Occurrence and Human Health Risk Assessment of PFAS in New Jersey's Environment

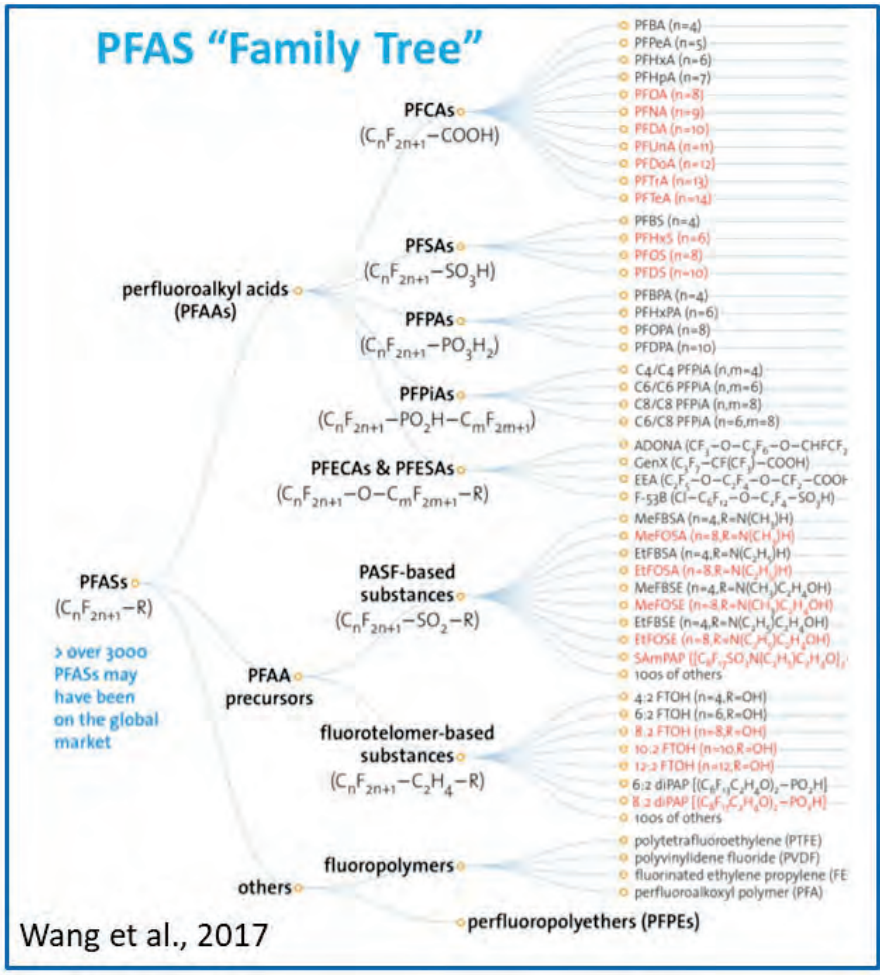
Gloria B. Post, Ph.D., DABT
Division of Science & Research
NJ Department of Environmental Protection

Emerging Contaminants/PFAS Symposium
Duke University
September 28, 2018

The conclusions expressed in this presentation do not necessarily reflect the policies of NJDEP.

What are PFAS and PFAAs?

- **Per- and polyfluoroalkyl substances (PFAS)**:
  - 1000s of compounds - many different structures.
  - Aliphatic compounds with at least one totally fluorinated carbon.
  - Focus of **current interest.**
  - Commercial and industrial uses.
  - Produced and used for over 60 years.
  - Most have little or no health effects or occurrence information.
  - Most not detected by commercial laboratory methods.
- **Perfluoroalkyl acids (PFAAs)**
  - Subset of PFAS.



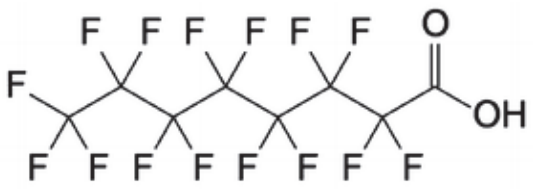
Wang et al., 2017

NJDEP Focus Primarily on Long-Chain Perfluoroalkyl Acids (PFAAs):

PFOA – Perfluorooctanoic acid, C8

PFNA - Perfluorononanoic acid; C9

PFOS - Perfluorooctane sulfonate, C8-S



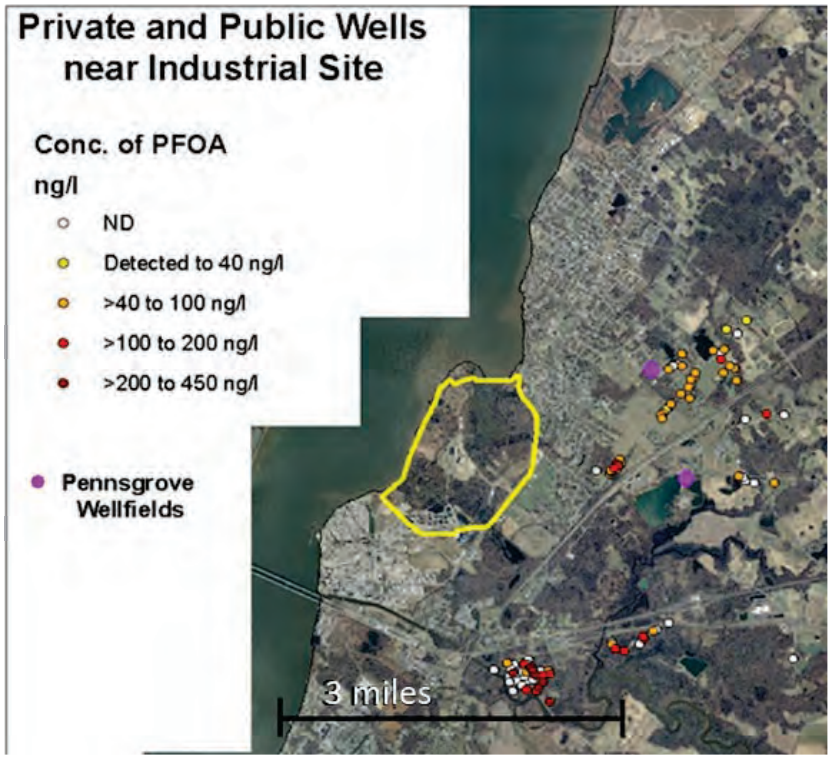
Perfluorooctanoic acid (PFOA)

Perfluorooctanesulfonate (PFOS)

- Totally fluorinated carbon chain - length varies.
- Charged functional group:
  - *Carboxylates (PFCAs; COO^-)*
  - *Sulfonates (PFSAs; SO_3^-)*
- Focus of **initial interest.**
- Considerable occurrence and health effects data.
- Detected by commercial laboratory methods.
- Included in USEPA 2013-15 nationwide public drinking water system monitoring program (Unregulated Contaminant Monitoring Rule 3, UCMR3).
- Although use has been phased out…..
  - ***Do not break down.***
  - ***Environmental contamination persists.***

Initial NJDEP Awareness & Actions on PFOA in NJ Waters in 2004-07

- ***2004:*** Reported in ground water at **large fluorotelomer manufacturing site** in Southwest NJ.
- ***2006:*** Nearby **public water system** (PWS).
  - **Tap water** tested by local environmental group:
    - Up to 64 ng/L; later up to 100 ng/L.
  - **PWS wells** tested by potential industrial source:
    - Up to 190 ng/L; later up to 280 ng/L.
  - Later – nearby **private wells:**
    - Up to > 600 ng/L.
- ***2006-2007: NJDEP Actions:***
  - NJ drinking water **occurrence study** of PFOA and PFOS (2006).
  - **Drinking water guidance – 40 ng/L** (2007; Post et al., 2009)
    - Requested by affected PWS in 2006.



NJ Risk Assessment, Occurrence Studies & Regulation of Emerging Drinking Water Contaminants since 1980s

- NJDEP studies found volatile organic chemicals in NJ waters in 1980s.
  - New Jersey is densely populated and highly industrialized.
  - "Emerging contaminants" of the time - no federal drinking water standards.
- ***New Jersey Safe Drinking Water Act Amendments (1984)***
  - Required development of ***Maximum Contaminant Levels*** (MCLs).
    - 23 listed contaminants (mostly VOCs).
    - Future additional contaminants based on occurrence & health effects.
  - Established ***Drinking Water Quality Institute (DWQI)*** - Advisory body charged with recommending MCLs to NJDEP.
    - Appointed by Governor (3), Assembly (3), and Senate (3) representing *environmental health community, academia,* and *water purveyors.*
    - NJDEP (3) and NJ Dept. of Health (2).
  - Funded drinking water research, including ***occurrence studies.***

DWQI & NJDEP Evaluations (1984-present)

Occurrence studies & recommended/adopted MCLs for many types of drinking water contaminants since the 1980s.

DWQI Evaluations
(1984-2009)

- Volatile Organic Contaminants*
- Methyl tertiary butyl ether (MTBE)*
- Radium*
- Arsenic*
- Perchlorate
- Radon
- Hexavalent chromium

…and many others

Recent DWQI Evaluations
(2009-present)

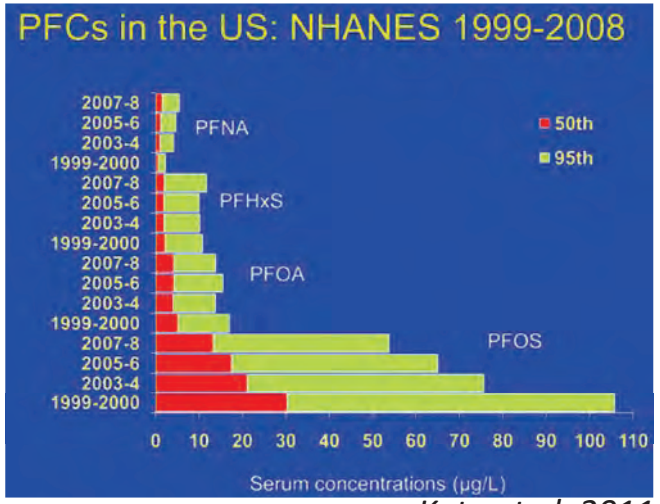
- 1,2,3-Trichloropropane*
- **PFNA***
- **PFOA & PFOS****

* *MCL adopted by NJDEP*

** *Recommended MCL, not yet proposed by NJDEP*

Also - *Periodic reevaluation of basis of previously developed standards.*

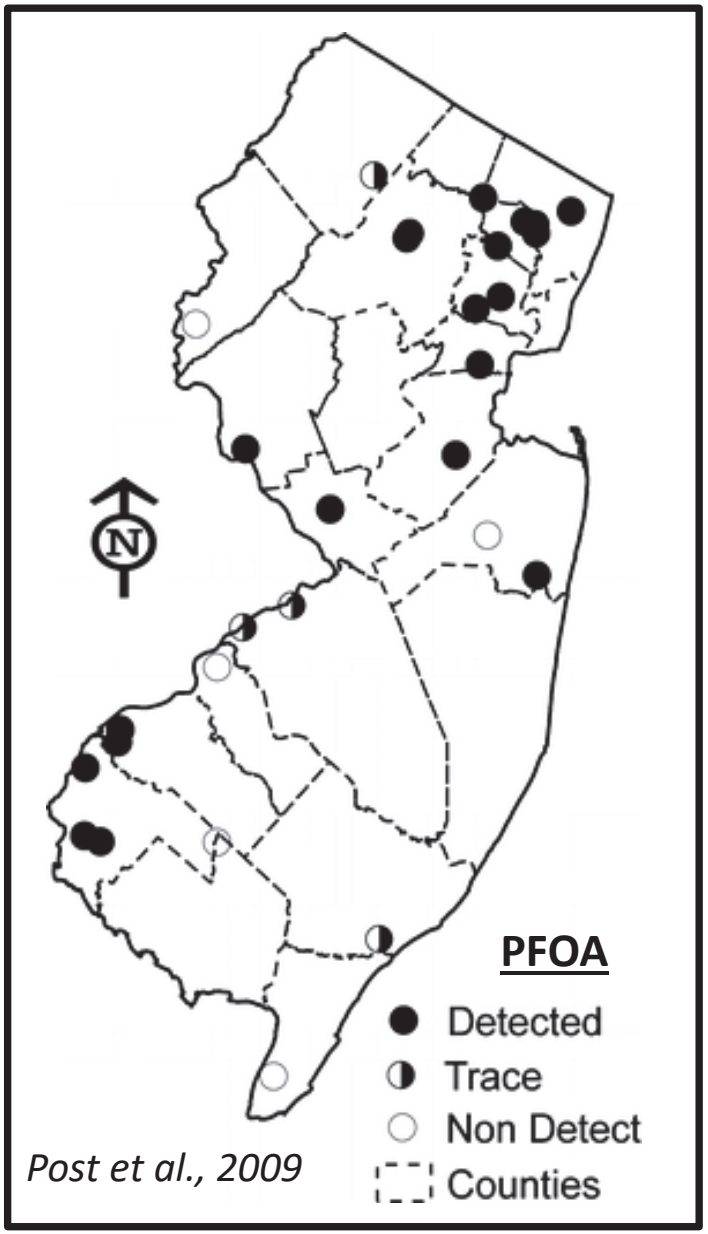
Why Are Long-Chain PFAAs of Concern as Drinking Water Contaminants?



