PFAS in Tribal Lands*

Dr. Kimberly Garrett
Northeastern University
(she/they)

Tribal PFAS Working Group Open House | 14 December 2023

SSEHRI

PFAS Project Lab
Northeastern University

Northeastern University
Social Science Environmental Health Research Institute

PFAS Project Lab

Northeastern University

www.pfasproject.com

Photo: Members of the PFAS Project Team at the 2022 Third National PFAS Conference

The PFAS Project Lab studies social, scientific, and political factors related to Per- and Polyfluoroalkyl substances (PFAS).

We produce rigorous, accessible research about the PFAS contamination crisis through collaborations with impacted communities, leading interdisciplinary researchers, and nonprofits.

We share this PFAS research with impacted communities and a broad range of other stakeholders.

Acknowledgements

PFAS Project Lab

Phil Brown

Alissa Cordner

Sam Ciaranca

Former Lab Members

Ricky Salvatore

Kira Mok

Tribal PFAS Working Group

Page Hingst

Kaylene Ritter

Attendees of the 2023 Tribal Lands and Environment Forum

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Critical Cartography

Maps & research aren't neutral.

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NSF National Science Foundation SES-1827817 and SES-2120510

This data comes from: publicly available environmental sampling, US Census Bureau (map files)

This data is analyzed by researchers at:

SSEHRI | PFAS Project Lab *Northeastern University*

Whitman College

Silent Spring Institute
Researching the Environment and Women's Health

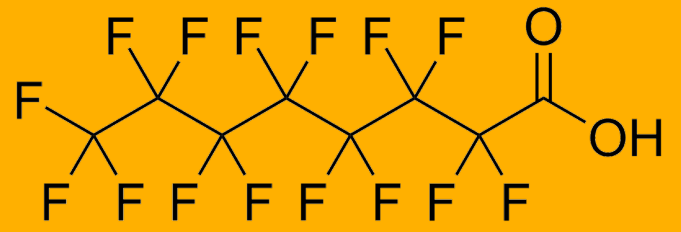
This data is available through:

- Presumptive and known contamination points are published at www.pfasproject.com and datasets are shared by request
- Peer-reviewed publications including Salvatore et al (2022) and Mok et al (2022).

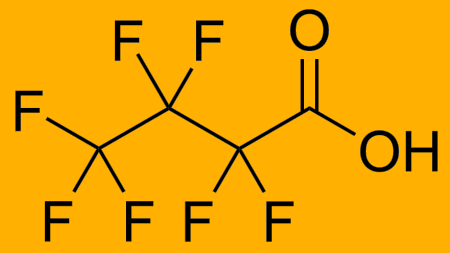
[1-4]

PFAS – “Forever Chemicals”

- Per- and polyfluoroalkyl substances
- Class of over 14,000 chemicals
- Characterized by fluorinated carbon(s)
- Known for
  - Ampiphobicity: repel both oil and water
  - Persistence
- Numerous industrial uses, non-stick cookware, waterproof clothing, cosmetics, firefighting foams…



PFOS (perfluorooctane sulfonate)



PFBA (perfluorobutanoic acid)

[5,6]

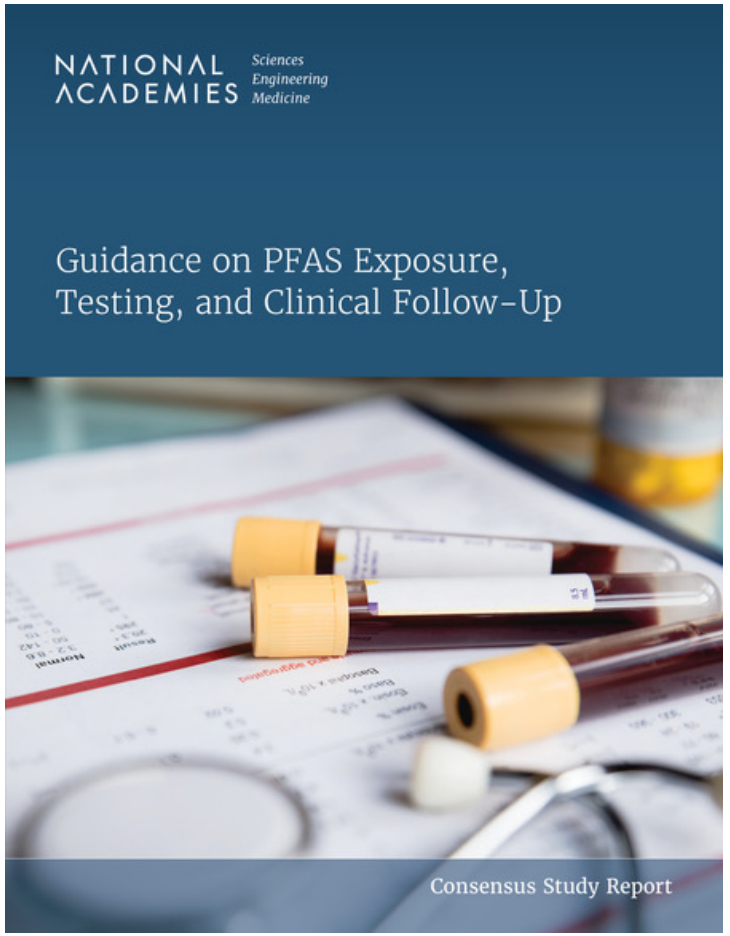
PFAS in the Environment

- Many PFAS remain in environmental media through conventional waste and water treatment methods.
- Some PFAS are carried through the water cycle and have been identified in rainwater around the world.
- Some sorb to soil and biosolids.
- PFAS have been identified in fish and game tissues, resulting in “do not eat” advisories.
- **Primary sources**: industrial facilities, airports, military bases
- **Secondary sources**: wastewater treatment plants, landfills

[7-10]

PFAS and Our Health

- In 2022, NASEM evaluated human health studies on 7 PFAS and identified “sufficient evidence of an association” between exposure and
  - Decreased antibody response
  - Dyslipidemia
  - Decreased infant and fetal growth
  - Increased risk of kidney cancers in adults
- PFOS was recently classified as a Group 1 carcinogen and PFOA as Group 2B



[11,12]

Whack-a-molecule

- Generally, EPA's approach to chemical regulation is chemical-by-chemical
- There are currently no enforceable national drinking water standards for any of the >14,000 PFAS chemicals.
- EPA has proposed enforceable Maximum Contaminant Levels (MCLs) for 6 PFAS, including PFOS and PFOA.
  - Were to be approved by the end of 2023 but have been delayed
- Some states have adopted MCLs for specific PFAS

The burden of demonstrating harm still falls largely on governments and the public, not the polluters.

[13-16]

Environmental Justice: “the right of all people to share equally in the benefits bestowed by a healthy environment”

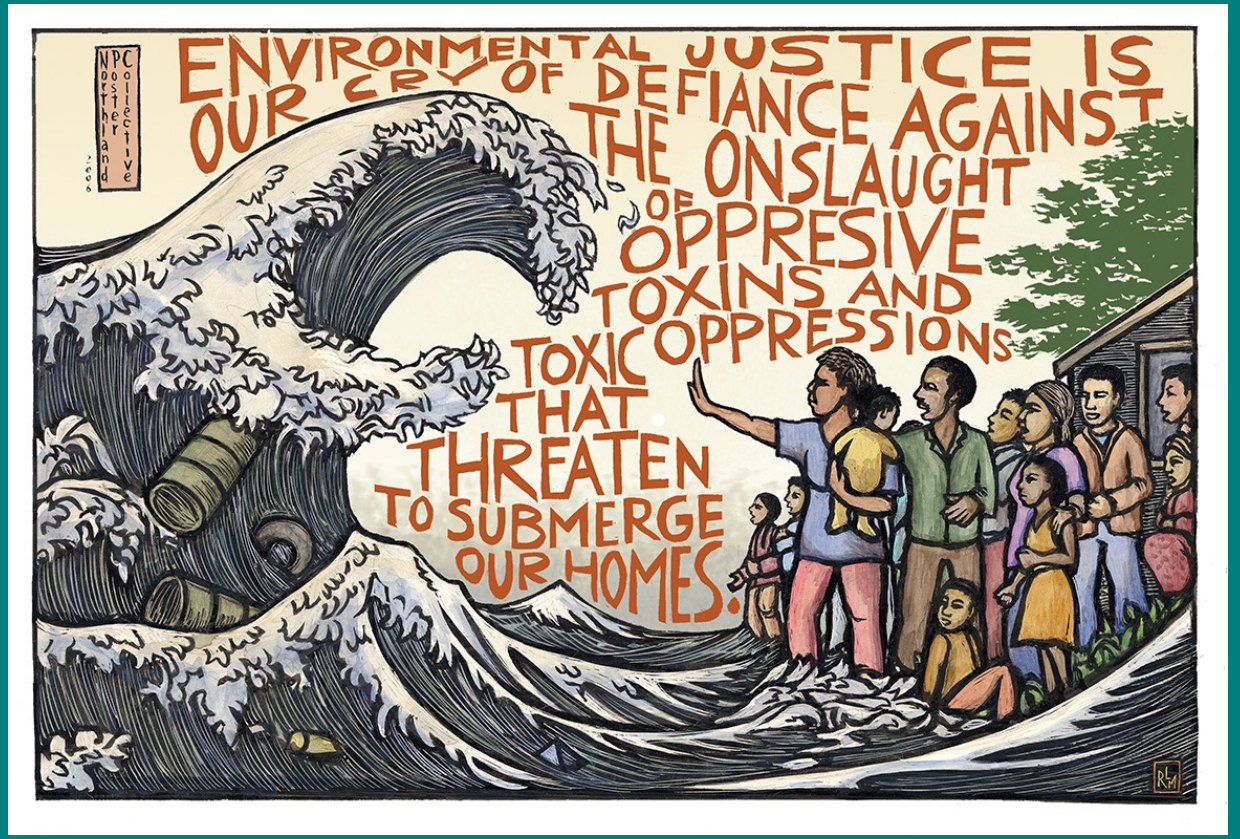


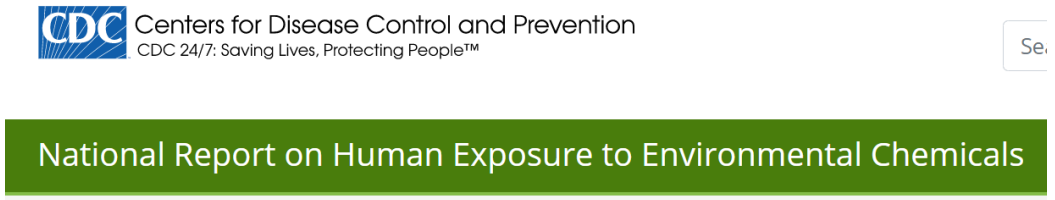
Image: Ricardo Lemins Morales, 2006

[17]

PFAS and Environmental Justice

PFAS exposure is ubiquitous. However…

CDC's NHANES: Non-Hispanic Black Americans and Asian Americans have highest exposure to certain PFAS



Liddie *et al*: PFAS sources & detections positively associated with communities of color

[10,18-20]

PFAS and Environmental Justice

PFAS exposure is ubiquitous. However…

- BIPOC, low income, and limited English populations disproportionately exposed to PFAS in New Jersey (Mueller et al. under review)
- Approximately ½ of U.S. carceral facilities are proximate to a presumptive PFAS contamination site (Poirier et al. under review)
- Tribal water systems and populations underrepresented in federal testing, and many Tribal lands are close to presumptive PFAS contamination sites

PFAS Project Lab work

[4]

PFAS and Indigenous Communities

- Water contamination (drinking and otherwise)
- Bioaccumulation in subsistence fish and game
- Land contamination
- Extension of colonialism
  - Who's producing and polluting? Who bears the burden?
  - Result of occupation by military forces
- Intersections with other systemic injustices

Image: Joe Brusky (2013) Creative Commons License CC BY-NC 2.0

[1,9,10,21]

Testing the Waters

US EPA's **Unregulated Contaminant Monitoring Rule (UCMR):** requires public water systems (PWS) to test and establish prevalence of specific contaminants every 5 years.

UCMR3 (2013-2015)

- Required PWS that serve >10,000 people to test for 6 PFAS
- Also sampled 800 smaller systems at random

UCMR5 (2023-2025)

- Requires PWS that serve >3,300 people to test for 29 PFAS
- Will again sample 800 systems at random

[22-24]

Testing isn't distributed equally

Research Letter

A Section 508–conformant HTML version of this article is available at https://doi.org/10.1289/EHP11652.

