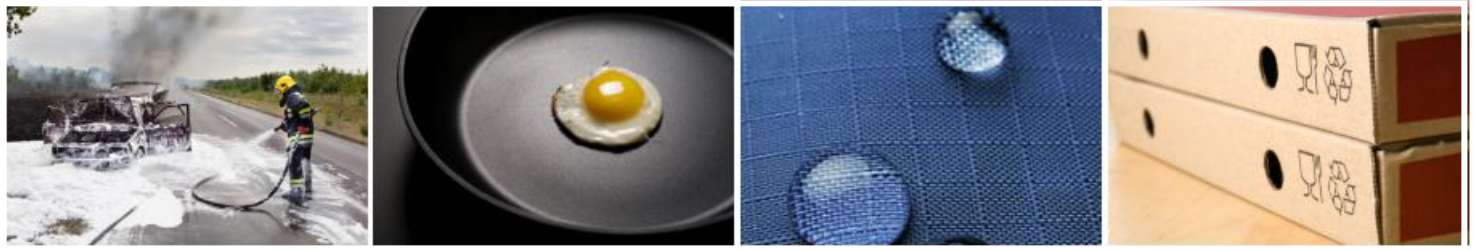

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Home

Your Results
- **PFAS**
- Indicators of septic influence
- Metals from plumbing
- Other metals

Overall Study Results

What You Can Do
- In Your Home
- In Your Community
- Treat Your Water

Common Questions

About STEEP
Methods
Contact Us

Your Results: PFAS

Your sample had one of the highest levels in the study of PFBS. Scroll down to see your results.

Click here to jump to your results

Where do these chemicals come from?

PFAS (per- and polyfluoroalkyl substances) are water-, heat-, and oil-resistant chemicals found in a wide range of consumer products such as stain-resistant carpets and upholstery, waterproof clothing, floor waxes, nonstick cookware, grease-proof food packaging, and even some dental floss. They are also added to certain firefighting foams that are commonly used at military bases, airports, and fire training areas. Potential sources of PFAS contamination in Cape Cod groundwater include runoff from landfills and wastewater from homes and businesses, as well as firefighting foams.

How are PFAS regulated in drinking water?

Currently, there are no federal standards regulating PFAS in drinking water. The U.S. Environmental Protection Agency (EPA) has issued non-enforceable guidelines for two PFAS chemicals, PFOS and PFOA. In 2018, the Massachusetts Department of Environmental Protection (MassDEP) issued a health guideline of 70 parts per trillion (ppt or ng/L) for the total amount of five PFAS chemicals (PFOA, PFOS, PFNA, PFHpA, and PFHxS) in public water supplies. MassDEP is in the process of revising this guideline.

Common Questions
- How can I reduce my exposure to each of these chemicals?
- How do I get my water tested again?
- I already have water treatment, why am I still high in some chemicals?
- Is there a safe level of exposure for PFAS chemicals?
- Was my cancer or other illness caused by my chemical exposures?
- What does "not detected" mean?
- What do the units "ng/L" mean for PFAS levels?
- Which chemicals did you test for?
- Why did you select these chemicals to study?

View a sample report: https://steep.reportback.org/r/report/demo

Participant report-back

- Headlines
- Chemical-specific info
- Info on water treatment
- Household tips

Your Results

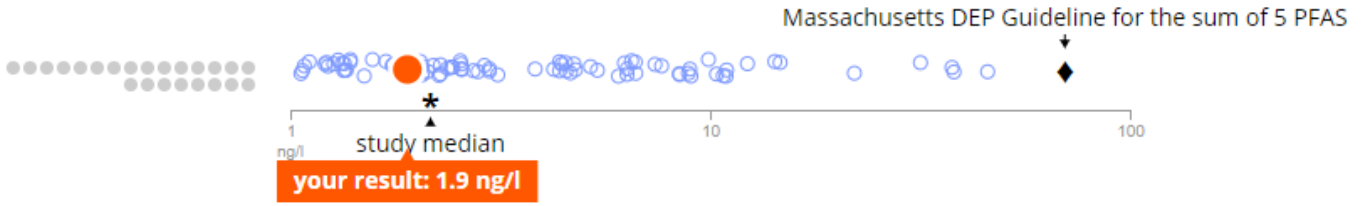
Graph legend

- your chemical level
- participants' chemical levels
- participants for whom the chemical was not detected
- * study median
- ♦ State or federal drinking water guideline (when available)

Tip: Mouse over your graphs to learn how to read them.

