

North Kent County PFAS Exposure Assessment (NKCEA)

Presentation of the Second Report

03/06/2024



Presentation Facilitator

Ellery Johnson, MPP
Community Engagement Lead



All lines are muted during the webinar.



Submit your questions in the 'Q&A' box.



Remember To...

- **Limit all personal identifying information** (including personal test results) in the chat.
- **If you have questions about your personal results** and how they relate to the report, please call **1-844-464-7327**, or email **MDHHS-PFASProject@Michigan.gov**.

Thanks for your time!

Presenters



Rachel Long, MSPH
Epidemiologist



Joost van 't Erve,
Ph.D.
Toxicologist

North Kent County PFAS Exposure Assessment (NKCEA)

Background and Purpose

Rachel Long,
Epidemiologist



Background

- PFAS (per- and polyfluoroalkyl substances) were discovered in private drinking water wells in this region.
- MDHHS applied CDC-ATSDR methods^[1] to **investigate the public health risks** from environmental chemical releases.
- The Belmont-Rockford community's chemical exposure was investigated by **blood testing** and **questionnaires** in the **North Kent County PFAS Exposure Assessment (NKCEA)**.
- NKCEA is **one step** in MDHHS's **continuing** public health investigation.

1: <https://www.atsdr.cdc.gov/pfas/activities/assessments/peatt.html>

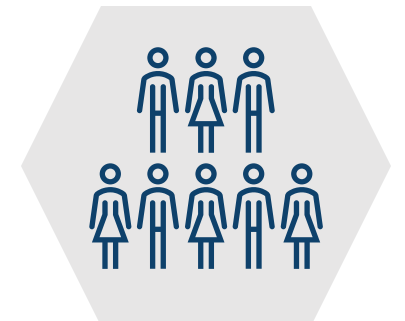
Second Report Objectives 1 & 2

Objective 1: Summarize the PFAS blood concentrations of NKCEA participants.

- Report 1 covered ages 12+ only.
- Report 2 covers all ages and by age group.

Objective 2: Compare blood PFAS concentrations of NKCEA participants to NHANES participants.

- Report 1 covered ages 12+ only.
- Report 2 covers all ages and by age group.



Second Report Objectives 3 & 4

Objective 3: Examine the connection between drinking water PFAS concentrations and blood PFAS concentrations.

Objective 4: Identify factors that can affect blood PFAS concentrations.



1/10/2024

**Drinking Water PFAS
Concentrations and
Exposure Factors
Influencing Measured and
Predicted Serum PFAS
Concentrations**

Report 2 of the North Kent County Exposure
Assessment



Read the Second Report

The full North Kent County PFAS Exposure Assessment (NKCEA) report is available at: Michigan.gov/DEHBio.

Households Were Eligible if They:

- Were on a **private drinking water well** tested by, or at the direction of, the Department of Environment, Great Lakes, and Energy (EGLE).



and

- Had a **detectable levels of PFAS** as reported to MDHHS from EGLE.



Household Selection

Group 1

Less than 70 ppt total PFAS in well water

591 households

235 (40%) selected

Group 2

Greater than or equal to 70 ppt total PFAS in well water

182 households

182 (100%) selected

ppt = parts per trillion (nanograms per liter [ng/L])

What Data Did We Collect in the Questionnaire?

All Participants (Adults and Minors)

- History of living in North Kent County.
- Water consumption.
- Dietary habits
 - (local foods)
- Demographics.

Adults

- Factors affecting PFAS excretion
 - e.g., diabetes, kidney disease, pregnancy, menstruation.
- Job history in PFAS-related industries and in affected area.

Adults with Children

- Breastfeeding and formula feeding.
- Schools and daycares in affected area.

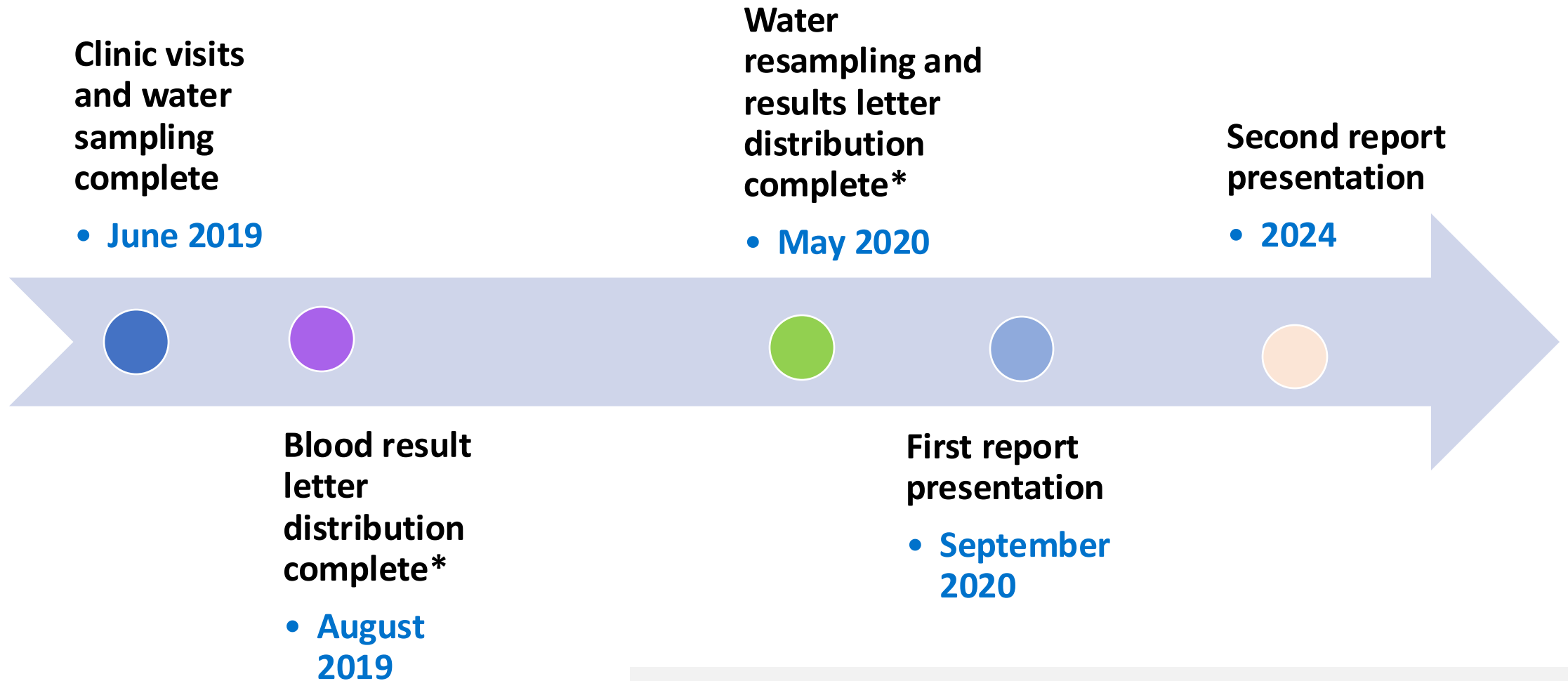
PFAS Measured in Blood and Water

PFOA**	L-PFOA*	Br-PFOA*	PFOS**	L-PFOS*	Br-PFOS*
PFHxS**	L-PFHxS*	Br-PFHxS*	PFNA	PFBS	PFTeA
PFTriA	PFDoA	PFUnA	PFDA	PFHpA	PFHxA
PFPeA	PFBA	PFDS	PFNS	PFHpS	PFPeS
PFOSA	FTS 8:2	FTS 6:2	FTS 4:2	EtFOSAA	MeFOSAA