Federal PFAS Testing and Tribal Public Water Systems

Kira Mok,[1] Derrick Salvatore,[2] Martha Powers,[1,3] Phil Brown,[1,3] Maddy Poehlein,[4] Otakuye Conroy-Ben,[5] and Alissa Cordner[6]

[1]Department of Sociology and Anthropology, Northeastern University, Boston, Massachusetts, USA
[2]Department of Marine and Environmental Sciences, Northeastern University, Boston, Massachusetts, USA
[3]Department of Health Sciences, Northeastern University, Boston, Massachusetts, USA
[4]PFAS Project Lab, Northeastern University, Boston, Massachusetts, USA
[5]School of Sustainable Engineering and the Built Environment, Arizona State University, Tempe, Arizona, USA
[6]Department of Sociology, Whitman College, Walla Walla, Washington, USA

https://doi.org/10.1289/EHP11652

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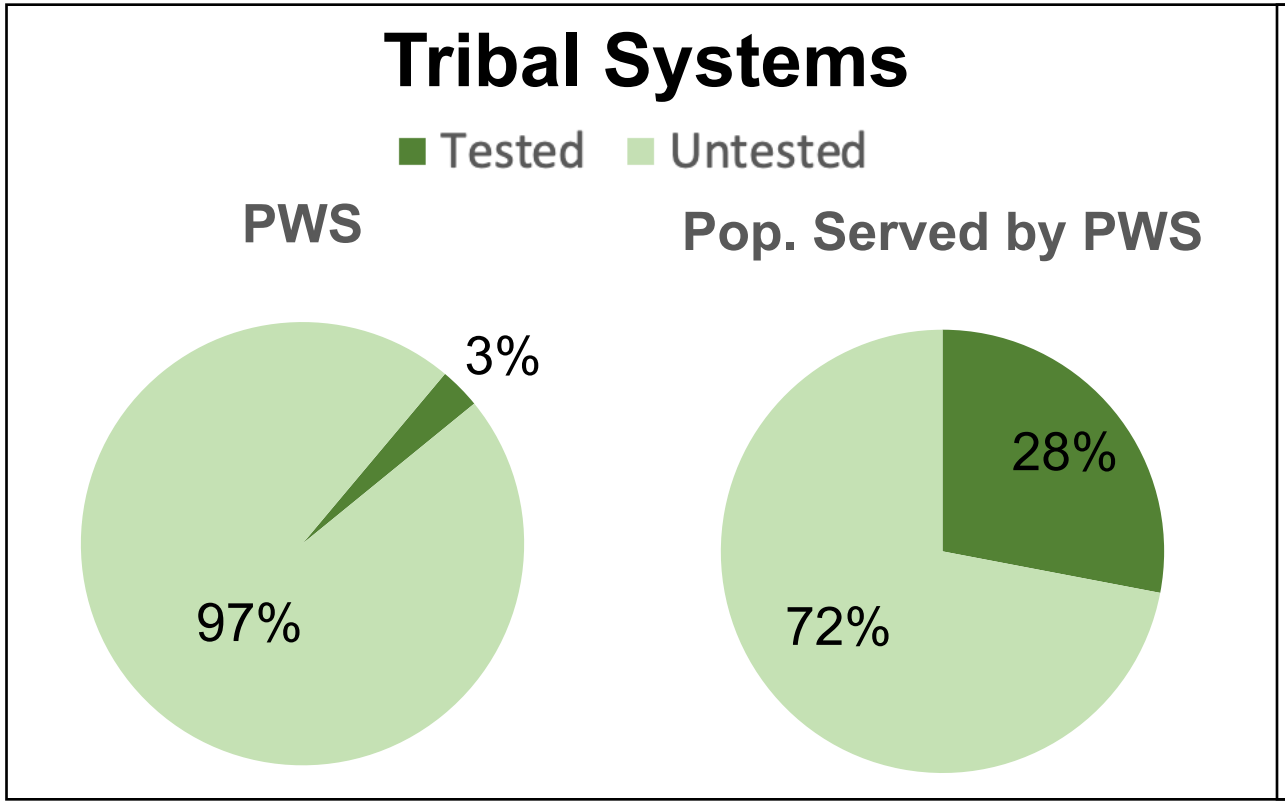
[4]

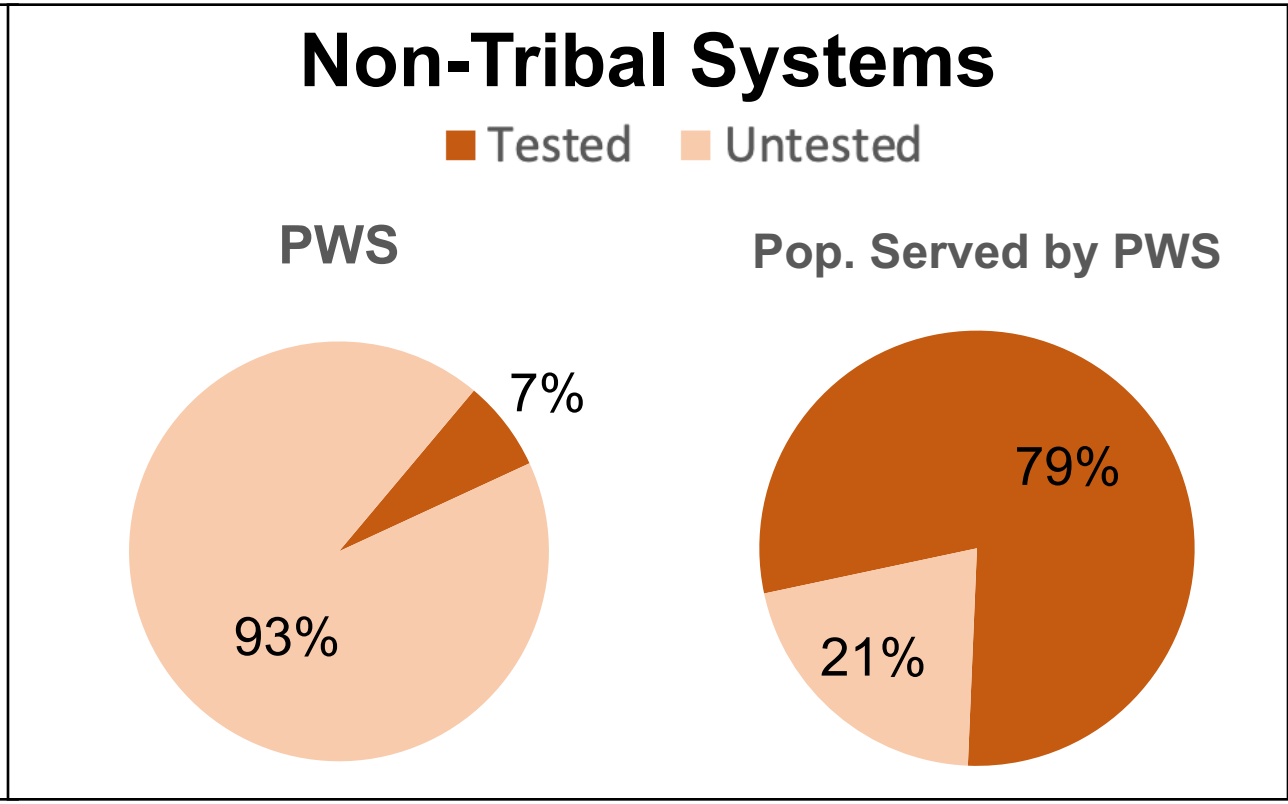
Study Methods

- Inclusion of Tribal PWS in Tribal vs. non-Tribal PWS sampled in UCMR3 and planned for sampling in UCMR5
- "Tribal PWS" had a "Native American" owner type in Safe Drinking Water Information System
- Interviews with EPA representatives

[4]

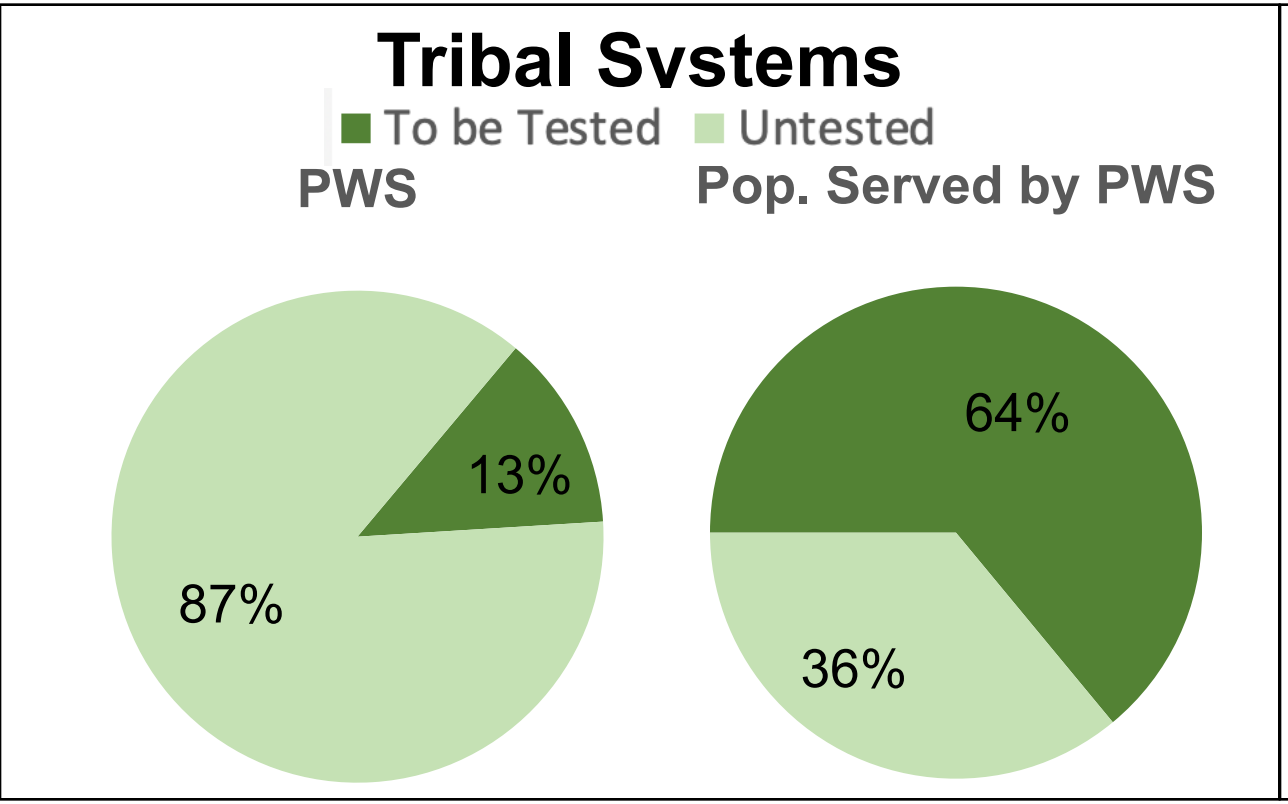
Tribal water systems and their communities were under-sampled for PFAS under UCMR3.

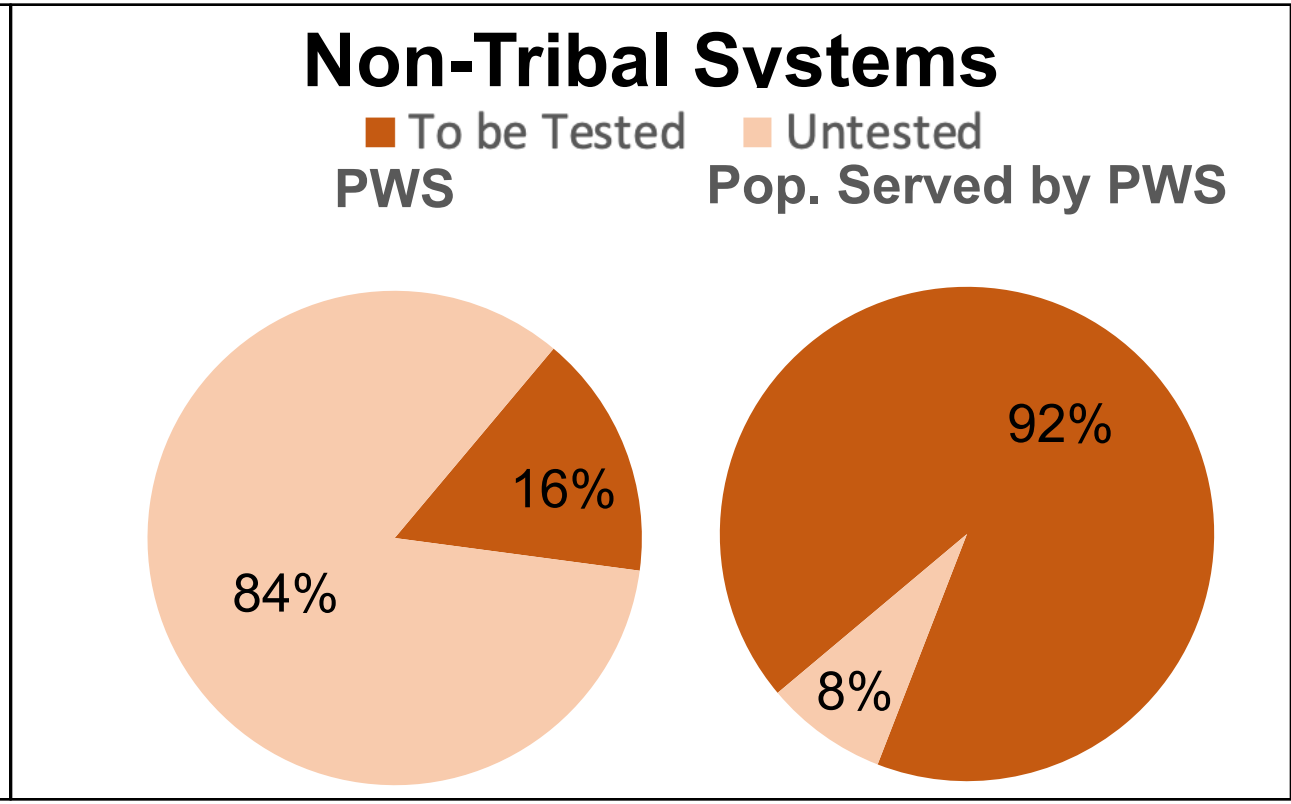




[4]

Under UCMR5, Tribal systems and their communities stand to be under-sampled for PFAS again.