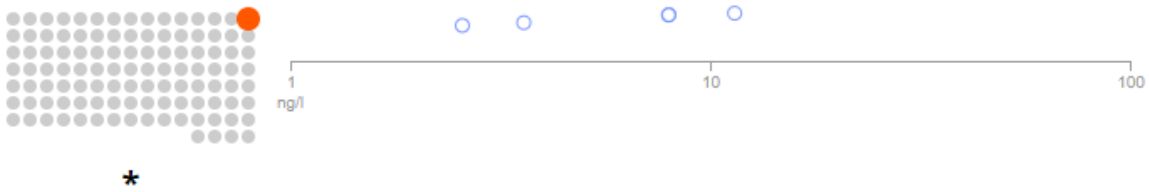
Sum of 5 PFAS chemicals in Massachusetts DEP guideline

In 2018, the Massachusetts Department of Environmental Protection (MassDEP) issued a health guideline of 70 parts per trillion (ppt) for the total amount of five PFAS chemicals (PFOA, PFOS, PFNA, PFHpA, and PFHxS) in public water supplies.



PFHpA

This chemical is included in MassDEP's drinking water guideline for the sum of five PFAS



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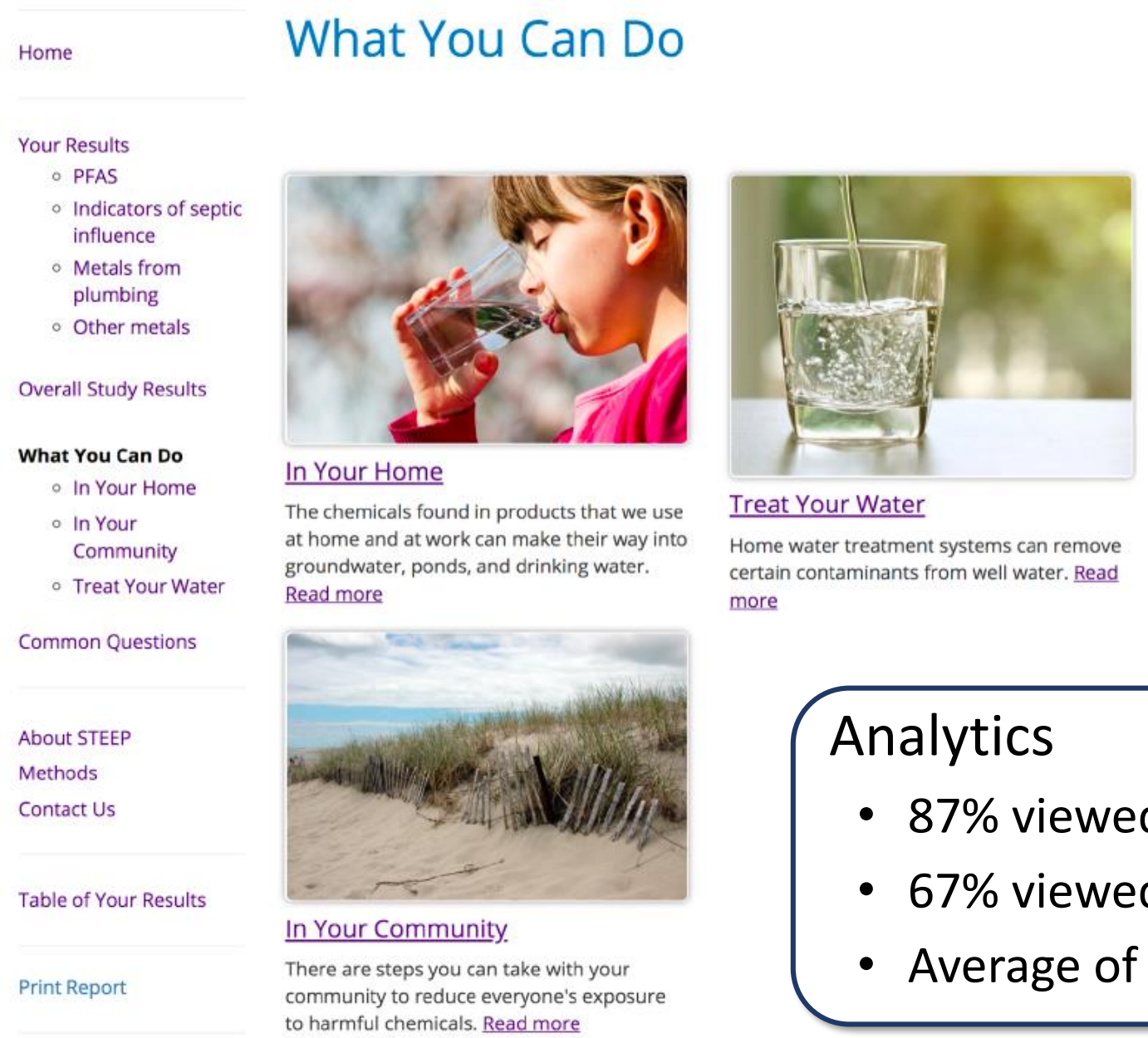