*Linear (L) and branched (Br) isomers

**Total sum of branched and linear

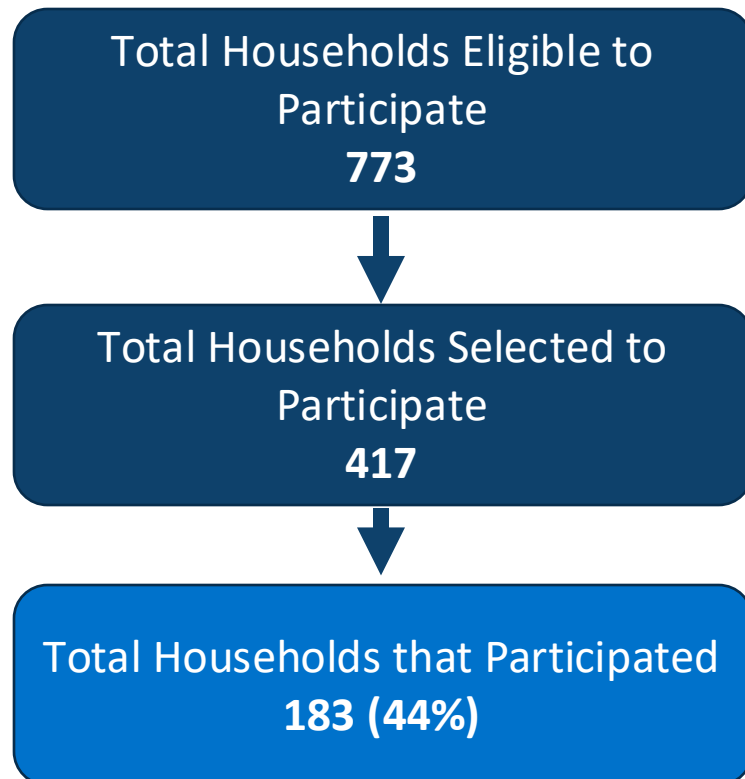
NKCEA Study Progress Timeline



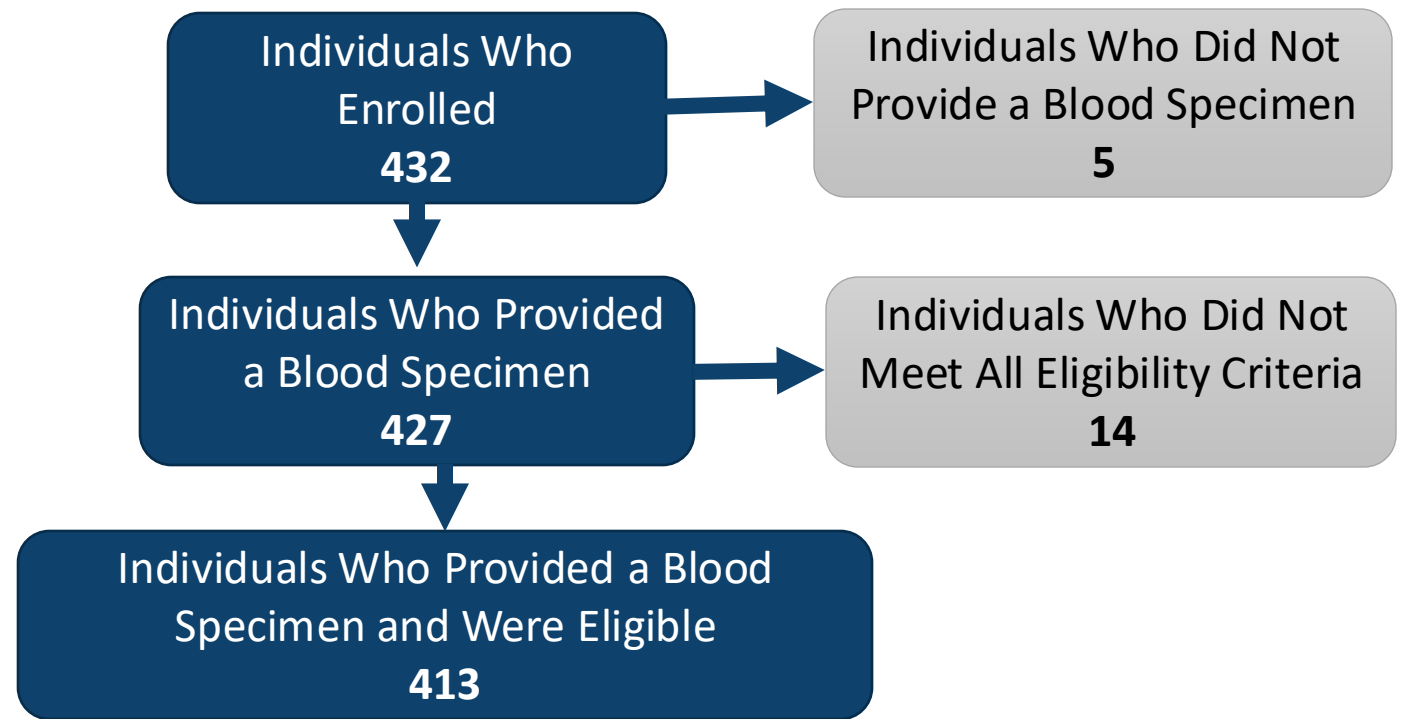
*If you never received your results or have questions about your personal results, please contact our study team at [1-844-464-7327](tel:1-844-464-7327).

Participants in NKCEA

Households



Individuals



North Kent County PFAS Exposure Assessment: Objective 1

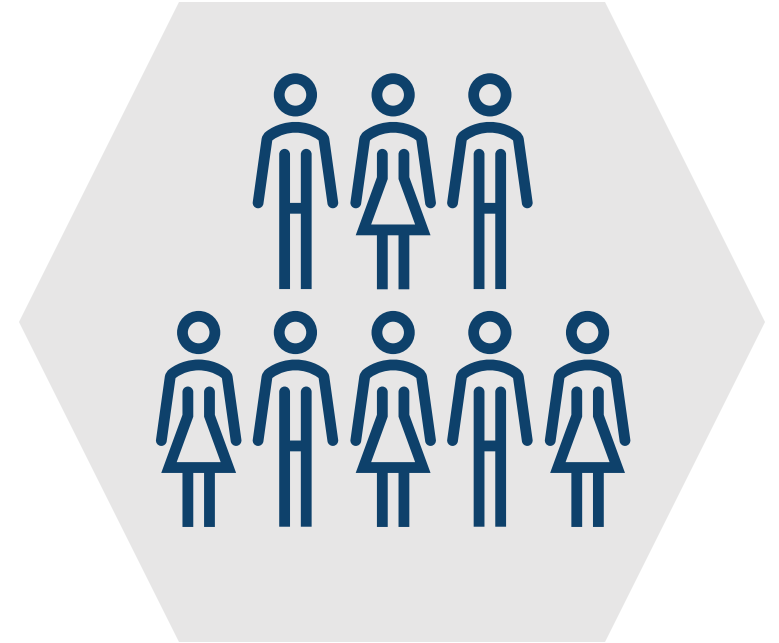
Summarize the blood PFAS concentrations of NKCEA participants.

- This objective is covered in Report 1 and Report 2, which can be viewed at Michigan.gov/DEHBio.
- It is not discussed in this presentation.



North Kent County PFAS Exposure Assessment: Objective 2.

Compare blood PFAS concentrations from **NKCEA participants** to **the U.S. population**, from the National Health and Nutrition Examination Survey (NHANES).



Rachel Long,
Epidemiologist



Statistical Comparisons of NKCEA to NHANES Ages 3-11 Years

Ages 3-11 years (n = 77)

<u>PFOA</u>	<u>L-PFOA</u>	<u>Br-PFOA</u>	<u>PFOS</u>	L-PFOS	<u>Br-PFOS</u>
<u>PFHxS</u>	L-PFHxS	Br-PFHxS	PFNA	PFBS	PFTeA
PFTriA	PFDoA	PFUnA	PFDA	PFHpA	PFHxA
PFPeA	PFBA	PFDS	PFNS	PFHpS	PFPeS
PFOSA	FTS 8:2	FTS 6:2	FTS 4:2	EtFOSAA	MeFOSAA



NKCEA average is significantly higher than NHANES



NKCEA average is significantly lower than NHANES

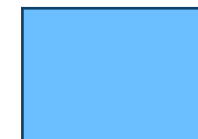
Black, bold text: PFAS included in analysis

Underlined PFAS: more than 5% of NKCEA participants were above the NHANES 95th percentile.

