

# Delaware River Basin Commission

## Lessons Learned from other watersheds: Delaware River Basin Contaminants of Emerging Concern Surveys & PCB TMDL

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**STAC workshop**

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**Delaware River Basin Commission**

DELAWARE • NEW JERSEY  
PENNSYLVANIA • NEW YORK  
UNITED STATES OF AMERICA

# Why was the DRBC created in 1961?

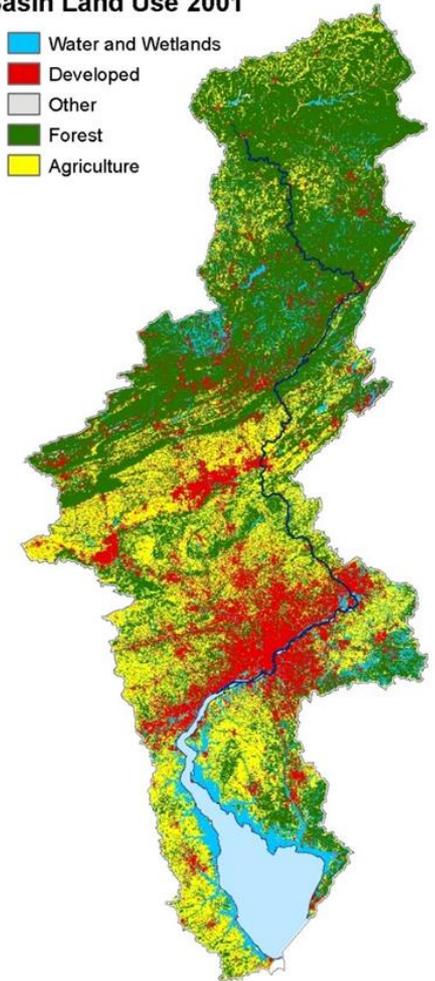


- Water supply shortages and disputes over the apportionment of the basin's waters;
- Severe pollution in the Delaware River and its major tributaries;
- Serious flooding

Five Equal Members:  
Delaware  
New Jersey  
Pennsylvania  
New York  
Federal Government

**Basin Land Use 2001**

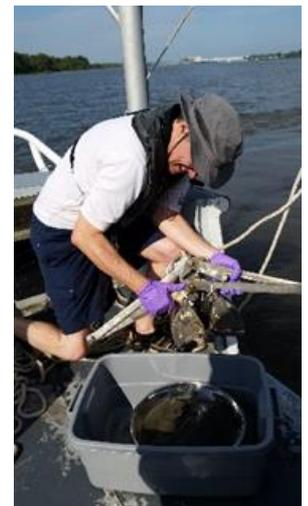
- Water and Wetlands
- Developed
- Other
- Forest
- Agriculture



# Strategy for Contaminants of Emerging Concern



- \* What are the occurrences and sources of CEC in the Delaware River and Bay?
- \* What are the risks to designated uses in Delaware River and Bay from CEC?
- \* What actions can be identified to minimize CEC impacts in the Delaware River and Bay?

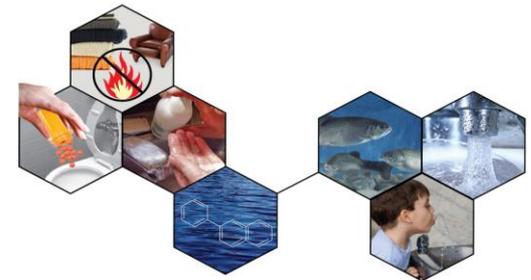


# Contaminants

## DRBC 2004 to 2018



- € Pharmaceuticals and Personal Care Products (PPCP)
- € Hormones
- € Stain repellants/non-stick surfaces/fire fighting foams [PFAS]
- € Flame Retardants [PBDE]
- € Detergents [NP]
- € Plasticizers [bis-phenol A]
- € Surveys in surface water, fish and sediment