[4]

“Our analysis shows that even systematic research may fail to equitably include certain populations.”

[4]

Accompanying Invited Perspective

Invited Perspective

A Section 508–conformant HTML version of this article
is available at https://doi.org/10.1289/EHP12187.

Invited Perspective: Tribal Water Issues Exemplified by the Navajo Nation

Lindsey Jones[1] and Jani C. Ingram[2]

[1]Water Infrastructure Finance Authority, Phoenix, Arizona, USA
[2]Department of Chemistry and Biochemistry, Northern Arizona University, Flagstaff, Arizona, USA

https://doi.org/10.1289/EHP12187

Refers to https://doi.org/10.1289/EHP11652

[25]

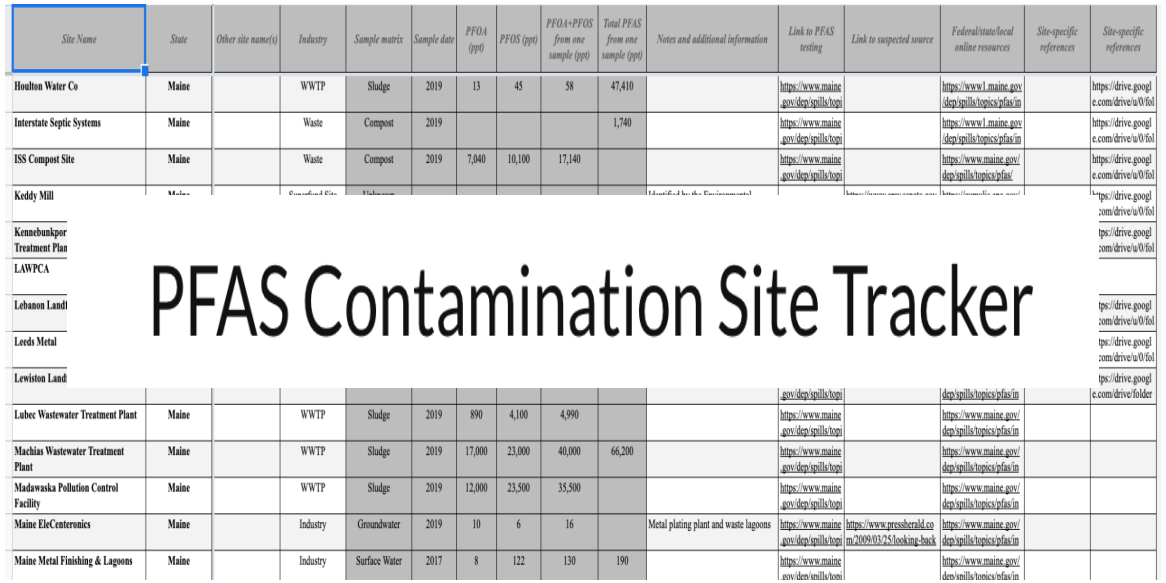
PFAS in the Environment

- Many PFAS remain in environmental media through conventional waste and water treatment methods.
- Some PFAS are carried through the water cycle and have been identified in rainwater around the world.
- Some sorb to soil and biosolids.
- PFAS have been identified in fish and game tissues, resulting in “do not eat” advisories.
- **Primary sources**: industrial facilities, airports, military bases
- **Secondary sources**: wastewater treatment plants, landfills

[7-10]

What we know about PFAS testing:

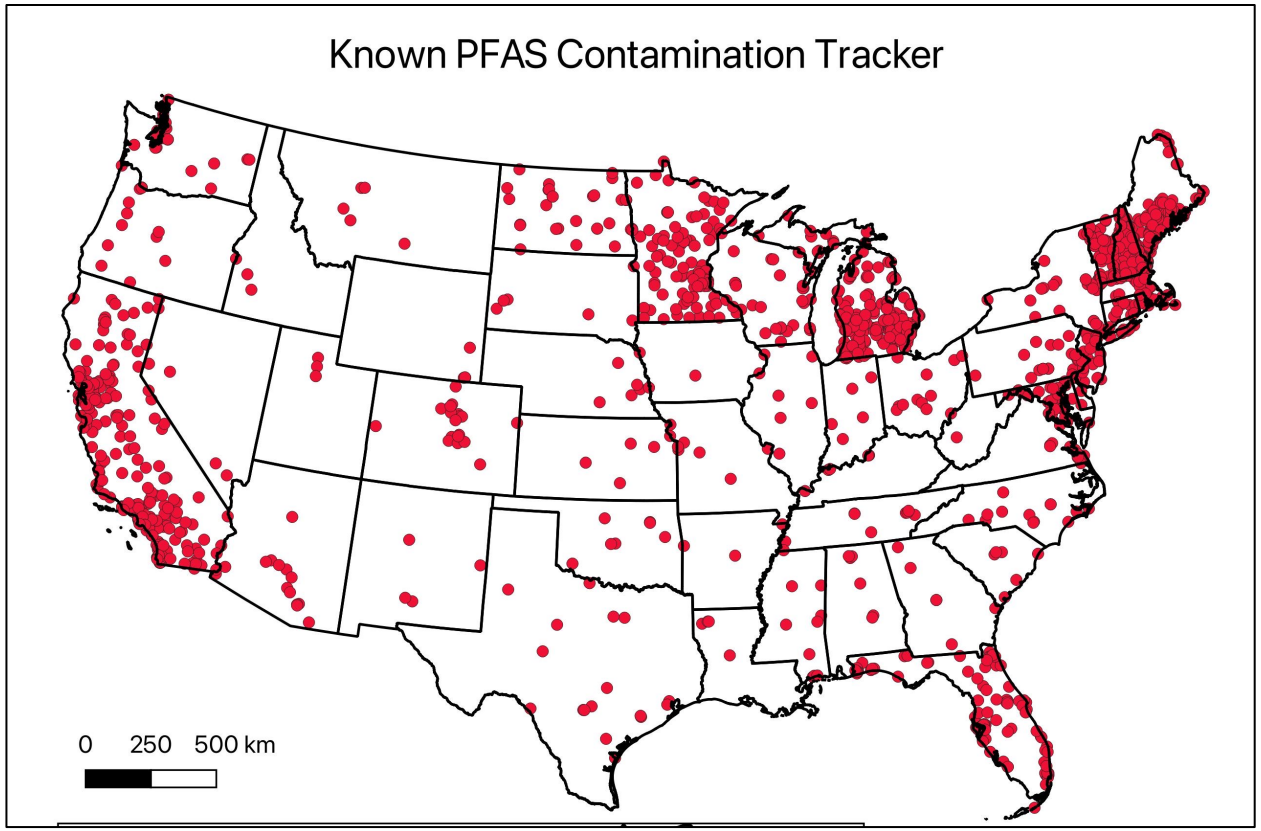
- Currently no systematic federal environmental testing and treatment
  - UCMR3 (2013-15) - small number of PFAS, high reporting levels, large water systems (>10,000 people)
  - UCMR5 (2023-25) requires public water systems serving >3,300 people to test for 29 PFAS
- Environmental PFAS testing occurs on a state-by-state basis

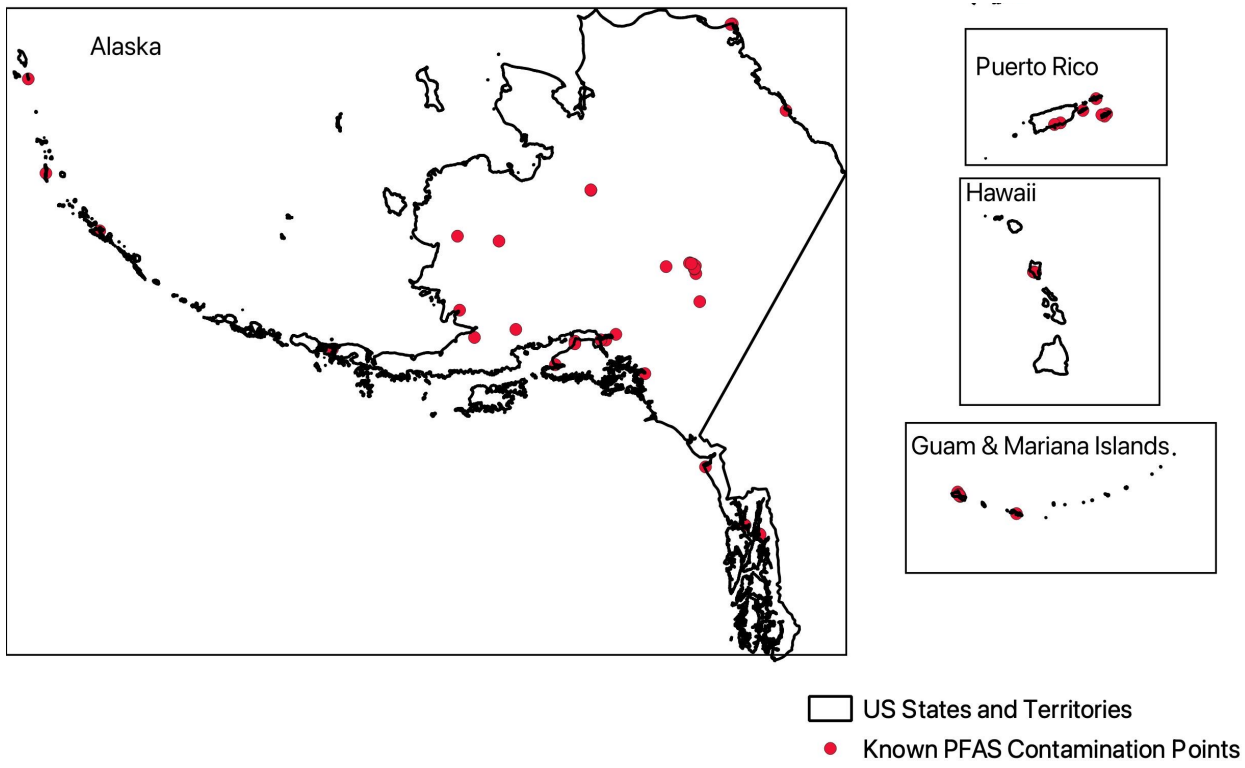


www.pfasproject.com/pfas-sites-and-community-resources

[15,23,24,26]

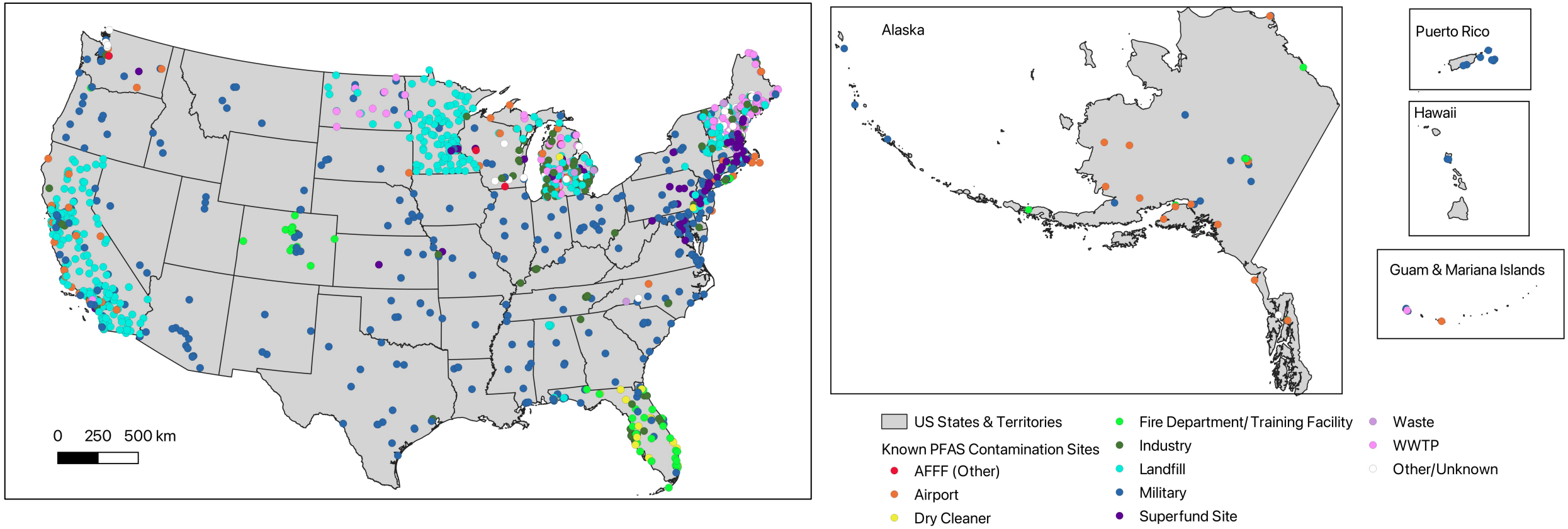
Known PFAS Contamination Sites





[3,26]

Known PFAS Contamination Sites (Unpublished)