Analytics

- 87% viewed online report
- 67% viewed on first day
- Average of 5.4 page views

View a sample report: https://steep.reportback.org/r/report/demo

Focus groups with study volunteers to assess motivations and barriers to well water testing

7 focus groups in 2020 and 2021 included:

- Private well study volunteers who had received well water results
- Volunteers whose well had not yet been tested

DATE	Female	Male	Total	Well water sampled?
9/14/20	3	6	9	Yes
10/8/20	4	3	7	Yes
2/16/21	7	1	8	Yes
2/24/21	1	6	7	Yes
3/9/21	4	4	8	No
3/16/21	1	3	4	No
3/17/21	6	2	8	No

Preliminary focus group findings

Motivations to test

- Moving into a new home
- Awareness of local environmental pollution
- Concern for personal or family health

Barriers to test

- Lack of a "trigger" event – a move, a local pollution event, etc.

Overall testing

- Most focus group members do not follow state guidelines for routine water testing

Participant interviews

- 20-minute interviews with participants in well study (n=20)
- Interview questions:
  - Motivation for participating in the study
  - Reactions, take-aways from the report
  - Specific feedback on the report
  - Findings of the study as a whole
  - Actions considered/taken as a result of the study
- Interviews transcribed and coded, analyses of major themes underway

Preliminary themes from interviews

- Appreciation for information provided in the report
- Awareness of Cape water issues
- Many participants do not conduct regular well testing
- Results reaffirmed prior knowledge
- Many participants preferred viewing printed report rather than online report
- Participants have shared their results with their neighbors or in social groups (colleagues, community groups, etc.)

Reanalysis of Round 1 samples

- Applied solid phase extraction (SPE) methods (Lohmann Lab, URI) on Round 1 samples with at least 1 detection in initial analyses
- Additional PFAS detected:
  - Previously not found: PFNA, PFUnDA, PFDoDA, PFTeDA, 6:2 FTS, FOSA, PFPeS
  - Additional compounds: FBSA, HFPO-DA, FHxSA
- SPE analyses conducted on samples after long holding time, concentrations are likely underestimates

Round 2 private well sampling (2021)

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Private well water sample collection protocol
Updated September 2021

About this kit

This water sample testing kit contains bottles to test your water for:

- PFAS
- Boron and trace metals, including lead and copper
- Nitrate

This test kit includes:

- Plastic gloves
- Bottles for sampling. You will fill the bottles in this order:
  1) 0.5-liter HDPE bottle for PFAS (P)
  2) 250 mL HDPE bottle for boron and trace metals (B)
  3) 250 mL HDPE bottle for nitrate (N)
- A form for you to fill out about your sample
- Plastic bags to place water samples in. Bags are labeled to indicate which sample bottle should be placed in each bag.

STEP 5. Collect the first sample in the 0.5-liter bottle with (P) (PFAS)

- Take the 0.5-liter bottle out of the plastic bag.
- Open the sample bottle. Do not set cap down or let anything touch the inside of the cap or bottle.
- Rinse the bottle by filling it one-quarter full, putting the lid back on, shaking the bottle, taking the lid off, and pouring out the water.
- Rinse the bottle two more times in the same way.
- Fill the sample bottle to the top (see example on the left) and replace the cap.
- Put the bottle back in the Ziploc bag.

We pivoted to participants collecting their own water samples due to pandemic

Precautions when collecting samples

We are measuring PFAS chemicals that are common in many household items, so it's important to avoid these types of products when you are collecting a sample of your water.

When collecting your water sample, **avoid**:

- Wearing Gore-Tex treated or other waterproof apparel, including boots.
- Fast food packaging (such as wrappers for sandwiches or burgers and microwave popcorn bags) in close proximity to where you will be collecting the water sample.
- Touching the inside of the lid or the threads at the top of the sampling bottles. Minimize the amount of time that bottles are open.

