PFAS and NJ Fish Consumption Advisories

CBP STAC: *"Improving the Understanding & Coordination of Science Activities for PFAS in the Chesapeake Watershed"*

Sandra Goodrow, Ph.D.
NJDEP Division of Science and Research
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NJDEP Fish Consumption Advisories

NJDEP uses fish tissue sampling of various sites in New Jersey and risk assessment methodology to determine the need for fish consumption advisories for PFAS

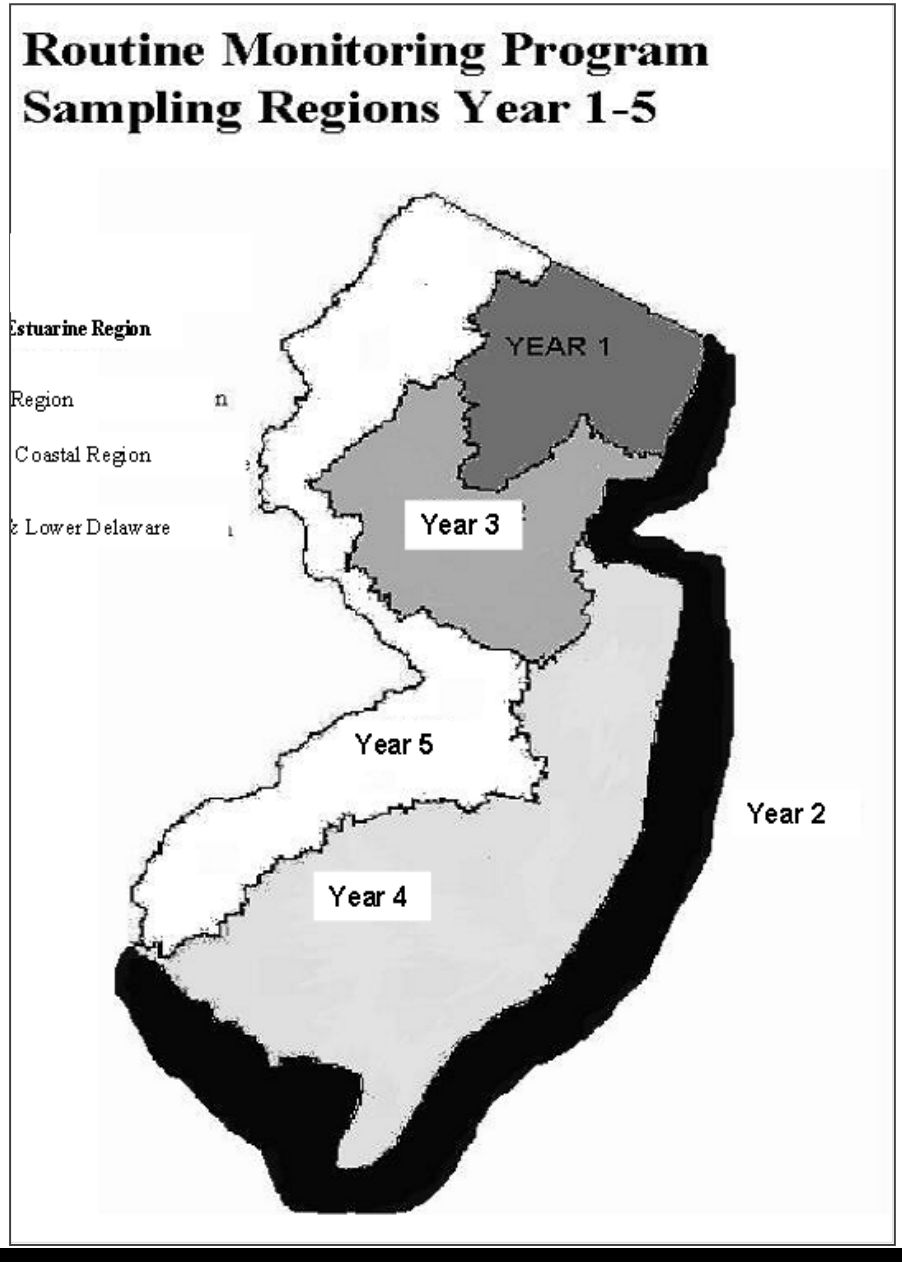
https://www.nj.gov/dep/dsr/njmainfish.htm

- Tiered Approach: Statewide, Regional (Pinelands) and Waterbody-specific Fish Consumption Advisories
- 100% of the state's lakes, streams and reservoirs are under the statewide/regional mercury advisories (4,100+ water bodies) *(once a week/once a month)*
- Most restricted advisories by species typically found in the Pinelands Region (for Mercury)
- Most advisories issued are for the High-Risk Population

General Design: Site Selection/Analysis

Sampling Sites - Selected through a random stratified approach of all available public waterways within each region.