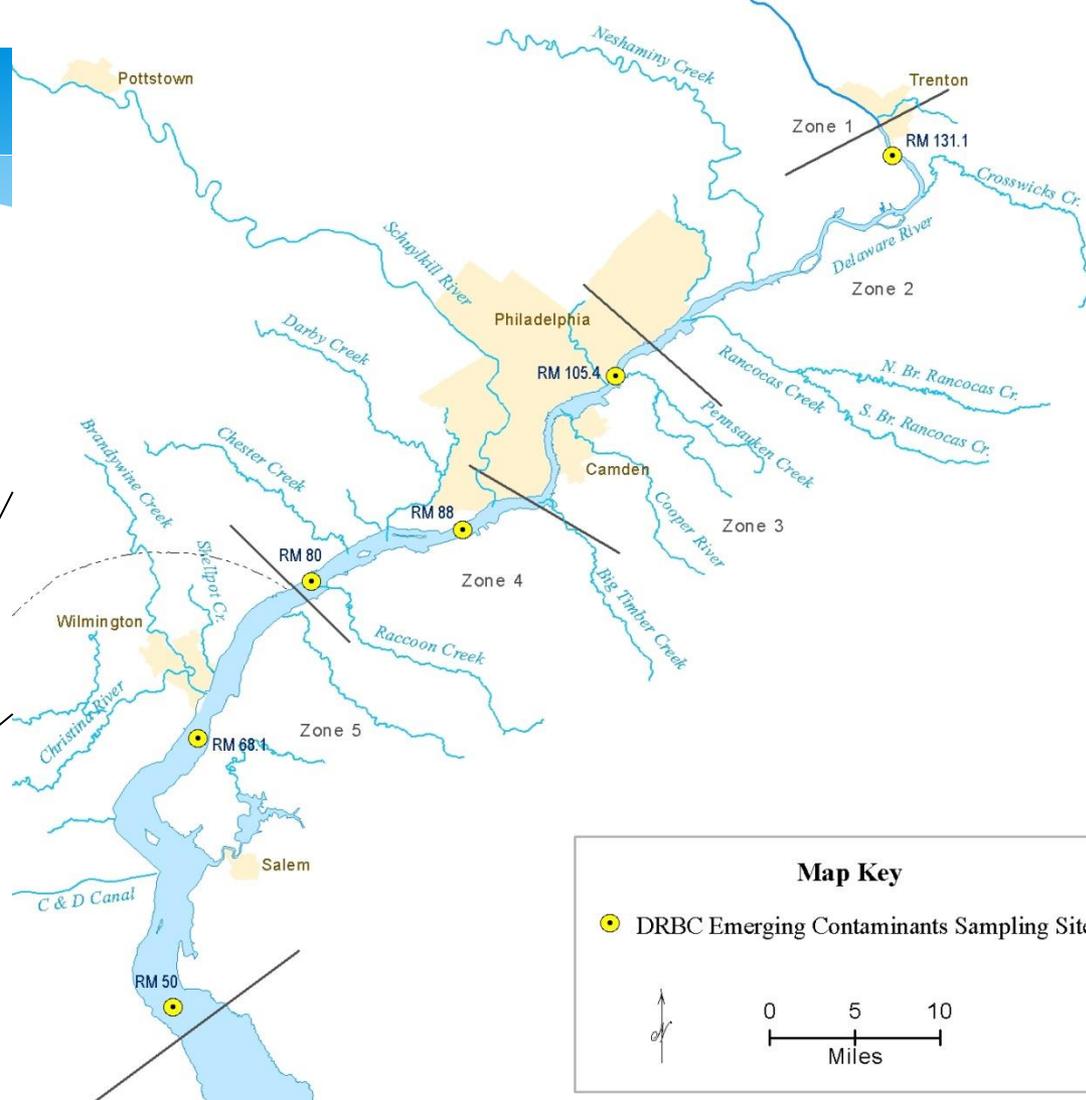


# Current Water Quality Concerns

## Why are Pharmaceuticals and Personal Care Products (PPCP) of concern?

- \* Biological effects (diclofenac, triclocarban)
- \* Resistant to degradation (carbamazepine)
- \* Widespread and increasing use (ibuprofen, metformin)
- \* Wastewater treatment plants are not designed to remove (trimethoprim, erythromycin)
- \* Effects on aquatic life (hormone EE2)

# Delaware River Basin



PPCP surveys 2007,  
2008, 2009



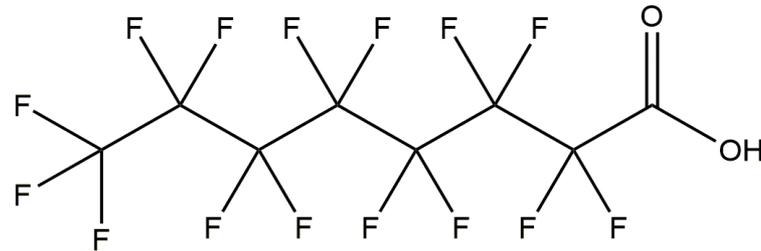




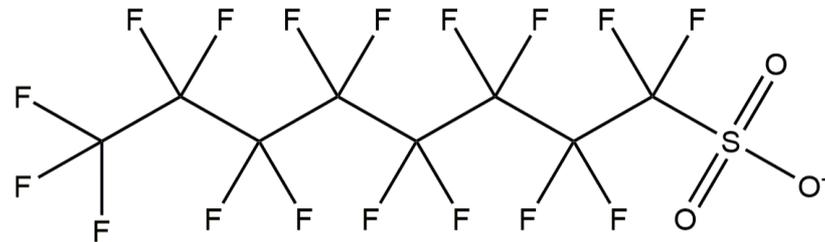
# Why are Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS) of Concern?



- \* Properties
- \* Uses
- \* Sources
- \* Stewardship
- \* Alternatives
- \* Discharges
- \* Persistence
- \* Toxicity
- \* Bioaccumulation



Perfluorooctanoic acid (PFOA)



Perfluorooctane sulfonate (PFOS)



# Human Health Effects



[www.itrcweb.org](http://www.itrcweb.org)

Association with liver damage, increased cholesterol, thyroid disease, decreased response to vaccines, asthma, decreased fertility and birth weight, pregnancy-induced hypertension

**EPA HA PFOS & PFOA 70 ng/L, NJDEP MCL PFNA 13 ng/L**



# Ecotoxicity



## Ecological Effects

- \* National WQC for aquatic life not derived
- \* Long chain PFAS bioaccumulate
- \* Many PFAS are persistent (short and long chain)
- \* Moderately acute and slightly chronically toxic to aquatic organisms (survival, growth and reproduction)
  - \* PNEC for PFOS 0.6 to 6.6 ug/L (Qi et al. 2011)
  - \* PNEC for PFOA 1,250 ug/L (Hoke et al. 2015)
  - \* PNEC for PFHxA (C6) 199 ug/L (Hoke et al. 2015)
- \* Sublethal effects observed (e.g., histopathology, neurological and immune effects) non-standard tests