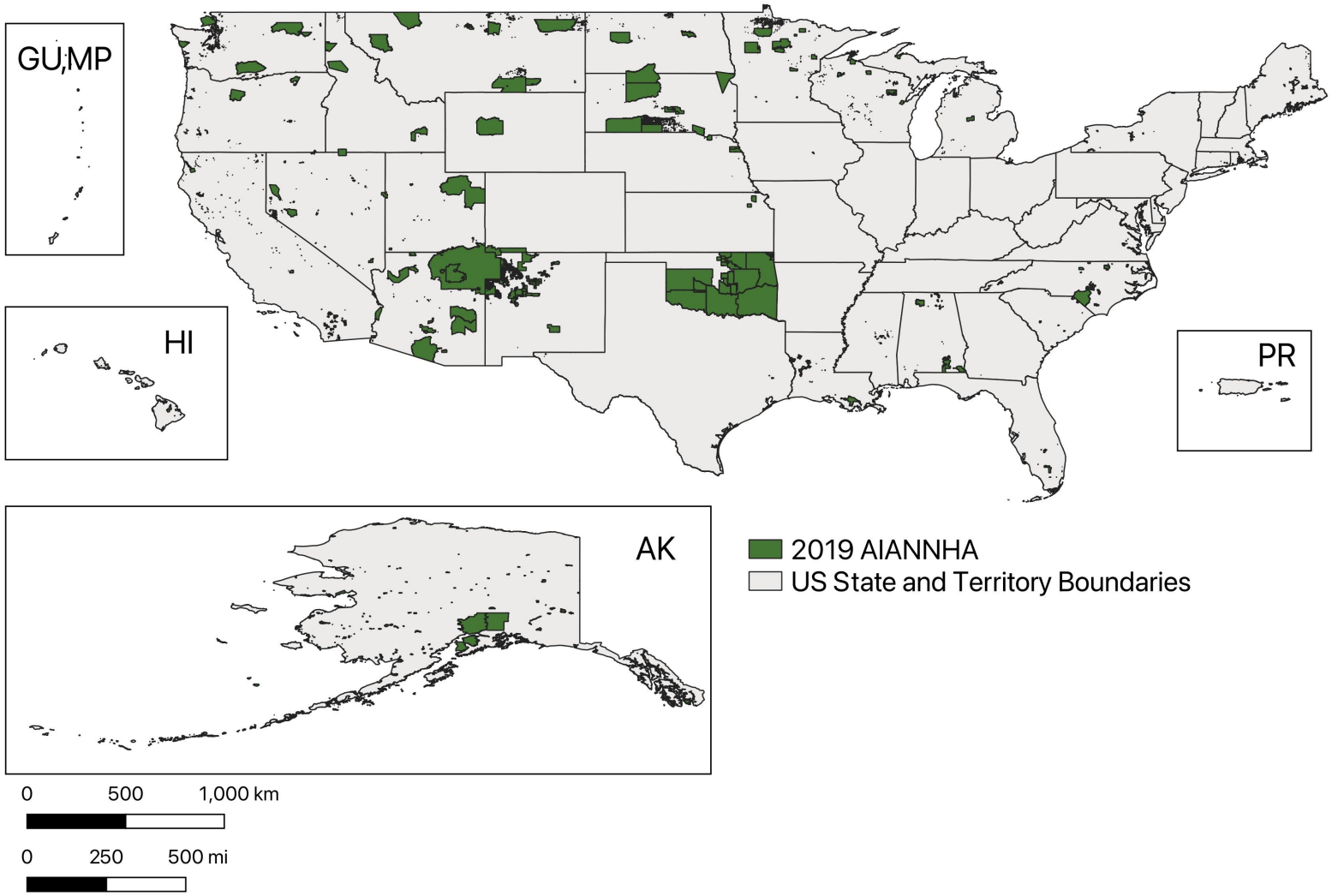
[26,36-38]

What do we know about PFAS sites on Tribal Lands?

What do we know about PFAS sites on Tribal Lands*?

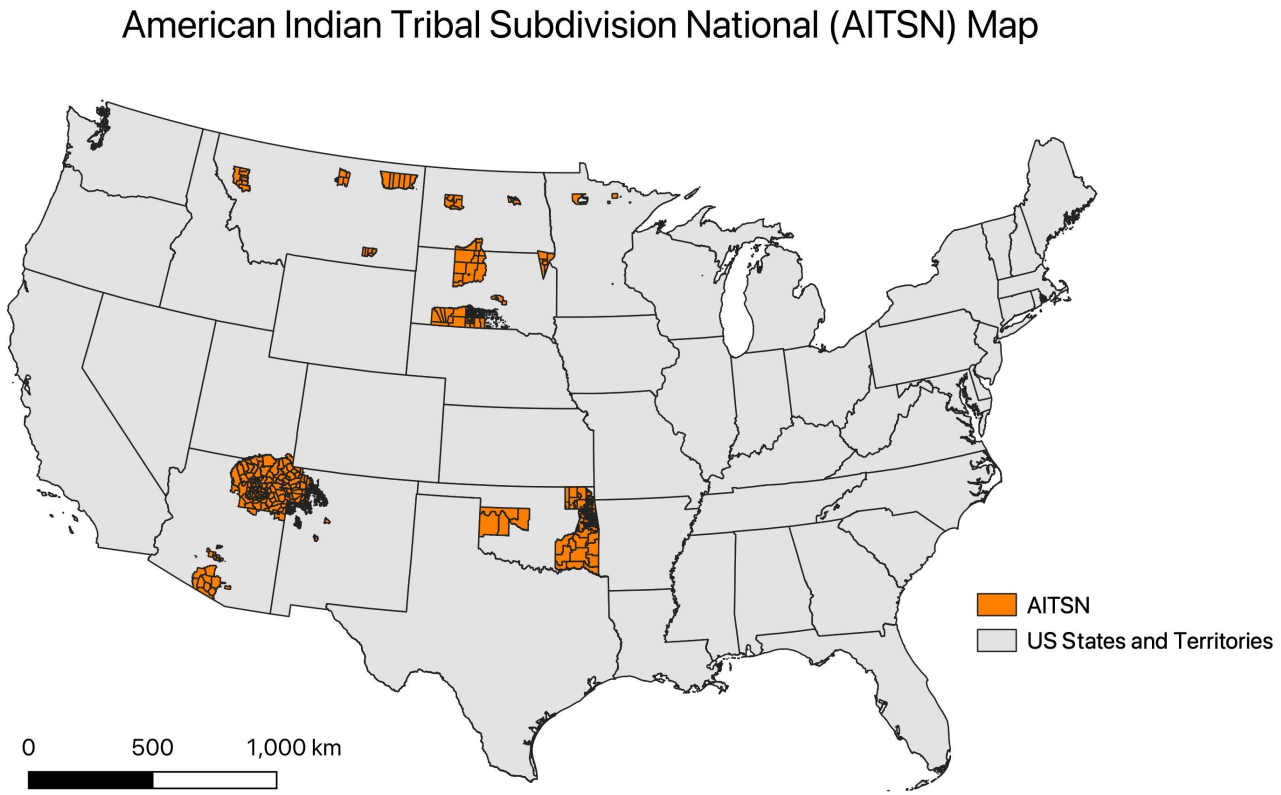
*US Census map for AIANNHA (2019)

(Alaska Native Regional Corporations (ANRC), Tribal Subdivisions, American Indian Reservations (AIR), Hawaiian Home Lands (HHL), Alaska Native Village Statistical Areas (ANVSA), Oklahoma Tribal Statistical Areas (OTSA), State Designated Tribal Statistical Areas (SDTSA), Tribal Designated Statistical Areas (TDSA), American Indian Joint-Use Areas (AIJUA))



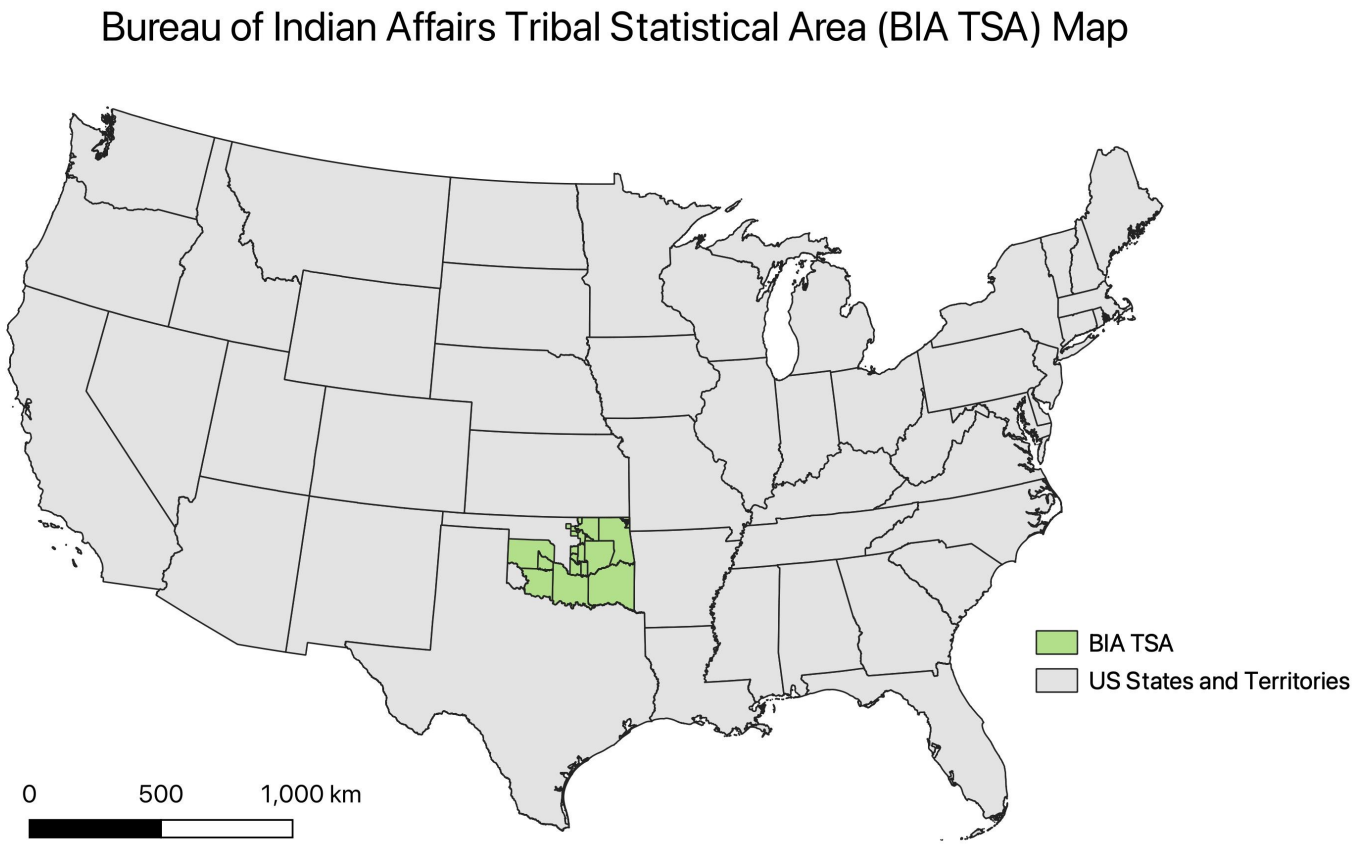
[27,28]

*American Indian Tribal Subdivision National (AITSN) Map



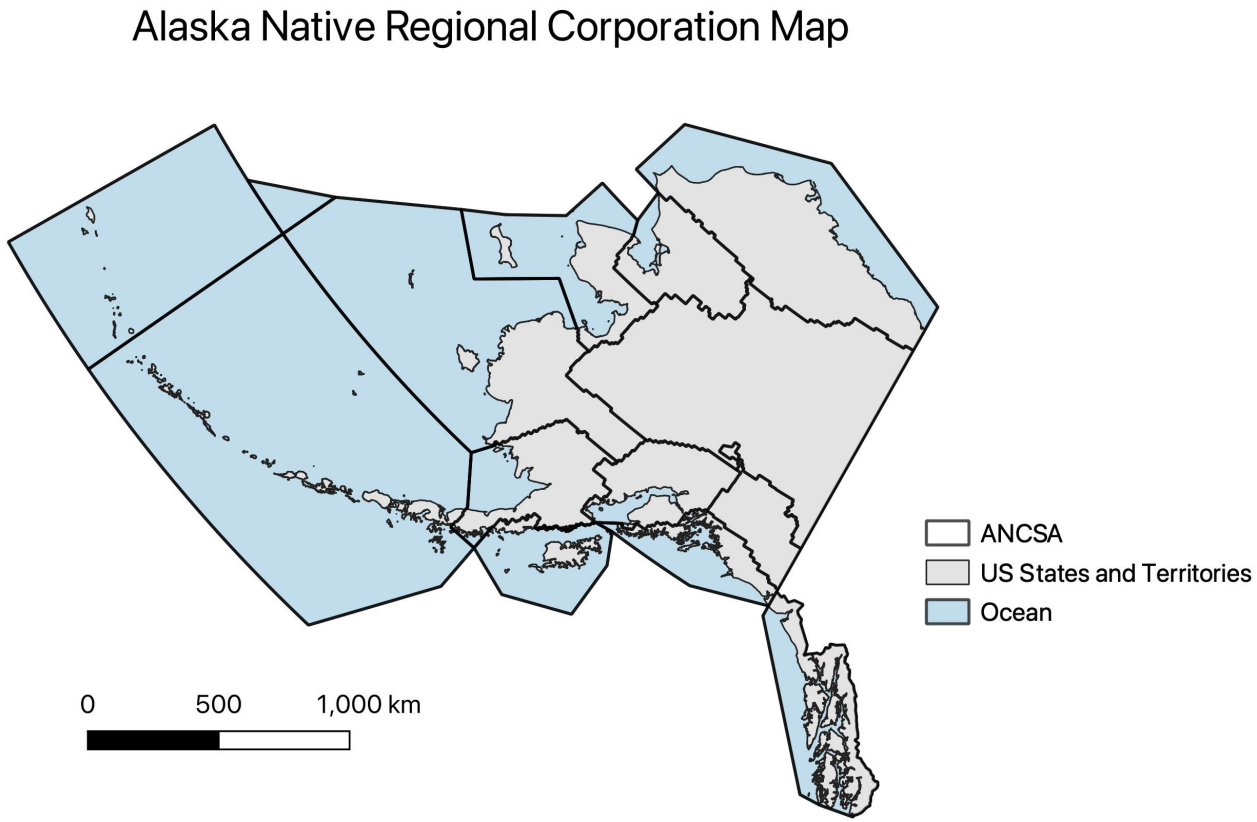
[27,29]