Kato et al. 2011

- Widespread drinking water occurrence.
- Do not break down in the environment.
- Ubiquitous in human blood serum.
- Human half-lives of several years.
  - *Remain in the body for many years after exposure ends.*
- Multiple types of toxicity in animals, including some at low doses.
  - ***More toxic than shorter chain PFAAs.***
- Associations with human health effects at low exposure levels.
- Relatively low drinking water levels can dominate other exposures.
  - *Unlike other persistent, bioaccumulative & toxic (PBT) chemicals such as PCBs & dioxins.*
- Higher drinking water exposures to infants, a sensitive subgroup.
- **Overall - suggests need for caution about exposure from drinking water.**

2006 NJDEP Study of PFOA & PFOS in NJ Public Water Systems (PWS)

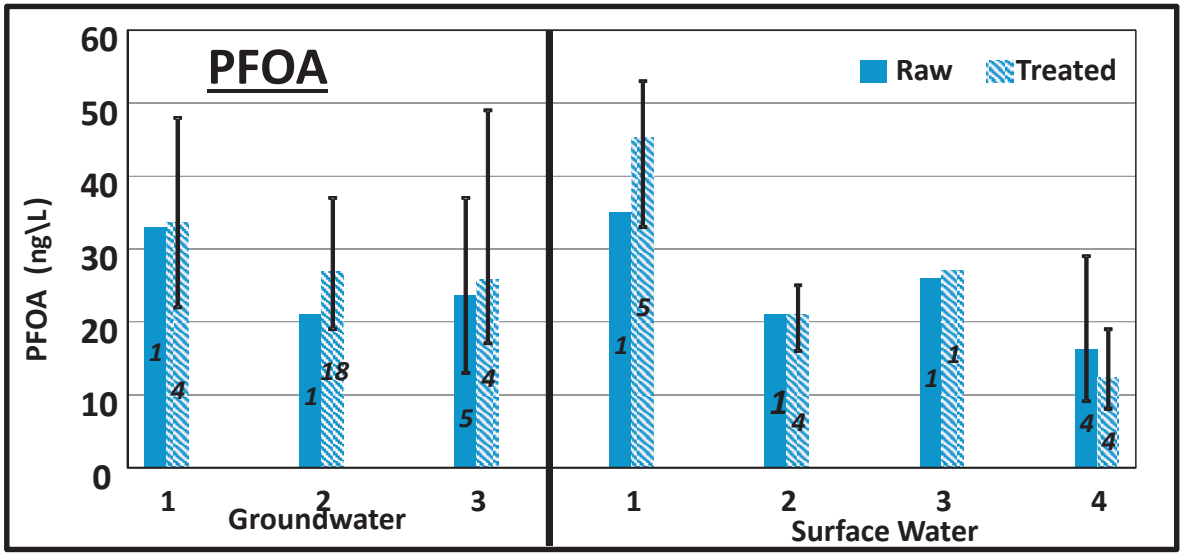


Post et al., 2009

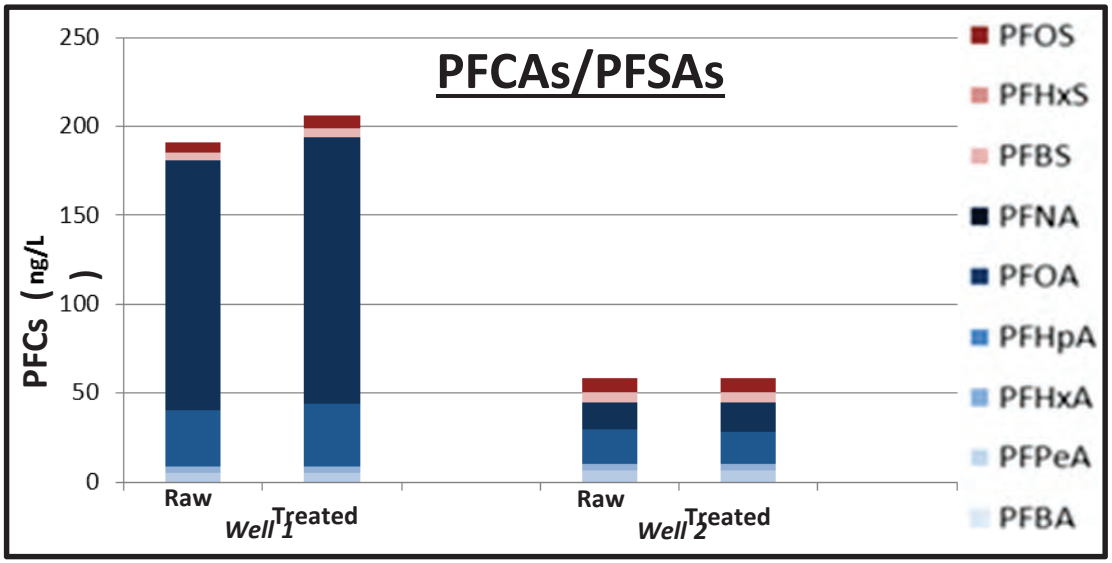
- **First state** to conduct such studies.
- 23 Public Water Systems
  - *Surface Water & Ground Water*
  - *Raw & Finished water*
- **PFOA - 65%; PFOS- 30%.**
  - ***Reporting Level - 4 ng/L***
- 2007-08 follow-up sampling:
  - *PFOA > 40 ng/L* in 5 PWS (including one PWS not in 2006 study); up to 140 ng/L.*

**2007 NJDEP PFOA guidance*

Raw Water versus Treated Water in NJ Public Water Systems Without Treatment Designed for PFAA Removal

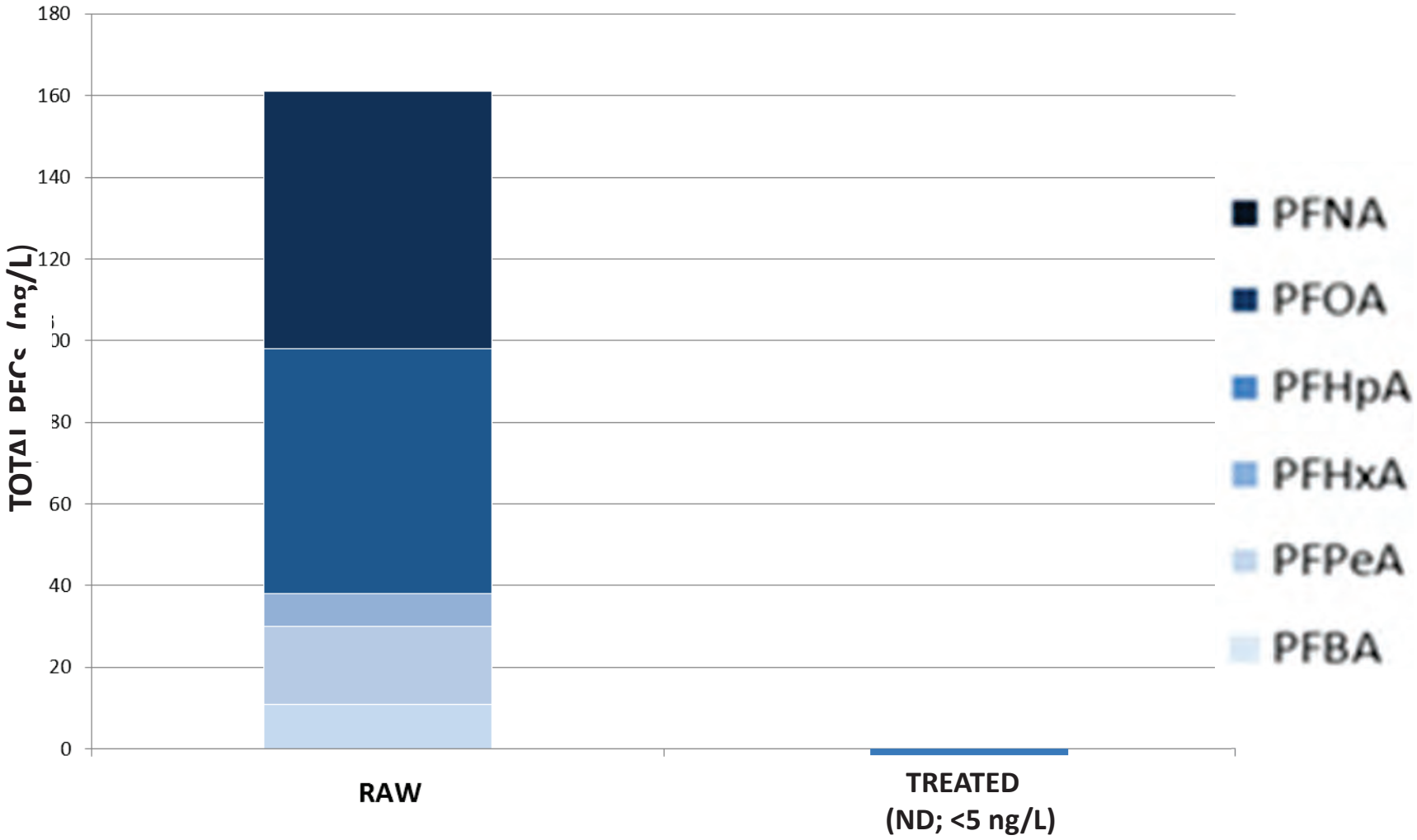


- **Source water is generally a good indicator of finished water.**
  - *Not removed by conventional drinking water treatment processes.*