- ❑ Water grab samples in HDPE bottles
- ❑ Fish samples are composites of five standard fillets.
- ❑ Sediment surficial grab with Ponar.
- ❑ Analytical Parameters & Methods: 13 compounds, isotope dilution, LC/MS/MS Method
- ❑ Analysis by SGS-Axys Analytical LTD



## Sulfonates and Sulfonamide

- 4 Perfluorobutanesulfonate (PFBS)
- 6 Perfluorohexanesulfonate (PFHxS)
- 8 Perfluorooctanesulfonate (PFOS)
- Perfluorooctane sulfonamide (PFOSA)

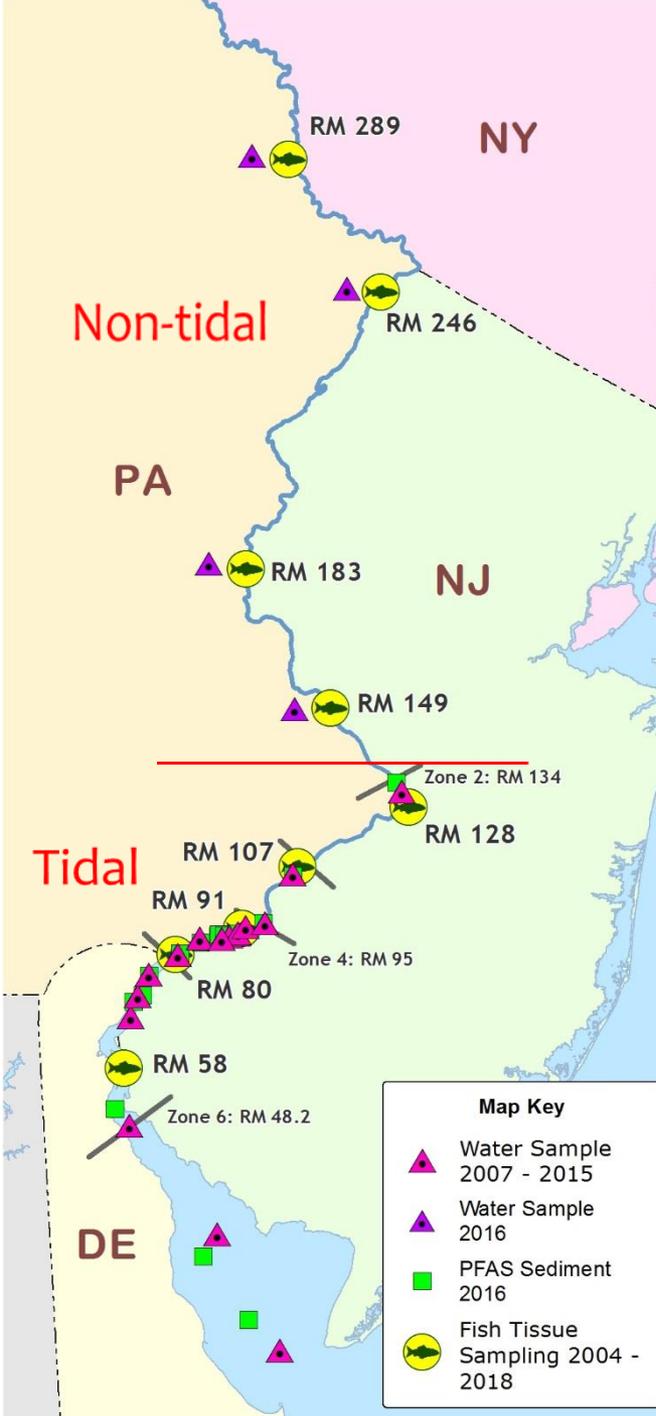
# of carbons



## Carboxylates

- 4 Perfluorobutanoate (PFBA)
- 5 Perfluoropentanoate (PFPeA)
- 6 Perfluorohexanoate (PFHxA)
- 7 Perfluoroheptanoate (PFHpA)
- 8 Perfluorooctanoate (PFOA)
- 9 Perfluorononanoate (PFNA)
- 10 Perfluorodecanoate (PFDA)
- 11 Perfluoroundecanoate (PFUnA)
- 12 Perfluorododecanoate (PFDoA)

