Woodard & Curran

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Understanding Distribution of & Changes to PFAS in a Riverine System: A Case Study

PRESENTED BY

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The Science of PFAS: Public Health & the Environment

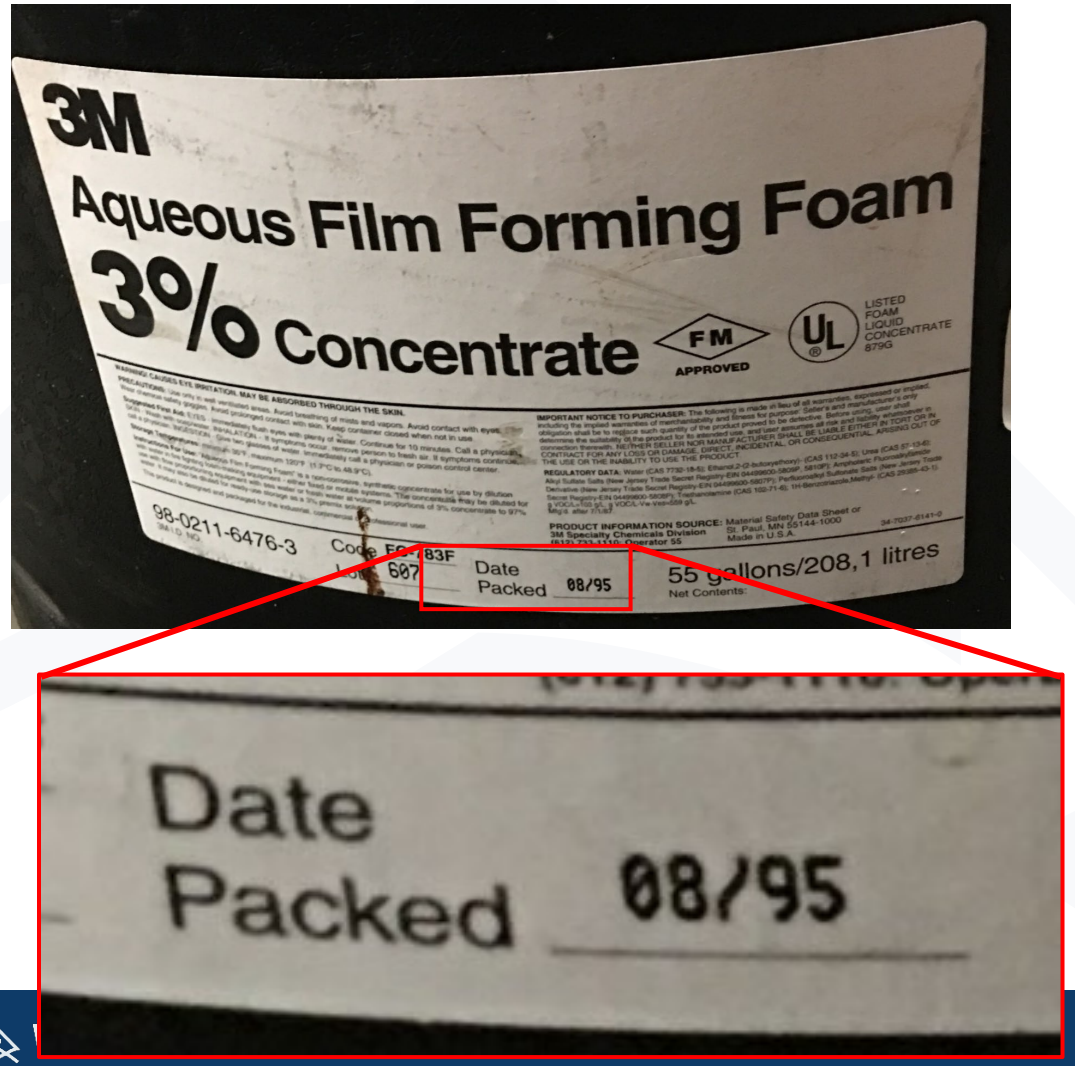
How does PFAS move in a river after a release?