Statistical Comparisons of NKCEA to NHANES Ages 12 Years and Older

Ages 12 years and older (n = 360)

<u>PFOA</u>	<u>L-PFOA</u>	Br-PFOA	<u>PFOS</u>	<u>L-PFOS</u>	<u>Br-PFOS</u>
<u>PFHxS</u>	L-PFHxS	Br-PFHxS	<u>PFNA</u>	PFBS	PFTeA
PFTriA	PFDoA	PFUnA	PFDA	PFHpA	PFHxA
PFPeA	PFBA	PFDS	PFNS	<u>PFHpS</u>	PFPeS
PFOSA	FTS 8:2	FTS 6:2	FTS 4:2	EtFOSAA	<u>MeFOSAA</u>



NKCEA average is significantly higher than NHANES



NKCEA average is significantly lower than NHANES

Black, bold text: PFAS included in analysis

Underlined PFAS: more than 5% of NKCEA participants were above the NHANES 95th percentile.

Objective 2: Summary

The blood PFAS concentrations found in certain ages of NKCEA participants were **higher** than the NHANES 95th percentile for some PFAS:

Ages 3-11

- PFOA
- L-PFOA
- Br-PFOA
- PFOS
- Br-PFOS
- PFHxS

Ages 12 and Older

- PFOA
- L-PFOA
- PFOS
- L-PFOS
- Br-PFOS
- PFHxS
- PFNA
- PFHpS
- MeFOSAA



North Kent County PFAS Exposure Assessment: Objective 3

Examine the **connection** between drinking water PFAS concentrations and serum (blood) PFAS concentrations.



Joost van 't Erve,
Toxicologist



Summary of Select PFAS Water Results

- Filtered and unfiltered water was collected from all 183 households in the study.
- 29 of the 30 measured PFAS were found in at least some of the unfiltered samples (all except PFTeA).
- Filtered samples had much lower detection frequencies (or number of times PFAS was found) and concentration of PFAS.

Analyte	Unfiltered drinking water detection frequency (%)	Maximum concentration (ppt)	Geometric Mean (ppt)
PFOA	54	13,184	14.97
PFOS	41	46,048	10.35
PFHxS	54	8,691	11.62

Analyte	Filtered drinking water detection frequency (%)	Maximum Concentration (ppt)
PFOA	1	5
PFOS	3	31
PFHxS	2	19

PFAS Included in Analysis

In this report, we studied the PFAS bolded and highlighted in green because we found that more than half of the NKCEA participants had these PFAS in their blood.

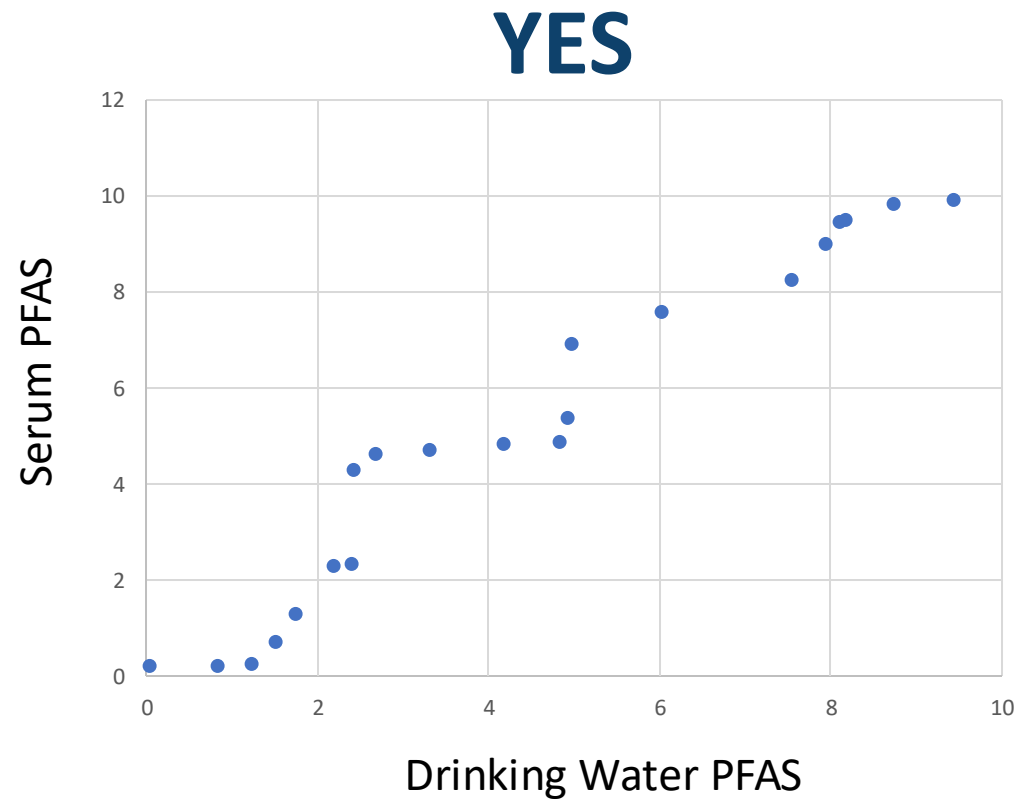
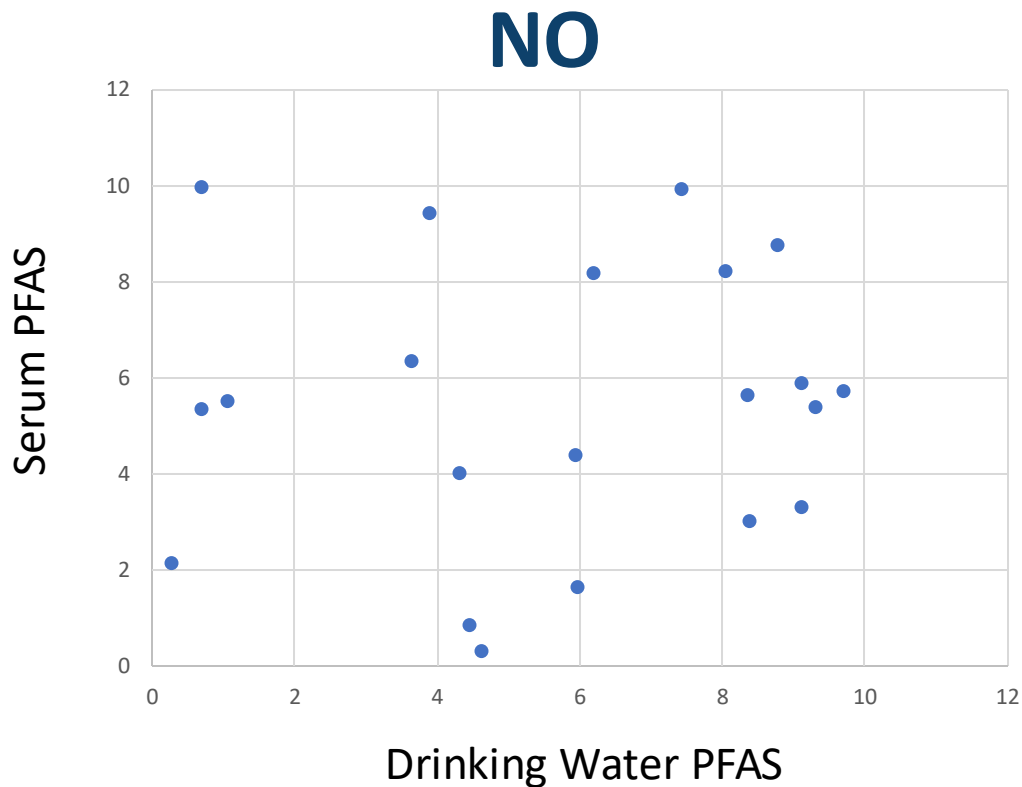
PFOA	L-PFOA	Br-PFOA	PFOS	L-PFOS	Br-PFOS
PFHxS	L-PFHxS	Br-PFHxS	PFNA	PFBS	PFTeA
PFTriA	PFDoA	PFUnA	PFDA	PFHpA	PFHxA
PFPeA	PFBA	PFDS	PFNS	PFHpS	PFPeS
PFOSA	FTS 8:2	FTS 6:2	FTS 4:2	EtFOSAA	MeFOSAA



PFOA	L-PFOA	PFOS
L-PFOS	Br-PFOS	PFHxS
L-PFHxS	Br-PFHxS	PFHpA
PFBA	PFHpS	PFPeS

Understanding Results: Looking for Associations

- Is there a connection or “association” between PFAS in serum (blood) and drinking water at the time of study?