# PFAS Sample Sites



## Surface water

Six tidal sites in 2007, 2008, 2009

Fifteen tidal sites in 2015

Four non-tidal sites in 2016

## Fish

Four non-tidal and five tidal sites

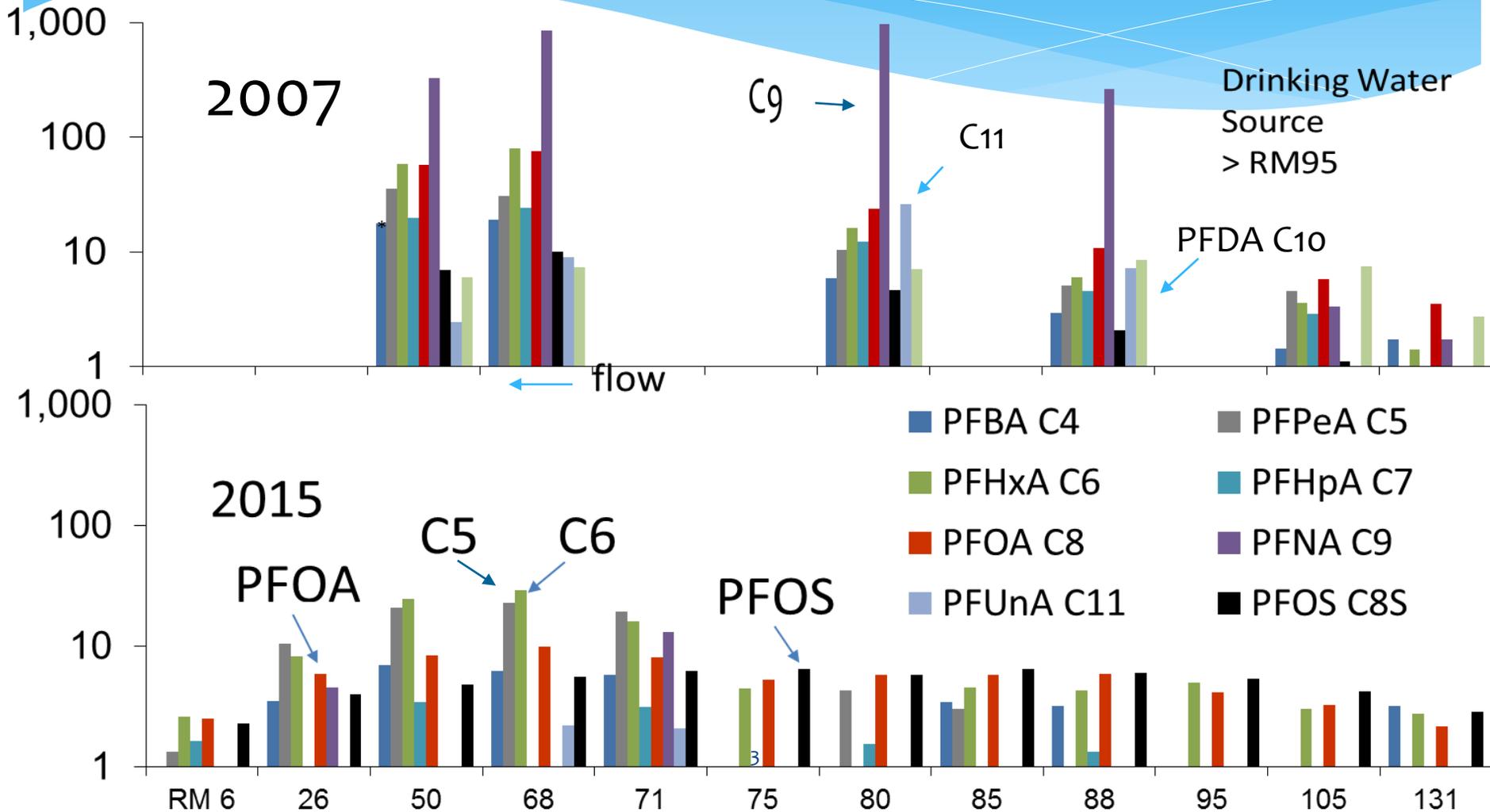
in 2004, 2005, 2006, 2007, 2010,

2012, 2015 and 2018

## Sediment

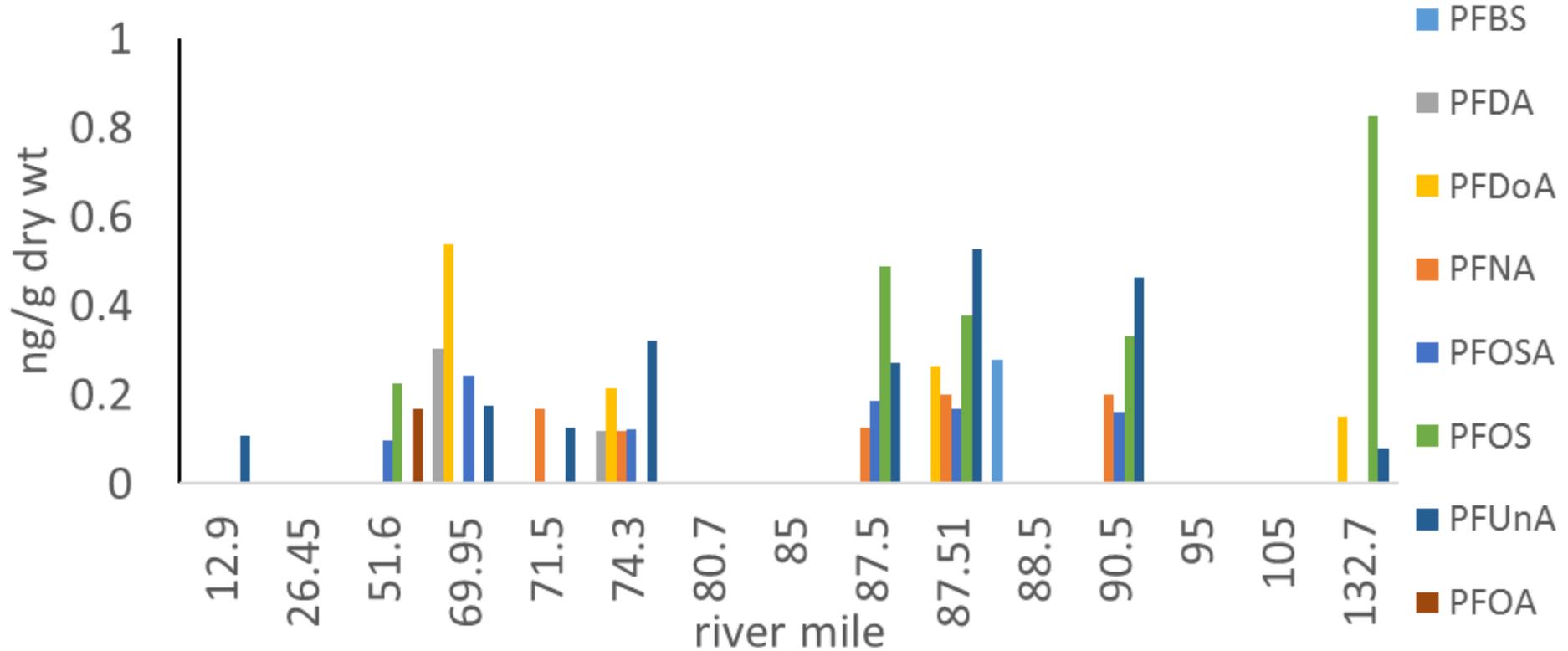
