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

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Division of Science & Research

DRBC Toxics Advisory Committee Meeting

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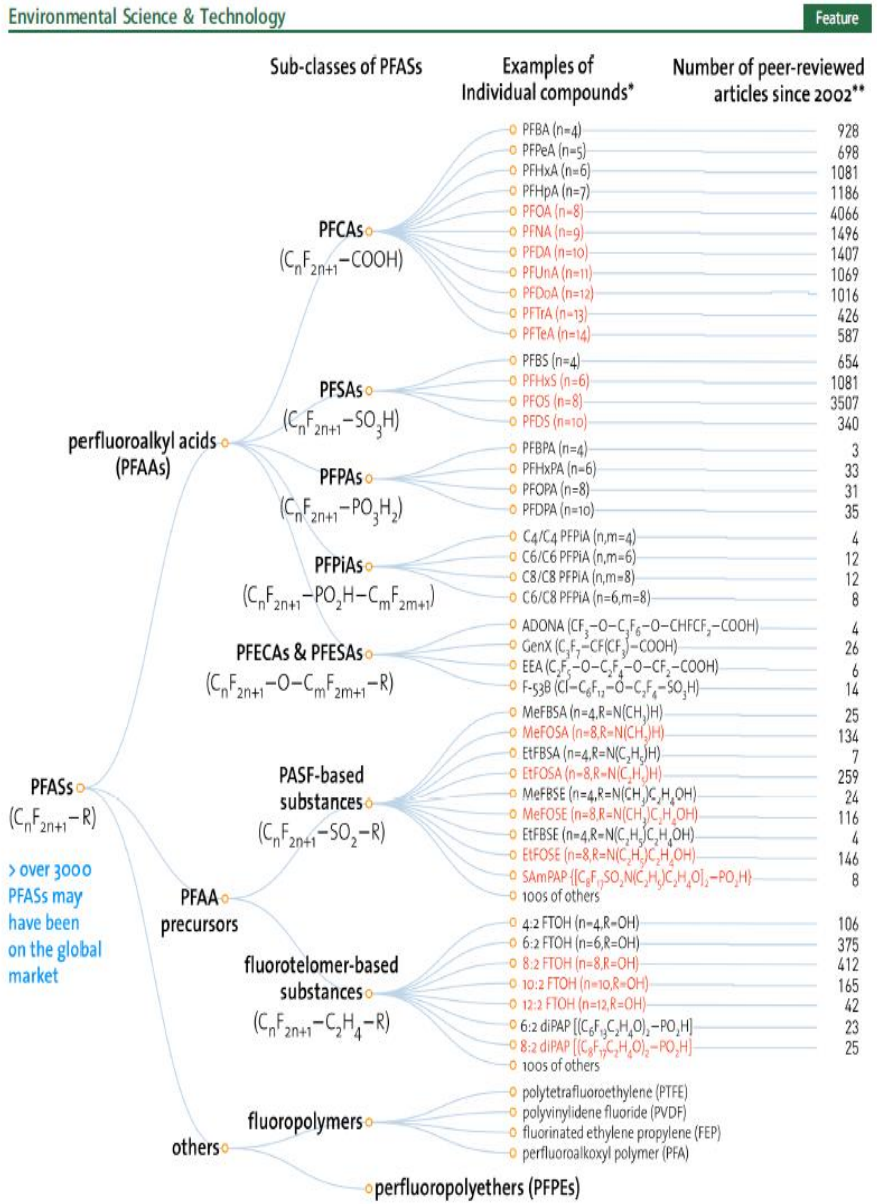
What are PFAS and PFAAs?

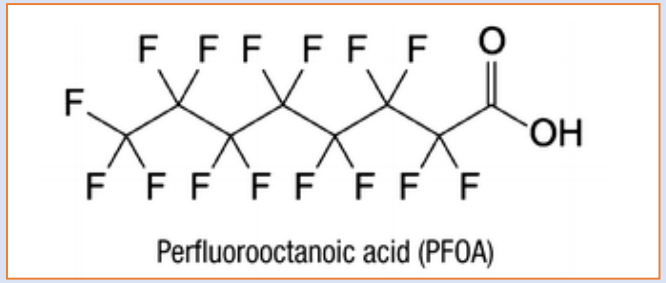
- **Per- and polyfluoroalkyl substances (PFAS):**
  - 1000s of compounds - many different structures.
  - Manmade, aliphatic compounds with at least one totally fluorinated carbon.
  - Many, many commercial and industrial uses.
    - To repel oil and water
    - To provide chemical and heat resistance
    - A component of aqueous film forming foam (AFFF)
  - Most have little or no health effects information or occurrence information.
  - Most not detected by commercial laboratory methods.
- **Perfluoroalkyl acids (PFAAs)**
  - Subset of PFAS
  - Focus of most New Jersey evaluations to date.

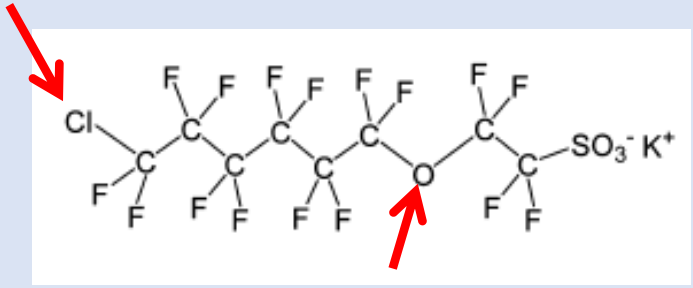


Wang, et al. 2017, "A Never-Ending Story of Per- and Polyfluoroalkyl Substances (PFASs)?" ES&T Vol. 51, 2508-2518

Per- and Polyfluoroalkyl Substances

- **When did it start?**
  - **Produced and used for over 60 years**
- **When was it found in NJ?**
  - **PFOA was first found in 2006.**
- **What is the analytical method?**
  - **EPA Method 537**
    - **Only recently updated**





- **Potential NJ Sources**
  - **Industry**
    - **Used as processing aid in the production of fluoropolymer plastics (e.g. PTFE, PVDF)**
    - **Used to make waterproof, chemical, and/or heat resistant fabrics**
    - **Used for water and stain resistant coatings for carpets and upholstery**
  - **AFFF on military bases, airports, fire training and fire response**
  - **WWTPs/biosolid application**
  - **Waste…Grease-proof food packaging…etc.**

Note: Products generally contain multiple compounds

Trigger Development

Toxicology studies find human health impacts for certain PFAS compounds ingested at certain levels (Reference Dose)

The Reference Dose is the daily dose not expected to pose a risk with lifetime exposure)

PFNA- 0.74 ng/kg/day, used as the basis for the recently finalized NJDEP Ground Water Quality Standard and Drinking Water MCL

PFOA (2.0 ng/kg/day) and **PFOS** (1.8 ng/kg/day) is used as the basis for the New Jersey Drinking Water Quality Institute MCL recommendation.

Protecting Human Health: NJ Drinking Water and Groundwater

PFNA:

- MCL – 13 ng/L (adopted September 2018).
  - First MCL in the nation for any PFAS.
  - Public water system monitoring is being phased in:
    - 2019: Small groundwater systems and non-transient noncommunity water systems.
    - 2020: Large groundwater systems and all surface water systems.
- Ground Water Quality Standard – updated to 13 ng/L by reference to MCL (September 2018).
- Added to NJ Hazardous Substances List (January 2018).