STEP 3. Collect the first sample in the 0.5-liter bottle with (P) (PFAS)

- Take the empty 0.5-liter bottle out of the plastic bag.
- Open the sample bottle. Do not set cap down or let anything touch the inside of the cap or bottle.
- Open the bottle labeled "PFAS field blank water" and pour all of this water into the empty bottle. The bottle should be filled to the fill line.
- Replace the cap on both bottles.
- Put the bottles back in the Ziploc bags.

Trainee Emily Kaye explaining instructions to participant

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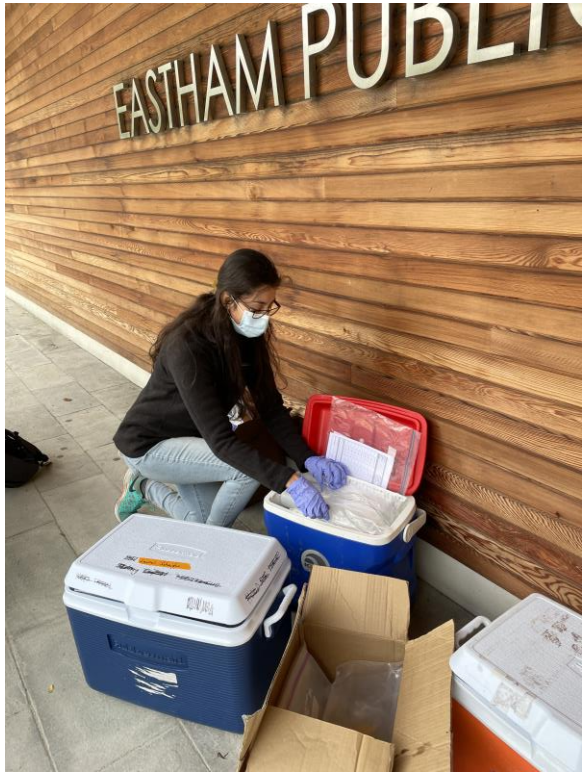
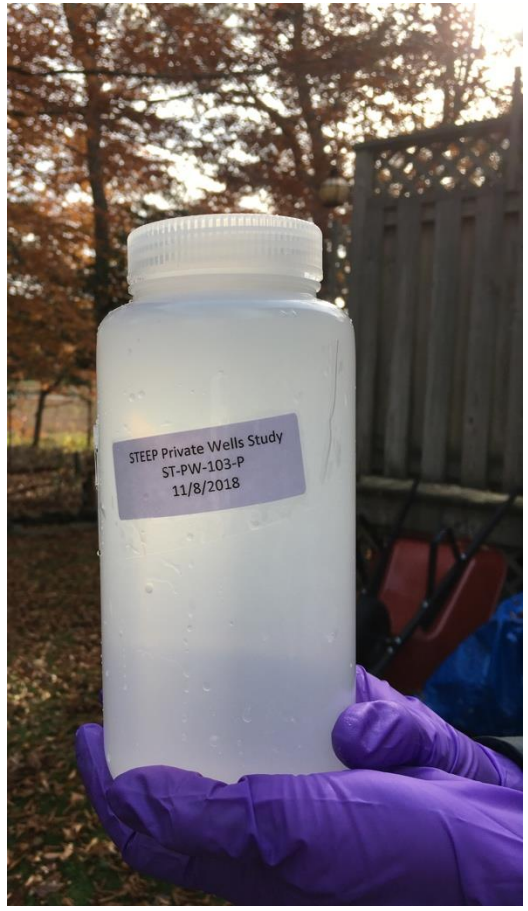


➤ *Silent Spring Institute research assistant Bethsaida Cardona*

➤ *Volunteers Betty Anne Bevis and Farley Lewis from Massachusetts Breast Cancer Coalition and CEC co-lead Laurel Schaider (Silent Spring)*