Fifteen tidal sites in 2016

# PFAS (ng/L) decreases in surface water vary by compound

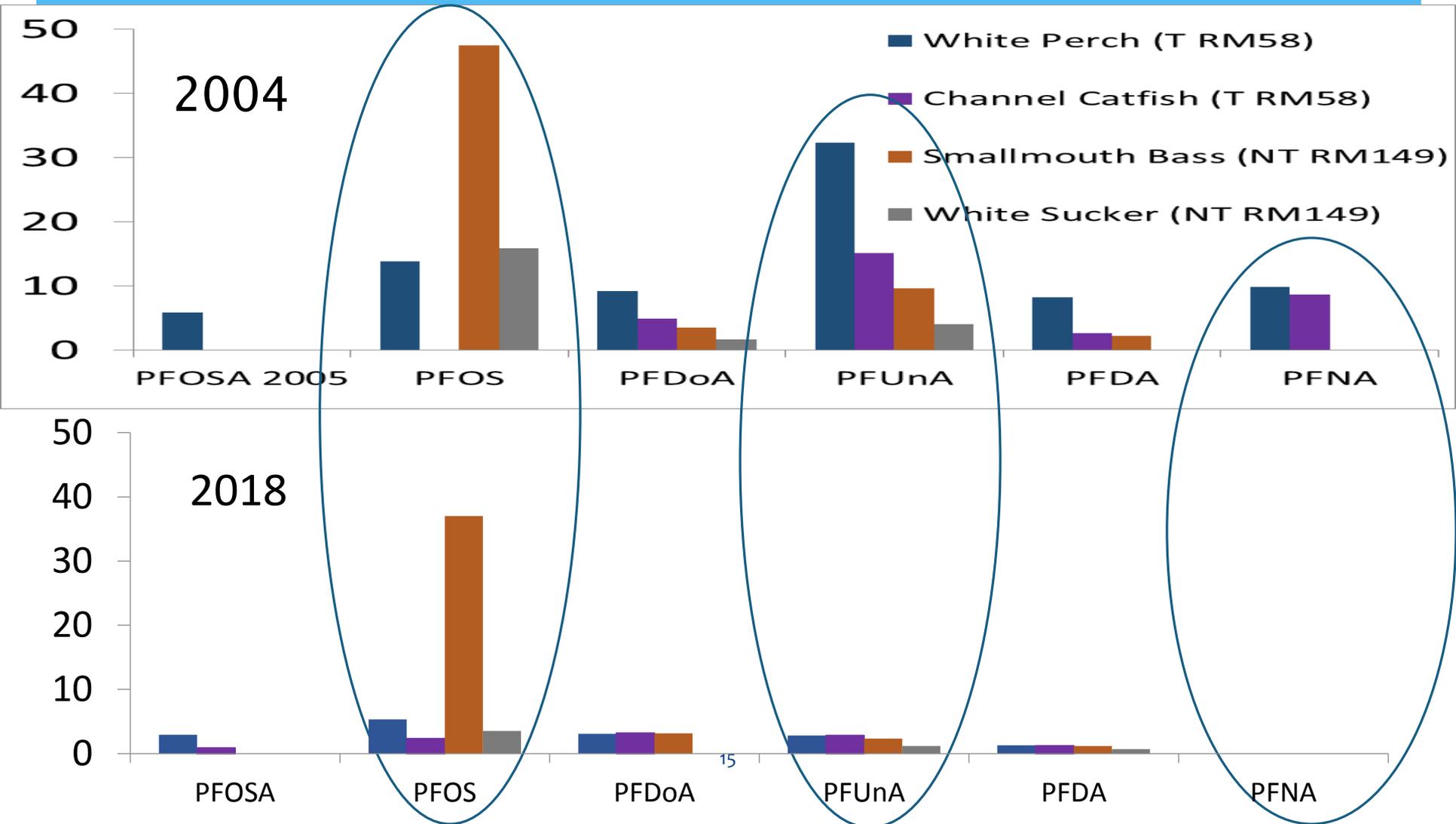


# PFAS in sediment 2016

low concentrations similar to other urban areas



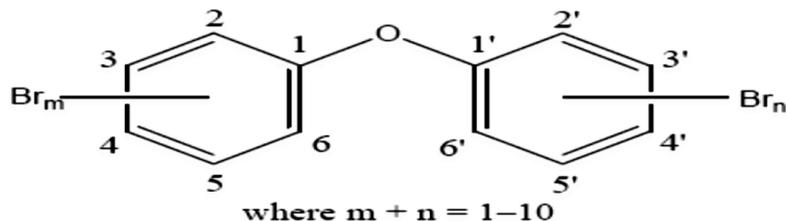
# PFAS (ng/g) in fish fillet vary by species, location and year