- public waterways (Federal, State, Municipal or other)
- ponds, lakes, reservoirs, streams and rivers (typically, greater than 10 acres)
- accessible to the public and open for recreational fishing
- containing viable populations of target fish species
- "unique lakes" (i.e., major recreational fisheries)



Investigation of Levels of Perfluorinated Alkyl Substances (PFAS) in NJ Fish Species

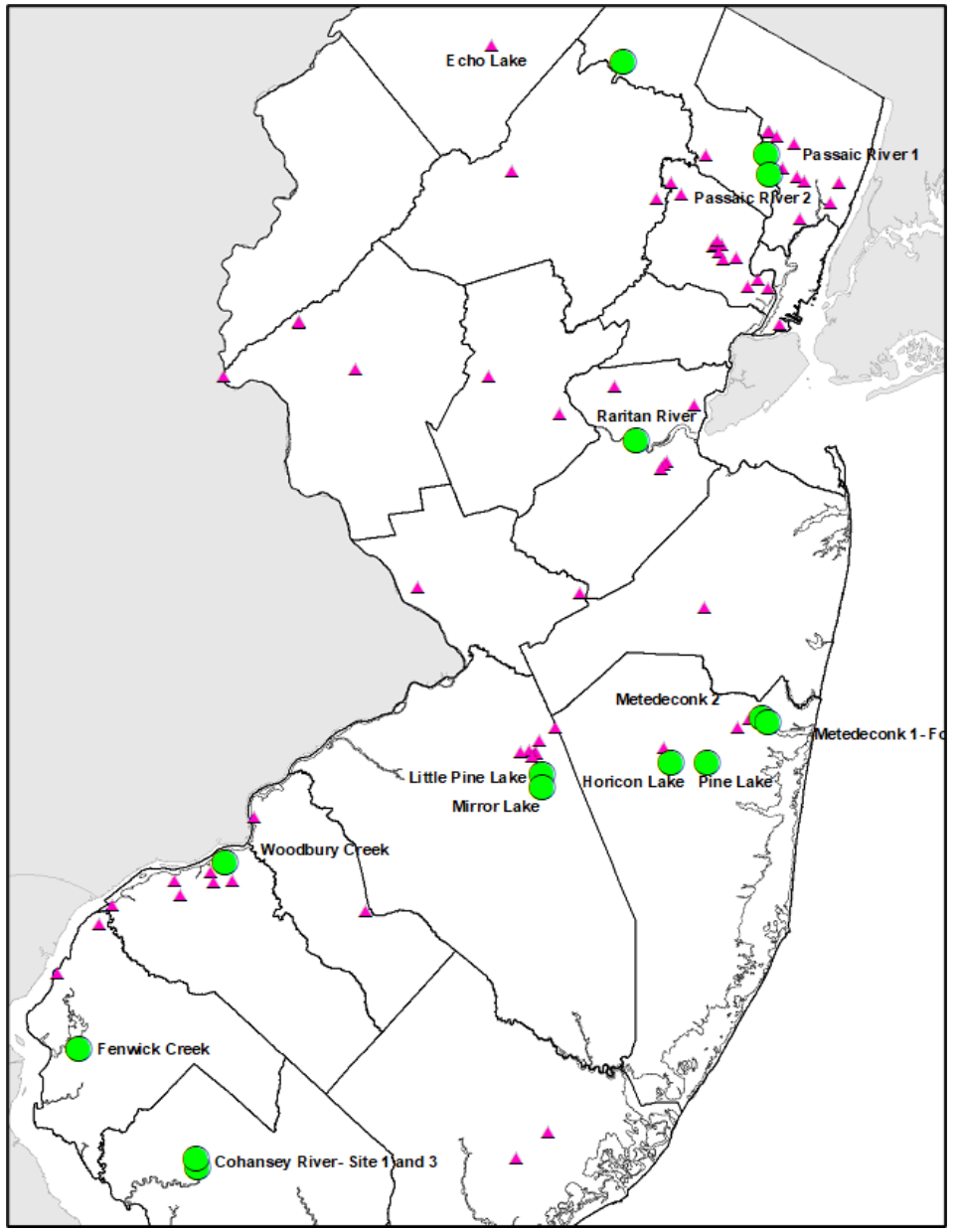
- Initial statewide assessment of the concentration of 13 perfluorinated compounds in fish tissue, sediments, and surface waters.
- Survey included 11 sites (one chosen as a likely background site) where recreational fishing is common.
- Sites were also located according to its proximity to a potential source (facility that manufactures PFAS compounds, or uses PFAS compounds in process)