*Bureau of Indian Affairs Tribal Statistical Area (BIA TSA) Map



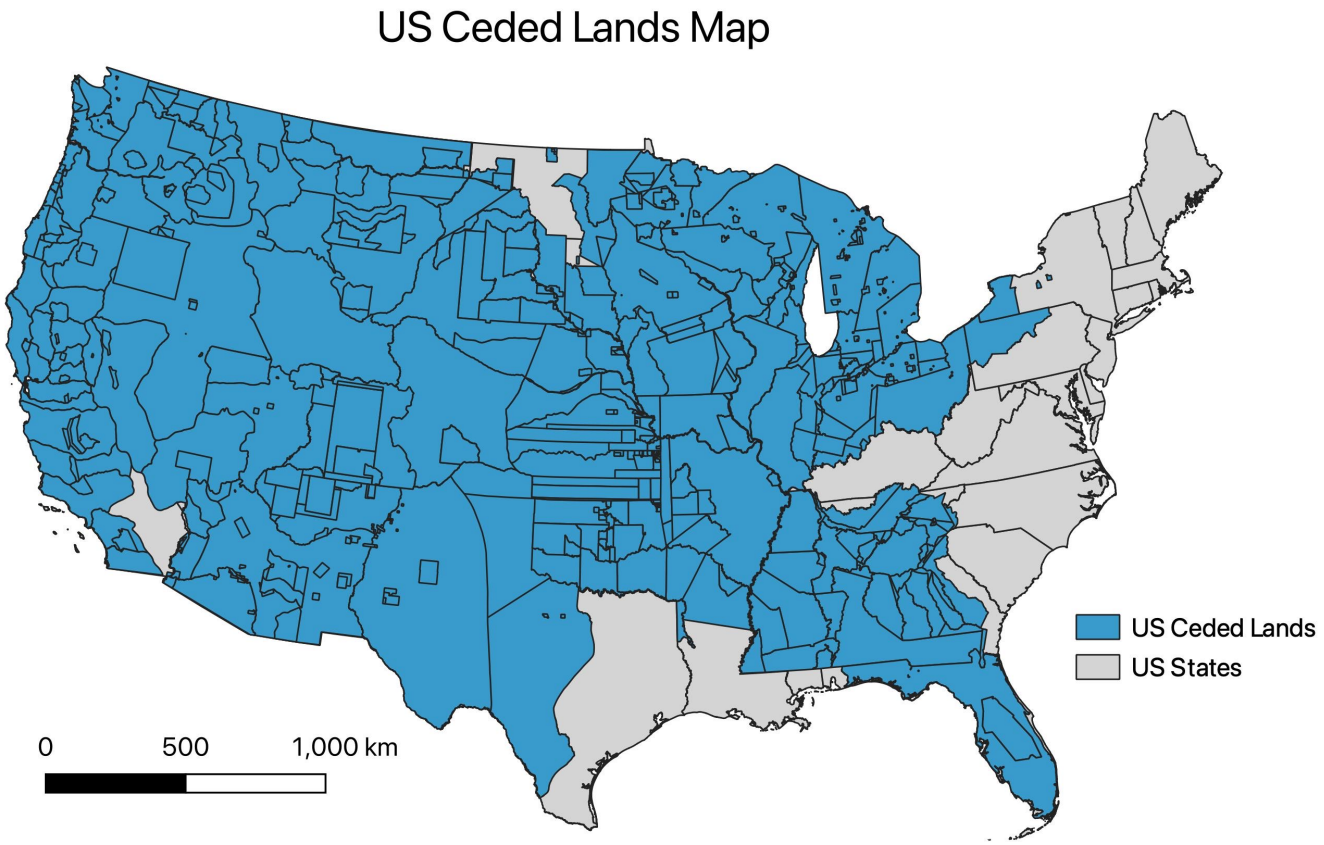
[27,30]

*Alaska Native Regional Corporation/Statistical Areas (ANRC/ANCSA) Map



[27,31,32]

*Ceded Territories Map

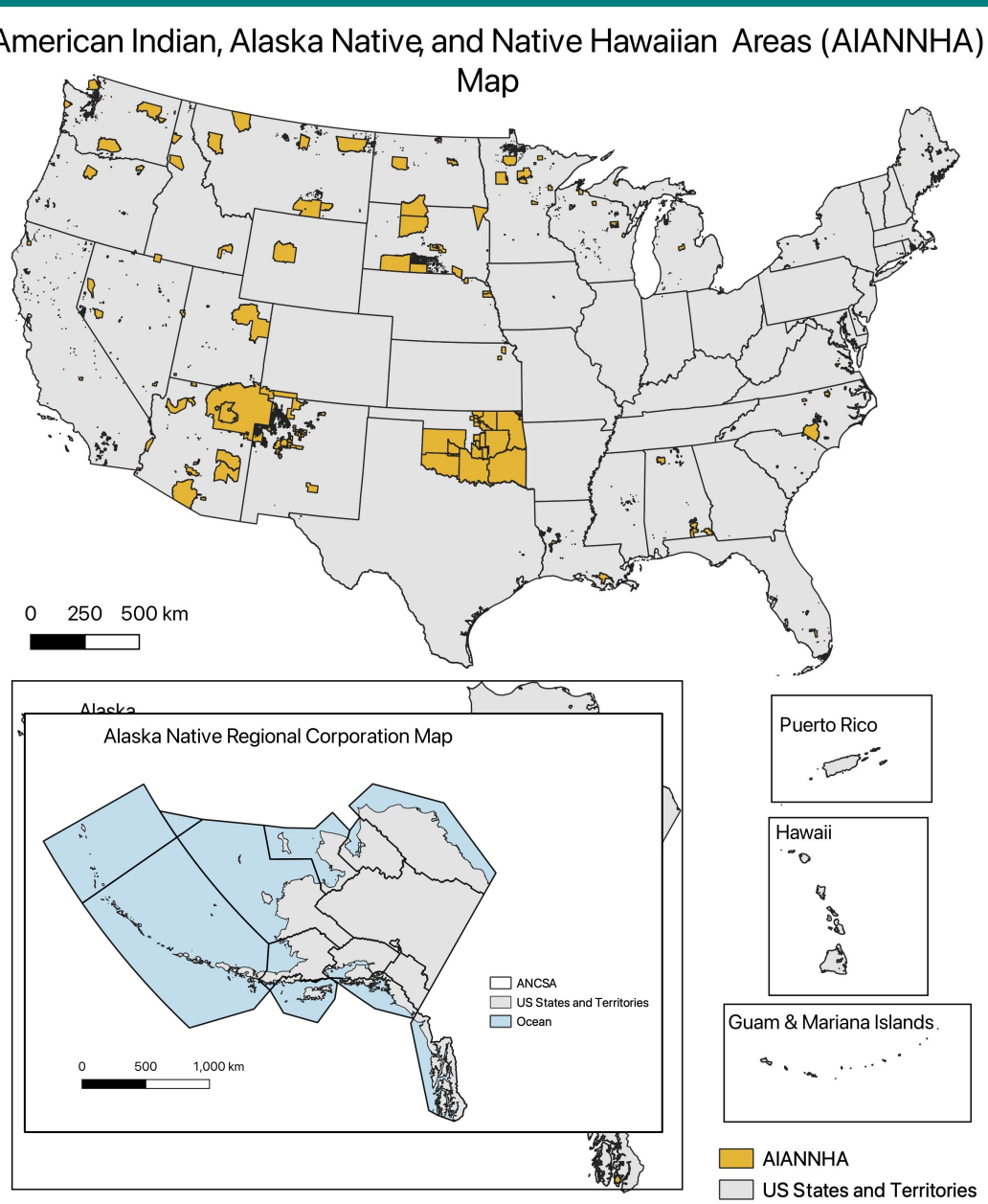


[27,33,34]

Tribal Lands Map (AIANNHA + ANRC)

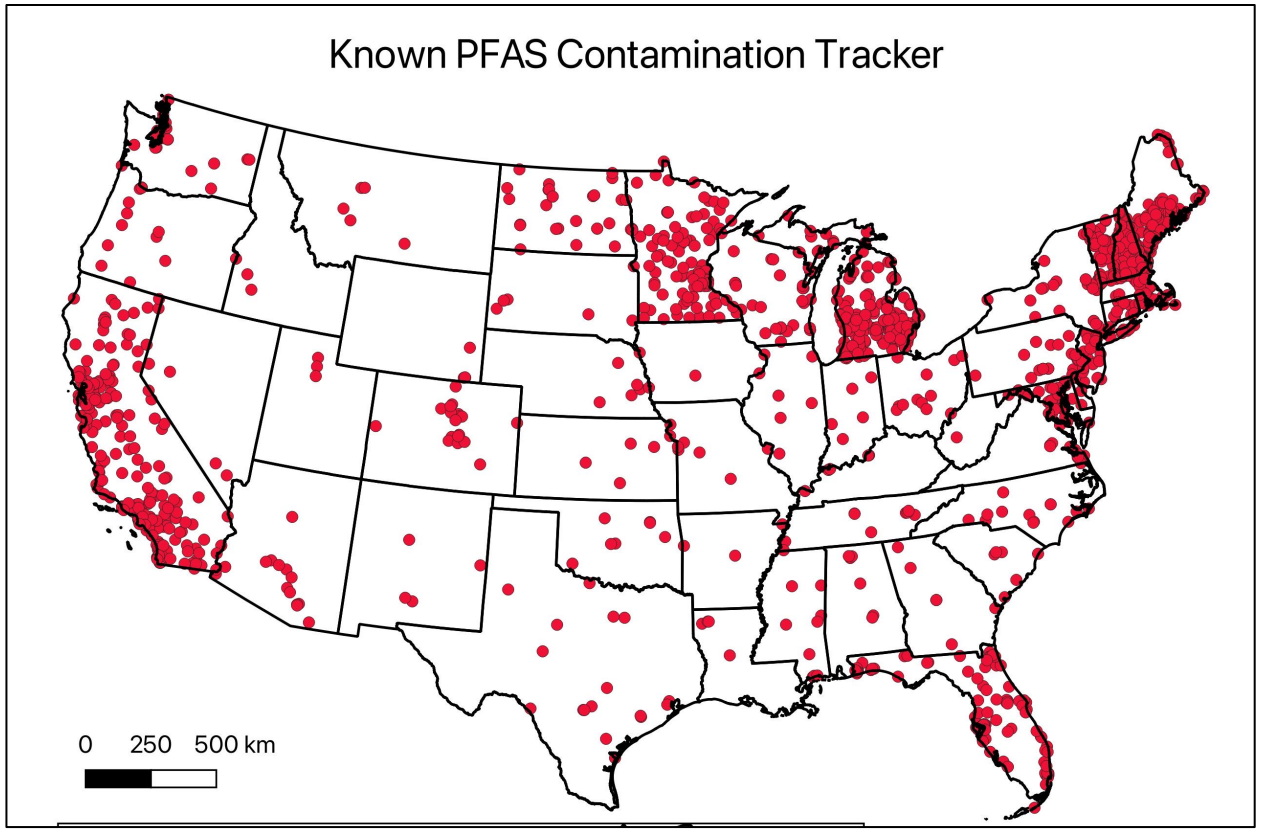
- Should I use a different representation of your land?
- Are there areas that are not included in this map that should be?
- Would you like your area to be excluded from analysis?