# Why are Polybrominated Diphenyl Ethers (PBDE) Flame Retardants of Concern?



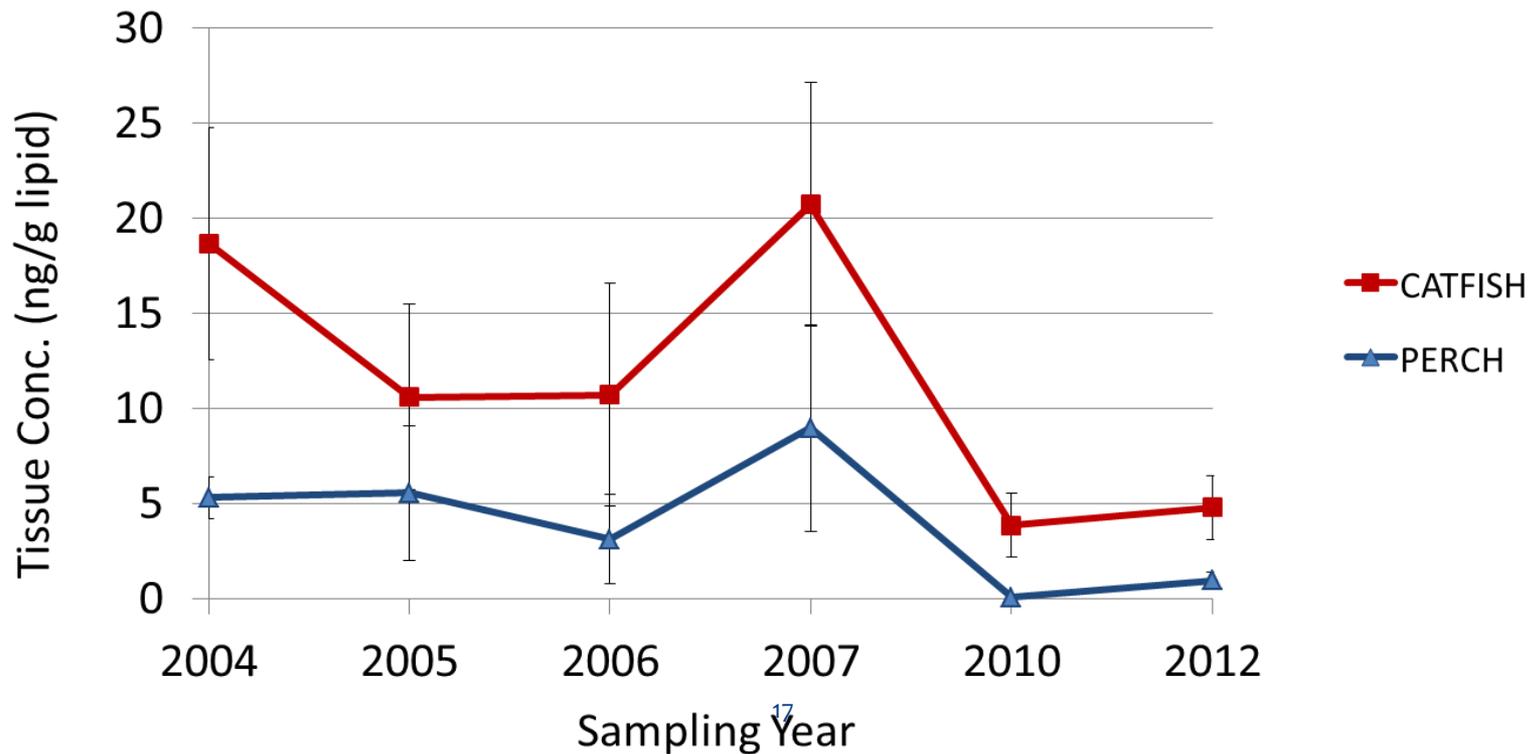
- \* Used in consumer products such as television casings and polyurethane foam inside furniture cushions.
- \* **Indoor dust** is believed to be the primary source of human exposure (~ 90%) but **dietary exposure** is also a concern
- \* PBDEs are characterized as persistent, bioaccumulative, toxic compounds.
- \* High PBDE levels in serum alter steroid hormones levels and thyroid function, motor and cognitive deficits in children
- \* Voluntary phase-outs, EPA action plan and SNUR, state bans including NY



# Polybrominated Diphenyl Ethers (PBDE) Flame Retardants



Lipid normalized tissue concentrations of BDE 209 in catfish and perch by year sampled





# Data Needs



- CEC have been detected in surface water, sediment and fish from the main stem Delaware River
- Data needs:
  - for fish consumption advisories (more main stem data and advisory triggers)
  - for source water protection (occurrence and sources)
  - for protection of aquatic life (measured environmental concentrations and predicted no effect concentrations, bioaccumulation factors (BAF))

# Contaminants of Emerging Concern Collaborative Projects



**DRBC & AXYS Analytical Services Ltd** - behavior of the triclosan investigated under laboratory chlorination conditions and in a wastewater treatment plant - 2010