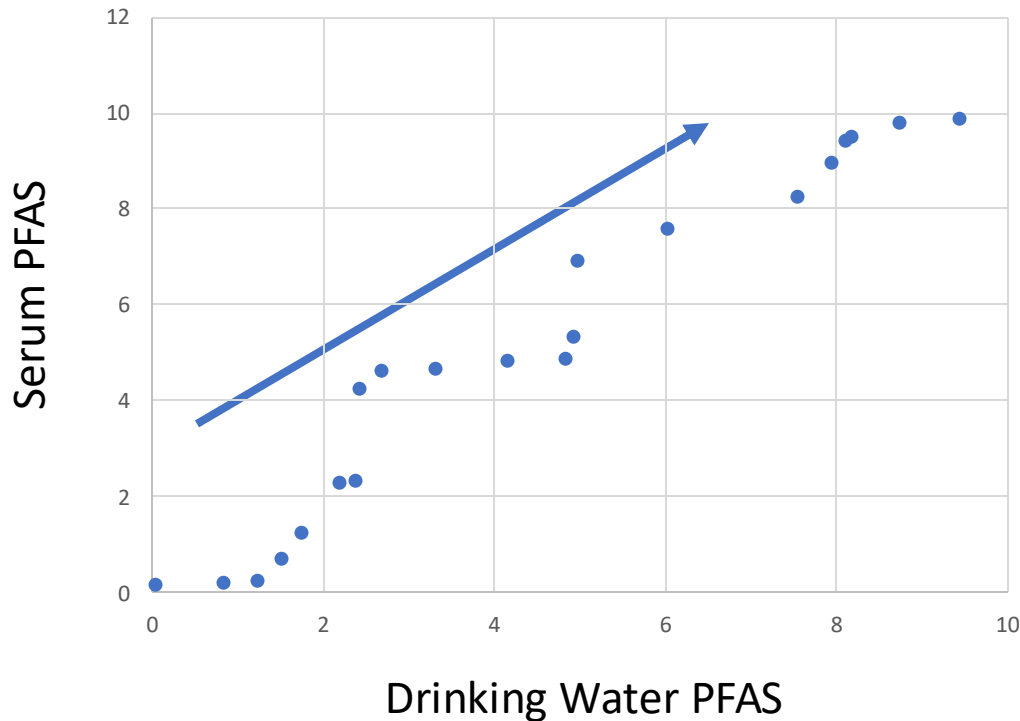


NOTE: Data is simulated and does not represent individuals in this study.

Understanding Results: Positive and Negative Associations

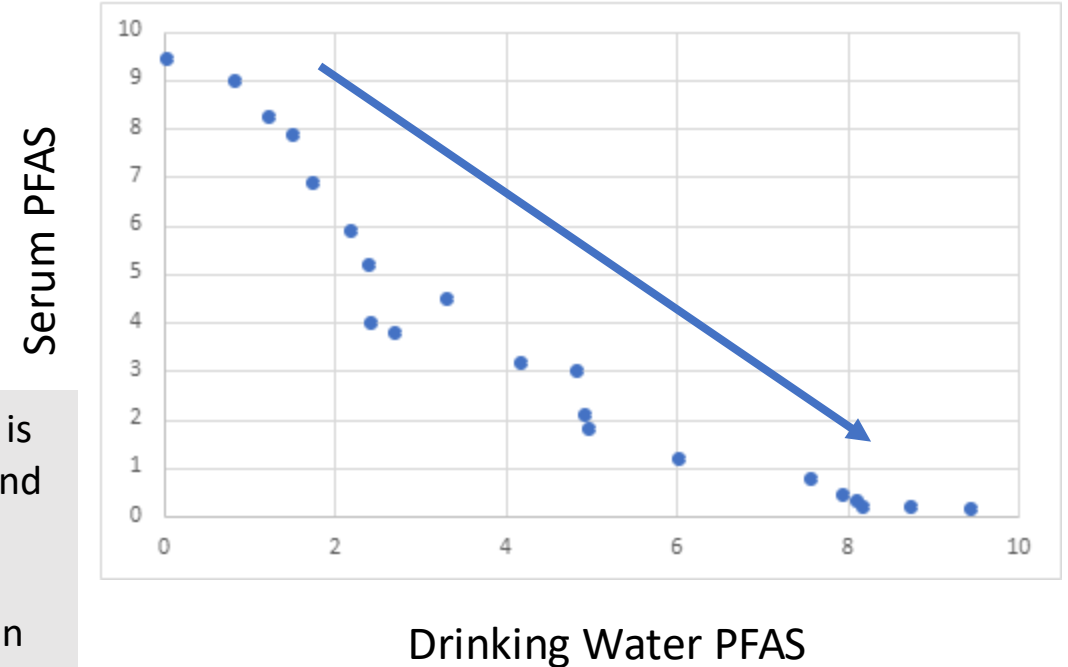
There are two types of associations discussed in this report.

Positive Association



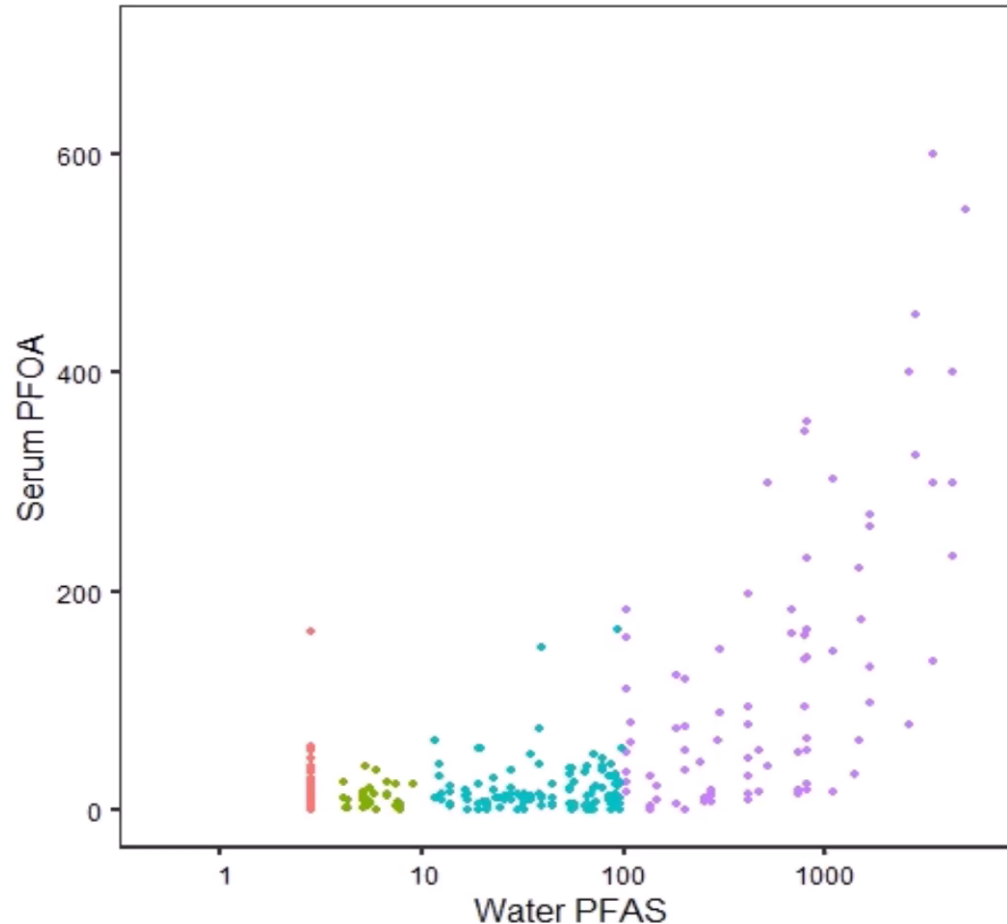
NOTE: Data is simulated and does not represent individuals in this study.