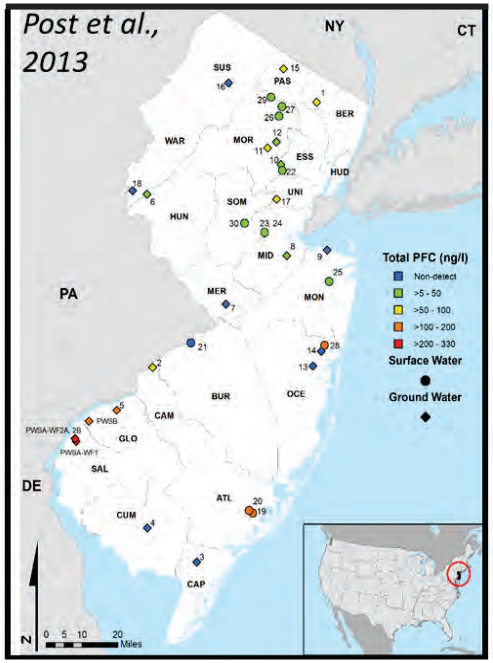


Data from Post et al., 2013

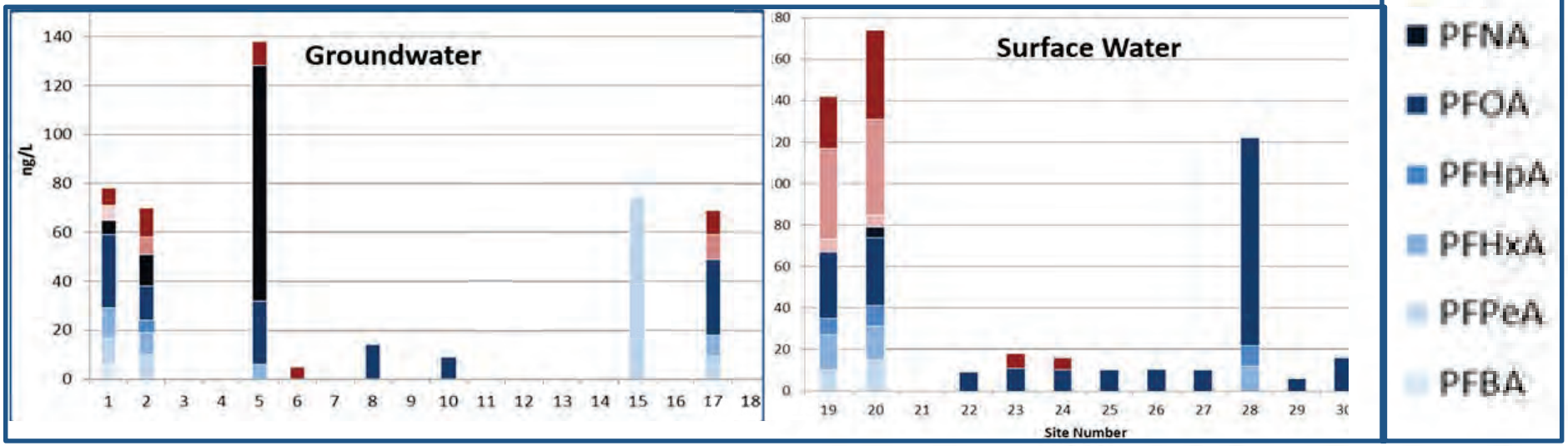
Raw versus Treated Groundwater at NJ Public Water System with Granular Activated Carbon Designed for PFAA Removal



2009-10 NJDEP Study of 10 PFAAs in Raw Water from 29 NJ PWS



- Seven carboxylates (PFCAs); Three sulfonates (PFSAs)
  - *Reporting Level – 5 ng/L.*
- Multiple PFAAs common; **1 - 8 PFAAs** in 60% of PWS.
  - *PFDA (C10) not found.*
- **PFOA & PFOS** – Similar to 2006 study:
  - PFOA: *55% - Most frequent; up to 100 ng/L.*
  - PFOS: 30% - *Up to 43 ng/L.*
- **PFNA (C9):** Up to 96 ng/L in Gloucester County.
  - *Highest reported in drinking water worldwide.*
- No extremely high levels (e.g. µg/L).



New Jersey vs. National PFAA Detections in 2013-15
USEPA Unregulated Contaminated Monitoring Rule 3 (UCMR3)

Compound	*Reporting Level (ng/L)*	*New Jersey PWS*		*National PWS other than NJ*	
		*# Detects**	*% Detects*	*# Detects***	*% Detects*
PFOA (C8)	20	**18/175**	**10.2%**	**90/4734**	**1.9%**
PFNA (C9)	20	**4/175**	**2.3%**	**10/4734**	**0.2%**
PFOS (C8-S)	40	6/175	3.4%	89/4734	1.9%
PFHxS (C6-S)	30	2/175	1.1%	53/4734	1.1%
PFBS (C4-S)	90	0/175	0%	8/4734	0.2%
PFHpA (C7)	10	6/175	3.4%	79/4734	1.7%

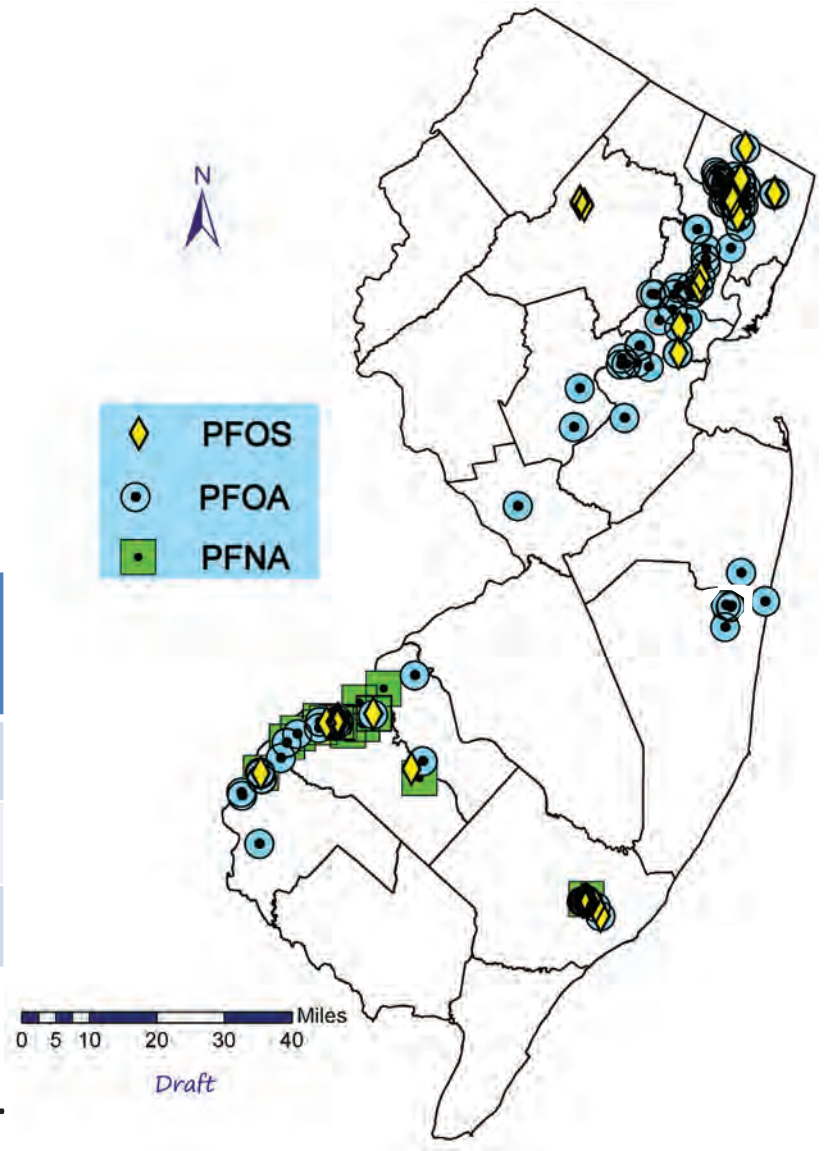
** New Jersey data as of 10/14/16. **USEPA data posted online as of 7/16.*

- Tested finished water at all large (>10,000 customers) and a few small PWS.
- **PFOA and PFNA - much more frequent in NJ than nationally.**
  - *PFNA – Southwestern NJ (Gloucester and Camden Counties).*
  - *PFOA – Various locations statewide.*
- **Other PFAAs** – Similar NJ and national occurrence.
- **Reporting Levels higher** than for most other NJ data.
  - *Much **lower % occurrence** than other NJ data.*
  - *Consistent with reevaluation of large subset of U.S. data at lower RLs.*

Detections above NJ PFAA MCLs in Raw or Finished Water from NJ PWS*

- **Current data** from ~216 of 580 NJ PWS.
  - NJDEP studies, UCMR3, and other data submitted to NJDEP.
  - *Note: UCMR3 RLs (20-40 ng/L) are above NJ MCLs (13-14 ng/L).*
- **Raw water** - wells or surface water intakes.
  Finished water - sampling locations.
  - *Multiple data points shown for some PWS.*
- Detected in **48 PWS** above at least one NJ MCL:

PFAA	NJ MCL*	# PWS	Highest Detection
PFOA	***14 ng/L***	38	280 ng/L
PFOS	***13 ng/L***	20	330 ng/L
PFNA	***13 ng/L***	14	150 ng/L



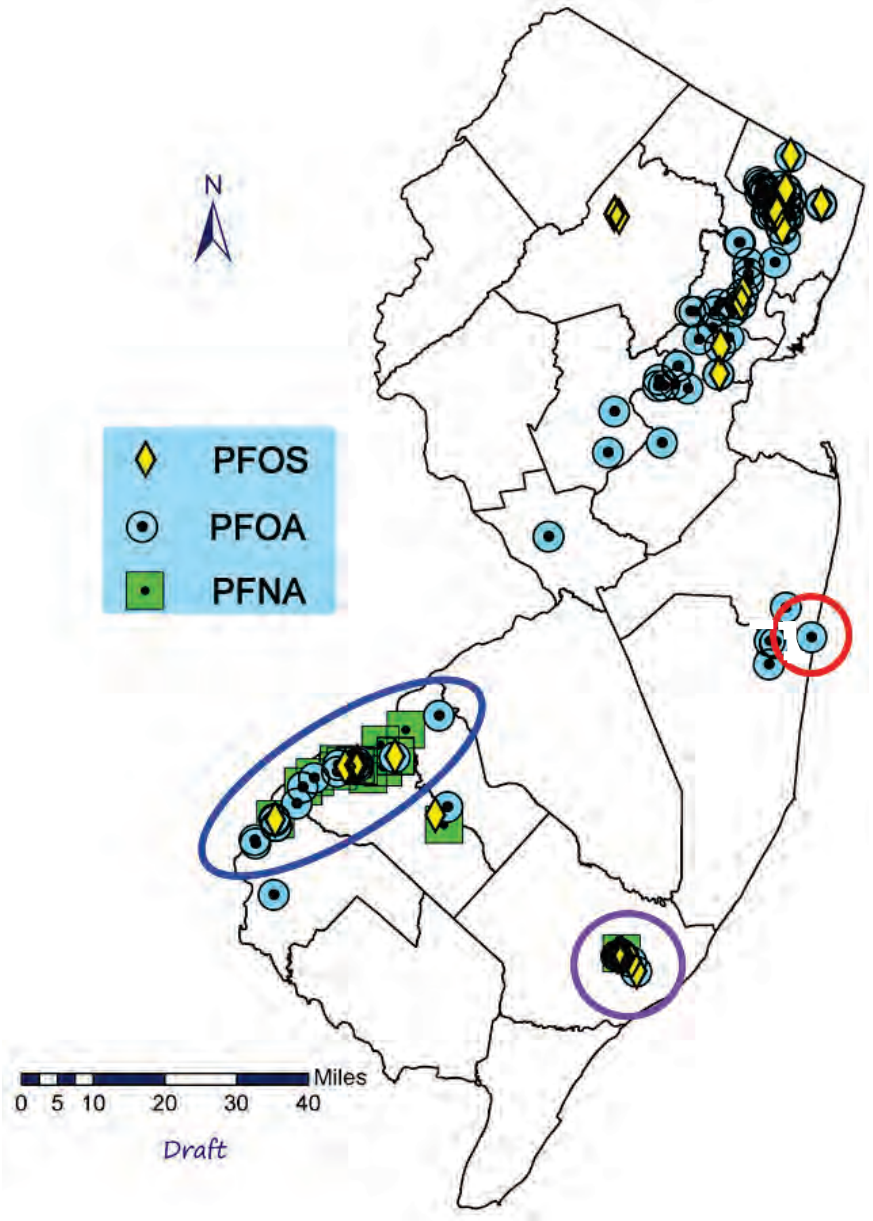
- Most of these PWS, including those with highest levels, **have acted to reduce exposure**.