PFOA and PFOS:

- DWQI MCL recommendations: PFOA – 14 ng/L (March 2017); PFOS - 13 ng/L (June 2018).
  - Recommended MCLs were accepted by NJDEP
    - Currently used guidance to recommend continued monitoring and/or measures to reduce exposure.
  - MCLs will be proposed in Spring 2019.
- Interim Ground Water Quality Standards: PFOA – 10 ng/L; PFOS – 10 ng/L.
  - Posted for public comment (January 2019).
  - Comment period has ended.

*NJDEP used **fish tissue sampling** of various sites in New Jersey and **risk assessment** methodology to determine the need for fish consumption advisories for PFAS and other contaminants of concern…*

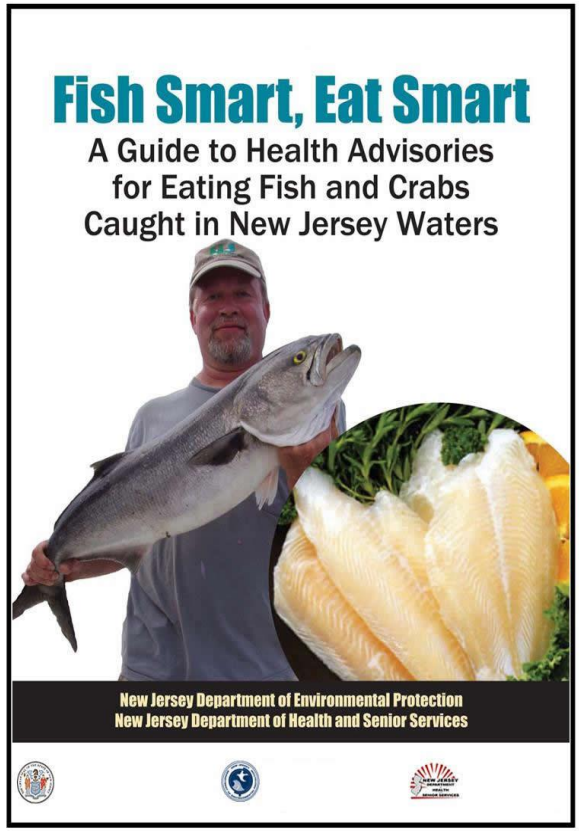
Fish consumption advisory triggers

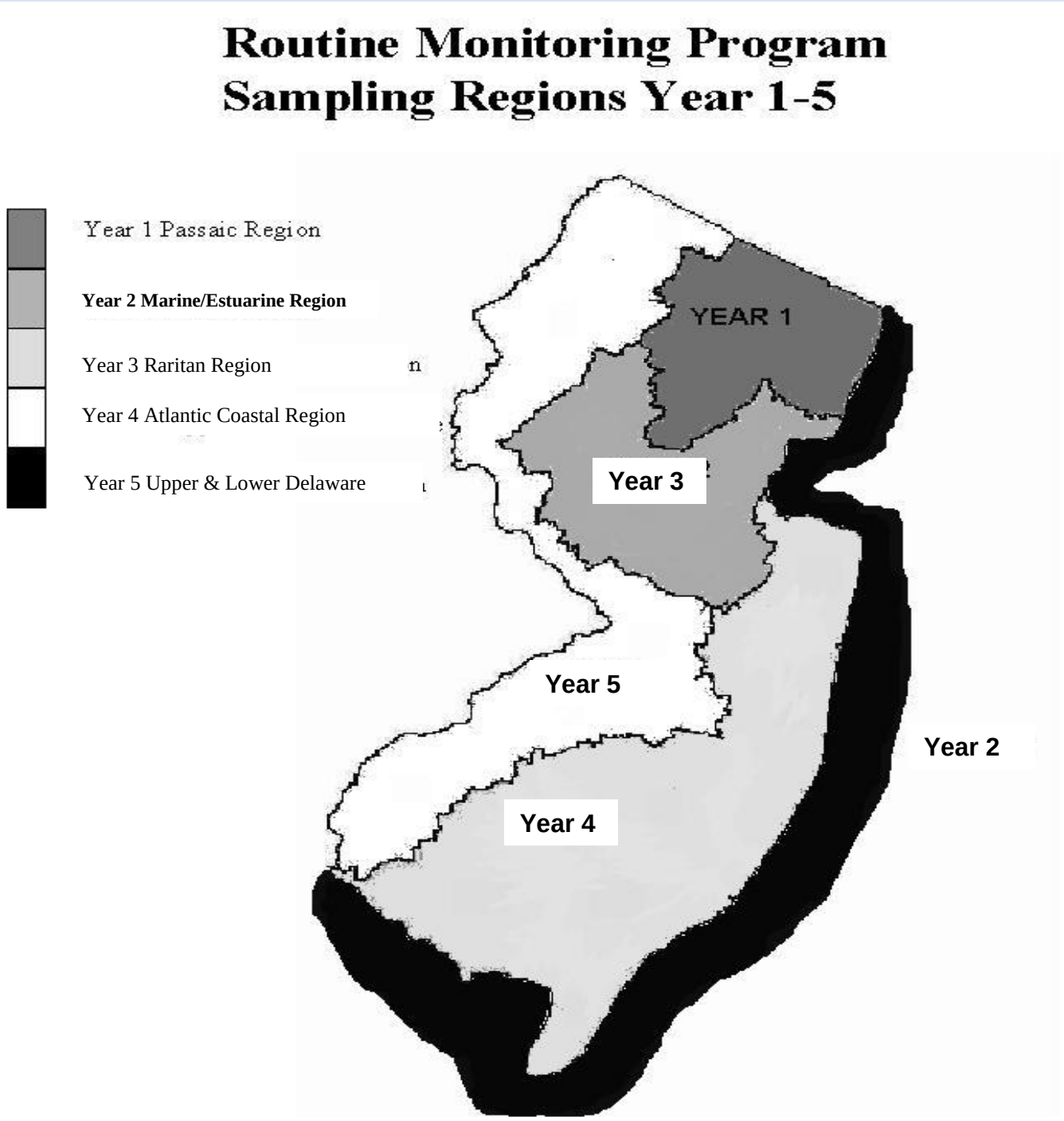
	General Population			High Risk Population*		
	PFOA (ng/g; ppb)	PFNA (ng/g; ppb)	PFOS (ng/g; ppb)	PFOA (ng/g; ppb)	PFNA (ng/g; ppb)	PFOS (ng/g; ppb
Unlimited	0.62	0.23	0.56	0.62	0.23	0.56
Weekly	4.3	1.6	3.9	4.3	1.6	3.9
Monthly	18.6	6.9	17	18.6	6.9	17
Once/3 months	57	21	51	N/A	N/A	N/A
Yearly	226	84	204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

**High Risk Individuals include infants, children, pregnant women, nursing mothers and women of childbearing age*

Fish Consumption triggers are based on the same Reference Doses used for the drinking water criteria, and assume 227 g (8oz) meal size and 70 kg body weight

Ongoing NJ Fish Tissue Monitoring Program





Investigation of Levels of Perfluorinated Compounds in NJ Fish Tissue, Surface Water and Sediment Study