Negative Association



Understanding Results: Going from Raw Data to Groupings and Statistics

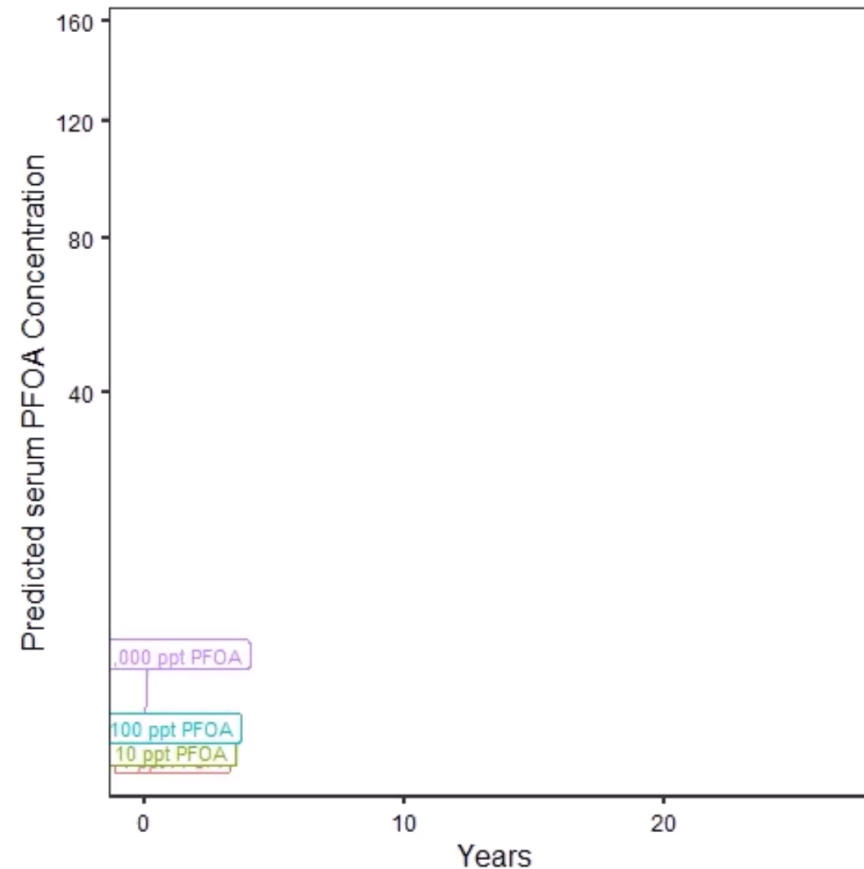
1. Grouping data
2. Visual of group distribution
3. Calculating group statistics
 - Geometric mean (average)
 - 5th percentile (bottom 5%)
 - 95th percentile (top 5%)
4. Comparing between groups



NOTE: Data is simulated and does not represent individuals in this study.

Estimating Serum (Blood) PFAS Concentrations for People Drinking Water with High PFAS Concentrations

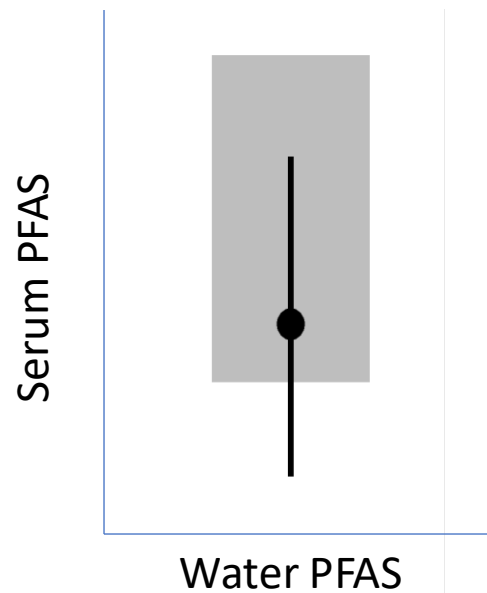
1. Simulating lifetime of PFAS exposure
2. Use maximum values to display boundaries
3. Shuffle axis to align with other graphs



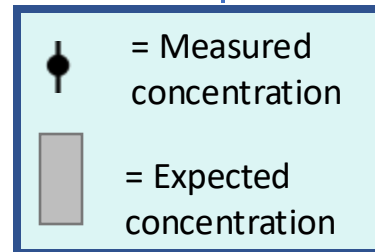
NOTE: Data is ideal simulation and does not represent individuals in this study.

Understanding Results: Comparing Predicted to Measured Serum (Blood) PFAS Concentrations

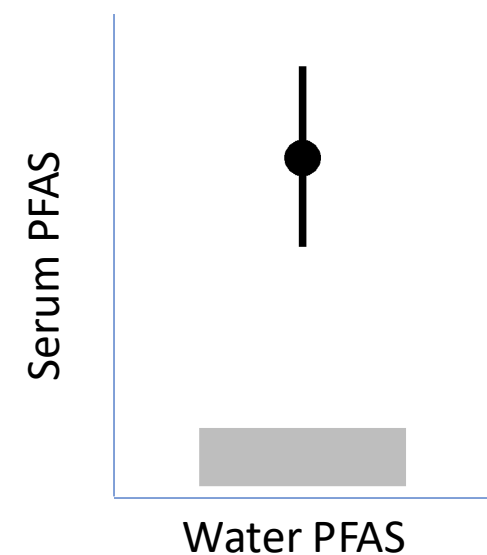
Good prediction or slight overprediction



Exposure through the drinking water pathway is likely the major water source.



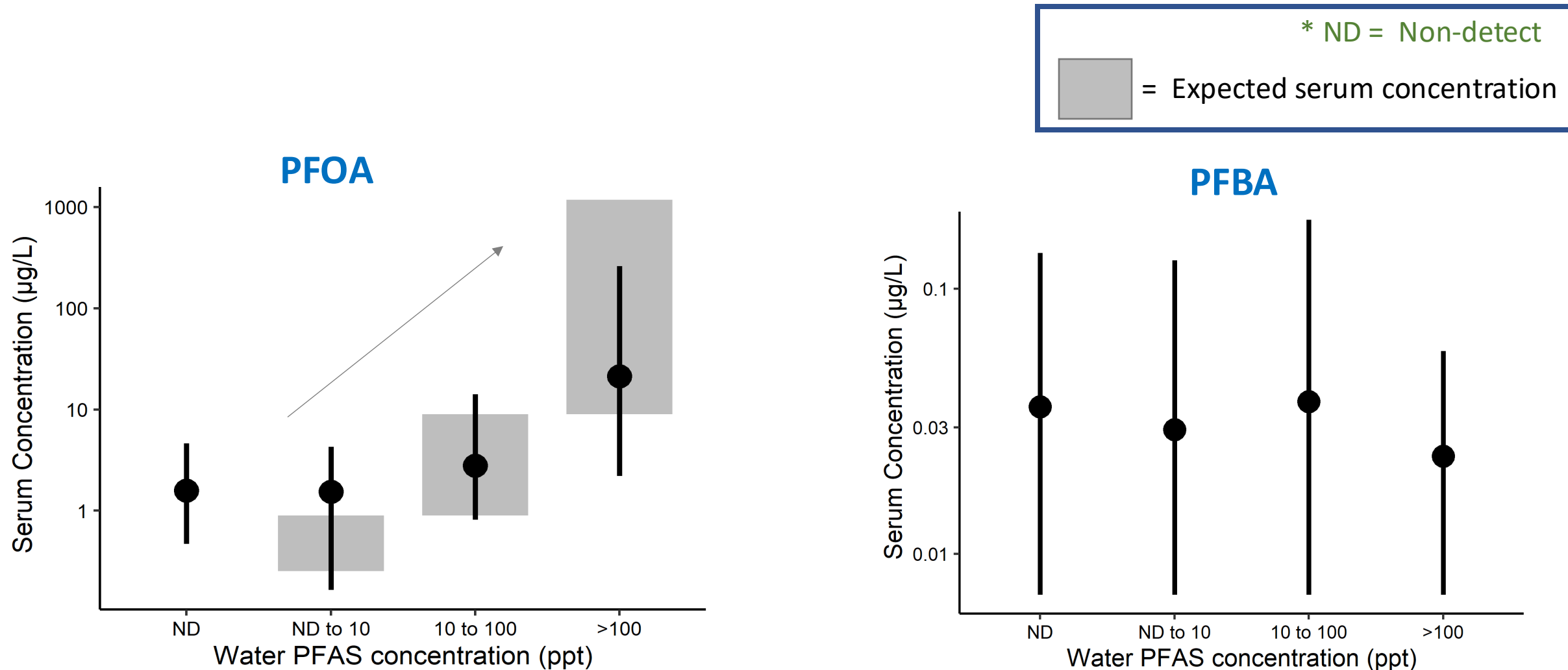
Underprediction



Sources of PFAS exposure other than drinking water are major sources.