Pape J, M Woudneh, R Grace, G Cavallo, R MacGillivray, T Fikslin, and J Cosgrove. 2013. Fate of Triclosan In Tertiary Wastewater Treatment: Chlorination. Water Quality Research Journal of Canada Vol 48 No 4 pp 333-343

**DRBC & Temple U. WET Ctr** - Occurrence and Aquatic Toxicity of Contaminants of Emerging Concern (CECs) in Tributaries of an Urbanized Section of the Delaware River Watershed – PPCP - manuscript submitted

**DRBC, PDE & Temple U. WET Ctr** - Delaware Estuary Microplastics Monitoring and Cleanup – NFWF - 2019 -2020

<https://www.state.nj.us/drbc/quality/reports/microplastics.html>

# Contaminants of Emerging Concern Collaborative Projects



**DRBC, NJDEP & EPA-NERL** - Detection, Evaluation, and Assignment of Multiple Poly- and Perfluoroalkyl Substances (PFAS) in Environmental Media from an Industrialized Area of New Jersey – DRBC staff collected surface water and sediment samples in tidal NJ Del R tribs as part of a larger survey - 2017

# PCB Monitoring Data in the Delaware Estuary



- 1) Fish Tissue
- 2) Ambient Water
- 3) Sediment
- 4) Atmosphere
- 5) Point Sources

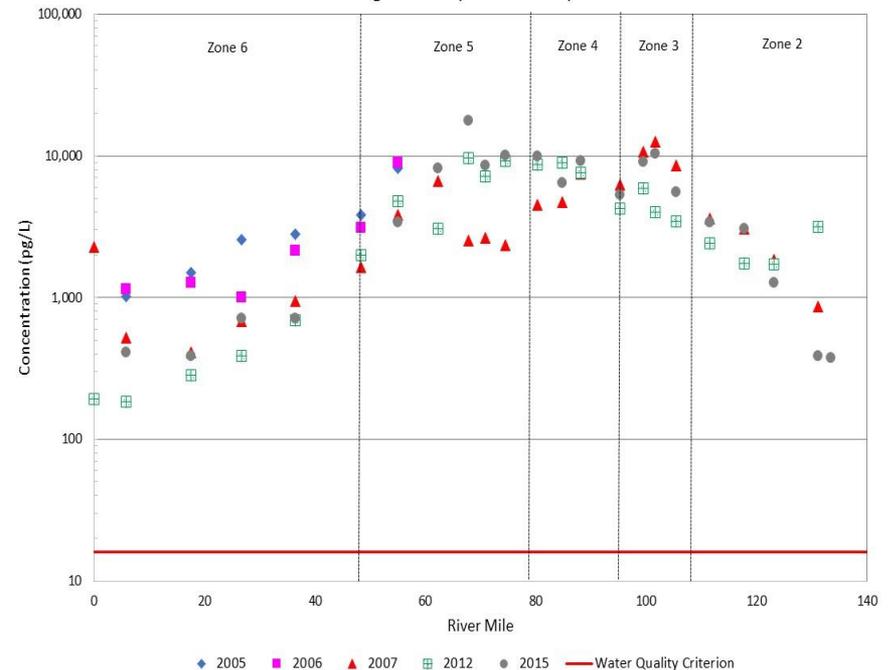


# PCB TMDLs for the Delaware Estuary



- ❑ Production of PCBs banned in 1970s but
  - Active sources – aging transformers, electrical equipment, hydraulic equipment, paint, caulk
  - Inadvertent production of PCBs
- ❑ Fish consumption advisories for the entire Estuary and Bay issued by all three states.
- ❑ Listed as “impaired” by all three states in 1990s.
- ❑ PCB levels in ambient water are 100s to 1000s times greater than the WQ criterion.
- ❑ DRBC developed and EPA established PCB TMDLs for the Delaware Estuary and Bay in 2003 and 2006.

PCB Ambient Water Concentrations of Total PCBs  
Stage 2 data (2005 - 2015)