Phase I Project Objectives

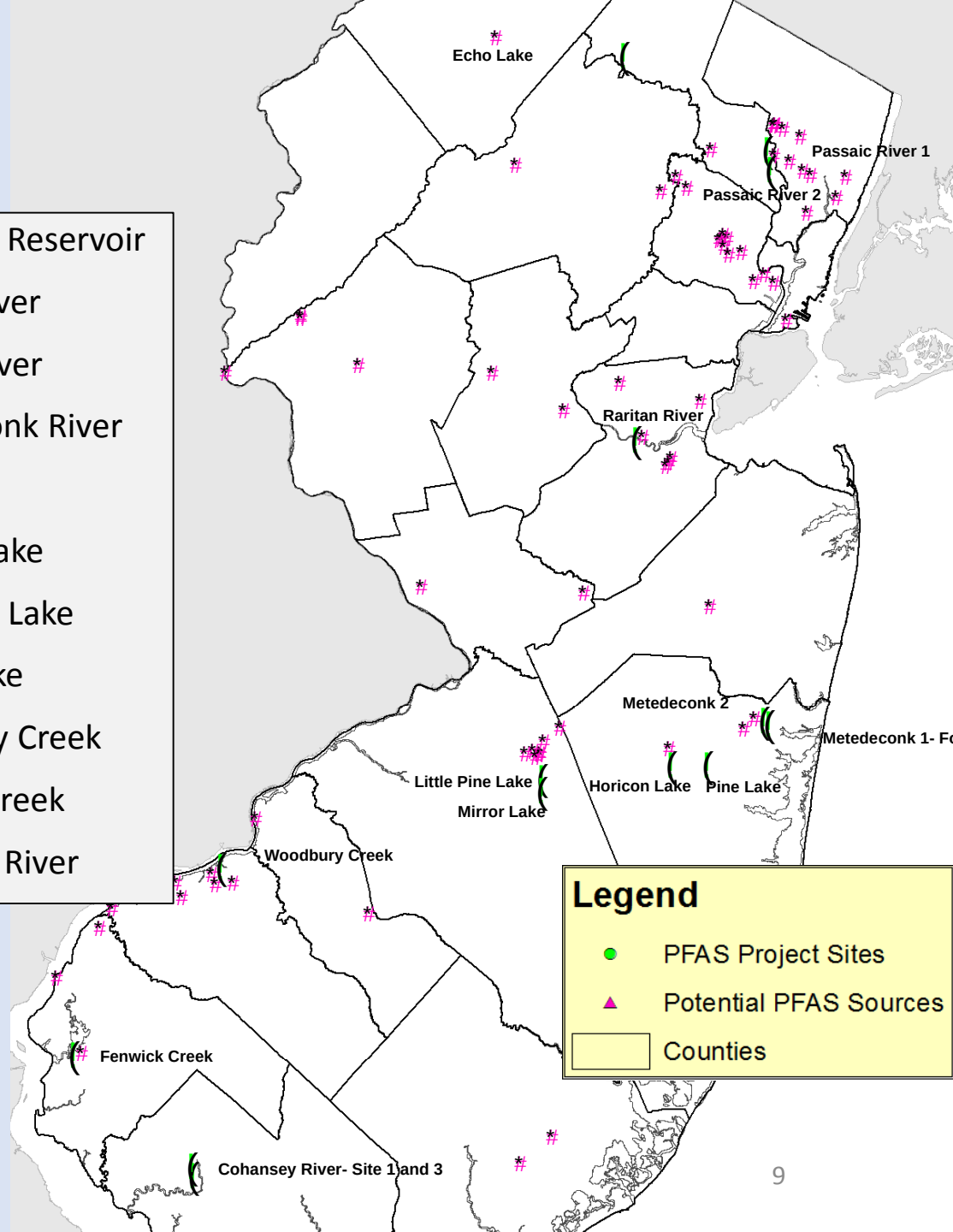
- To collect fish from **key recreational fishing areas** that are located near potential or identified sources to evaluate levels of PFAS in the consumable fish tissue.
- To **collect surface water and sediment to help determine the fate and transport** of these compounds through the system.
- To apply Reference Dose concentrations to determine if **advisories on frequency of consumption** is warranted.

NJ Fish Tissue, sediment and surface water study:

Targeted Study:

- Eleven waterways across the state
- Analyzed sediment, surface water, and fish tissue for 13 perfluoroalkyl acids
- 14 Sediment and Surface Water samples
- 94 fish tissue samples
- All sites, excluding background site, were determined to be located in the vicinity of a potential or identified source.
- Sites were selected based on susceptibility to PFAS contamination and areas of high fish consumption

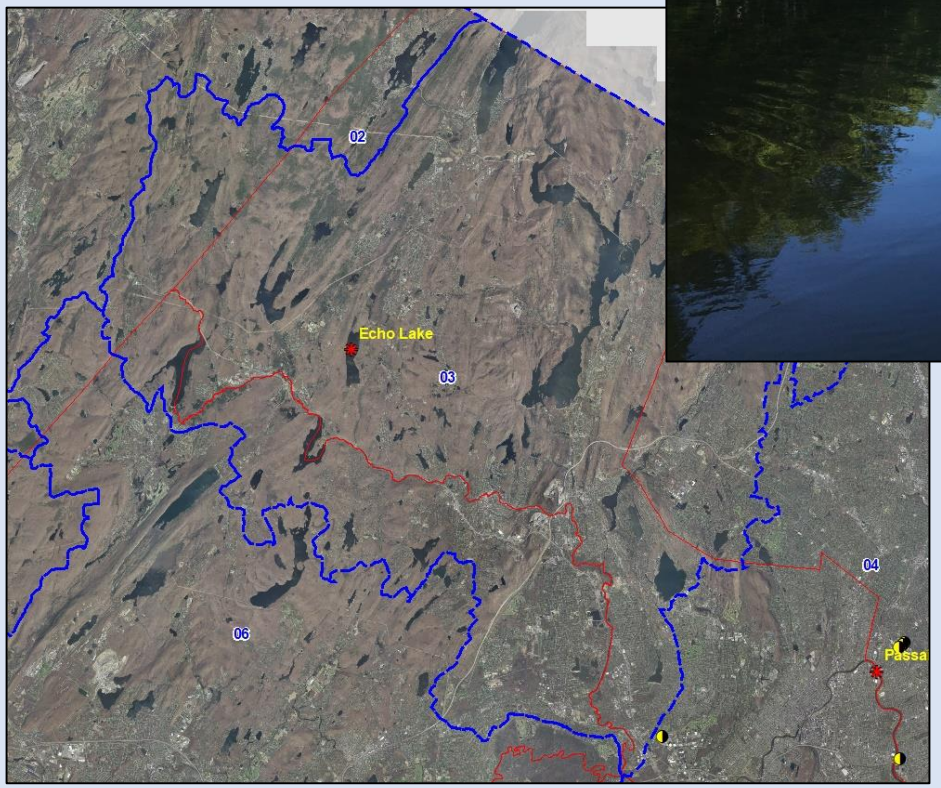
- Echo Lake Reservoir
- Passaic River
- Raritan River
- Metedeconk River
- Pine Lake
- Horicon Lake
- Little Pine Lake
- Mirror Lake
- Woodbury Creek
- Fenwick Creek
- Cohansey River