**PFNA MCL is adopted. PFOA & PFOS MCLs are DWQI recommendations used as guidance.*

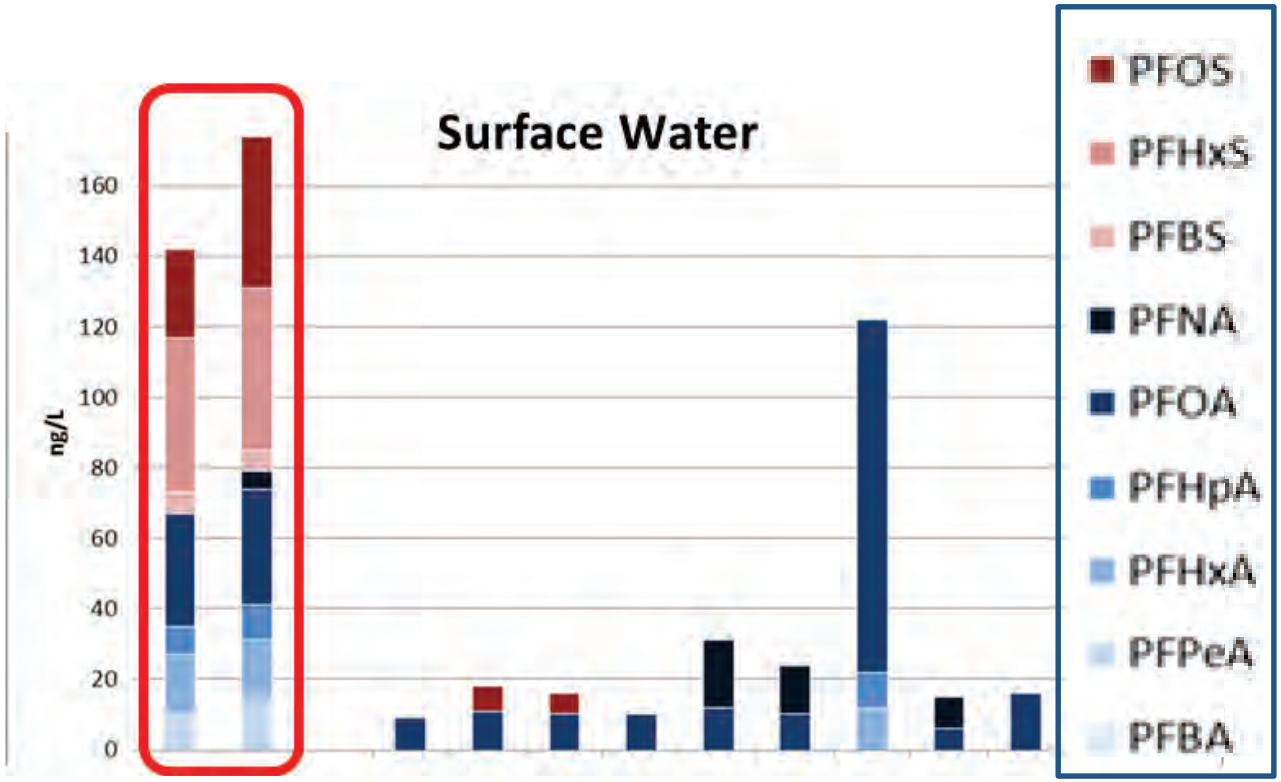
Some Likely Sources of PFAAs in NJ PWS

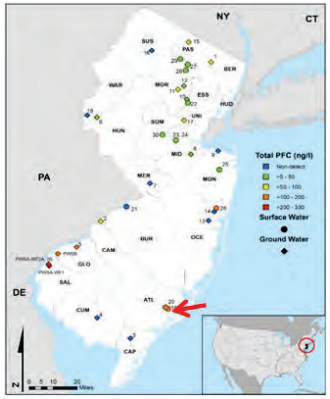
- **PFOA and PFOS in Northeast NJ & other locations:**
  - *Sources are unknown for most sites.*
- **PFOA & PFNA in Southwest NJ.**
  - *Two large industrial sites - likely sources.*
- **PFOA (100 ng/L) in surface water at Ocean County PWS.**
  - *Small industrial facility upstream of river intake - likely source.*
- **Mixture of PFCAs & PFSAs in Atlantic County PWS**
  - *Military use of aqueous fire fighting foam - likely source.*

(Raw and finished water sampling locations shown; multiple data points shown for some PWS)

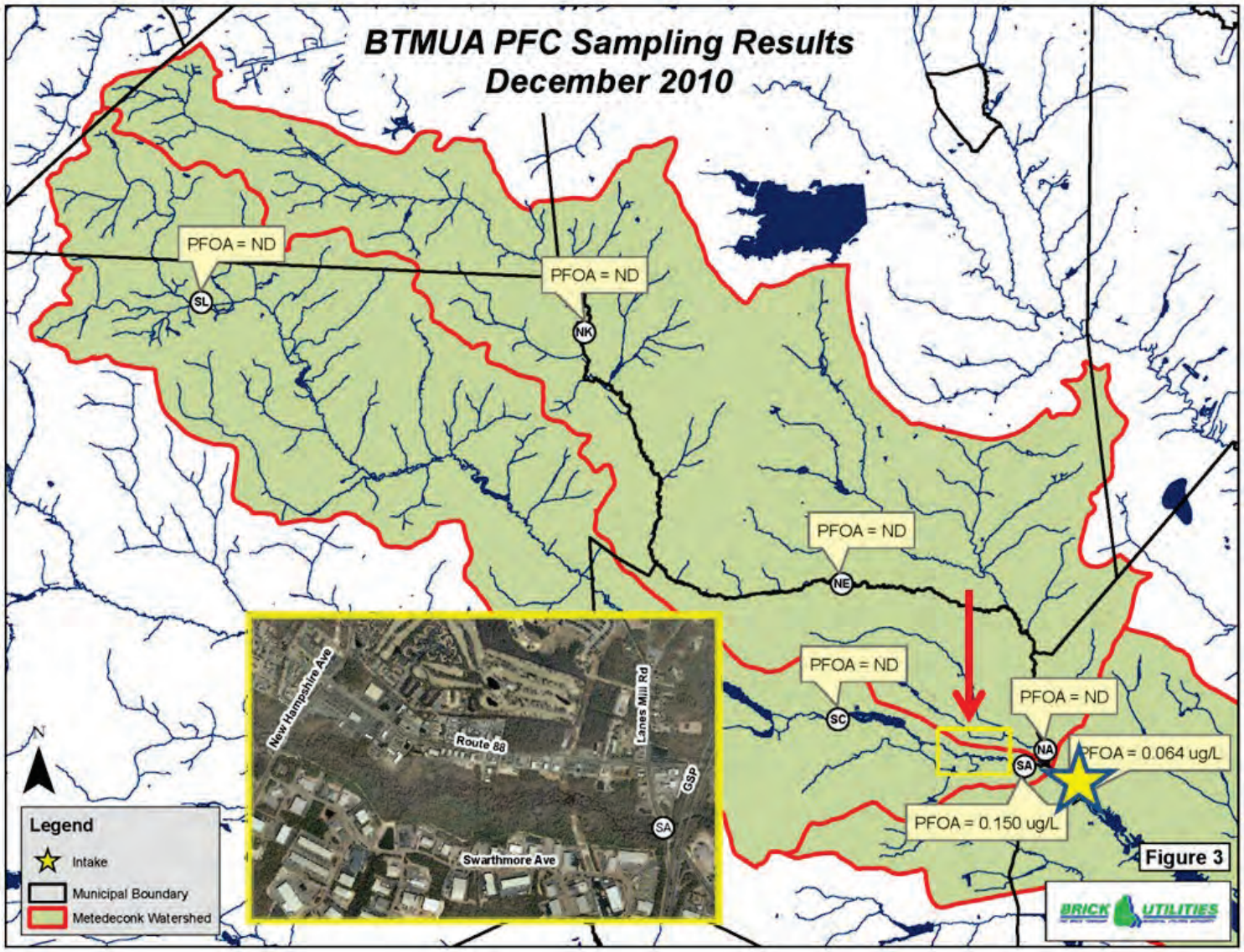


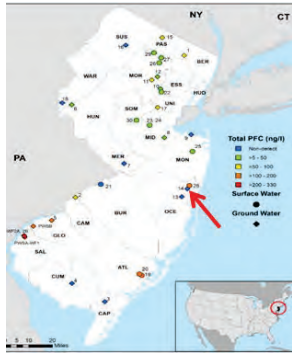
Aqueous Fire Fighting Foam - Likely Source of PFCAs & PFSAs Mixture in PWS Reservoirs & Wells Near Military Site





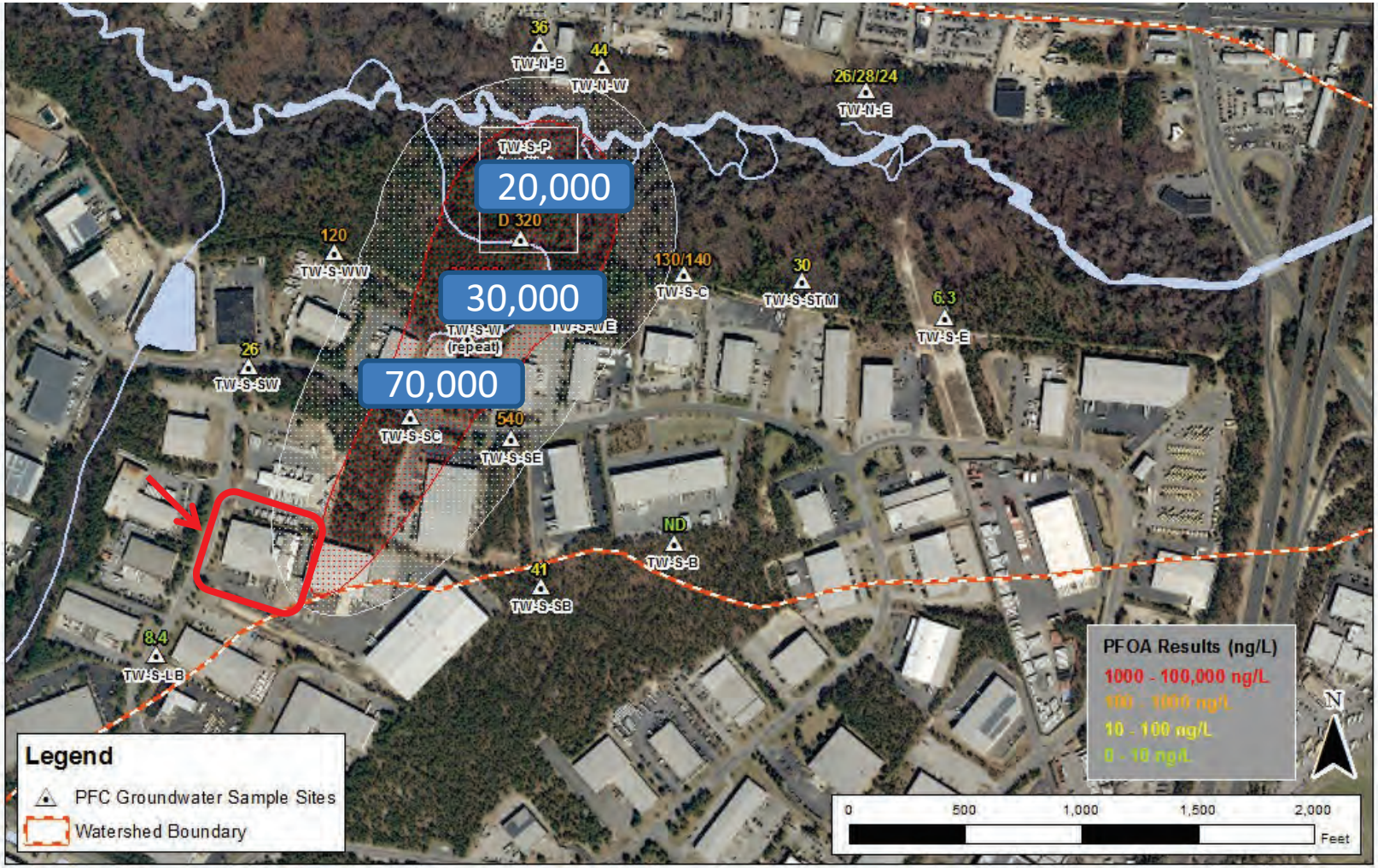
Trackdown of Potential Source of PFOA (100 ng/L) in PWS River Intake in 2009-10 Study