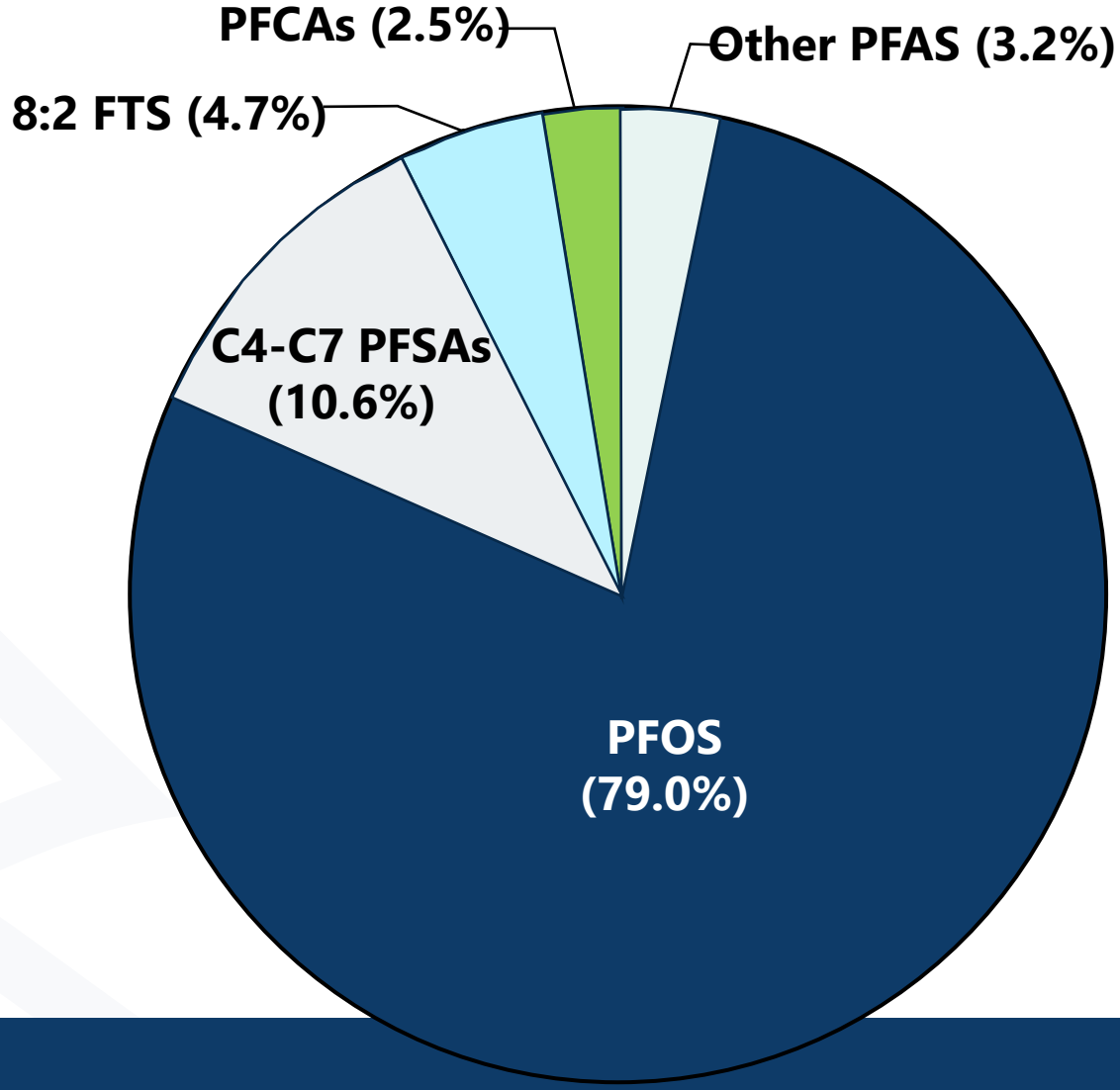
- How do concentrations change over time?
- How do PFAS compartmentalize into various media?