Targeted sampling: 1 “Background”

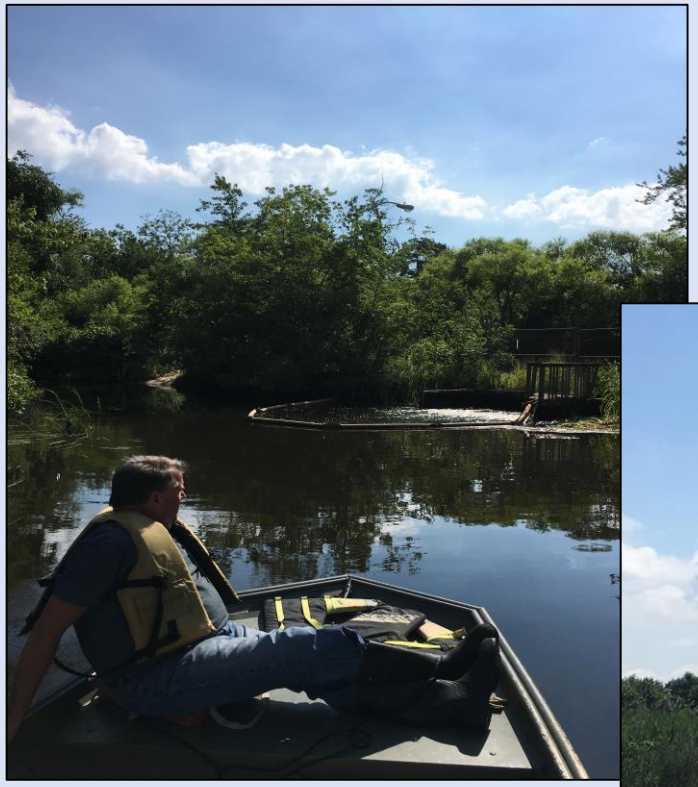
Echo Lake Reservoir

- Managed by the Newark Watershed Conservation & Development Corporation
- The Newark-Pequannock Watershed is 35,000 acres and covers six municipalities in three counties
  - Morris, Passaic, and Sussex
  - Kinnelon, Rockaway, Jefferson, West Milford, Vernon, and Hardystown
- Supplies the City of Newark with its drinking water



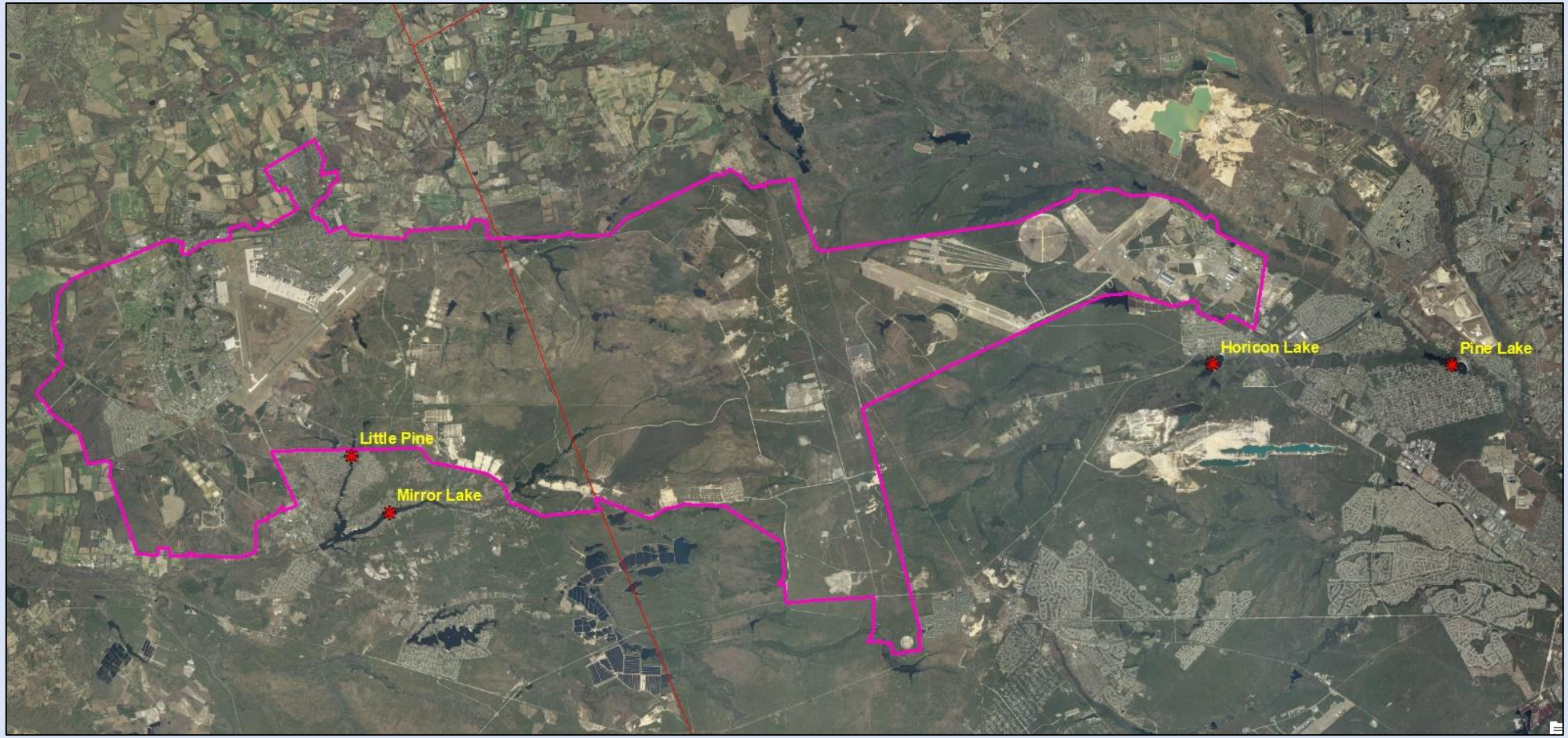
6 Industrial Sites

- Passaic River
- Raritan River
- Metedeconk River
- Woodbury Creek
- Fenwick Creek
- Cohansey River



4 Sites around Joint Base McGuire-Dix-Lakehurst

- Pine Lake
- Horicon Lake
- Little Pine Lake
- Mirror Lake

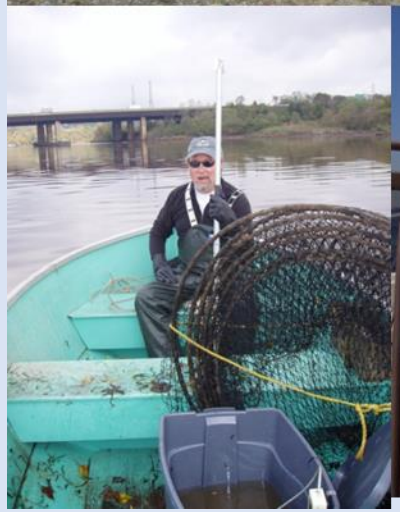


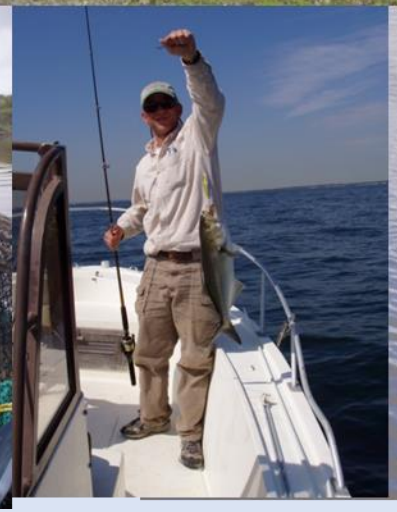
Sample collection- Surface Water and Sediment