Fish caught by electrofishing or netting included:

- Yellow perch
- Largemouth bass
- Pumpkinseed
- American eel
- White perch
- Chain pickerel
- Yellow bullhead

Investigation of Levels of Perfluorinated Alkyl Substances (PFAS) in NJ Fish Species

- To collect fish from **key recreational fishing areas** that are located near potential 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.



Results

Surface water (ppt)

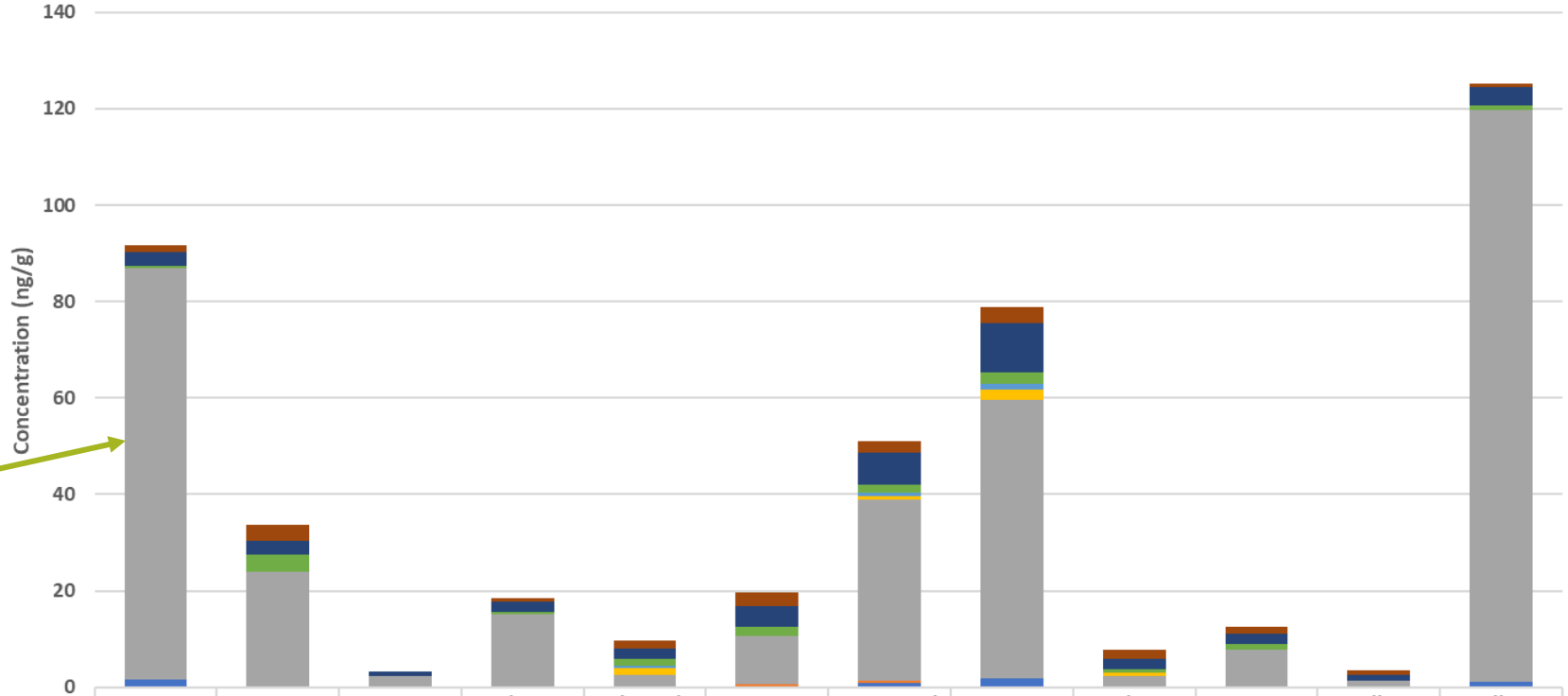
Site Name	PFBA	PFBS	PFPeA	PFHxA	PFHxS	PFHpA	PFOA	PFOS	PFOSA	PFNA	PFDA	PFUnA	PFDoA	*Total PFAS*
Echo Lake Reservoir	2.2	<	2.7	<	<	14.6	4.9	<	<	<	<	<	<	*24.3*
Passaic River 1	6.2	2.4	18.3	14.9	3.8	7.7	14.1	13.0	<	2.5	<	<	<	*83.0*
Passaic River 2	6.6	4.2	17.4	10.8	2.9	8.2	13.0	13.2	<	<	<	<	<	*76.3*
Raritan 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