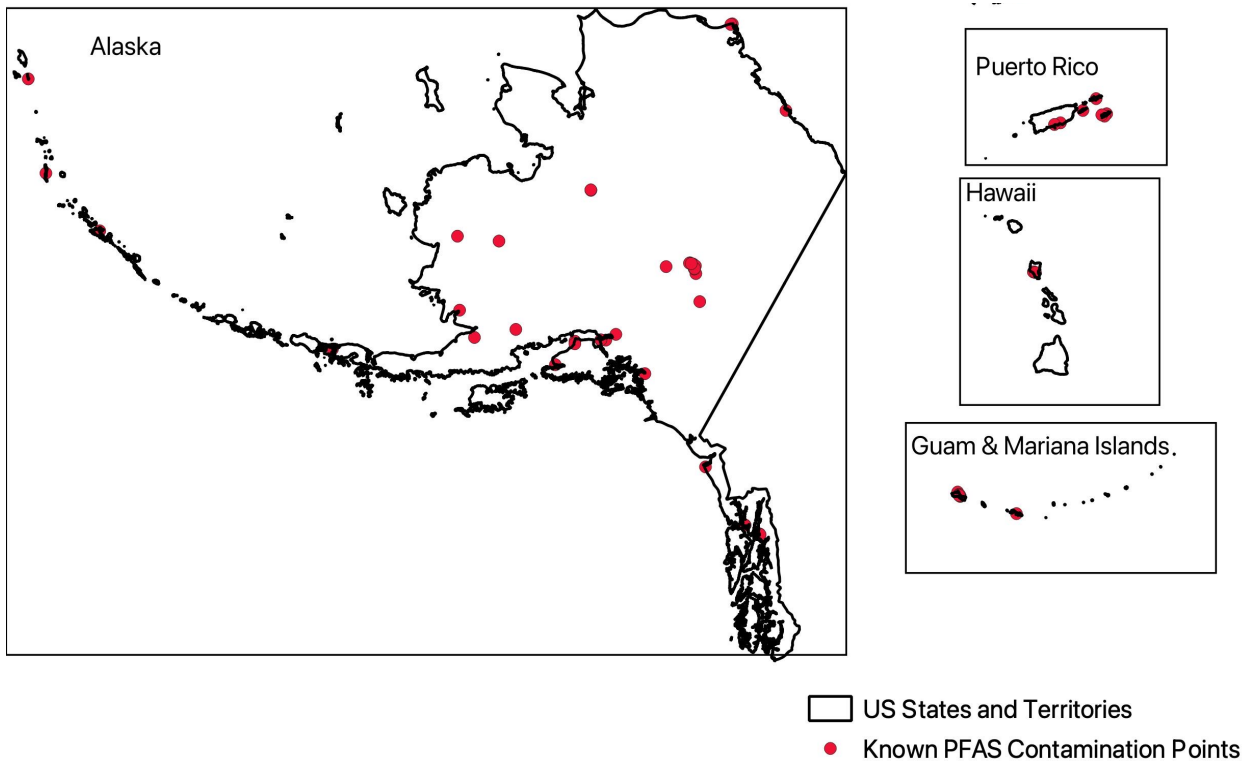
k.garrett@northeastern.edu



[27,28,32]

Known PFAS Contamination Sites





[3,26]

Preliminary Analysis (Unpublished)

Table 2. Known PFAS Contamination Sites within Tribal areas compared to US States and Counties

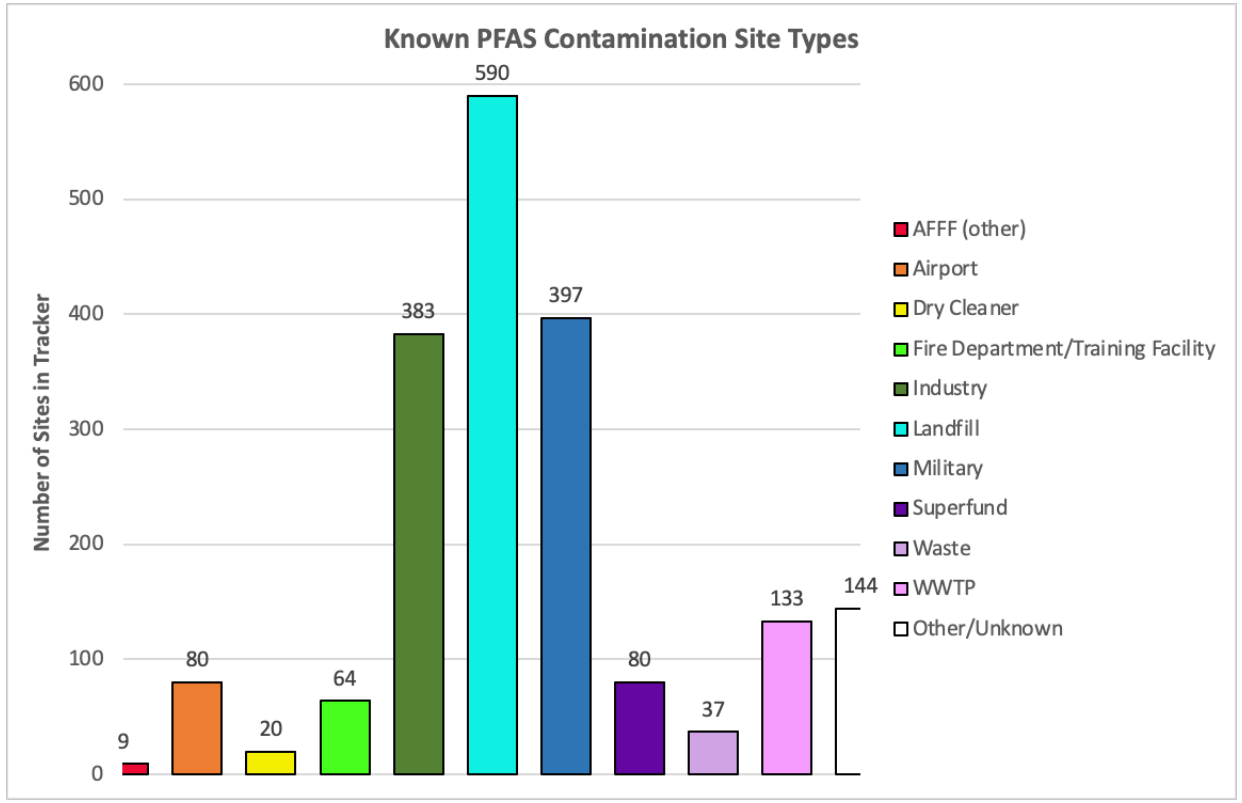
Area Unit	n	Total Sites	Average sites per unit (±SE)	Median sites per unit	Maximum sites per unit	Average sites per million km^2 (±SE)	Median sites per million km^2	Maximum sites per million km^2	Average sites per 100,000 population (±SE)	Median sites per 100,000 population	Maximum sites per 100,000 population
State	56	1938	35 (±11)	8	471	1.4 (±0.51)	0.08	20	1.6 (±0.65)	0.22	34
County	3234	1938	0.6 (±0.07)	0	110	0.35 (±2.1)	0	61	0.98 (±0.10)	0	151
AIANNHA	695	22	0.03 ($\pm 8.8 \times 10^{-3}$)	0	3	0.30 (±0.12)	0	48	3.2 (±1.6)	0	926
ANCSA	12	45	3.4 (±1.3)	2.5	16	0.013 (±0.0052)	0.0055	0.059	14 (±4.8)	6.9	47
Tribal Areas*	487	52	0.1 (±0.04)	0	16	0.025 (±0.35)	0	5.6	0.47 (±0.19)	0	53
Ceded Territories	718	1024	1.4 (±0.29)	0	147	0.34 (±0.086)	0	33	N/A	N/A	N/A

*Merger of AIANNHA and ANCSA boundaries

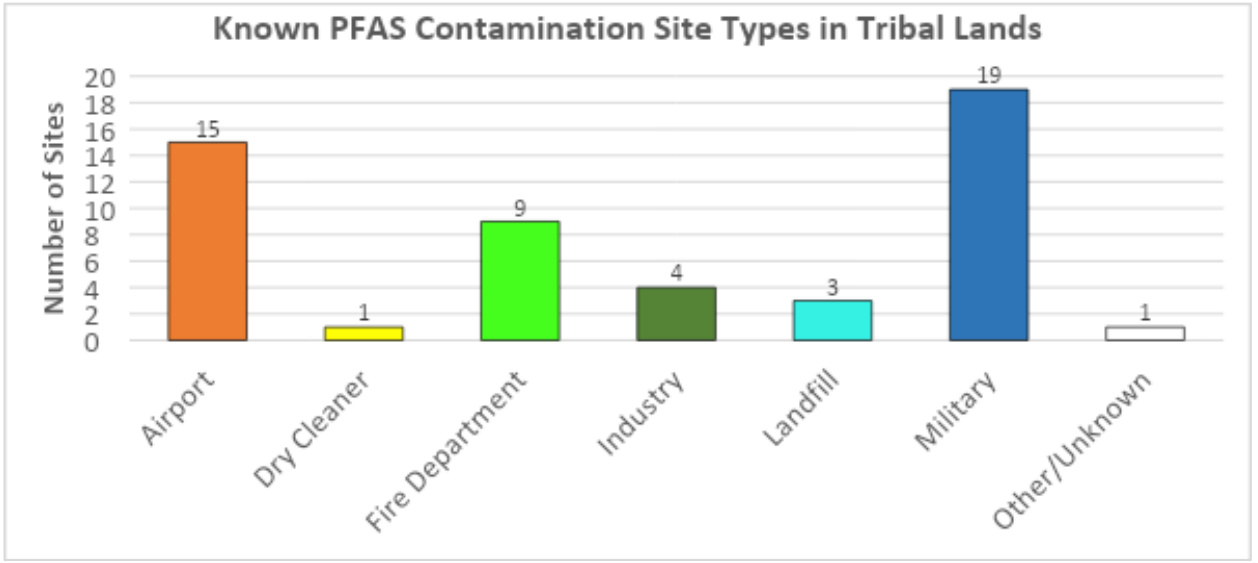
[27-35]

Knowledge Gaps (Unpublished)

Full Dataset



Tribal Areas



[26]

The Presumptive PFAS Contamination Model

ENVIRONMENTAL Science & Technology LETTERS

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Letter

Presumptive Contamination: A New Approach to PFAS Contamination Based on Likely Sources

Derrick Salvatore, Kira Mok, Kimberly K. Garrett, Grace Poudrier, Phil Brown, Linda S. Birnbaum, Gretta Goldenman, Mark F. Miller, Sharyle Patton, Maddy Poehlein, Julia Varshavsky, and Alissa Cordner*

Cite This: https://doi.org/10.1021/acs.estlett.2c00502 Read Online

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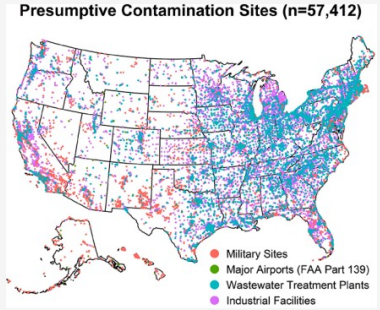
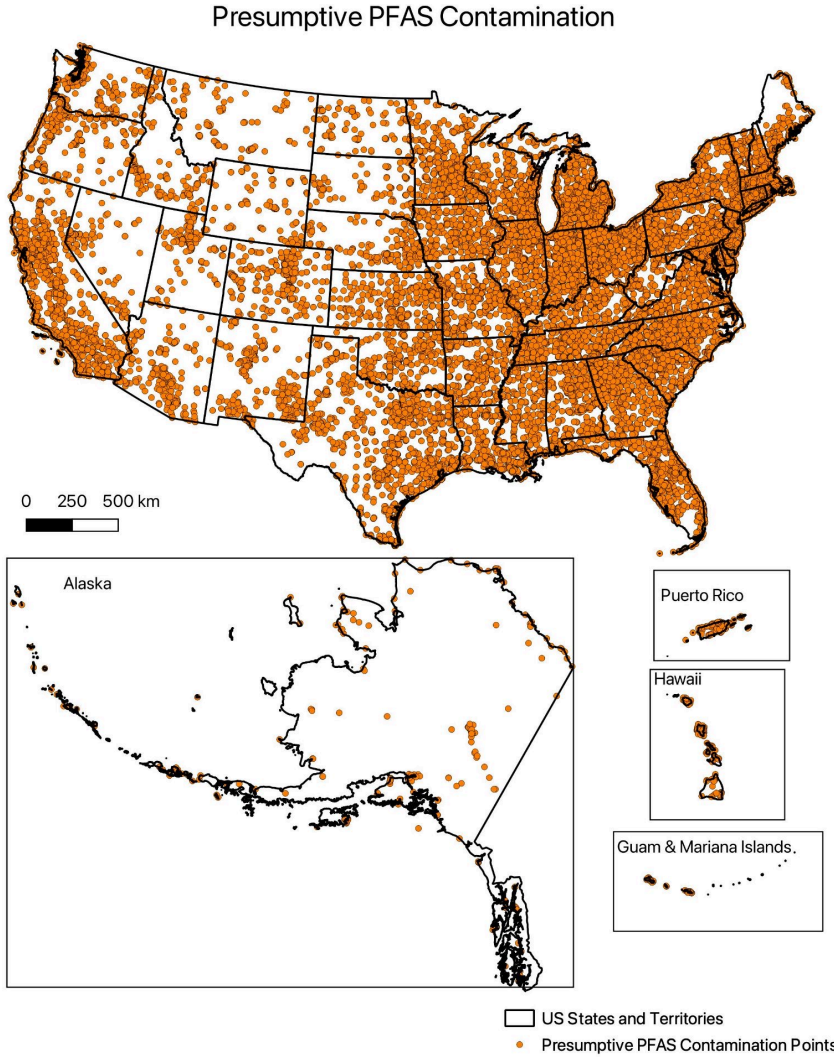
ABSTRACT: While research and regulatory attention to per- and polyfluoroalkyl substances (PFAS) has increased exponentially in recent years, data are uneven and incomplete about the scale, scope, and severity of PFAS releases and resulting contamination in the United States. This paper argues that in the absence of high-quality testing data, *PFAS contamination can be presumed* around three types of facilities: (1) fluorinated aqueous film-forming foam (AFFF) discharge sites, (2) certain industrial facilities, and (3) sites related to PFAS-containing waste. While data are incomplete on all three types of presumptive PFAS contamination sites, we integrate available geocoded, nationwide data sets into a single map of presumptive contamination sites in the United States, identifying 57,412 sites of presumptive PFAS contamination: 49,145 industrial facilities, 4,255 wastewater treatment plants, 3,493 current or former military sites, and 519 major airports. This conceptual approach allows governments, industries, and communities to rapidly and systematically identify potential exposure sources.