- Surface water
  - One grab sample
  - Collected 6-inches below the surface
- Sediment
  - one grab sample
  - Collected by ponar dredge
- Additional grab samples collected at three sites (Cohansey, Metedeconk, and the Passaic)

Sample collection- Electrofishing

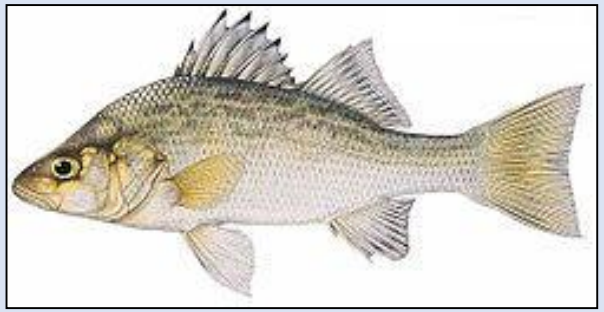
Thanks to the Bureau of Freshwater and Biological Monitoring!!





Fish Tissue

Species	Latin Name	Habitat	Trophic Level Descriptors	Trophic Level
Largemouth Bass	*Micropterus salmoides*	Pelagic	Top Trophic Level Piscivore (top Carnivore)	4
Chain Pickerel	*Esox niger*	Pelagic	Top Trophic Level Piscivore (top Carnivore)	4
White Perch	*Morone americana*	Pelagic	Lower Trophic Level Insectivore/Piscivore	3
Yellow Perch	*Perca flavescens*	Pelagic	Lower Trophic Level Insectivore/Piscivore	3
Bluegill Sunfish	*Lepomis macrochirus*	Pelagic	Lower Trophic Level Insectivore/Piscivore	3
Pumpkinseed Sunfish	*Lepomis gibbosus*	Pelagic	Lower Trophic Level Insectivore	3
Channel Catfish	*Ictalurus punctatus*	Benthic	BenthicTrophic Level Insectivore/Piscivore	4
White Catfish	*Ameiurus catus*	Benthic	Benthic Trophic Level Insectivore/Piscivore	4
Yellow Bullhead	*Ameiurus natalis*	Benthic	Benthic Insectivore / Invertivore	3
Brown Bullhead	*Ameiurus nebulosus*	Benthic	Benthic Insectivore / Invertivore	3
Common Carp	*Cyprinus carpio*	Benthic	Benthic Trophic Level Omnivore	2
American Eel	*Anguilla rostrata*	Benthic	Benthic Trophic Level Piscivore/Carnivore	4



Results

Surface Water and Sediments

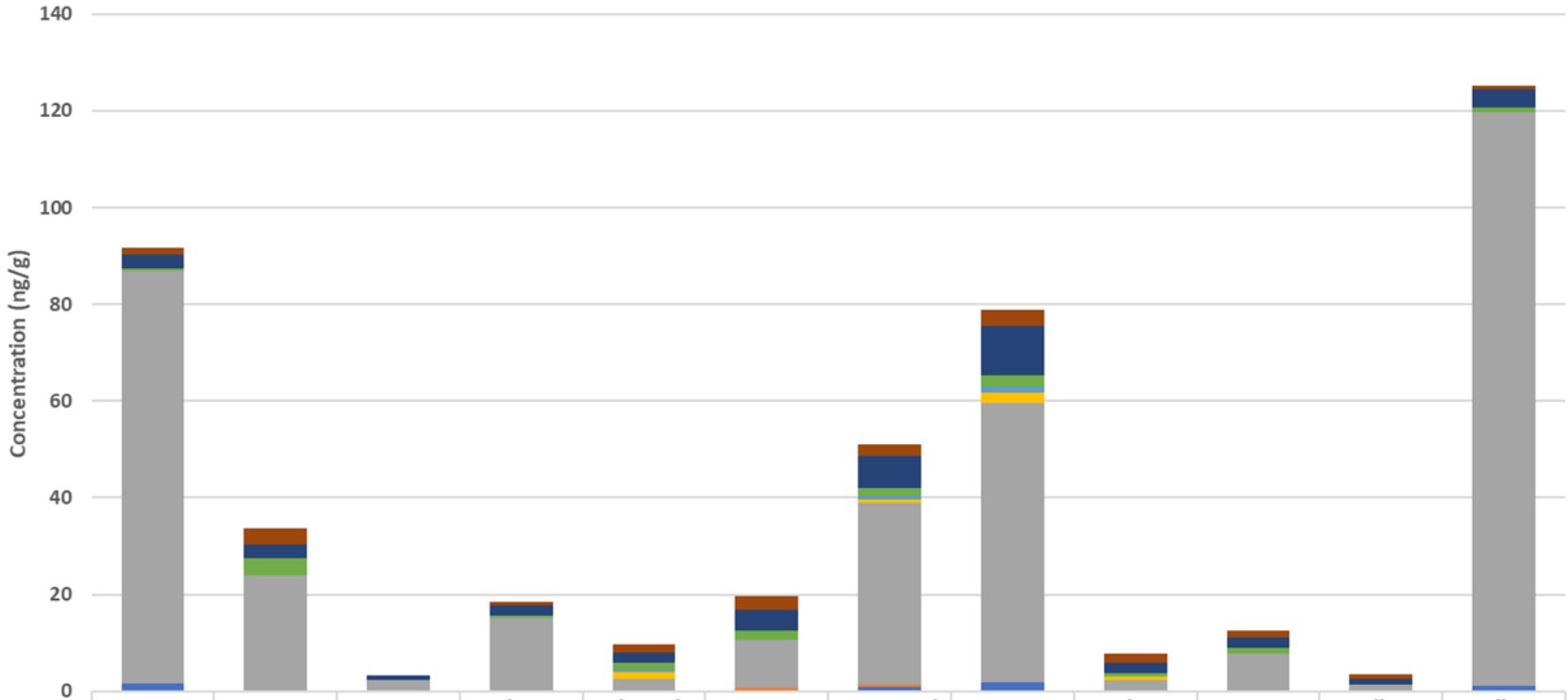
Surface water (ppt)