Procopio et al., 2017

Presumed Source: Small industrial facility that used PFOA and other PFAS to make various products

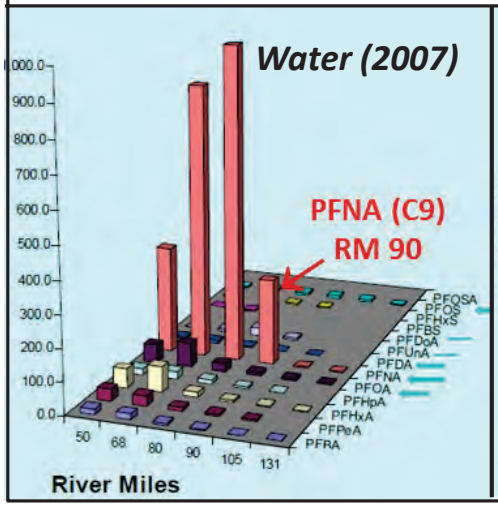


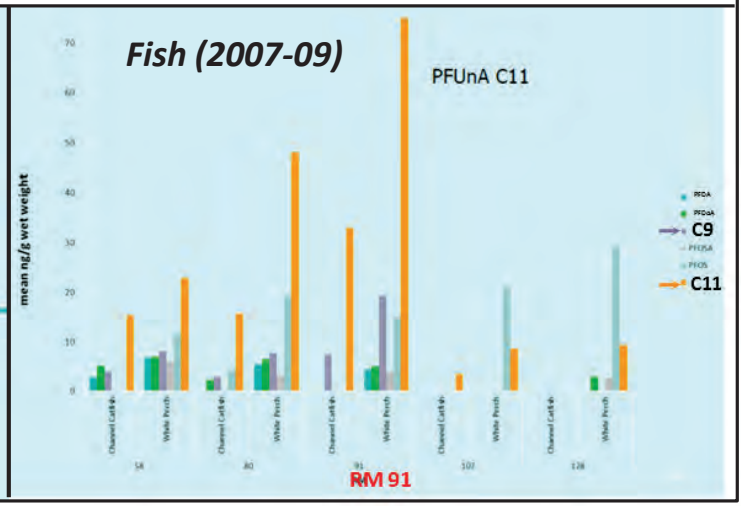
PFNA (C9) in Drinking Water, Surface Water, & Fish in Gloucester County, NJ

- PFNA rarely detected nationally or elsewhere in NJ.
  - *Only 10 of 4734 non-NJ PWS (0.2%) in UCMR3 (>20 ng/L).*
- **Wells of 2 Gloucester County PWS** – highest drinking water levels reported worldwide (up to 150 ng/L).
  - *Later found in **wells of 10 additional nearby PWS**, also nearby **private wells.***
- **Delaware River** in this vicinity – highest surface water levels reported worldwide (up to 976 ng/L).
  - *River not used as drinking water source here.*
- Also, elevated PFNA and PFUnA (C11) in **fish** at these river locations.

PFNA in PWS Wells

PFAS in Tidal Delaware River *(Delaware River Basin Commission, 2012)*





Likely Industrial Source of PFNA Identified

Literature search revealed that PFNA was primary component of PFAS mixture used as processing aid in production of fluoropolymer (polyvinylidene fluoride; PVDF) at Thorofare, NJ facility.

- Large amounts (tons/year) released to air & water for > 20 yrs.
- Use ceased in 2010.
- PFNA in drinking water from industrial source not known to be investigated elsewhere.

TABLE S2. Commercial PFCA Products Characterization

Product Identification	Figure S1 Process	% Branched Isomers	8 PFO	9 PFN	10 PFD	11 PFU	12 PFDD	13 PFTD
Fluorad® FC-143	1	15	99	0.22	≤LOQ	nm	<LOQ	nm
Surflon® S-111*	3	0	0.78	74	0.37	20	0.1	5
APFO - DuPont	2	0	99	nd	≤LOQ	<LOQ	<LOQ	nm

**PFC mixture used as processing aid in manufacture of PVDF*

Global production of PVDF by the emulsion process (2002)

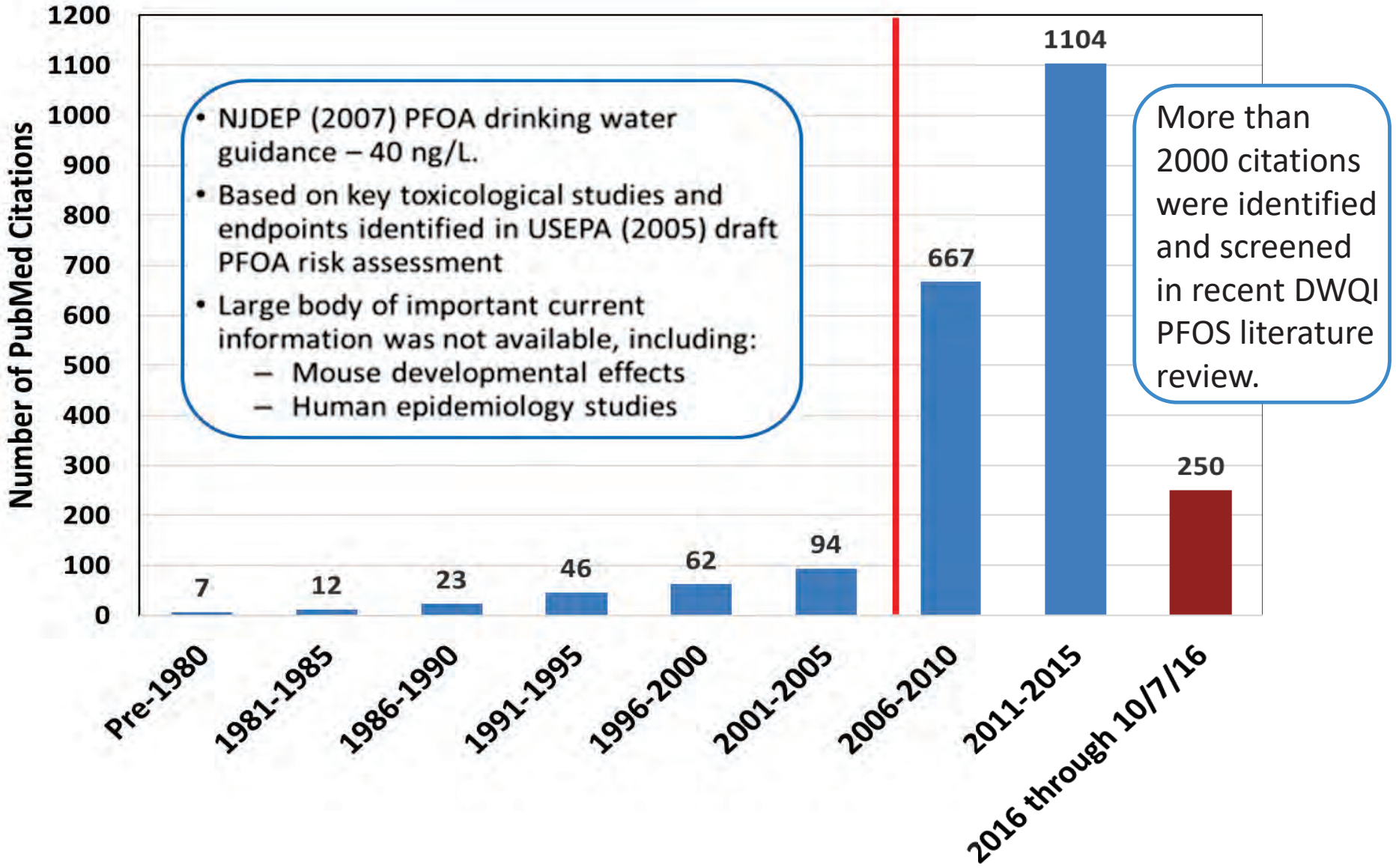
Producer	Location	Process	Capacity, ktonne/year
	Calvert City, KY, USA	Emulsion	8.4
	Thorofare, NJ, USA	Emulsion	7.7
	Decatur, AL, USA	Suspension	2.3
	Pierre Bénite, France	Emulsion	2.2
	Tavaux, France	Suspension	5.0
	Ube, Japan	Emulsion?	0.3
	Settsu, Japan	Suspension?	0.1
	Iwaki, Japan	Suspension	1.2
TOTAL			**27.2**

Source: Prevedouros et al. 2006. Environ. Sci. Technol. 40: 32-44. Supporting Information.

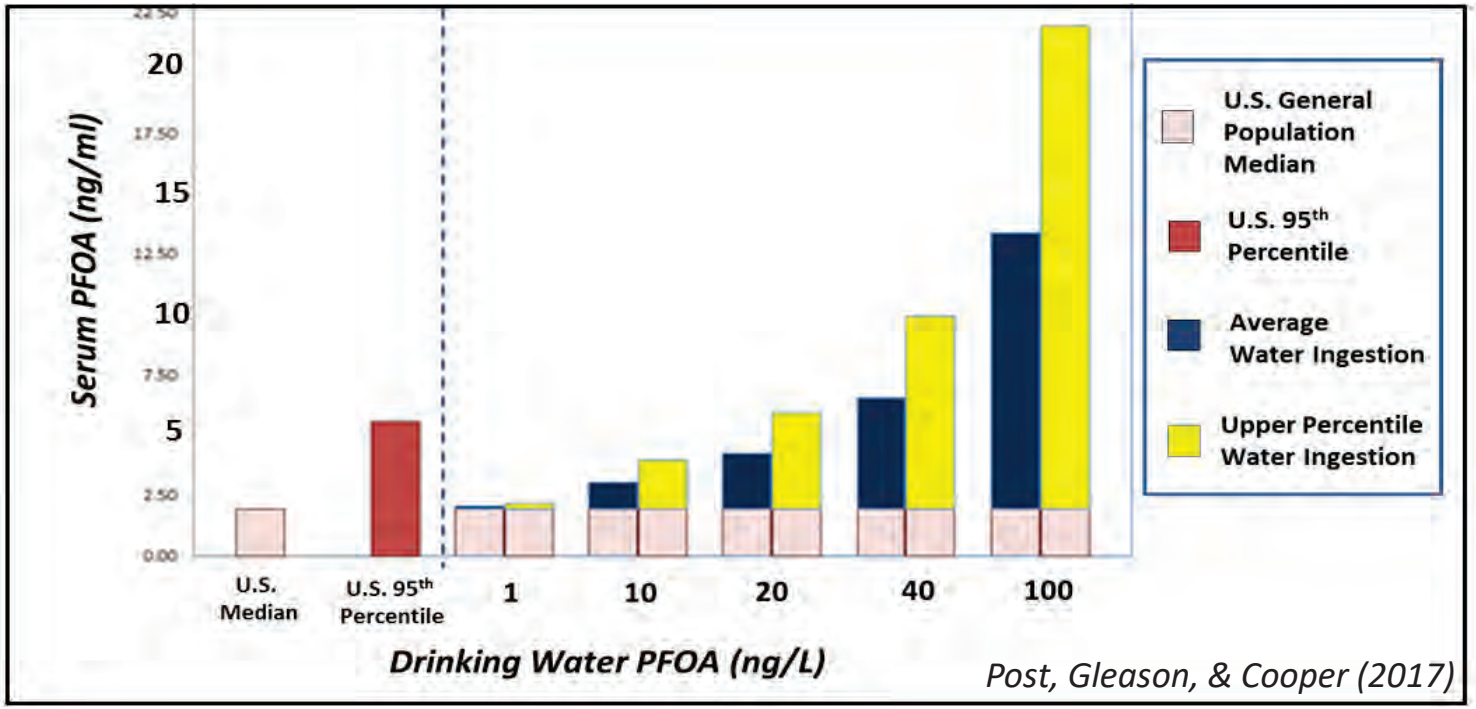
Human Health Risk Assessment of PFOA, PFOS, & PFNA:

General Approach and Major Conclusions

Great Increase in PFAS Research in Recent Years: Example - PFOA



Low Drinking Water Concentrations of Long-chain PFAAs Can Dominate Other Exposure Sources



Post, Gleason, & Cooper (2017)

- **Clearance factor** (CL) - relates external dose & serum level:

  Dose (µg/kg/day) = Serum Conc. (µg/L) x CL (L/kg/day)

- **PFOA:** Predicted serum:drinking water ratios:
  - ***114:1*** *- average water consumption;* ***200:1*** *- upper percentile water consumption.*
- Ratio of **>100:1 supported by empirical data** from studies in several locations.
- **Higher ratios** predicted for PFOS, PFNA & other PFAAs with longer half-lives.
- Drinking water not important exposure route for other (PBT) chemicals (e.g. dioxins, PCBs)

EHP Environmental Health Perspectives
Brief Communication

Online Serum PFOA Calculator for Adults

Scott M. Bartell

First Published: 24 October 2017 | Cited by: 1

INPUT:

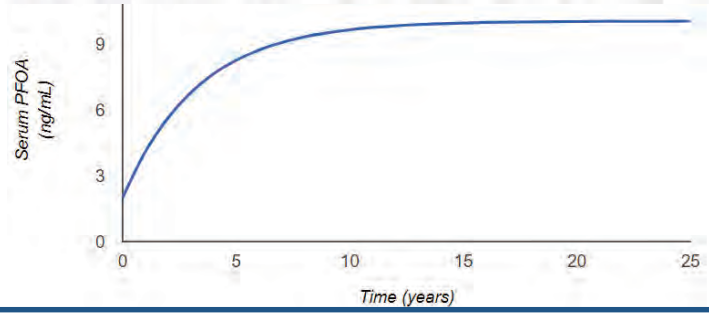
Please enter the following values, then click on the "submit" button:

1. How much PFOA was in your blood sample?
Starting serum PFOA concentration (µg/L, ng/mL, or ppb) [ ]

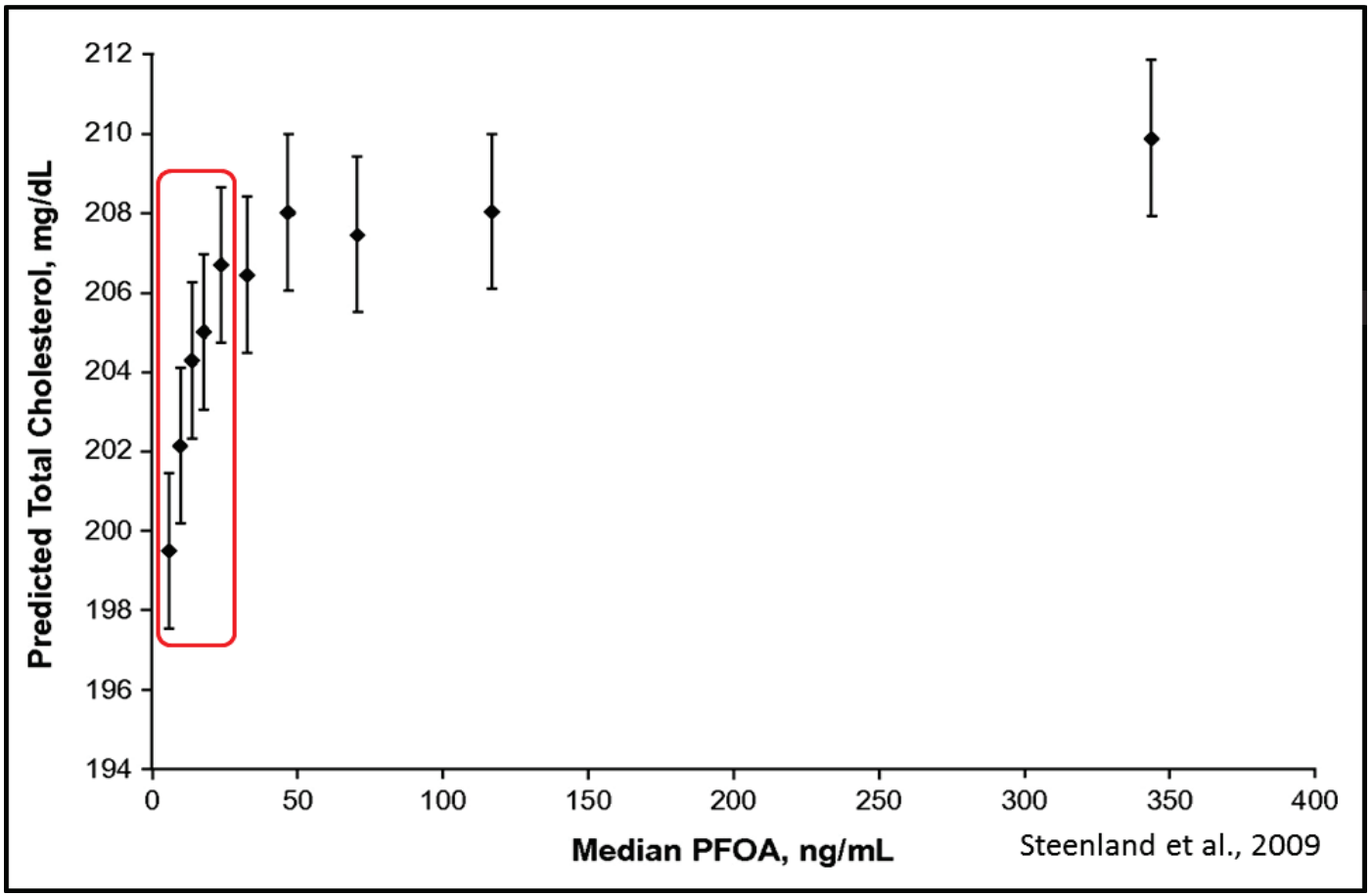
2. How much PFOA is in your drinking water? Enter 0 if you're drinking only bottled water, carbon-filtered water, or water treated by reverse osmosis.
Water PFOA concentration for ongoing consumption (ng/L, or ppt) [ ]

OUTPUT:

Starting serum PFOA concentration: 2 ng/mL
Water PFOA concentration: 70 ppt
Serum PFOA contribution from other ongoing exposures: 2.08 ng/mL
Half-life of PFOA in serum: 2.3 years
Steady-state ratio for serum:water concentrations: 114
Predicted steady-state serum PFOA concentration: 10.06 ng/mL



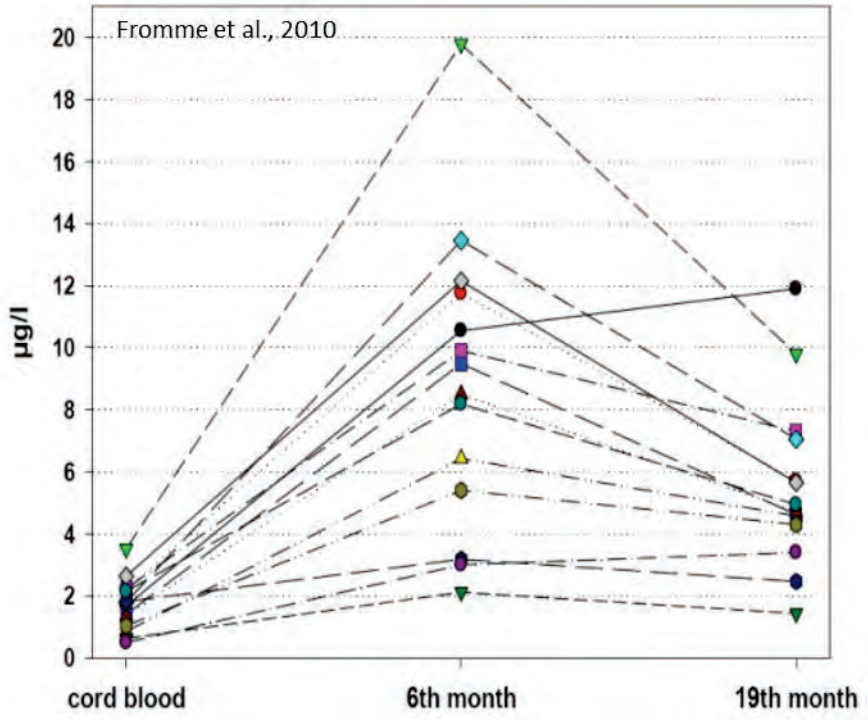
Steep Dose-Response for Some Effects at Low Serum Levels - Example: Association of ↑ Cholesterol and PFOA Drinking Water Exposure

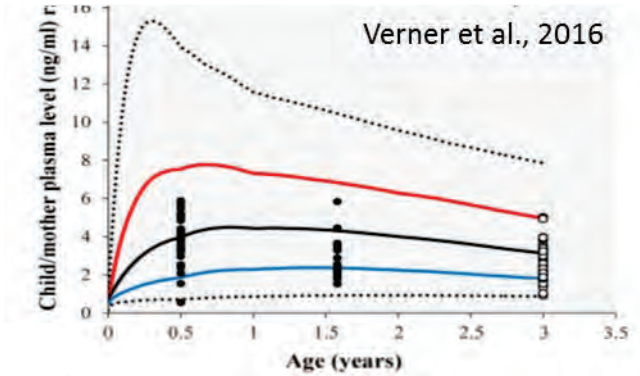


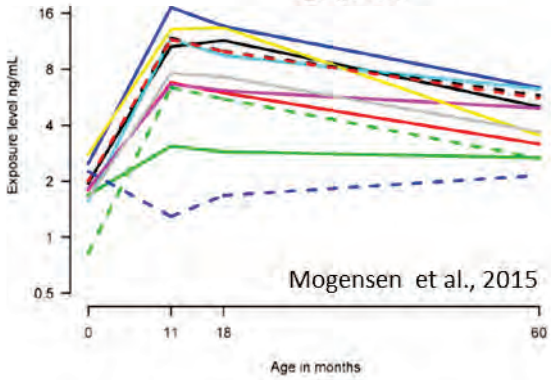
Other associations at low serum levels include ↑ liver enzymes, ↓ vaccine response, and ↓ birth weight.

Increases of Long Chain PFAAs in Serum Are Greater in Infants – Example: PFOA

- Higher exposures - from breast milk or formula:
  - *PFAA levels in breast milk similar or higher than in maternal drinking water.*
  - *Ingest much more fluid per body weight than older individuals.*
- Similar data for other long-chain PFAAs.
- Sensitive subpopulation for developmental & other short-term effects.







Conclusions: Use of Human Epidemiology Data in Risk Assessment of Long-Chain PFAAs

- **Much more human data than for most other drinking water contaminants.**
- In general, **human studies preferred as basis**, if data are appropriate.
  - However, **animal studies are usually used**.
- **Associations** for long-chain PFAAs with some endpoints are **generally consistent.**
  - Within **general population exposure range**, even without additional exposure from drinking water…. and, **for PFOA, with elevated exposures from drinking water.**
- Generally **concordant** with effects in **animal toxicology** studies.