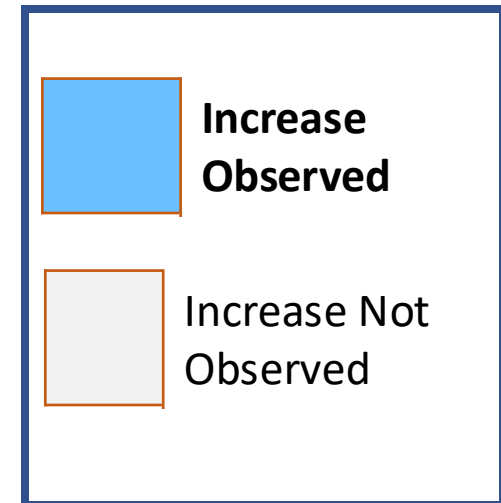
NOTE: Data is simulation and does not represent individuals in this study.

Measured and Estimated Serum (Blood) PFAS Concentrations in Unfiltered Drinking Water

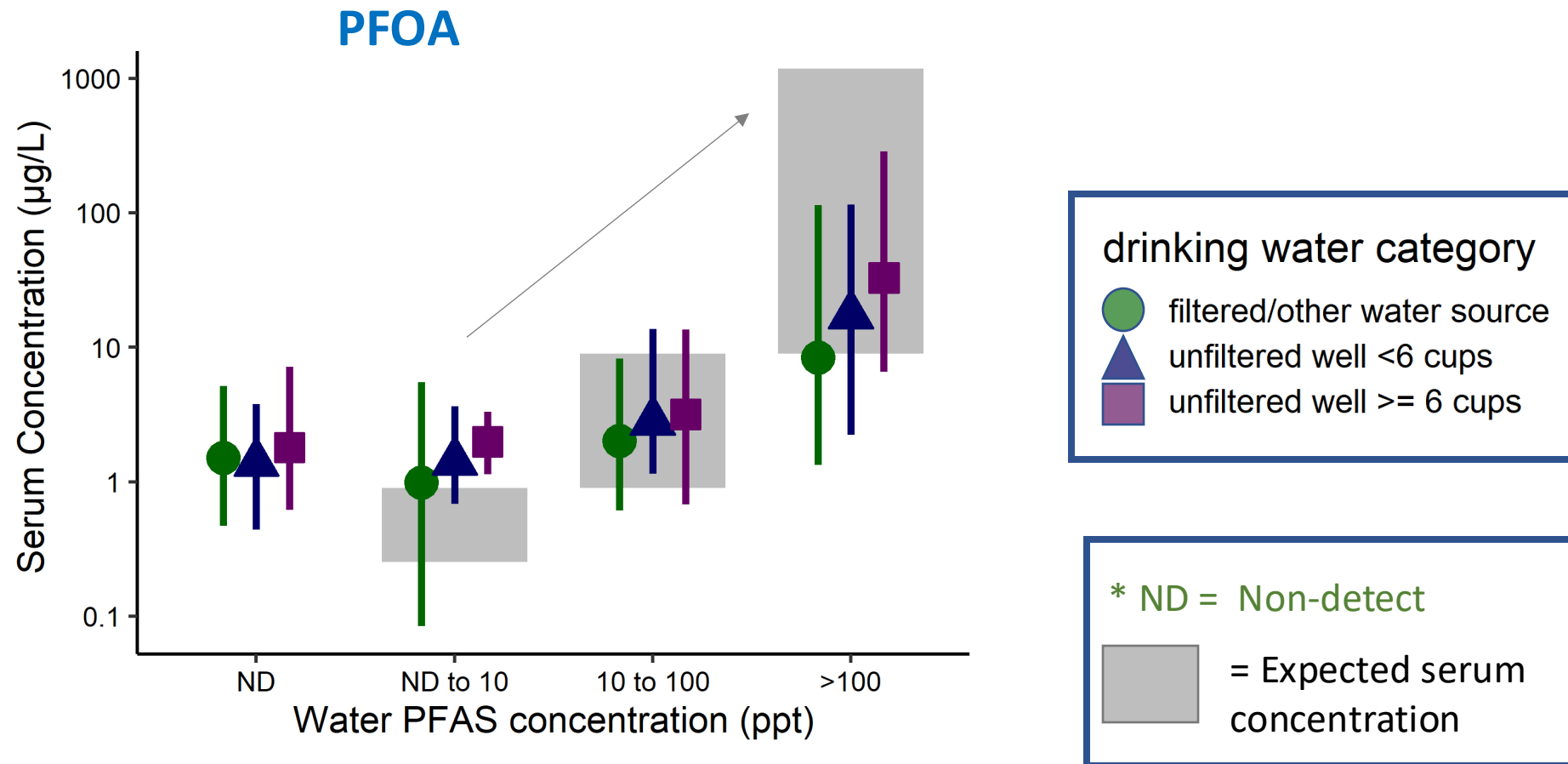


Increase in Serum (Blood) PFAS Concentrations with Greater Unfiltered Drinking Water PFAS Concentrations

PFOA	L-PFOA	PFOS
L-PFOS	Br-PFOS	PFHxS
L-PFHxS	Br-PFHxS	PFHpA
PFBA	PFHpS	PFPeS

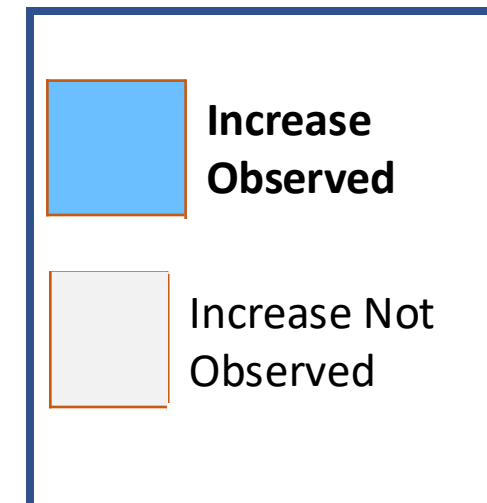


How Drinking Unfiltered Water Versus Filtered Water at Different Concentrations Affects Serum (Blood) PFAS Concentrations



Influence of Unfiltered Drinking Water Consumption Amount and Filter Use on Serum (Blood) PFAS

PFOA	L-PFOA	PFOS
L-PFOS	Br-PFOS	PFHxS
L-PFHxS	Br-PFHxS	PFHpA
PFBA	PFHpS	PFPeS



Combining PFAS Concentration and Drinking Water Amount Into One Metric

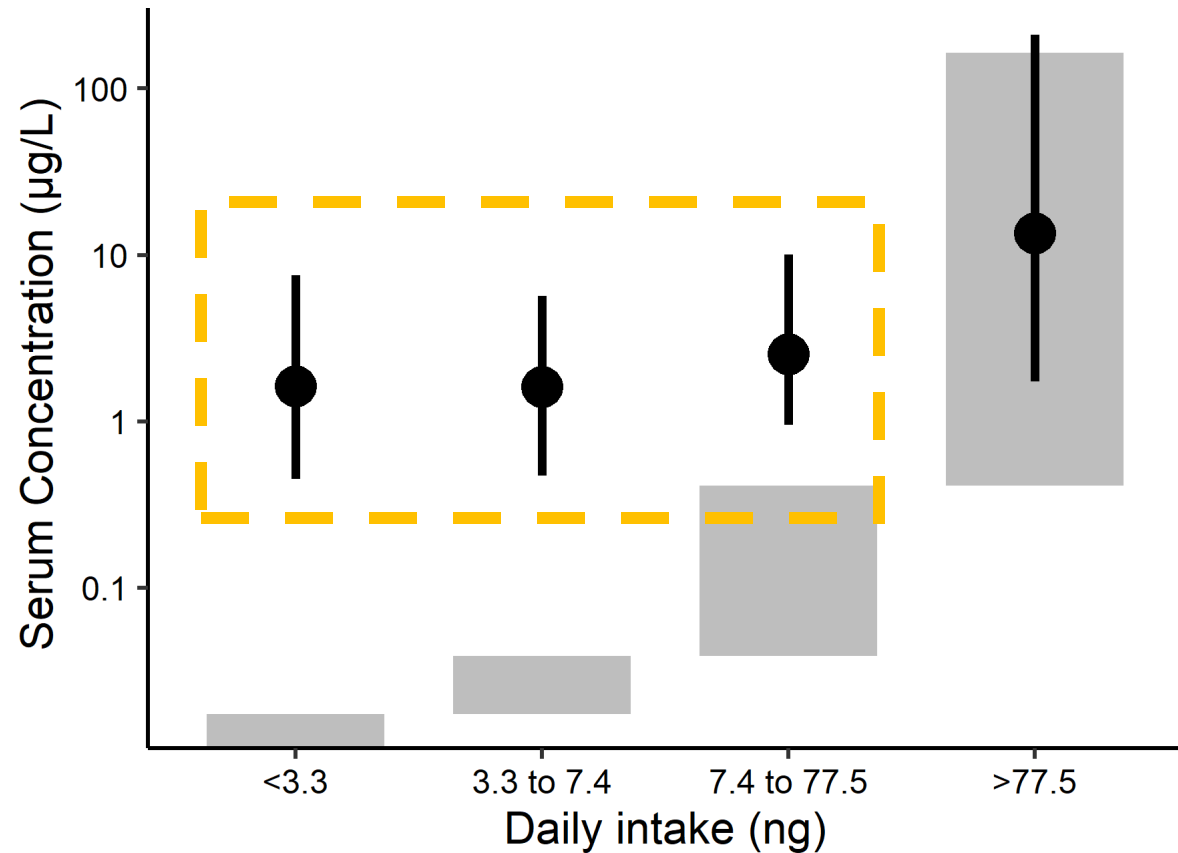
- Use participant-provided survey responses and exposure history to calculate average amount of PFAS consumed per day.
 - Assumptions are that drinking bottled water or using a filter does not add to PFAS exposure for the time reported.
 - Considers people who drink a lot of water with low PFAS concentrations or people who don't drink as much water but have higher PFAS water concentrations.