KEYWORDS: *per- and polyfluoroalkyl substances (PFAS), presumptive contamination, PFAS testing and investigation, AFFF, PFAS waste and disposal*



[3]

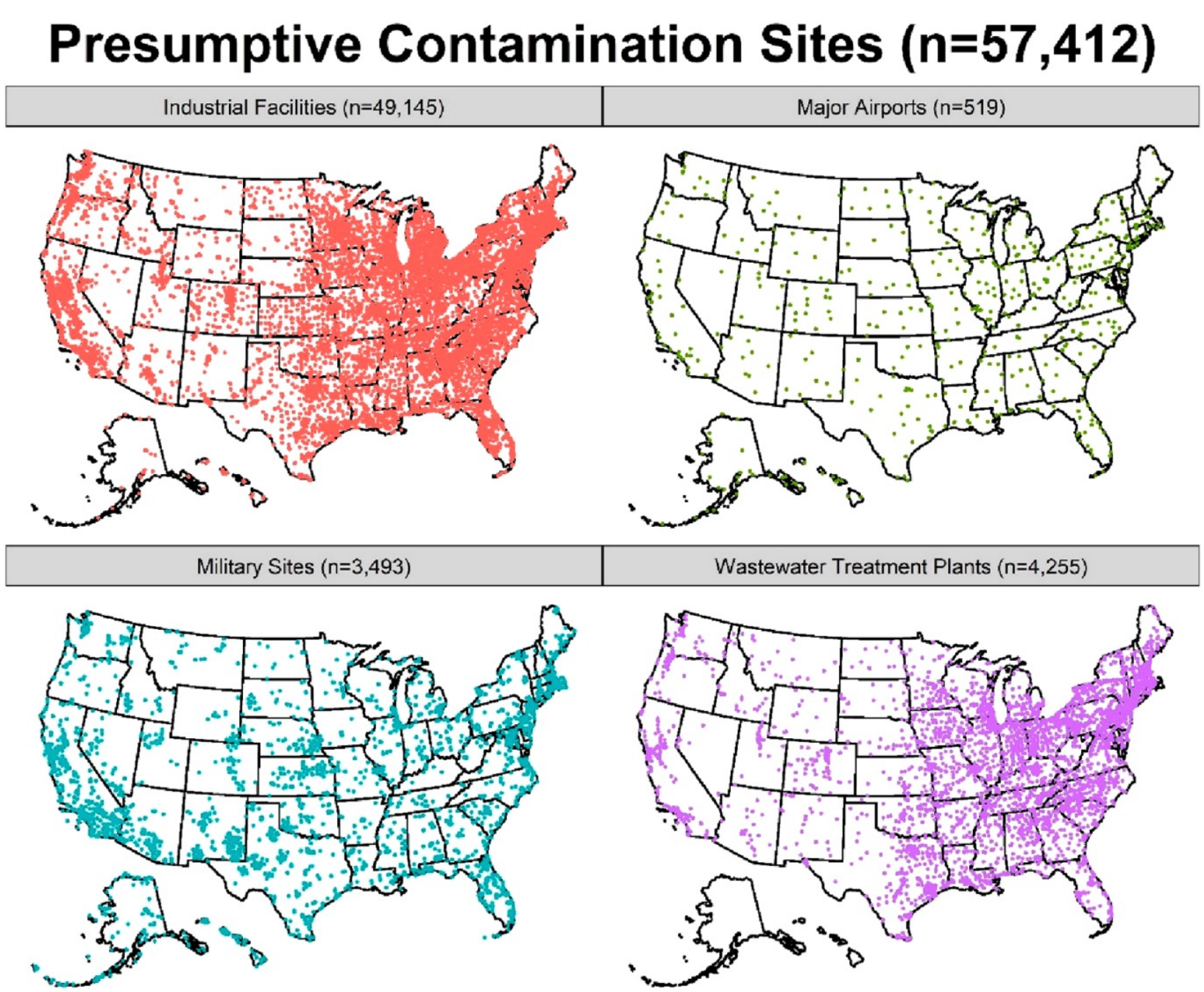


Figure 2. Map of presumptive contamination sites identified using presumptive contamination model.[61]

[3]

Preliminary Analysis (Unpublished)

Table 3. Presumptive PFAS Contamination Points within Tribal areas compared to US States and Counties

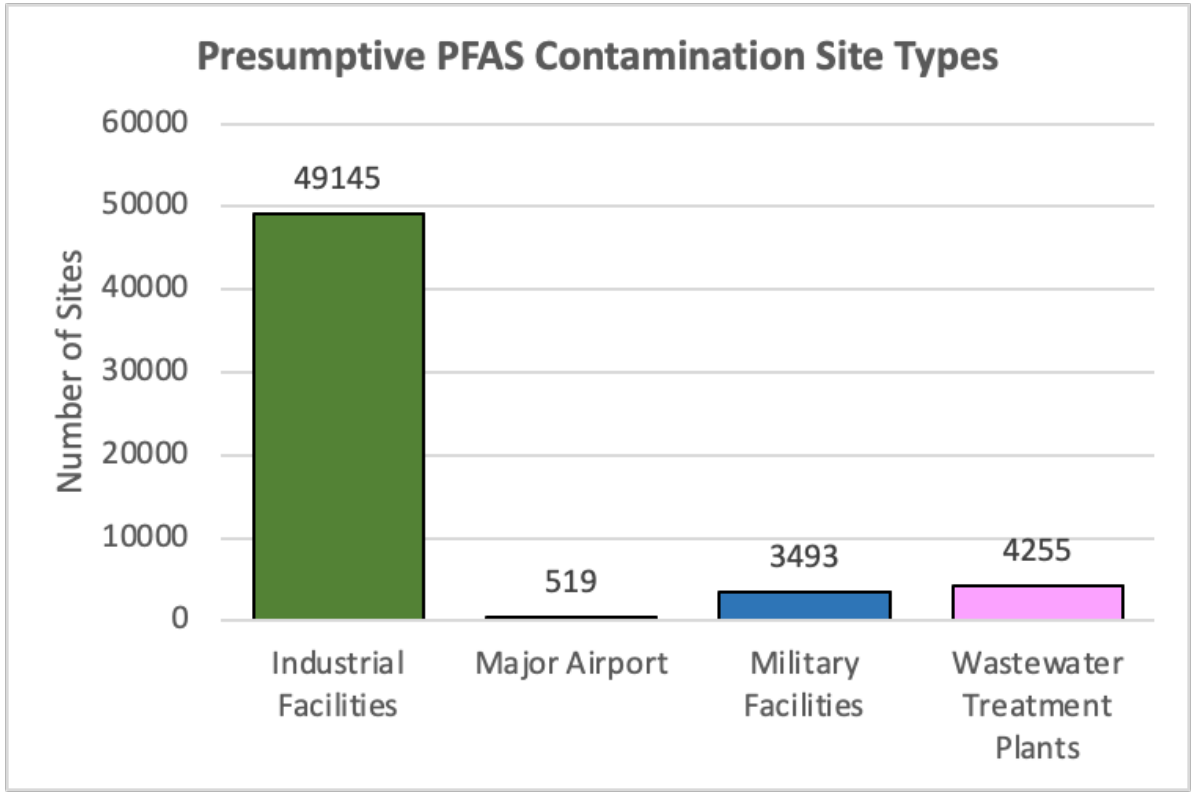
Area Unit	n	Total Points	Average points per unit (±SD)	Median points per unit	Maximum points per unit	Average points per million km^2 (±SD)	Median points per million km^2	Maximum points per million km^2	Average points per 100,000 population (±SD)	Median points per 100,000 population	Maximum points per 100,000 population
State	56	57412	1024 (±159)	699	7172	2.4 (±6.8)	8.9	340	19 (±1.0)	18	47
County	3234	57412	17 (±1.1)	4	1914	15 (±1.0)	2.6	1200	23 (±0.83)	16	1220
AIANNHA	695	1521	1.2 (±0.30)	0	147	11 (±4.4)	0	2400	61 (±23)	0	12500
ANCSA	12	237	20 (±4.3)	16	44	0.095 (±0.028)	0.081	0.28	124 (±37)	83	424
Tribal Areas*	487	978	2.0 (±0.46)	0	147	12 (±6.1)	0	2400	58 (±30)	0	12500
Ceded Territories	718	40576	56 (±7.0)	2	1647	9.1 (±1.6)	0.42	840	N/A	N/A	N/A

*Merger of AIANNHA and ANCSA boundaries

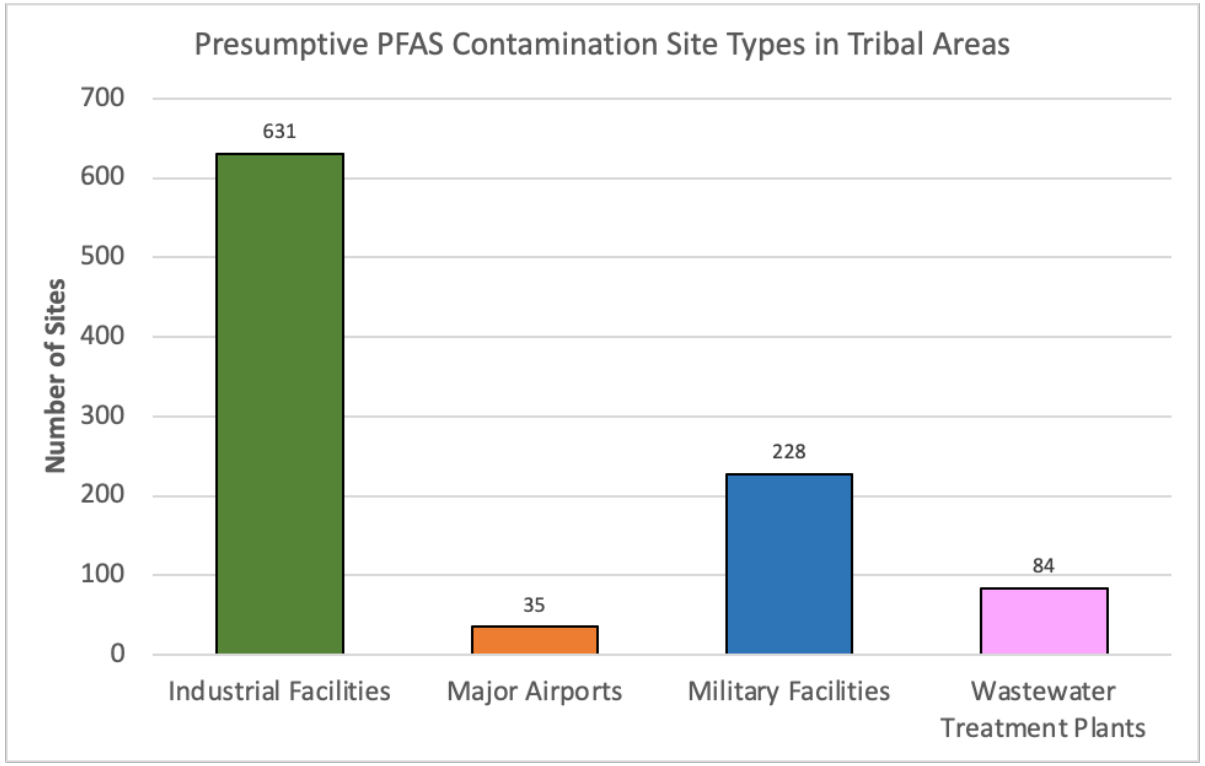
[3,27-35]

Presumptive PFAS Source Types (Unpublished)

Full Dataset



Tribal Areas



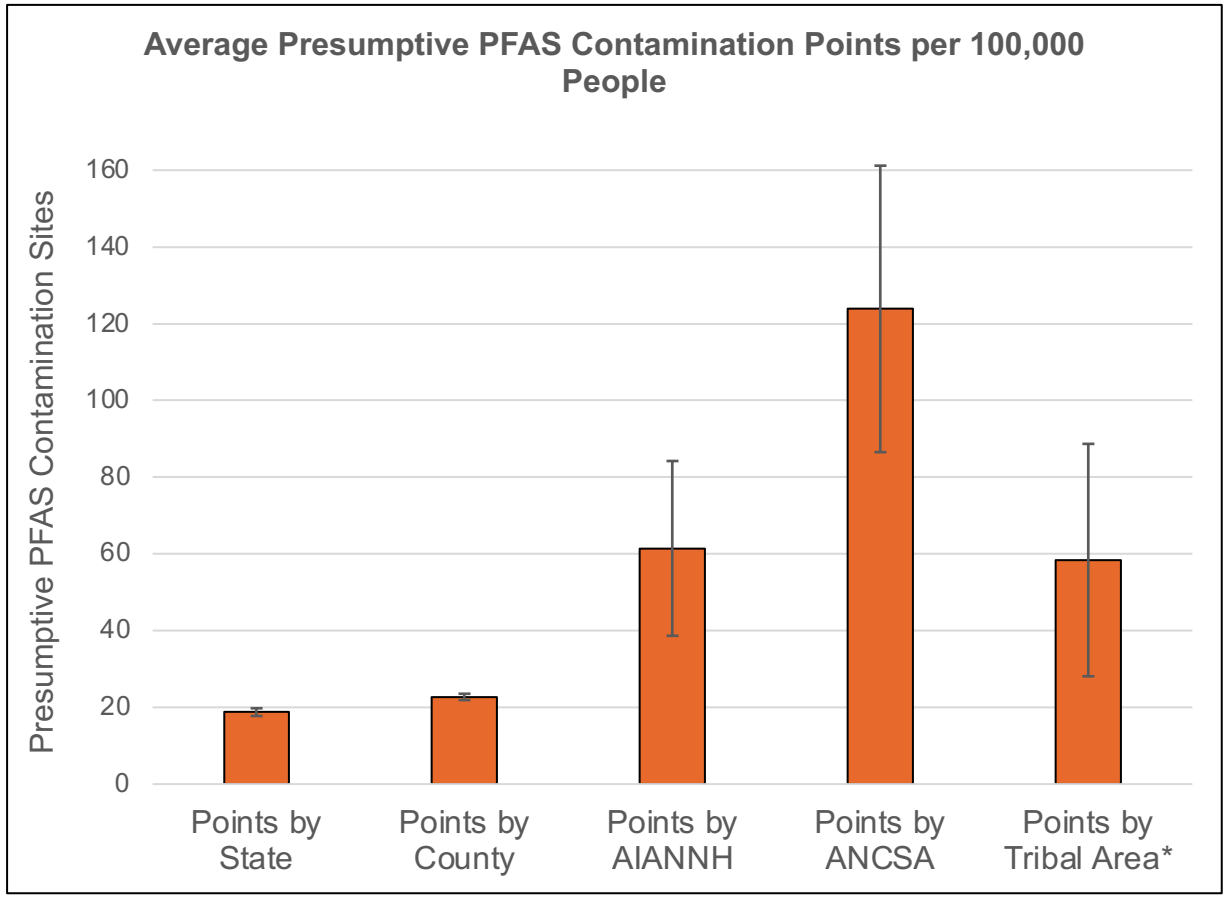
[3]