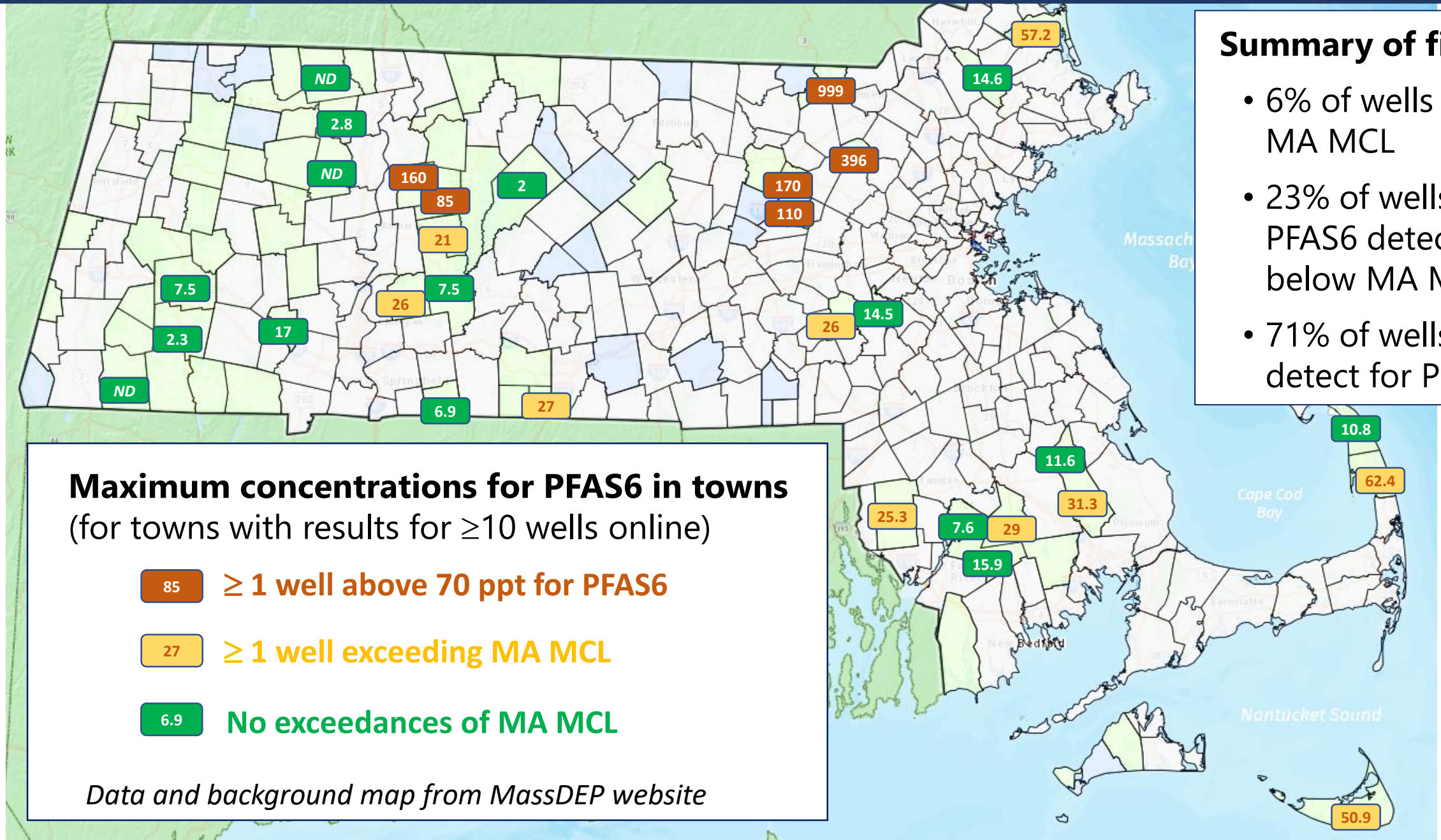
CEC co-lead Alyson McCann (URI) being interviewed by WCAI local radio station ➤

Next steps and future data analysis



- Analyze samples from 65 additional wells sampled in Round 2 (2021) with SPE method in Lohmann lab (URI)
- Evaluate associations between PFAS and:
  - Well depth
  - Density of residential development
  - Proximity to potential sources (landfills, fire stations, car washes, wastewater discharges to groundwater)
- Evaluate possible sources near highest wells

RESULTS FROM MASSDEP PRIVATE WELLS TESTING



Summary of findings

- 6% of wells exceed MA MCL
- 23% of wells with PFAS6 detected below MA MCL
- 71% of wells non-detect for PFAS6

Maximum concentrations for PFAS6 in towns

(for towns with results for ≥10 wells online)

85 — ≥ 1 well above 70 ppt for PFAS6

27 — ≥ 1 well exceeding MA MCL

6.9 — No exceedances of MA MCL

Data and background map from MassDEP website

Acknowledgements

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- Silent Spring Institute:
  - Katie Boronow, Erik Haugsjaa, Cheryl Osimo, Lauren Richter (now at RISD)
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- STEEP Cape Cod Advisory Committee
- Barnstable County Water Quality Laboratory

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pfas-exchange.org

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