Site Name	PFBA	PFBS	PFPeA	PFHxA	PFHxS	PFHpA	PFOA	PFOS	PFOSA	PFNA	PFDA	PFUnA	PFDoA	*Total PFAS*
Echo Lake Reservoir	2.2	<	2.7	<	<	14.6	4.9	<	<	<	<	<	<	*24.3*
Passaic River 1	6.2	2.4	18.3	14.9	3.8	7.7	14.1	13.0	<	2.5	<	<	<	*83.0*
Passaic River 2	6.6	4.2	17.4	10.8	2.9	8.2	13.0	13.2	<	<	<	<	<	*76.3*
Raritan River	8.2	<	7.6	7.9	4.7	4.2	8.7	6.9	<	1.1	<	<	<	*49.4*
Metedeconk 1	3.5	4.9	5.2	6.1	<	5.0	**28.3**	<	<	<	<	<	<	*53.0*
Metedeconk 2	2.7	4.6	6.7	5.9	<	5.5	**33.9**	2.8	<	<	<	<	<	*62.1*
Pine Lake	3.4	2.6	6.2	10.4	**24.6**	6.2	13.6	**102.0**	<	1.8	<	<	<	*170.7*
Horicon Lake	<	<	1.0	1.5	7.3	1.1	1.9	10.0	<	<	<	<	<	*22.9*
Little Pine Lake	5.2	6.6	10.0	26.0	**95.9**	7.8	**25.9**	**100.0**	<	2.1	<	<	<	*279.5*
Mirror Lake	3.6	5.2	8.1	14.2	**57.0**	5.8	13.2	**72.9**	<	1.0	<	<	<	*180.9*
Woodbury Creek	5.5	<	10.4	8.9	2.9	4.2	7.2	6.4	<	**7.7**	<	<	<	*53.1*
Fenwick Creek	10.0	2.9	17.7	25.0	<	10.6	10.5	3.1	<	**6.7**	<	<	<	*86.5*
Cohansey River	1.9	<	3.1	3.9	<	3.2	4.9	<	<	1.0	<	<	<	*17.9*
Cohansey River 2	3.1	2.1	5.6	5.4	<	4.4	4.3	<	<	2.3	<	<	<	*27.2*

Sediment (ppb)

	PFBA	PFBS	PFPeA	PFHxA	PFHxS	PFHpA	PFOA	PFOS	PFOSA	PFNA	PFDA	PFUnA	PFDoA	Total PFAS
Reservoir	<	<	<	<	<	<	<	<	<	<	<	<	<	0.00
Passaic River 1	<	<	<	<	<	<	<	0.289	<	<	<	<	<	0.29
Passaic River 2	<	<	<	<	<	<	<	0.514	<	<	<	<	<	0.51
Raritan River	<	<	<	<	<	<	0.112	0.643	<	<	<	<	<	0.76
Metedeconk 1	<	<	<	<	<	<	0.097	<	<	<	<	<	<	0.10
Metedeconk 2	<	<	<	<	<	<	0.215	0.517	<	<	<	0.188	0.207	1.13
Pine Lake	<	<	<	<	0.378	<	0.3	**19.3**	**6.53**	<	<	0.395	0.651	27.55
Horicon Lake	<	<	<	<	0.643	<	<	3.25	<	<	<	0.862	<	4.76
Little Pine Lake	<	<	<	<	0.989	<	0.395	**27.1**	0.411	0.186	0.33	1.03	0.493	30.93
Mirror Lake	<	<	<	<	0.2335	<	<	3.07	<	<	<	0.1415	0.106	3.55
Woodbury Creek	<	<	<	<	<	<	<	0.57	0.262	1	0.188	2.14	<	4.16
Fenwick Creek	<	<	<	<	<	<	<	0.462	0.238	<	<	0.46	0.121	1.28
Cohansey River	<	<	<	<	<	<	0.056	<	<	<	<	0.105	0.137	0.30
Cohansey River 2	<	<	<	<	<	<	0.122	0.552	0.479	0.132	0.141	0.412	0.111	1.95

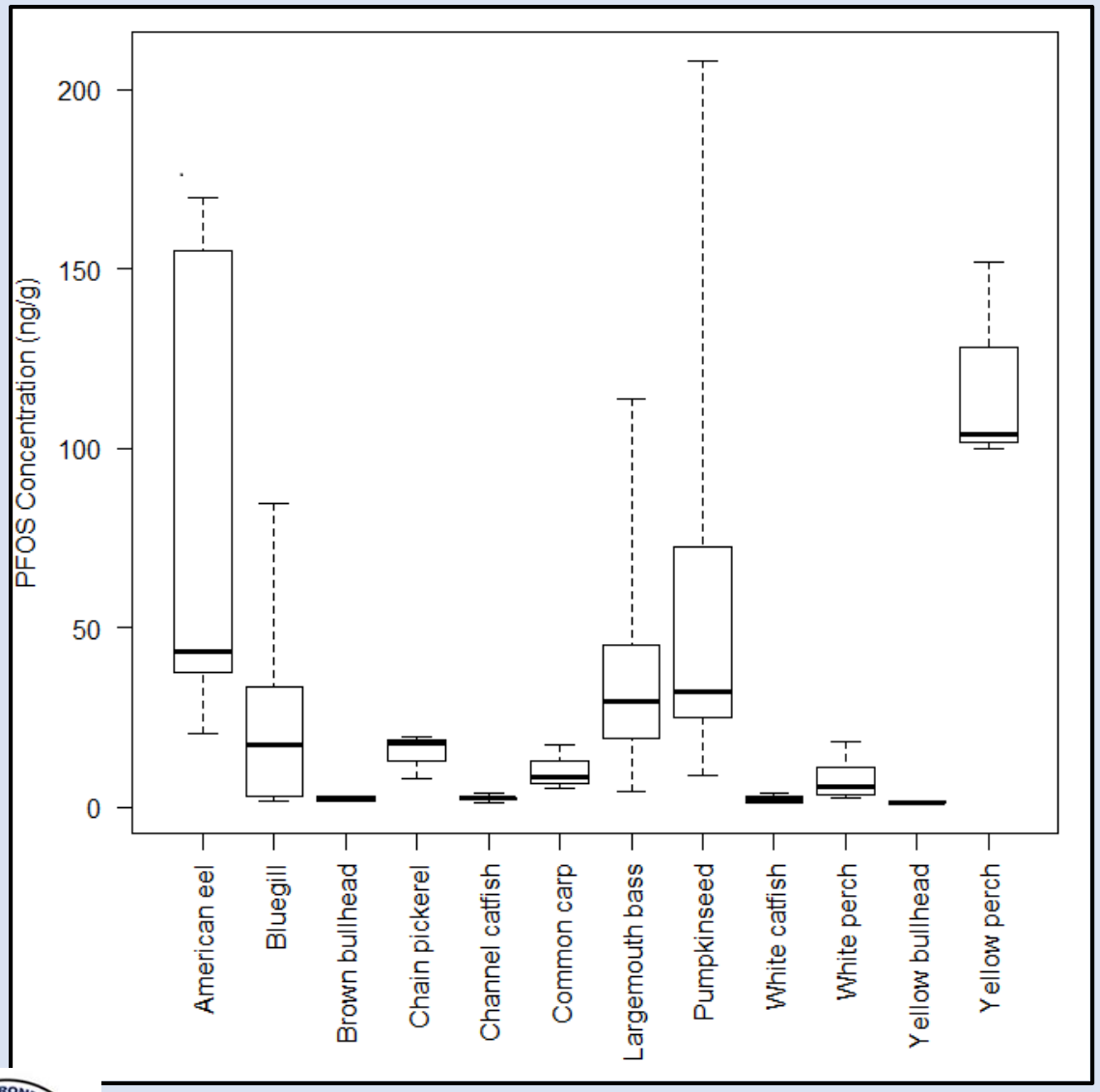
Average Fish Tissue Sampling Results



	American Eel	Bluegill	Brown Bullhead	Chain Pickerel	Channel Catfish	Common Carp	Largemouth Bass	Pumkinseed	White Catfish	White Perch	Yellow Bullhead	Yellow Purch
PFDoA	1.4	3.5		0.7	1.7	2.8	2.4	3.2	1.8	1.6	0.9	0.7
PFUnA	2.7	2.7	0.8	2.0	2.2	4.3	6.6	10.3	2.1	2.0	1.1	3.8
PFDA	0.6	3.6		0.5	1.4	1.9	1.6	2.3	0.8	1.2		1.1
PFNA					0.5		0.8	1.4				
PFOSA					1.4		0.7	2.1	0.5			
PFOS	85.2	24.0	2.4	15.2	2.5	9.9	37.5	57.6	2.4	7.9	1.4	118.6
PFOA						0.7	0.5					
PFHxS	1.7						1.0	1.9				1.0