June 2019 Release

- Malfunction of fire suppression system in hangar at Bradley International Airport
  - 40,000 gallons AFFF/water released
  - Discharged to Farmington River via wastewater treatment plant

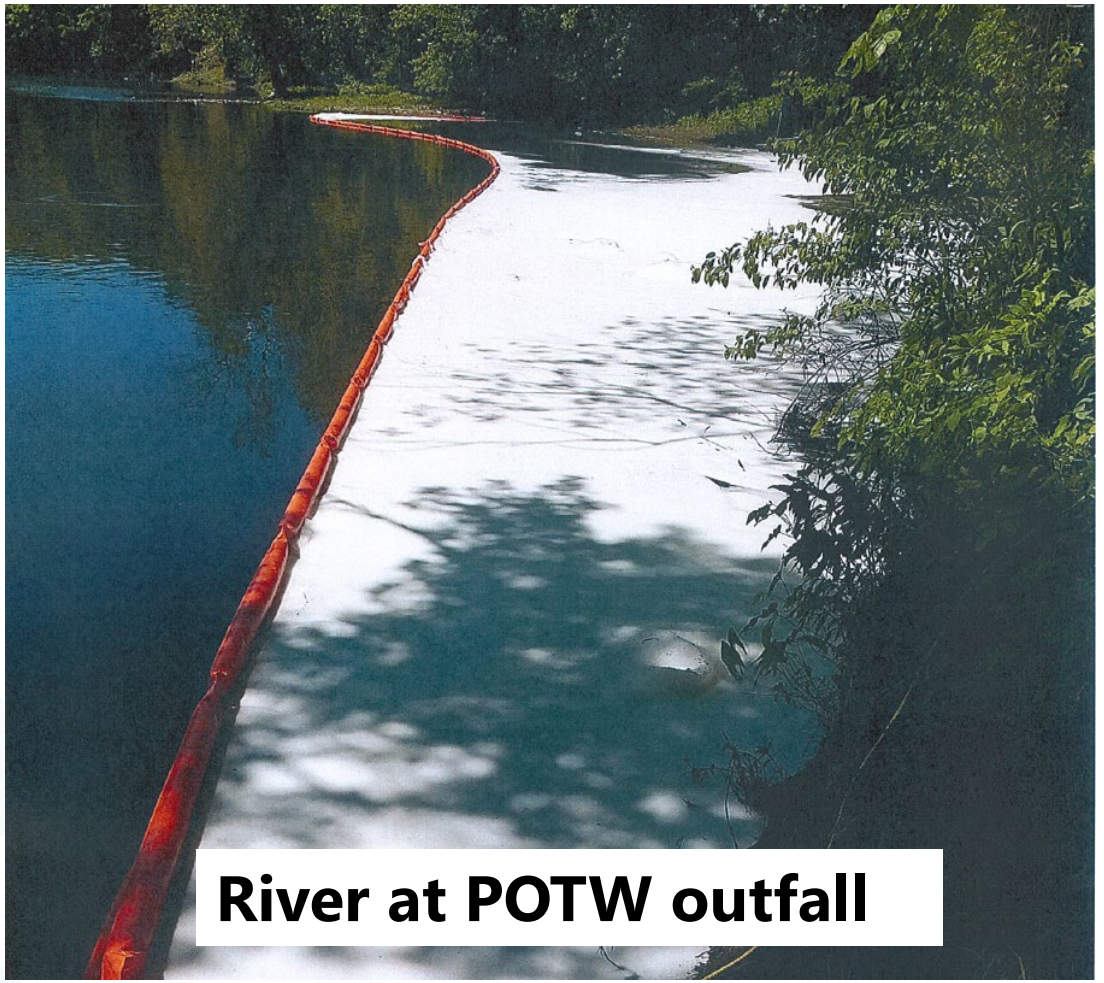
AFFF was primarily a legacy (PFOS-based) product





AFFF transported through sewer to POTW and discharged to river

Foam from a storm sewer grate



River at POTW outfall

October 2019 World War II B-17 Crash

- Up to 25,000 gal. of AFFF/water mixture
- Portion entered Rainbow Brook, drains to Farmington River