Fish Tissue Sampling Results

PFOS



	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

Bioaccumulation

- PFOS preferentially partitions to certain **proteins**
  - Therefore, they accumulate in the blood and liver more than in muscle tissue
- PFOS has been shown to rapidly depurate in fish (Relative to PCBs)
  - Falk (2015) found that the longest elimination half life was 8.4 days in muscle tissue
- Temporal and spatial pairing of fish tissue and water samples are key to determining BAFs
- Highest bioaccumulation appeared to occur in White perch (3), largemouth bass (4), Bluegill sunfish (3), and common carp (2).

Species	BAF	Trophic Level
White Perch	4703.333	3
Largemouth Bass	3964.184	4
Bluegill	2975.433	3
Common Carp	2476.821	2
Brown Bullhead	1777.167	3
Pumpkinseed	1635.081	3
Chain Pickerel	1521.333	4
Yellow perch	1186	3
American eel	1063.577	4
White Catfish	285.3692	4
Channel Catfish	214.3068	4
Yellow Bullhead	112.3333	3

From NJDEP PFAS in Fish Tissue Study, 2020

Triggers

Setting the Consumption Advisory Levels

Fish consumption advisory triggers

New Jersey developed fish consumption triggers using the **Reference Doses** for previously developed for use in drinking water and ground water standards.

- PFOA (2 ng/kg/day; NJDWQI, 2017),
- PFOS (1.8 ng/kg/day; NJDWQI, 2018), and
- PFNA (0.74 ng/kg/day; NJDEP, 2017)
- PFUnA- coming soon
- ClPFPECA- research on BAF currently being performed

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

General Equation for unlimited consumption:

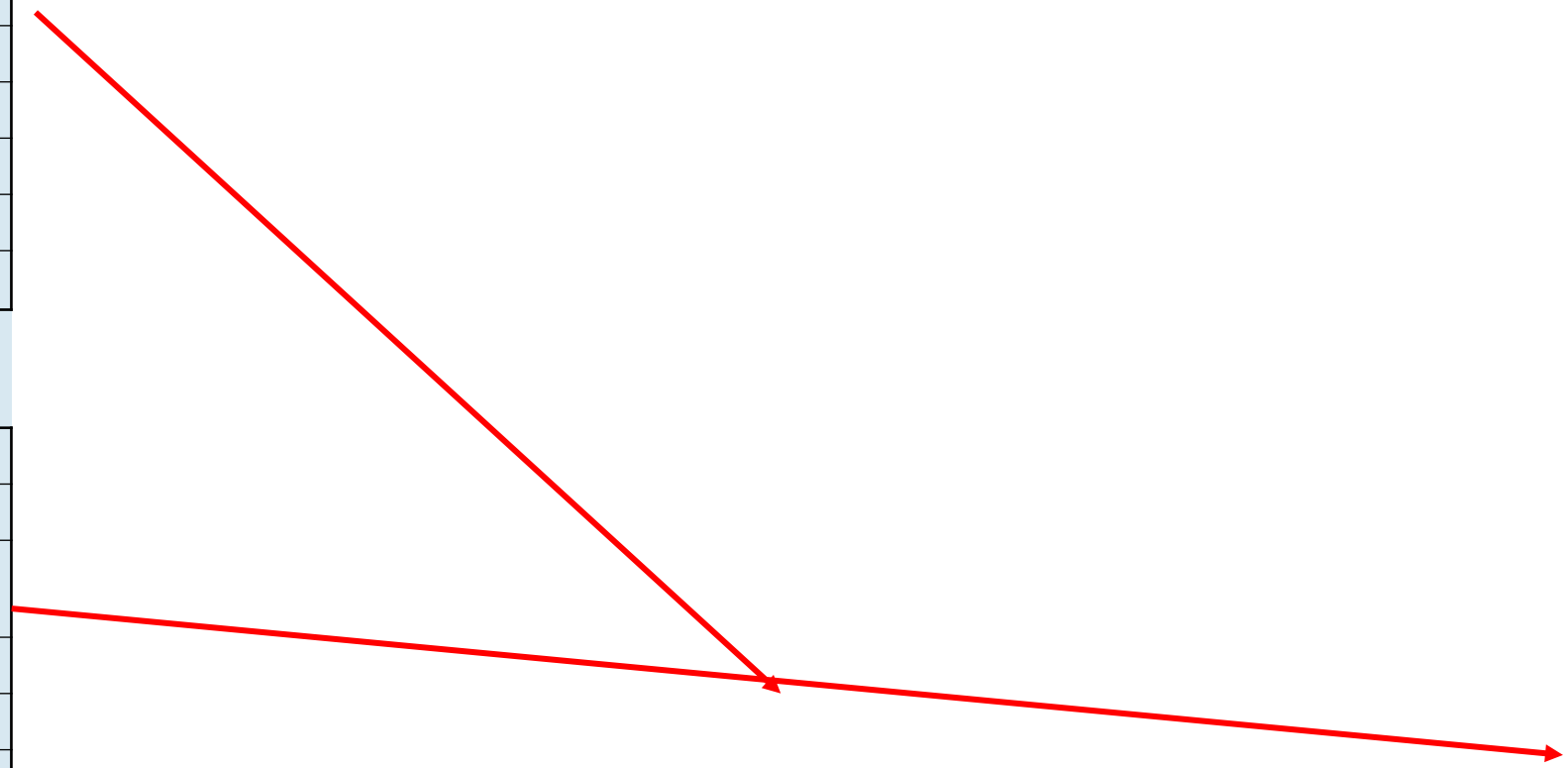
$$\text{Daily trigger concentration}\left(\frac{\text{ng}}{\text{g}}\right) = \frac{\text{RfD } (ng/kg/day)\text{x Body Weight (kg)}}{\text{Meal size (g)}}$$

- Where body weight= 70 kg and meal size is 227 g
- For consumption triggers that are less than daily, the triggers are multiplied by the appropriate timeframe

Lakes near military base- PFOS

Horicon Lake	PFOS	
Chain pickerel	17.9	*ppb*
Chain pickerel	19.7	*ppb*
Chain pickerel	8.04	*ppb*
Yellow bullhead	1.02	*ppb*
Yellow bullhead	1.83	*ppb*
Surface Water	10.0	*ppt*
Sediment	3.25	*ppt*

Pine Lake	PFOS	
American eel	170	*ppb*
American eel	155	*ppb*
Largemouth bass	114	*ppb*
Pumpkinseed	76.9	*ppb*
Pumpkinseed	208	*ppb*
Pumpkinseed	72.7	*ppb*
Surface Water	102.0	*ppt*
Sediment	19.3	*ppt*



Pine Lake Advisory based on PFOS= No more than yearly for all species
Horicon Lake Advisory based on PFOS= No more than Monthly for Chain pickerel and Weekly for Yellow bullhead