Data from NJDEP 2018. Investigation of Levels of Perfluorinated Compounds in New Jersey Fish, Surface Water and Sediment. June.

PFOS Concentration in Fish Tissue



Number and Species of Fish Collected at Each Site

Site	Channel Catfish	Largemouth Bass	Pumpkinseed sunfish	Bluegill sunfish	Brown Bullhead	Common Carp	White Catfish	White perch	Yellow Perch	Chain pickerel	Yellow bullhead	American eel
Echo Lake Reservoir		3		3	3							
Passaic River 1 &2*		3		3		3						
Raritan River	3					3	3	3				
Metedeconk 1 &2*		3				3		3				
Pine Lake		1	3									3
Horicon Lake										3	3	
Little Pine Lake		3	3						3			
Mirror Lake		3		3								3
Woodbury Creek	3	3	3									
Fenwick Creek	3					3	3					
Cohansey River 1 & 2*	3							3				

Results

Site Specific Results

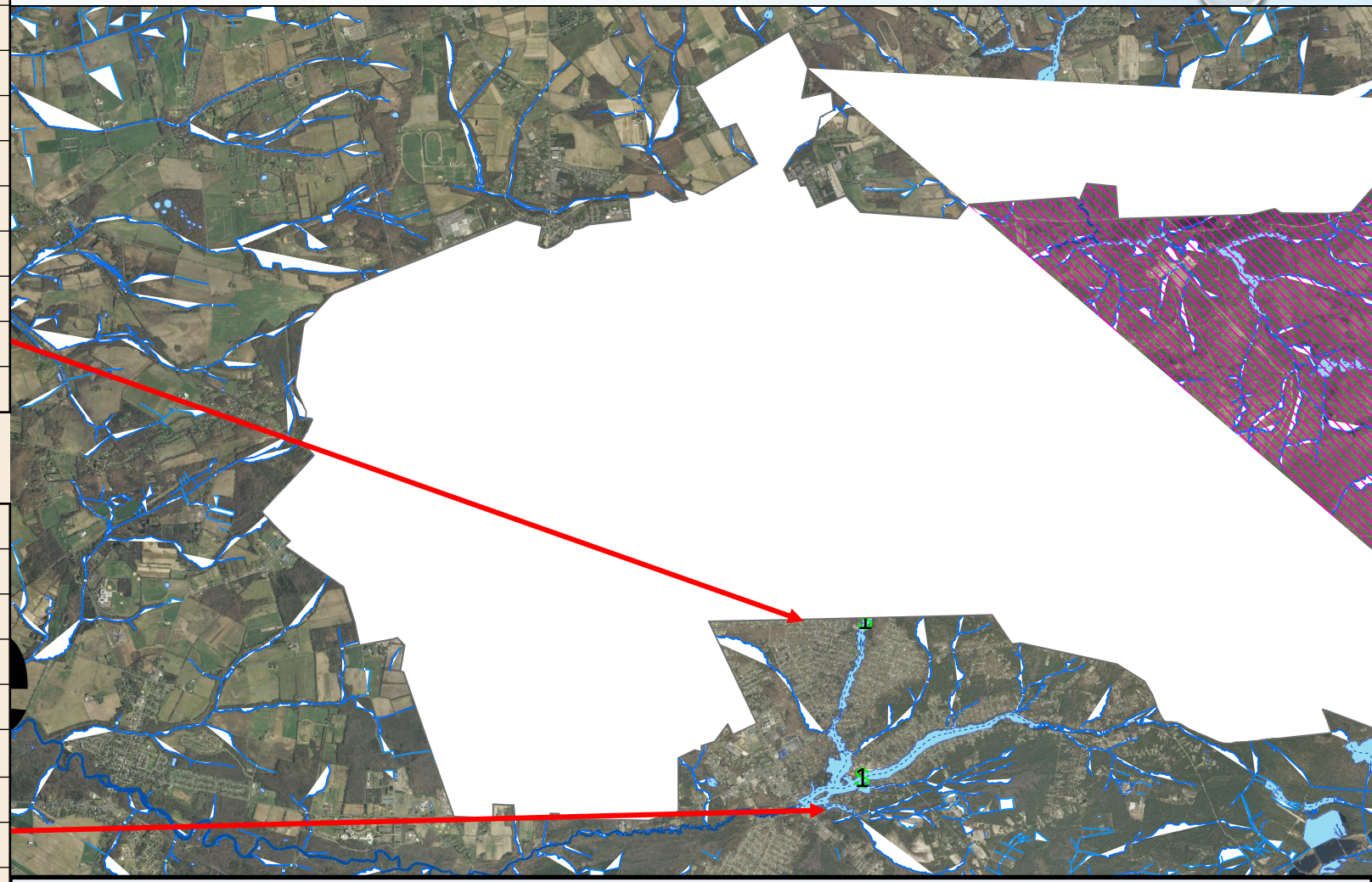
Including

Fish Consumption Advisories

LITTLE PINE AND MIRROR LAKES- PFOS

Little Pine Lake	PFOS	
Largemouth bass	65.8	*ppb*
Largemouth bass	74.2	*ppb*
Largemouth bass	81	*ppb*
Pumpkinseed	24.3	*ppb*
Pumpkinseed	26.5	*ppb*
Pumpkinseed	44.6	*ppb*
Yellow perch	104	*ppb*
Yellow perch	99.8	*ppb*
Yellow perch	152	*ppb*
Surface Water	100	*ppt*
Sediment	27.1	*ppb*

Mirror Lake	PFOS	
American eel	37.4	*ppb*
American eel	20.3	*ppb*
American eel	43.5	*ppb*
Bluegill	35.2	*ppb*
Bluegill	17.4	*ppb*
Bluegill	14	*ppb*
Largemouth bass	41.8	*ppb*
Largemouth bass	45.9	*ppb*
Largemouth bass	31.2	*ppb*
Surface Water	72.9	*ppt*
Sediment	3.07	*ppb*



Little Pine Lake Advisory based on PFOS= No more than yearly for LMB and Yellow perch; No more than once/3 months for Pumpkinseed sunfish.