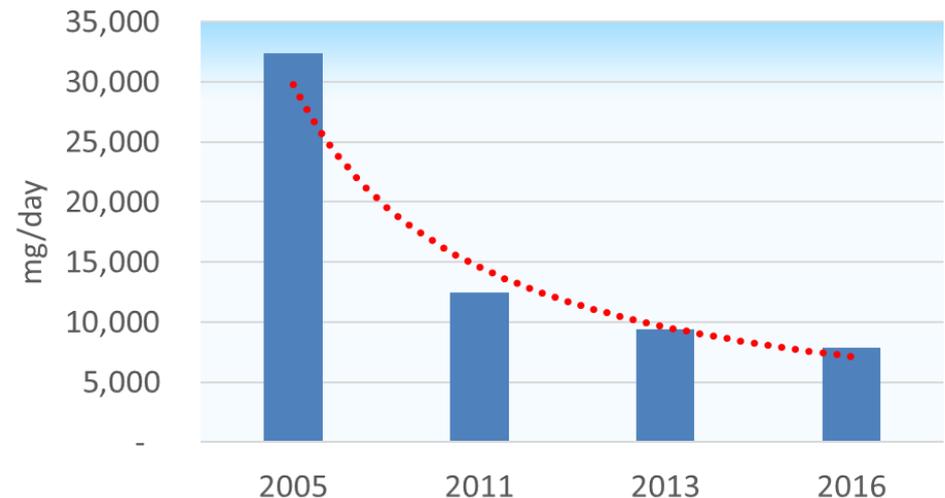


# Implementation PCB TMDLs



- ❑ DRBC adopted Pollutant Minimization Plan (PMP) Requirements for Discharges of Toxic Pollutants: Water Quality Regulations § 4.30.9 (incorporated by reference at 18 CFR Part 410).
- ❑ Over 90 point dischargers have developed and implemented PCB PMPs since 2005.
  - Removal of know sources
  - Tracking back potential sources and removal
  - Monitoring using EPA method 1668A
- ❑ Cleanup and cutoff PCB pathways of contaminated sites by state agencies.
- ❑ DRBC is currently developing State 2 PCB TMDLs for Delaware Estuary and Bay
  - DRBC adopted the revised PCB criterion in 2013.
  - Added element, action level, in implementation strategy to ensure the continuous PCB load reduction is achieved

## 76% reduction in PCB loadings from Top Ten Point Source Dischargers



# Fish Consumption Advisory Changes for General Population

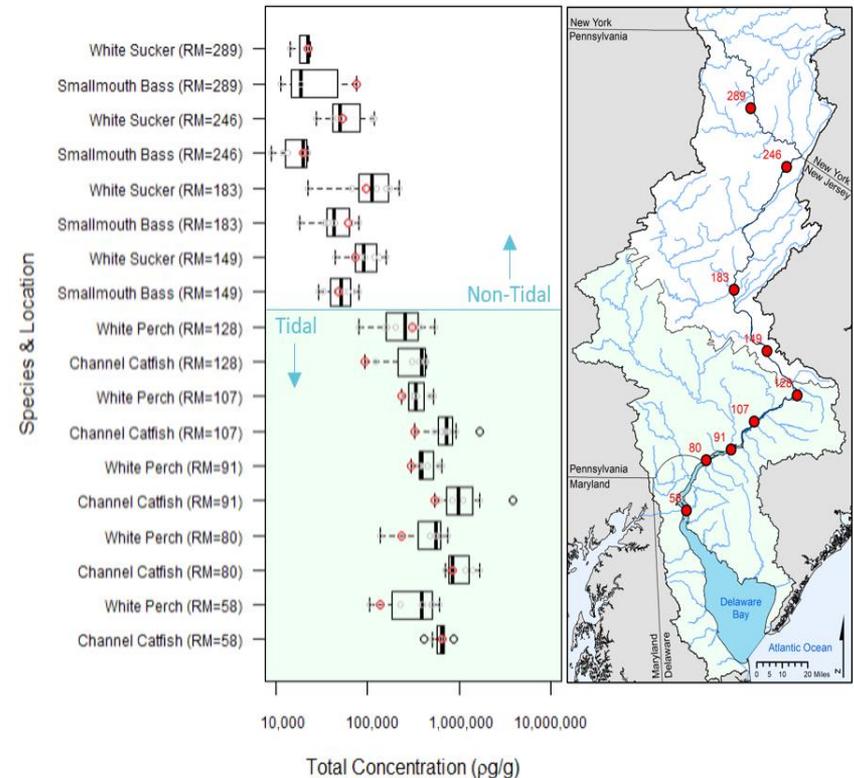


□ New Jersey and Delaware have revised advisories in the Delaware Estuary (tidal) from PA/DE Border to C&D Canal (RM:80-58)

- All fin fish including; white perch and channel catfish
  - Before 2015 Do not eat
  - 2015-2017 One meal per year
  - 2018 Three meals per year

□ PA revised advisories from Trenton, NJ to Morrisville PA bridge to PA/DE border

- for carp
  - Before 2015 Do not eat
  - 2016 Six meals per year



# Lessons Learned

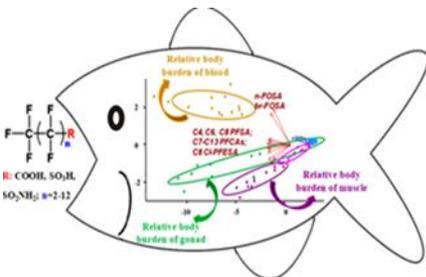
## from PCB TMDLs and Implementation

- \* Importance of centralized organization
  - \* Basin, intrastate approach: Delaware River Basin Commission, Chesapeake Bay Program
- \* For consistency in:
  - \* Data quality (sampling method, analytical method, and detection limits)
  - \* Centralized data management and data sharing
  - \* Regulation (WQC and Pollutant Minimization Plan in DRBC's WQRs)
  - \* Adaptive Management (PMPs)
  - \* Communication
    - quarterly co-regulators conference call focused on implementation of PCB TMDLs
    - Numerous workshops for the regulated community on implementation of PMPs

# Lessons Learned from CEC



- \* Importance of basin and interstate approach (Delaware River Basin Commission, Chesapeake Bay Program)
- \* High Quality Consistent Analysis (trends)
- \* Collaborate (academics and basin states)
- \* Piggy-back projects (PCB TMDL, Nutrient Surveys, CEC)
- \* Expect the unexpected
- \* Communicate (TAC, workgroups, presentations)



# Questions



Shi et al, 2018 ES&T

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DRBC Contaminants of Emerging Concern

<https://www.state.nj.us/drbc/quality/reports/cecs.html>

PCBs

<https://www.state.nj.us/drbc/quality/toxics/pcb.html>