River PFAS Assessment

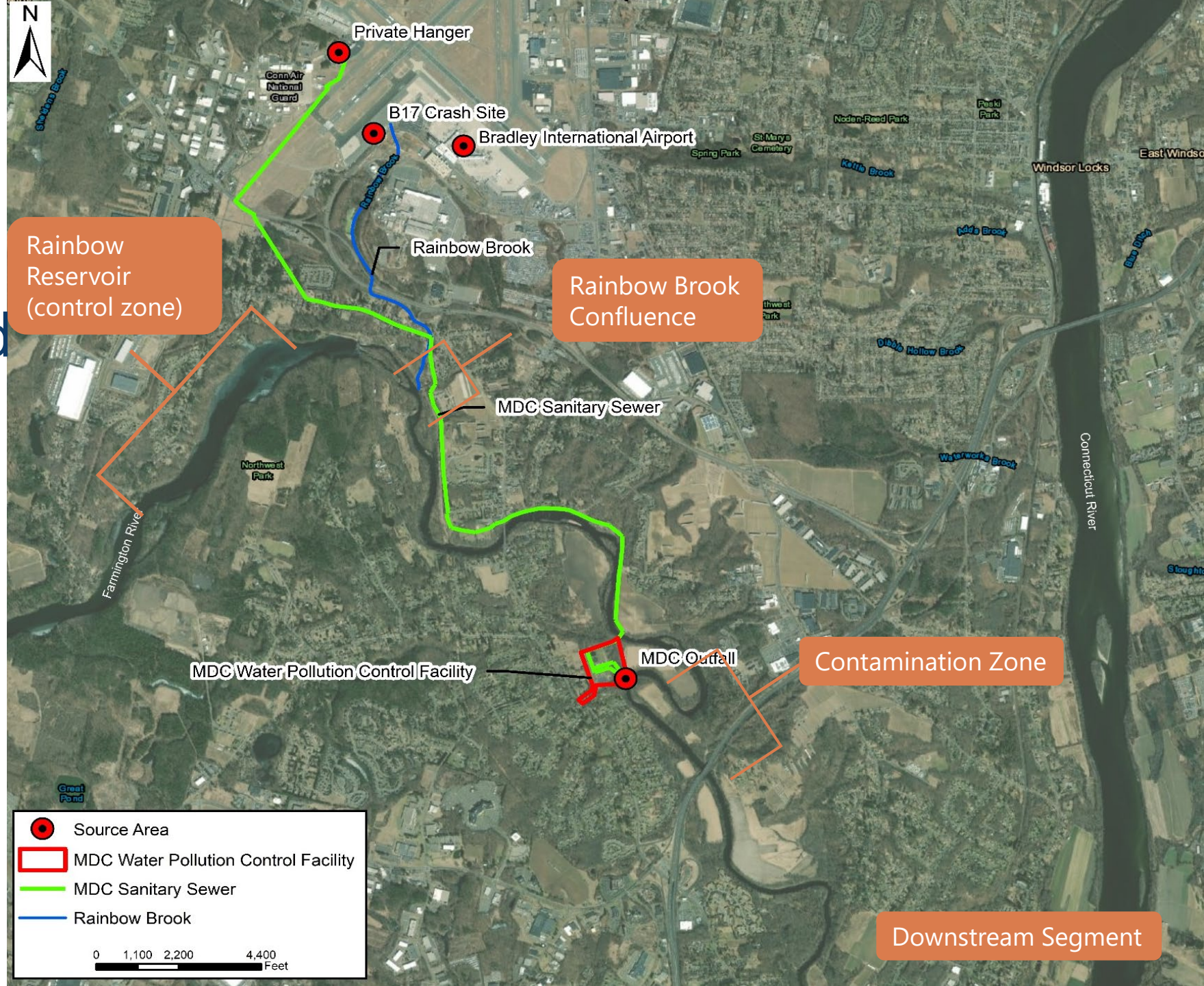
Objectives

- Determine PFAS concentrations in surface water, fish tissue, and sediment
- Delineate linear extent
- Evaluate impact change with time
- Use data to inform recreational restrictions

Challenge

- How do we tease out impacts from other sources?