Mirror Lake Advisory based on PFOS= No more than Monthly for all species

METEDECONK/FORGE POND

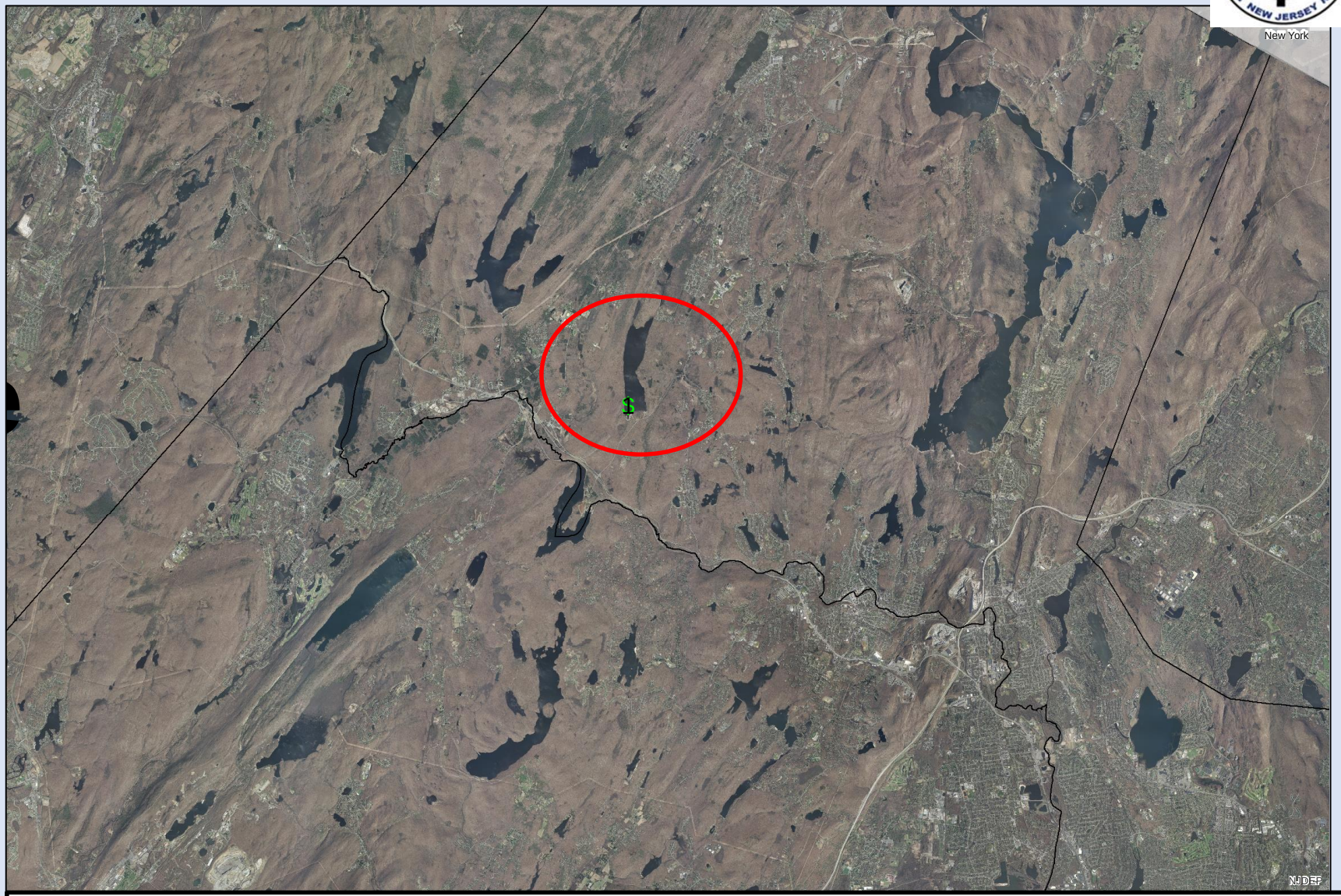
Species	PFOS concentration	
Common carp	6.46	*ppb*
Common carp	6.66	*ppb*
Common carp	5.96	*ppb*
Largemouth bass	26.8	*ppb*
Largemouth bass	16.1	*ppb*
Largemouth bass	20.7	*ppb*
White perch	11.3	*ppb*
White perch	5.36	*ppb*
White perch	5.86	*ppb*
Surface Water-2	33.9	*ppt*
1	28.3	*ppt*
Sediment-2	ND	
1	0.517	*ppb*

Metedeconk/Forge Pond Advisory based on PFOS= No more than monthly for carp and White Perch; No more than once/3 months for LMB

Echo Lake

Species	PFOS concentration	
Bluegill	2.39	ppb
Bluegill	1.7	ppb
Bluegill	2.9	ppb
Brown Bullhead	3	ppb
Brown Bullhead		
Brown Bullhead	1.86	ppb
Largemouth Bass	5.12	ppb
Largemouth Bass	4.53	ppb
Largemouth Bass	4.24	ppb
Surface Water	ND	ppt
Sediment	ND	ppb

- Echo Lake has no identified sources
- No other parameters were identified in the sediment sample
- Only low levels of short chained PFAS were detected in the surface water samples



Echo Lake Advisory based on PFOS= No more than weekly for Bluegill sunfish and Brown bullhead; No more than monthly for LMB

All advisories

Waterbody	Species	Avg. PFOS (ng/g)	Advisory
Echo Lake	Bluegill	2.33	Weekly
	Brown Bullhead	2.43	Weekly
	Largemouth Bass	4.63	Monthly
Passaic River	Bluegill	47.43	Once/3 months
	Common Carp	9.10	Monthly
	Largemouth Bass	39.30	Once/3 months
Raritan	Channel Catfish	3.10	Weekly
	Common Carp	11.54	Monthly
	White Catfish	2.27	Weekly
	White Perch	13.11	Monthly
Forge Pond	Common Carp	6.36	Monthly
	Largemouth Bass	21.20	Once/3 months
	White Perch	7.51	Monthly
Pine Lake	American Eel	162.50	Yearly
	Largemouth Bass	114.00	Yearly
	Pumpkinseed	119.20	Yearly

Waterbody	Species	Avg. PFOS (ng/g)	Advisory
Horicon	Chain pickerel	15.21	Monthly
	Yellow bullhead	1.43	Weekly
Little Pine	Largemouth Bass	73.67	Yearly
	Pumpkinseed	31.80	Once/3 months
	Yellow perch	118.60	Yearly
Mirror Lake	American Eel	33.73	Once/3 months
	Bluegill	22.20	Once/3 months
	Largemouth Bass	39.63	Once/3 months
Woodbury	Channel Catfish	0.44	Unlimited
	Largemouth Bass	21.30	Once/3 months
	Pumpkinseed	21.91	Once/3 months
Fenwick	Channel Catfish	0.57	Weekly
	Common Carp	12.39	Monthly
	White Catfish	2.53	Weekly

**However, the Woodbury Channel catfish contained concentrations of PFNA that required an advisory of "no more than weekly" consumption.

Next steps

- Continue with **Phase II** of fish, sediment and surface water sample collection in other areas of recreational fishing with potential sources:
  - Areas of potential car wash discharge
  - Surface waters near biosolid application sites
  - Surface waters downstream of WWTP discharge
- Explore analytical potential to capture a wider array of PFAS

For Questions or More Information:

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https://www.nj.gov/dep/dsr/njmainfish.htm