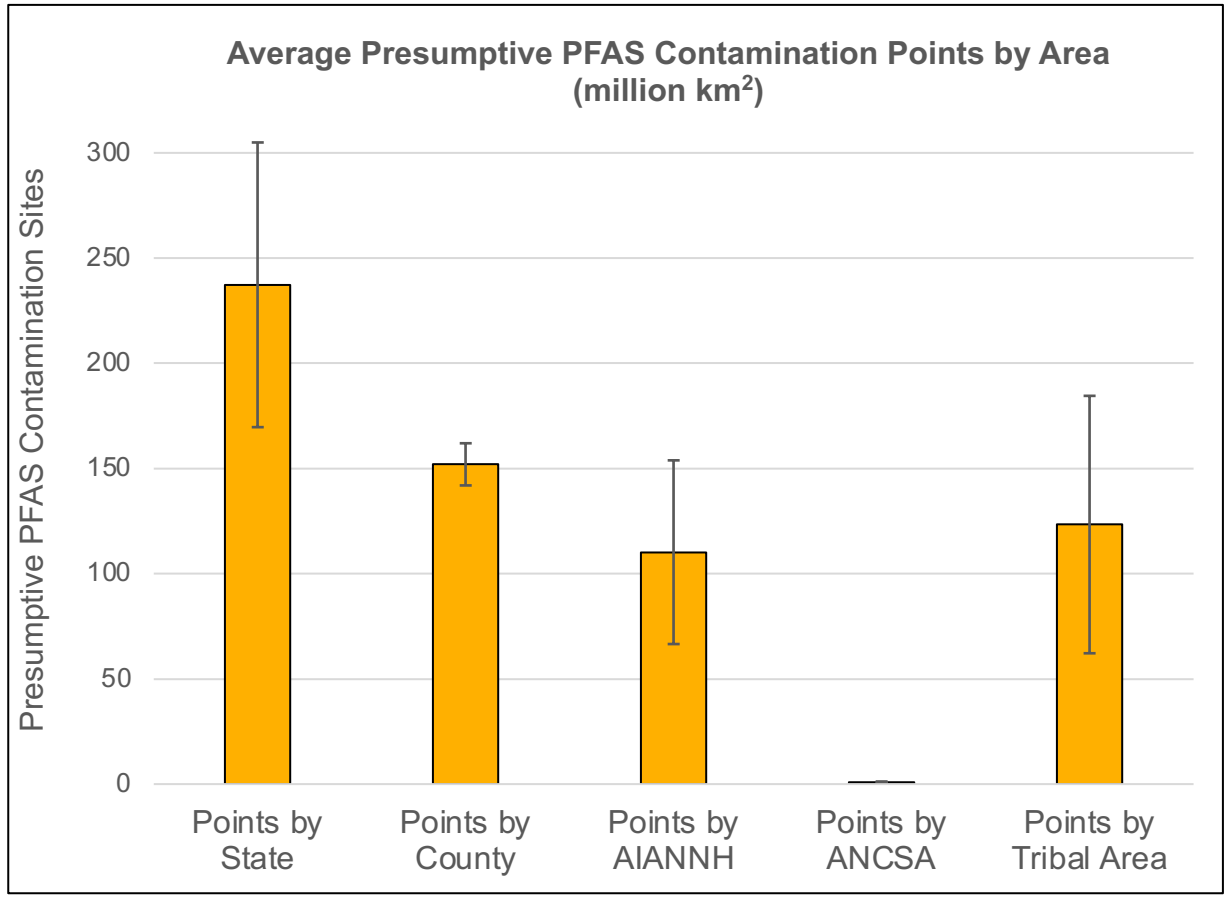
Presumptive PFAS Industrial Sites (Unpublished)

Full Dataset	Tribal Areas
1 Electroplating, Plating, Polishing, Anodizing, Coloring	1 Misc. Fabricated Metal Product Manufacturing
2 Misc. Fabricated Metal Product Manufacturing	2 Solid Waste Landfill
3 Solid Waste Landfill	3 Metal Coating, Engraving
4 Commercial Printing	4 Electroplating, Plating, Polishing, Anodizing, Coloring
5 Metal Coating, Engraving	5 Hazardous Waste Collection

[3]

PFAS Site Distribution (Unpublished)





Bars represent standard error

[3]

Preliminary Findings

- There are major gaps in our knowledge of the spatial distribution of PFAS sources. These gaps are particularly wide for Tribal areas.
- Most presumptive PFAS contamination sites in our dataset and the Tribal area subset are industry facilities.
  - Military facilities may be overrepresented in the Tribal data compared to the general dataset

Lack of clear disparities in this preliminary analysis do not mean they don't exist – we know that there's less information available about PFAS in Tribal areas compared to the general US!

[4]

What might be missing?

- Tribal areas that aren't found in this analysis
  - Federally unrecognized groups
  - Ancestral homelands
- Illegal dump sites
- Historical land use
- Atmospheric transport and bioaccumulation (particularly in Arctic communities)

Next Steps

- Incorporate federally-unrecognized groups into analysis
- Develop site-associated PFAS concentration index
- Look for associations between socioeconomic and other indicators to identify areas of concern
- Add Tribal Lands layer to interactive map tool (pfasproject.com)
- Storymapping to show relationships to land

What would you like to see?

Let's Talk!

Dr. Kimberly Garrett, MPH
k.garrett@northeastern.edu
@kimkgarrett
www.kkgarrett.com

SSEHRI

PFAS Project Lab
Northeastern University

Northeastern University
Social Science Environmental Health Research Institute

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Environmental Justice in Public Health Practice

- Environmental risks and exposures are not distributed equally.
  - *This distribution often reflects systemic & structural biases.*
- Environmental justice is an approach that recognizes this inequality and that all people are entitled to protection from environmental hazards. It also incorporates equity and access to resources (one of which is safety).
- When addressing a hazard from an EJ perspective, we ask:

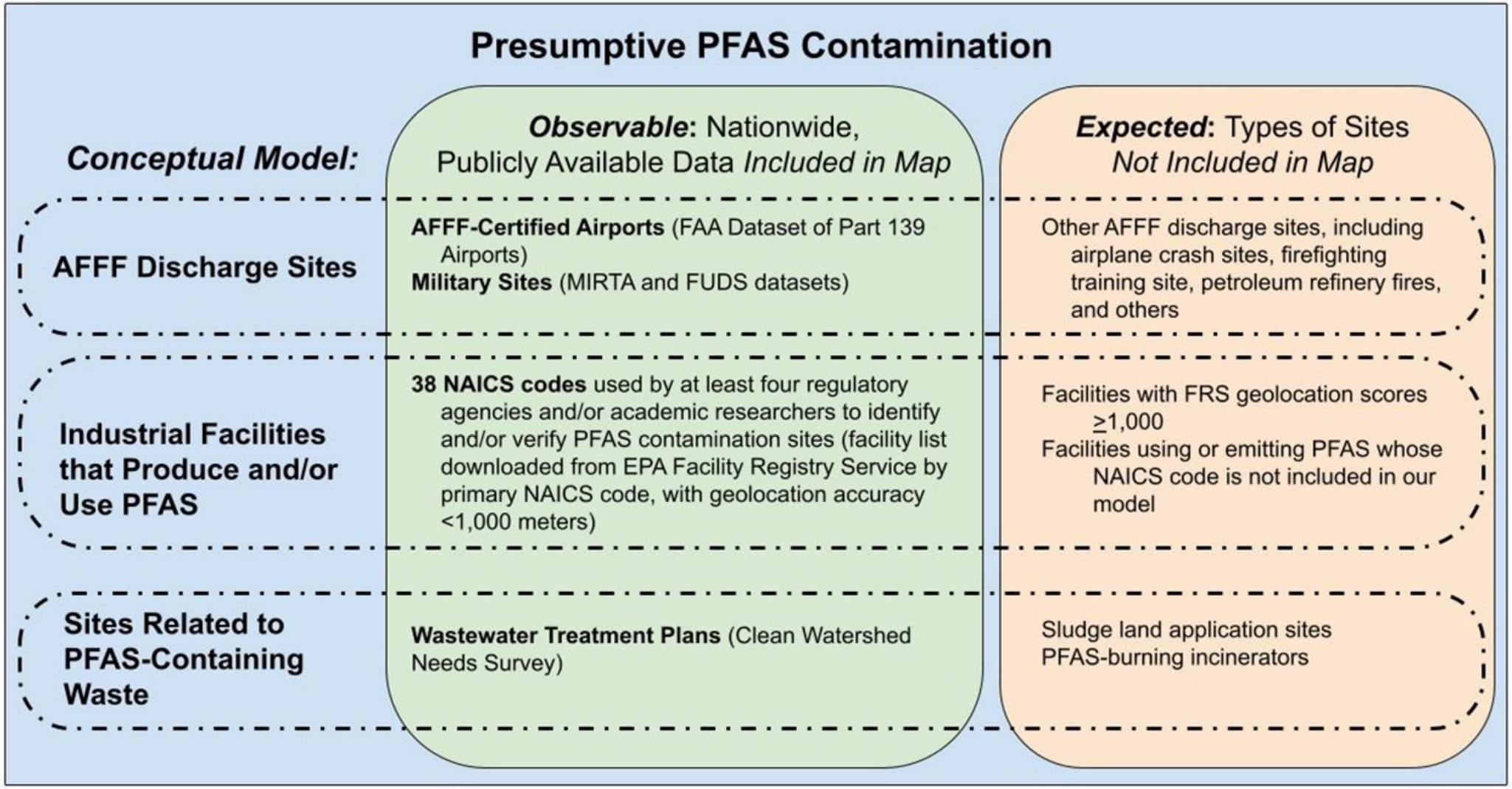
Who holds the power to control the risk?

How do social, economic, and political factors impact risk?

What barriers do communities face in responding to the hazard?

What consequences might they face in refusing to accommodate the risk?

Where is the PFAS coming from?



Supplemental 1

Table S-1. NAICS codes included in presumptive contamination

NAICS code	title
313320	Fabric Coating Mills
325510	Paint and Coating Manufacturing
322220	Paper Bag and Coated and Treated Paper Manufacturing
313210	Broadwoven Fabric Mills
322121	Paper (except Newsprint) Mills
332813	Electroplating, Plating, Polishing, Anodizing, and Coloring
324110	Petroleum Refineries
325612	Polish and Other Sanitation Good Manufacturing
334413	Semiconductor and Related Device Manufacturing
326113	Unlaminated Plastics Film and Sheet (except Packaging) Manufacturing
332812	Metal Coating, Engraving (except Jewelry and Silverware), and Allied Services to Manufacturers
333318	Other Commercial and Service Industry Machinery Manufacturing
334419	Other Electronic Component Manufacturing
562212	Solid Waste Landfill
325199	All Other Basic Organic Chemical Manufacturing
323111	Commercial Printing (except Screen and Books)
313110	Fiber, Yarn, and Thread Mills
314110	Carpet and Rug Mills
316110	Leather and Hide Tanning and Finishing
325211	Plastics Material and Resin Manufacturing
324191	Petroleum Lubricating Oil and Grease Manufacturing
325998	All Other Miscellaneous Chemical Product and Preparation Manufacturing
562211	Hazardous Waste Treatment and Disposal
562213	Solid Waste Combustors and Incinerators
313310	Textile and Fabric Finishing Mills
322219	Other Paperboard Container Manufacturing
323120	Support Activities for Printing
313220	Narrow Fabric Mills and Schiffli Machine Embroidery
313230	Nonwoven Fabric Mills
322130	Paperboard Mills

313110	Fiber, Yarn, and Thread Mills
314110	Carpet and Rug Mills
316110	Leather and Hide Tanning and Finishing
325211	Plastics Material and Resin Manufacturing
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