$$\text{Daily intake} = \text{Water Concentration} \left(\frac{\text{ng}}{\text{L}} \right) \times \text{Water consumption amount} \left(\frac{\text{L}}{\text{day}} \right)$$

Example	Daily intake (ng/day)	Water concentration (ng/L or ppt)	Water consumption amount (L/day)
1	28	20	1.4
2	28	10	2.8
3	30	50	0.6


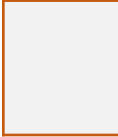
Average Daily Intake from Drinking Water and Blood PFAS

- Modeled and measured PFAS blood concentrations are very similar for higher daily intake from drinking water.
- At lower drinking water intake, other exposure sources also significantly contribute (yellow box).





Increase in Daily Intake and Serum (Blood) PFAS

PFOA	L-PFOA	PFOS
L-PFOS	Br-PFOS	PFHxS
L-PFHxS	Br-PFHxS	PFHpA
PFBA	PFHpS	PFPeS

	Increase Observed
	Increase Not Observed

Daily Intake and Residence Duration

PFOA	L-PFOA	PFOS
L-PFOS	Br-PFOS	PFHxS
L-PFHxS	Br-PFHxS	PFHpA
PFBA	PFHpS	PFPeS

	Increase Observed
	Increase Not Observed

Summary of Objective 3

- For almost all PFAS, we saw higher concentrations in serum (blood) with increasing concentrations in the drinking water.
- Determining the average daily intake of PFAS in the drinking water best describes the expected serum concentrations.
- Drinking from a well with PFAS for a longer period does not necessarily further increase serum PFAS concentrations.
- These are very important for determining further influences (Objective 4) since participants' drinking water exposure varied widely.



North Kent County PFAS Exposure Assessment: Objective 4

- **Identify factors** that can affect how much PFAS is in people's blood.
- Factors beyond drinking water include **demographic, diet, occupational history, and health conditions.**



Rachel Long,
Epidemiologist



Demographic Characteristics: Age and Sex and Serum (Blood) PFAS

Age

PFOA	L-PFOA	PFOS
L-PFOS	Br-PFOS	PFHxS
L-PFHxS	Br-PFHxS	PFHpA
PFBA	PFHpS	PFPeS

Sex - Males

PFOA	L-PFOA	PFOS
L-PFOS	Br-PFOS	PFHxS
L-PFHxS	Br-PFHxS	PFHpA
PFBA	PFHpS	PFPeS

Significant Positive Association
(meaning being older and/or male are linked to **higher** blood PFAS concentrations)

Significant Negative Association
(meaning being older and/or male are linked to **lower** blood PFAS concentrations)

No Significant Association
(meaning being older and/or male are **not linked** to PFAS concentrations at all)

Eating Fish Caught from Ponds, Lakes, or Rivers and Serum (Blood) PFAS

Wild-caught fish from anywhere

PFOA	L-PFOA	PFOS
L-PFOS	Br-PFOS	PFHxS
L-PFHxS	Br-PFHxS	PFHpA
PFBA	PFHpS	PFPeS

Wild-caught fish from inside study area

PFOA	L-PFOA	PFOS
L-PFOS	Br-PFOS	PFHxS
L-PFHxS	Br-PFHxS	PFHpA
PFBA	PFHpS	PFPeS

Significant Positive Association
(wild-caught fish from anywhere/wild-caught fish from inside study area is linked to **higher** blood PFAS concentrations)

Significant Negative Association
(wild-caught fish from anywhere/wild-caught fish from inside study area is linked to **lower** blood PFAS concentrations)

No Significant Association
(wild-caught fish from anywhere/wild-caught fish from inside study area is **not linked** to PFAS concentrations at all)

Eating Deer and Serum (Blood) PFAS

Deer hunted anywhere

PFOA	L-PFOA	PFOS
L-PFOS	Br-PFOS	PFHxS
L-PFHxS	Br-PFHxS	PFHpA
PFBA	PFHpS	PFPeS

Deer hunted inside study area

PFOA	L-PFOA	PFOS
L-PFOS	Br-PFOS	PFHxS
L-PFHxS	Br-PFHxS	PFHpA
PFBA	PFHpS	PFPeS

Significant Positive Association
(deer hunted anywhere/deer hunted inside study area is linked to **higher** blood PFAS concentrations)

Significant Negative Association
(deer hunted anywhere/deer hunted inside study area is linked to **lower** blood PFAS concentrations)

No Significant Association
(deer hunted anywhere/deer hunted inside study area is **not linked** to PFAS concentrations at all)

Eating Wild Game and Serum (Blood) PFAS

Wild game hunted anywhere

PFOA	L-PFOA	PFOS
L-PFOS	Br-PFOS	PFHxS
L-PFHxS	Br-PFHxS	PFHpA
PFBA	PFHpS	PFPeS

Wild game hunted inside study area

PFOA	L-PFOA	PFOS
L-PFOS	Br-PFOS	PFHxS
L-PFHxS	Br-PFHxS	PFHpA
PFBA	PFHpS	PFPeS

Significant Positive Association
(game hunted anywhere/game hunted inside study area is linked to **higher** blood PFAS concentrations)

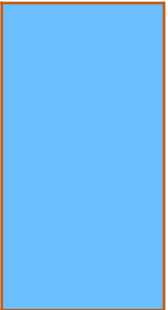
Significant Negative Association
(game hunted anywhere/game hunted inside study area is linked to **lower** blood PFAS concentrations)

No Significant Association
(game hunted anywhere/game hunted inside study area is **not linked** to PFAS concentrations at all)

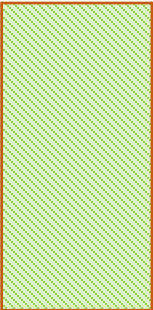
Eating Chicken Eggs and Serum (Blood) PFAS

Eggs from chickens raised inside study area

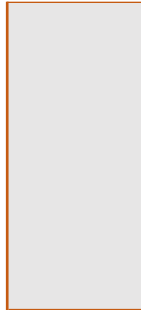
PFOA	L-PFOA	PFOS
L-PFOS	Br-PFOS	PFHxS
L-PFHxS	Br-PFHxS	PFHpA
PFBA	PFHpS	PFPeS



Significant Positive Association
(eggs from chickens raised inside study area linked to **higher** blood PFAS concentrations)



Significant Negative Association
(eggs from chickens raised inside study area linked to **lower** blood PFAS concentrations)



No Significant Association
(eggs from chickens raised inside study area **not linked** to PFAS concentrations at all)

Connection Between Eating Certain Foods within the NKCEA Study Area and Blood (Serum) PFAS Concentrations

- The following foods from **inside the NKCEA area** had no important effect on blood PFAS concentrations:
 - Hunted game.
 - Vegetables.