- Limitations **preclude human data as quantitative basis** for risk assessment.
  - Exposures to multiple PFAS are correlated, preventing determination of dose-response for individual PFAS.
- **Human data provide support for public health protective approach based on animal toxicology data.**
  - **Justify concern about substantial ↑ in blood levels from drinking water.**

Selection of Studies & Endpoints for NJ PFAA Risk Assessments

- Long-chain PFAAs cause **multiple types of toxicity** in laboratory animals:
  - *Hepatic*
  - *Developmental*
  - *Immune system*
  - *Neurobehavioral*
  - *Male reproductive*
  - *Tumors (PFOA, PFOS)*

  ….and other toxicological effects

- Based on **Reference Doses** for **most sensitive non-cancer endpoints** that are *well-established, adverse, and relevant to humans.*
  - For **PFAAs** – study must provide **serum data** needed for dose-response analysis.
    - Animal-to-human comparison based on **internal dose,** not administered, dose, because **animal half-lives are much shorter than human half-lives.**
- **Carcinogenicity:** PFOA and PFOS - "Suggestive evidence"
  - Cancer risk was evaluated and was **not driving factor** for risk assessment.

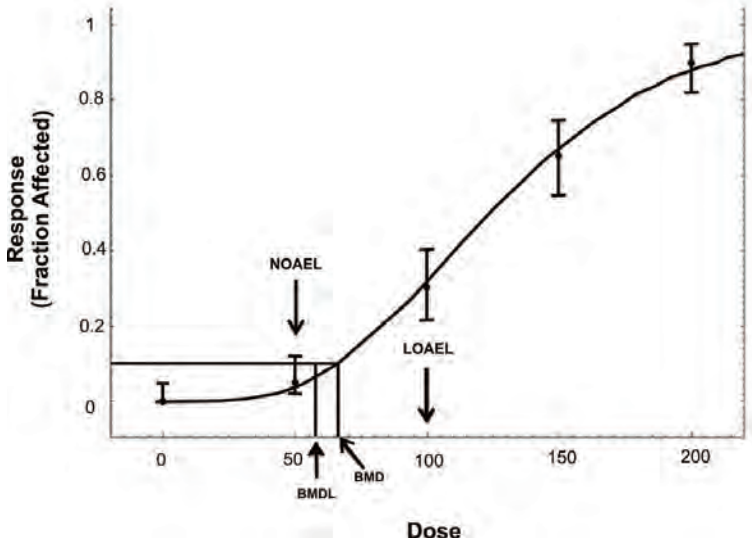
Reference Dose for Non-Cancer Effects

$$\text{Reference Dose (mg/kg/day)} = \frac{\text{Point of Departure}}{\text{Uncertainty Factors}}$$

Definition: "Daily oral dose to humans (including sensitive subgroups) likely to be **without appreciable risk** of deleterious effects during a lifetime."

Point of Departure from within range in study is "starting point" for application of UFs:

- **No Observed Adverse Effect Level (NOAEL)**
  Highest dose not causing effect.
- **Lowest Observed Adverse Effect Level (LOAEL)**
  Lowest dose causing effect.
- **Benchmark Dose (BMD/BMDL)**
  Modeling used to predict dose causing specified minimal change (e.g. 10%; 1 SD).



Development of Drinking Water Guidelines for Non-Cancer Effects

Health-based MCL *or* Lifetime Health Advisory =

$$\frac{\text{RfD (mg/kg/day) x Relative Source Contribution (\%)}}{\text{Drinking Water Consumption (L/kg/day)}}$$

EXPOSURE ASSUMPTIONS:

Drinking Water Consumption:

New Jersey: 0.029 L/kg/day.
- Default adult - 2 L/day (upper percentile); 70 kg body weight.

USEPA: 0.054 L/kg/day.
- 90th percentile for lactating woman.

Relative Source Contribution (RSC):

- Accounts for non-drinking water exposure sources (e.g. food, air).
- Higher RSC results in higher HBMCL/LHA.
- 20% default
  - *New Jersey and USEPA - for PFOA and PFOS.*
  - *Assumes 80% exposure comes from non-drinking water sources.*
- Up to 80% can be used if supported by contaminant-specific data.

NJ & USEPA PFOA & PFOS Reference Doses, NJ Health-based MCLs (HBMCL) & USEPA Lifetime Health Advisories (LHA)

		Toxicological Basis	*RfD* (ng/kg/day)	*HBMCL or LHA* (ng/L)*
PFOA	**NJ**	Delayed mammary gland development	0.11	***(0.77**)***
		Not recommended due to lack of precedent as basis for risk assessment.		
		Increased liver weight • Includes **database uncertainty factor of 10** for more sensitive developmental effects (e.g. mammary gland development)	2	14
	USEPA	Delayed ossification & accelerated puberty in offspring. *Supported by immunotoxicity, body wt. & ↑ kidney wt., in other studies.* ↓	20	70***
PFOS	**NJ**	Immunotoxicity – ↓ plaque forming cell response	1.8	13
	USEPA	Decreased offspring body wt.	20	70***

*Assumed water consumption: NJ - 0.029 L/day, default adult upper %. USEPA – 0.054 L/kg/day, 90th % lactating woman. Relative Source Contribution: NJ & USEPA – default, 20%.

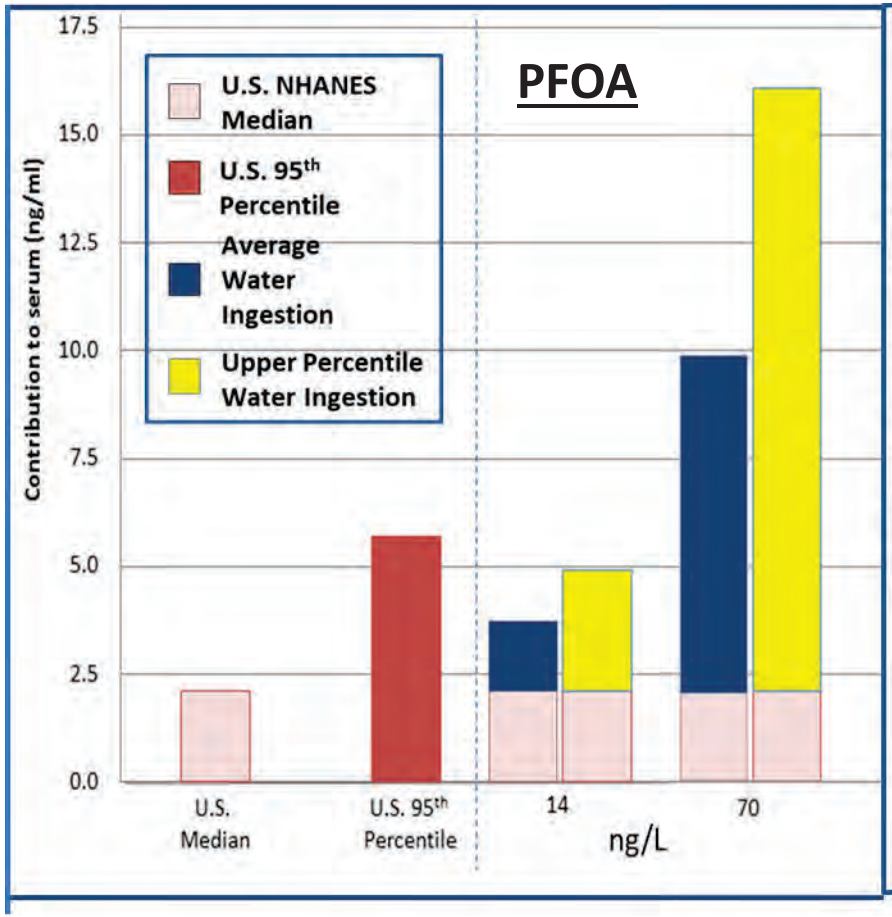
***Applies to total of PFOA and PFOS.

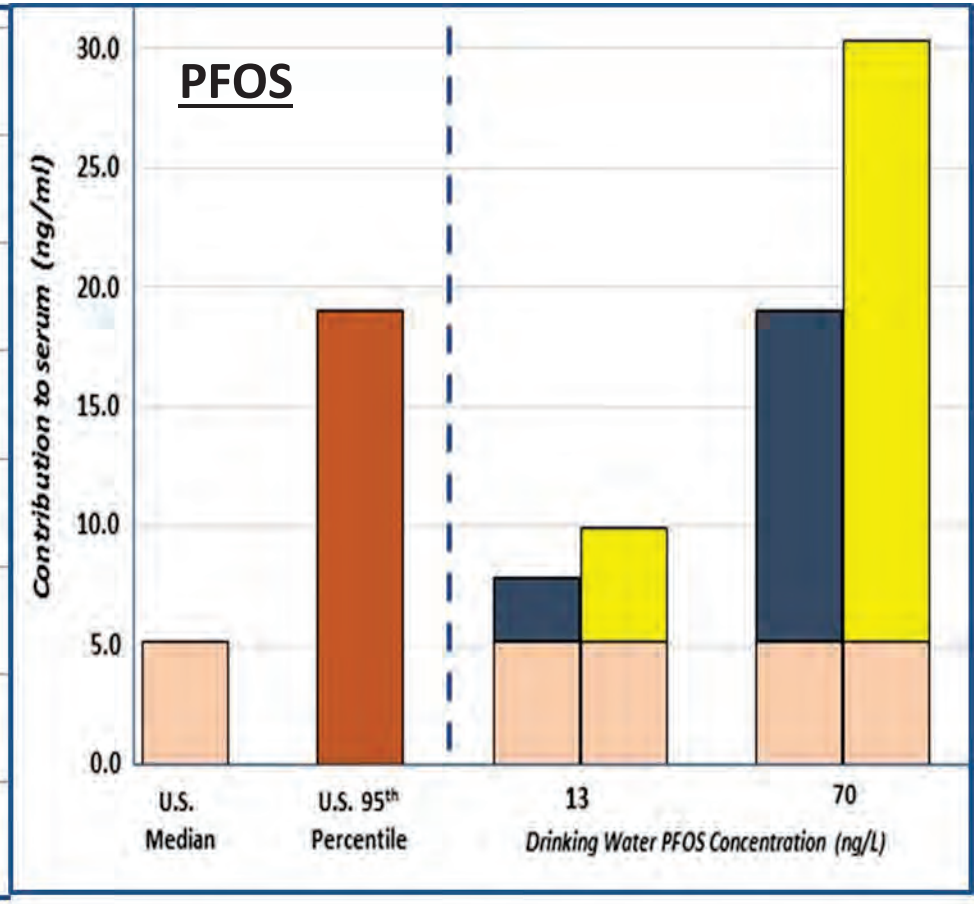
PFOS - Support for Immune System Toxicity as Basis for NJ RfD

(Pachkowski et al. 2018. Env. Research)

- **Decreased plaque forming cell response** – reported in several PFOS mouse studies.
  - **More sensitive** than decreased offspring body weight used by USEPA.
  - **Well-established** endpoint: Used for recent **USEPA IRIS RfDs** for other chemicals**.**
- Supported by **human associations** with ↓ vaccine response (analogous effect) and ↑ infectious disease incidence**.**
- **Recent PFOS evaluations:**
  - **NTP (2016) systematic review:** Presumed human immune hazard.
    - *High level of evidence for **suppressed antibody response in animals**.*
    - *Moderate level of evidence from human studies.*
  - **Minnesota DOH (2017) RfD:**
    - *UF of 3 for potentially more sensitive immunotoxicity.*
  - **Draft ATSDR (2018) Intermediate Minimum Risk Level (MRL) - 2 ng/kg/day**:
    - *Immunotoxicity - most sensitive endpoint.*
    - *Not used as primary basis because no toxicokinetic model for serum PFOS in relevant mouse strains.*
    - *MRL based on ↓ rat pup weight includes UF of 10 for immunotoxicity.*
- **Peer reviewed publications** (Lilienthal et al., 2017; Dong et al., 2017):
    - *Immunotoxicity more sensitive than developmental effects.*