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*

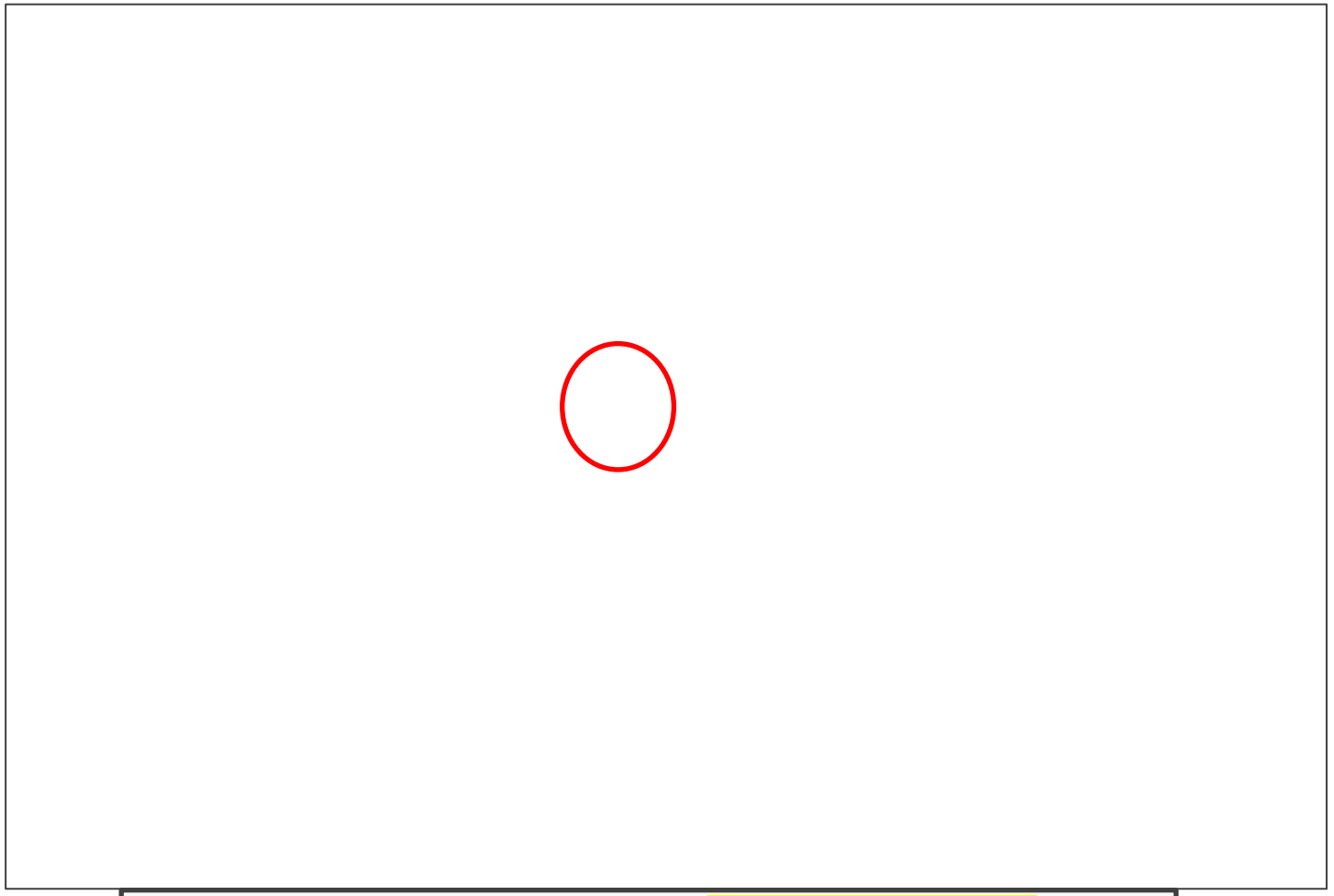
Mirror Lake	PFOS	
American eel	37.4	ppb
American eel	20.3	ppb
American eel	43.5	ppb
Bluegill	35.2	ppb
Bluegill	17.4	ppb
Bluegill	14	ppb
Largemouth bass	41.8	ppb
Largemouth bass	45.9	ppb
Largemouth bass	31.2	ppb
Surface Water	72.9	ppt
Sediment	3.07	ppb

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

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
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.

In Summary:

- This project was intended to quantify the concentration of PFAS in consumable fish tissue
- This original study was a targeted study
    - Sites located near identified or possible sources of PFAS
- Using the health impact value of the Reference Dose, an advisory level of fish tissue consumption was assigned for three compounds- PFNA, PFOA, and PFOS
- PFOS is the compound that is often found in areas of PFAS contamination, and it is highly bioaccumulative

Next Steps

- Continue with of fish, sediment and surface water sample collection in other areas of recreational fishing with potential sources. (Phase II)
- Ongoing BAF studies in saline and freshwater
- Integration of PFAS into the Routine Monitoring Network

SANDRA GOODROW, PH.D.
NJDEP
DIVISION OF SCIENCE, RESEARCH AND ENVIRONMENTAL HEALTH

SANDRA.GOODOW@DEP.NJ.GOV