Other Factors Specific to Adult NKCEA Participants: Kidney Disease and Blood and Plasma Donation

Kidney Disease

PFOA	L-PFOA	PFOS
L-PFOS	Br-PFOS	PFHxS
L-PFHxS	Br-PFHxS	PFHpA
PFBA	PFHpS	PFPeS

Blood/Plasma Donation

PFOA	L-PFOA	PFOS
L-PFOS	Br-PFOS	PFHxS
L-PFHxS	Br-PFHxS	PFHpA
PFBA	PFHpS	PFPeS

Significant Positive Association
(kidney disease/ blood & plasma donation is linked to **higher** blood PFAS concentrations)

Significant Negative Association
(kidney disease/ blood & plasma donation is linked to **lower** blood PFAS concentrations)

No Significant Association
(kidney disease/ blood & plasma donation is **not linked** to PFAS concentrations at all)

Other Factors Specific to NKCEA Adult Participants

- The following factors **were not linked** to higher or lower blood PFAS concentrations:
 - Anemia.
 - Ever having worked in an industry that uses PFAS, such as firefighting.
- Having diabetes was linked to higher blood PFHpA concentrations.



Pregnancy and Menstruation and Blood PFAS Among Adult Female NKCEA Participants

These factors were generally linked to **lower** blood PFAS concentrations:

- **Greater number of births.**
- **Menstruating in the past three years.**

*However, these relationships were not statistically significant.



Breastfeeding and Blood PFAS

- Total months adult female participants spent breastfeeding children was linked to **lower** blood PFAS.
- Total months minor participants were breastfed was linked to **higher** blood PFAS.

*However, these relationships were not statistically significant.



Summary of Objective 4 – Significant Results

- For some PFAS, **increased age and male sex** were associated with **higher** blood PFAS concentrations.
- **Eating wild-caught fish from anywhere** was associated with **higher** blood PFOS, L-PFOS, and PFBA concentrations.
- **Eating wild-caught fish from the study areas** was only associated with **higher** blood L-PFOS concentrations.
- **Kidney disease and blood donation** were associated with **lower** blood PFAS concentrations for many PFAS.



Summary of Objective 4, Continued

These factors were not linked to higher or lower blood PFAS concentrations in participants:

- Eating hunted game or vegetables inside the study area.
- Anemia.
- Ever having worked in an industry that uses PFAS.
- Pregnancy.
- Menstruation.
- Breastfeeding a child (women).
- Being breastfed (children).



Conclusions

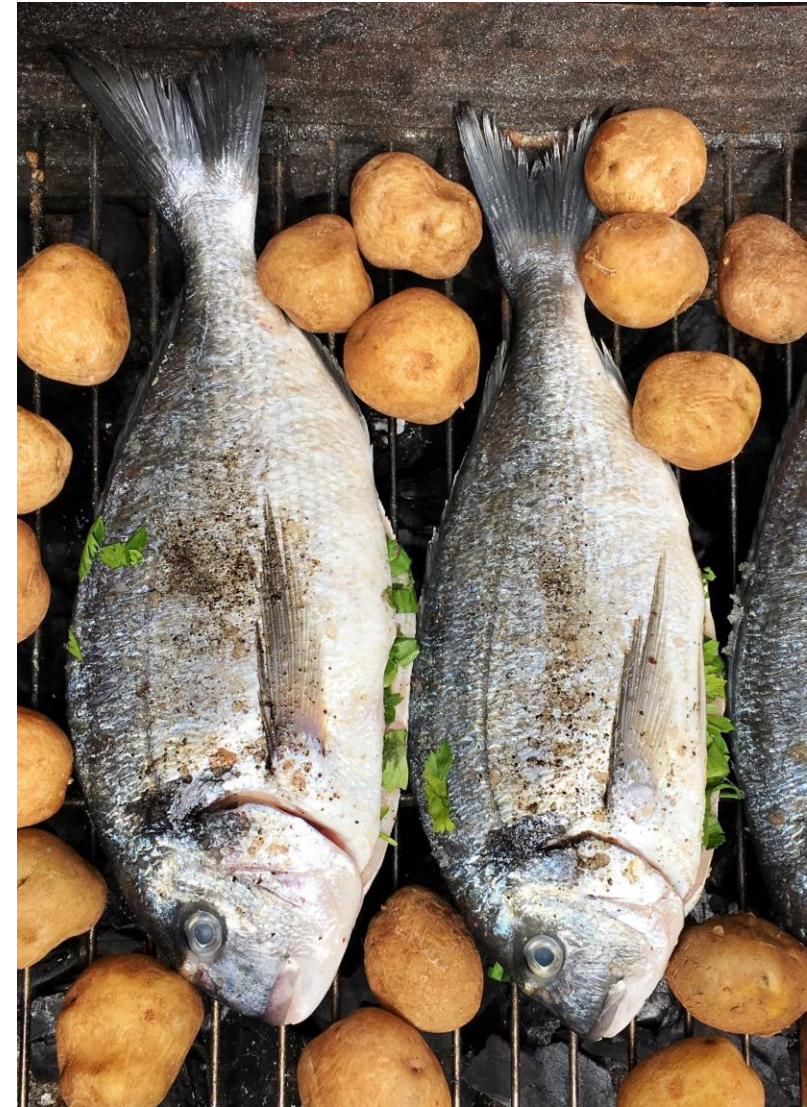
- Participants in the North Kent County Exposure Assessment had higher concentrations for PFOA, PFOS, PFHxS, PFHpS, and MeFOSAA than the general U.S. population.
- Water PFAS concentrations in private drinking water wells varied greatly.
- Exposure via the wells had been greatly reduced at the time the study took place due to implementation of filters.



Conclusions, Continued

For certain PFAS, high blood PFAS concentrations can be caused by drinking water with high levels of PFAS.

- For NKCEA participants with low concentrations of PFAS found in their drinking water, other sources of PFAS exist, which can increase blood PFAS concentrations.
- Other significant predictors of **higher** blood PFAS concentrations were:
 - Increasing age.
 - Male sex.
 - Eating wild caught fish.
- Significant predictors of **lower** blood PFAS concentrations were blood/plasma donation and kidney disease (adults).



North Kent County PFAS Exposure Assessment (NKCEA)

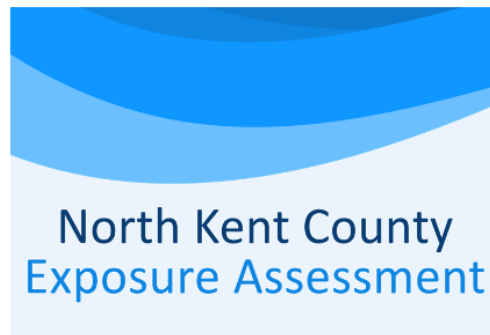
Future: Looking Ahead

Joost van 't Erve,
Toxicologist

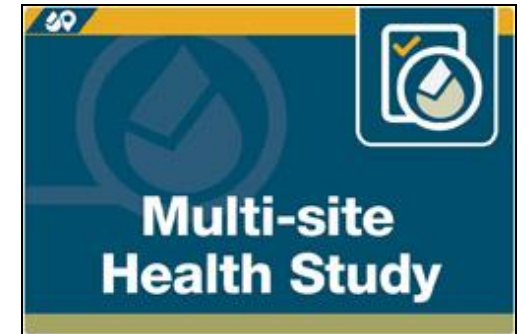


More MDHHS Studies

Exposure Assessment



Two Health Studies



MiChEM
Michigan Chemical
Exposure Monitoring

- Determine average concentrations of PFAS in Michigan adults.
- Will help interpret NKCEA data.

Goal of MDHHS Health Studies



The goal of these research studies is to learn how drinking water that contains PFAS may affect health.

The Michigan PFAS Exposure and Health Study (MiPEHS)



Michigan.gov/DEHBio

- MiPEHS started in **2020** and people can still join for one more study visits -- in 2025.
- We invited eligible people from **City of Parchment/Cooper Township** and **Belmont/Rockford area**.
 - In January 2025, we'll be asking people to return for their next visit or join for the first time.
- Learning more about PFAS and health in these communities will **benefit** the health of **all Michiganders**.

THANK YOU!

MDHHS and KCHD thank the NKCEA participants and staff for their time and effort on this study!