Increases in Serum PFOA & PFOS Predicted from NJ MCL (13-14 ng/L) and USEPA Health Advisory (70 ng/L)





New Jersey RfD & Health-based MCL for PFNA (C9)

- **"New Jersey-specific contaminant"** – not evaluated by USEPA.
- Effects (hepatic, developmental, immune, male reproductive) generally **similar to PFOA** but:
  - *More **persistent** in the body.*
  - *Effects at **lower doses.***
  - *More **severe** effects (e.g. delayed offspring growth persists to adulthood).*
- Estimated serum:drinking water ratio of **200:1** (~ 2-fold higher than for PFOA)
- RfD based on ↑ **liver weight** in pregnant mice (Das et al., 2015)
  - *Only study with numerical **serum PFNA data** needed for dose-response.*
- UF of 3 for **more sensitive effects** at lower doses:
  - ***Hepatic necrosis** – Numerical serum PFNA data not provided.*
  - *Mammary gland development – potential effect; has not been studied.*
- Health-based MCL is **13 ng/L.**

Factors Considered in New Jersey MCL Development

- **Health-based MCL**
  - *Non-carcinogens – no health effects expected from lifetime exposure.*
  - *Carcinogens – 1 in 1 million lifetime cancer risk.*
- **Practical Quantitation Level (PQL)**
  - *Level that can be reliably measured by drinking water laboratories.*
- Availability of **treatment removal technology.**

*** Health-based MCL is the goal ***

- *PFAA MCLs were not limited by analytical or treatment factors.*

- **Therefore, PFAA MCLs were set at Health-based MCLs.**

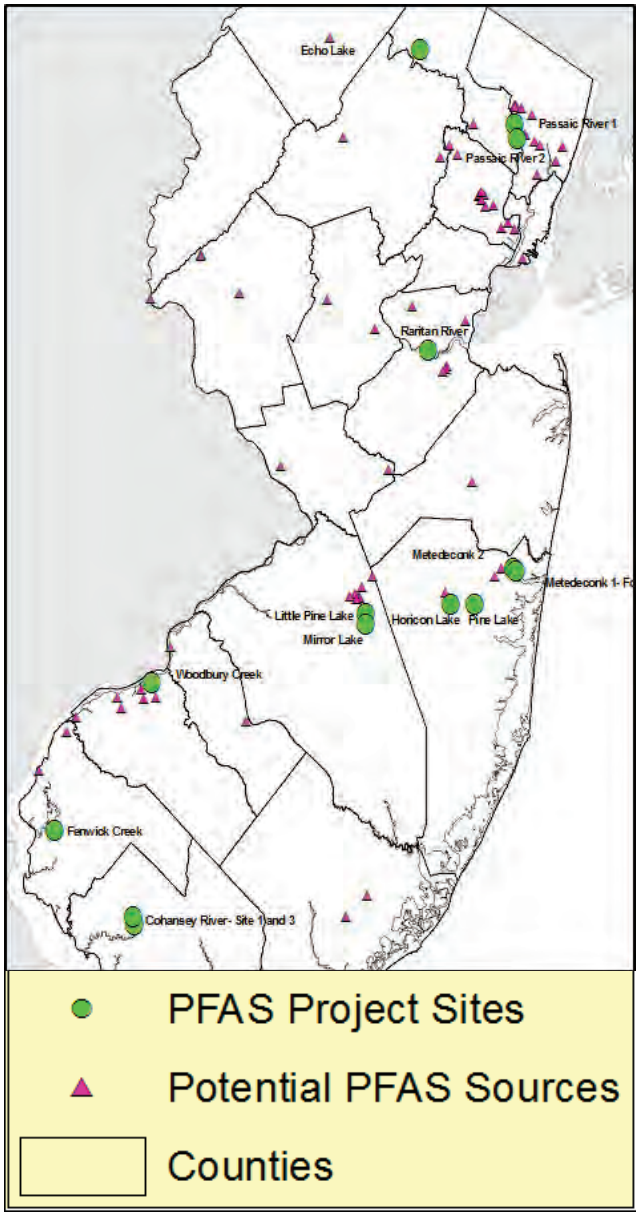
(Units: ng/L)	Health-based MCL	Analytical PQL	Treatment Removal	Recommended MCL
PFOA	**14**	**6**	**Not limiting**	**14**
PFOS	**13**	**4.2**	**Not limiting**	**13**
PFNA	**13**	**5**	**Not limiting**	**13**

NJDEP Study of PFAS in Fish Tissue, Sediments & Surface Water

- 11 sites statewide selected for:
  - Proximity of potential source.
  - Recreational and/or subsistence fishing.
- ~100 fish collected.
  - 12 species (2-4 species per site)
  - 3 trophic levels
- Shorter-chain PFAAs detected in almost all surface water samples, but not in fish.

Compound	# of Sites (n=11)	# of Species-Sites (n=32)	Maximum conc. (ng/g)
PFOS	11	30	162.5
PFUnA	11	31	27.2
PFDoA	10	28	5.42
PFDA	10	24	3.57
PFOSA	3	5	2.83
PFHxS	3	4	1.66
PFNA	2	4	1.39
PFOA	1	2	0.72

Reporting Levels: 0.5 – 1 ng/g (ppb)



NJ Fish Consumption Advisories for PFAS (2018)

	General Population			High Risk Population*		
	PFOA (ng/g; ppb)	PFNA (ng/g; ppb)	PFOS (ng/g; ppb)	PFOA (ng/g; ppb)	PFNA (ng/g; ppb)	PFOS (ng/g; ppb)
Unlimited	0.62	0.23	0.56	0.62	0.23	0.56
Once/Week	4.3	1.6	3.9	4.3	1.6	3.9
Once/Month	18.6	6.9	17	18.6	6.9	17
Once/3 months	57	21	51	N/A	N/A	N/A
Once/Year	226	84	204	N/A	N/A	N/A
Do Not Eat	**>226**	**>84**	**>204**	**>18.6**	**>6.9**	**>17**

** High risk – infants, children, pregnant & nursing women, women of childbearing age.*

- **Consumption Advisory Triggers** based on NJ Reference Doses for PFOS, PFOA, and PFNA.
  - *Assume 227 g (8 oz.) meal size, 70 kg body weight.*
- **Advisories for PFOS at all study sites.**
  - *Consumption frequency ranges from once per week to once per year.*
  - *For 1 – 3 species at each site.*

Status of NJDEP PFAS Standards & Regulations

PFNA

- **MCL** – 13 ng/L (adopted Sept. 2018).
- **Ground Water Quality Standard** –
  - 10 ng/L (adopted Jan. 2018).
  - Updated to 13 ng/L by reference to MCL (Sept. 2018).
- Added to **NJ Hazardous Substances List** (September 2018).

PFOA

- DWQI MCL **recommendation** – 14 ng/L (March 2017).
- NJDEP Commissioner accepted recommended MCL, and stated that MCL will be proposed (October 2017).
- Currently used guidance by **NJDEP**.

PFOS

- DWQI MCL **recommendation** - 13 ng/L (June 2018).
- Currently used as guidance by **NJDEP**.

Many current and former colleagues from:

New Jersey Department of Environmental Protection

New Jersey Department of Health

and the

New Jersey Drinking Water Quality Institute

contributed to the work presented here.

Thank you!

For more information,
see publications and reports on next slides
or contact:

gloria.post@dep.nj.gov

NJDEP Division of Science & Research PFAS Publications

- Pachkowski, B.**,** Post, G.B., Stern, A.H. (2018). The derivation of a Reference Dose (RfD) for perfluoroctane sulfonate (PFOS) based on immune suppression. Env. Research (accepted manuscript is online).
- Post, G.B., Gleason, J.A., Cooper, K.R. (2017). Key scientific issues in developing drinking water guidelines for perfluoroalkyl acids: Contaminants of emerging concern. PLoS Biol. 15(12):e2002855.
- Procopio, N.A., Karl, R., Goodrow, S.M., Maggio, J., Louis, J.B., Atherholt, T.B.. (2107). Occurrence and source identification of perfluoroalkyl acids (PFAAs) in the Metedeconk River Watershed, New Jersey. Environ Sci Pollut Res Int. 24:27125-27135.
- Gleason, J.A., Post, G.B, and Fagliano, J.A. (2015). Associations of perfluorinated chemicals (PFCs) serum concentrations and select biomarkers of health in the US population (NHANES), 2007-2010 Env. Research 136: 8-14.
- Post, G.B., Louis, J.B., Lippincott, R.L., and Procopio, N.A. (2013). Occurrence of perfluorinated chemicals in raw water from New Jersey public drinking water systems. Env. Sci. Technol. 47 (23):13266-75.
- Post, G.B., Cohn, P.D., and Cooper, K.R. (2012). Perfluorooctanoic acid (PFOA), an emerging drinking water contaminant: a critical review of recent literature. Env. Res. 116: 93-117.
- Post, G.B., Louis, J.B., Cooper, K.R., Boros-Russo, B.J., and Lippincott, R.L. (2009). Occurrence and potential significance of perfluorooctanoic acid (PFOA) detected in New Jersey public drinking water systems. Environ. Sci, Technol. 43: 4547–4554.

NJDEP & NJ Drinking Water Quality Institute Reports

NJ Drinking Water Quality Institute Maximum Contaminant Levels Recommendations

Perfluorooctane Sulfonate (PFOS), June 2018

- Appendix A – Health-Based Maximum Contaminant Level Support Document for PFOS
- Appendix B – Report on the Development of a Practical Quantitation Level for PFOS in Drinking Water
- Appendix C – Second Addendum to Appendix C: Recommendation on Perfluorinated Compound Treatment Options for Drinking Water
- Appendix D – Responses to Comments on DWQI Health Effects Subcommittee Report: "Public Review Draft - Health-Based Maximum Contaminant Level Support Document: PFOS"

Perfluorooctanoic Acid (PFOA), March 2017

- Appendix A – Health-Based Maximum Contaminant Level Support Document" PFOA
- Appendix B – Report on the Development of a Practical Quantitation Level for PFOA in Drinking Water
- Appendix C – Addendum to Appendix C: Recommendation on Perfluorinated Compound Treatment Options for Drinking Water
- Appendix D – Responses to Comments on DWQI Health Effects Subcommittee Report: "Public Review Draft-Health-Based Maximum Contaminant Level Support Document: PFOA"

Perfluorononanoic Acid (PFNA), July 2015

- Appendix A – Health-Based Maximum Contaminant Level Support Document: PFNA
- Appendix B – Report on the development of a Practical Quantitation Level for PFNA
- Appendix C – Recommendation on Perfluorinated Compound Treatment Options for Drinking Water

NJDEP Studies

Investigation of Levels of Perfluorinated Compounds in New Jersey Fish, Surface Water, and Sediment (2018)

Identification of Perfluorinated Carboxylic Acids (PFCAs) in the Metedeconk River Watershed (February 2016)

- Research Project Summary Full Report

Occurrence of Perfluorinated Chemicals in Untreated New Jersey Drinking Water Sources (2009 Study)

EXTRA SLIDES

Development of NJ PFAA Reference Doses

Serum Level Point of Departure (POD) for animal endpoint

(ng/ml; BMDL, NOAEL, or LOAEL)

↓

Apply Uncertainty Factors

(Note: Animal-to-Human – 3; Toxicokinetic differences accounted for by use of serum level as dose metric)

Target Human Serum Level (ng/ml; µg/L)

↓

Apply Clearance Factor:

Target Human Serum Level (µg/L) x ***Clearance (L/kg/day)*** *= RfD (µg/kg/day)*

↓

Reference Dose (µg/kg/day)