Overview of Source Areas and Sampling Zones



Sample Collection

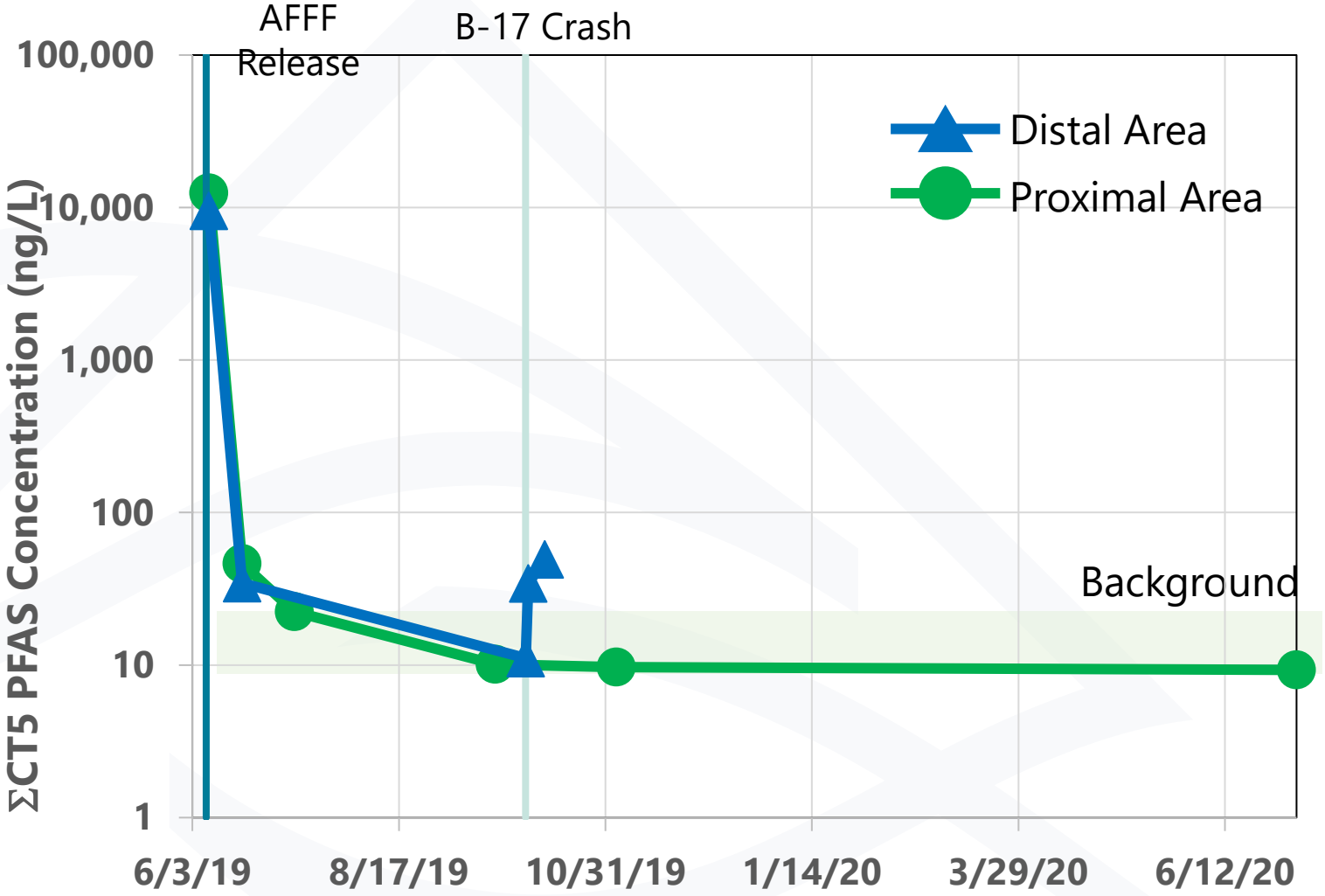
Medium	# Rounds	# Samples	Notes
AFFF Product	1	2	✓ From drum and holding tank; ✓ June 2019
Wastewater and Biosolids	1	8 / 3	✓ From various stages of treatment; ✓ July 2019
Surface Water	6	25	✓ From upper 1' of water column; ✓ June, July, Sept., Oct., Nov. 2019, July 2020
Fish Fillet	3	40	✓ Yellow Perch (*Perca flavescens*) ✓ White Sucker (*Catostomus commersonii*) ✓ Composites of 5 fish; descaled, filets, skin ✓ July, September 2019; July 2020
Sediment	1	13	✓ From 0-2" depth; ✓ November 2019

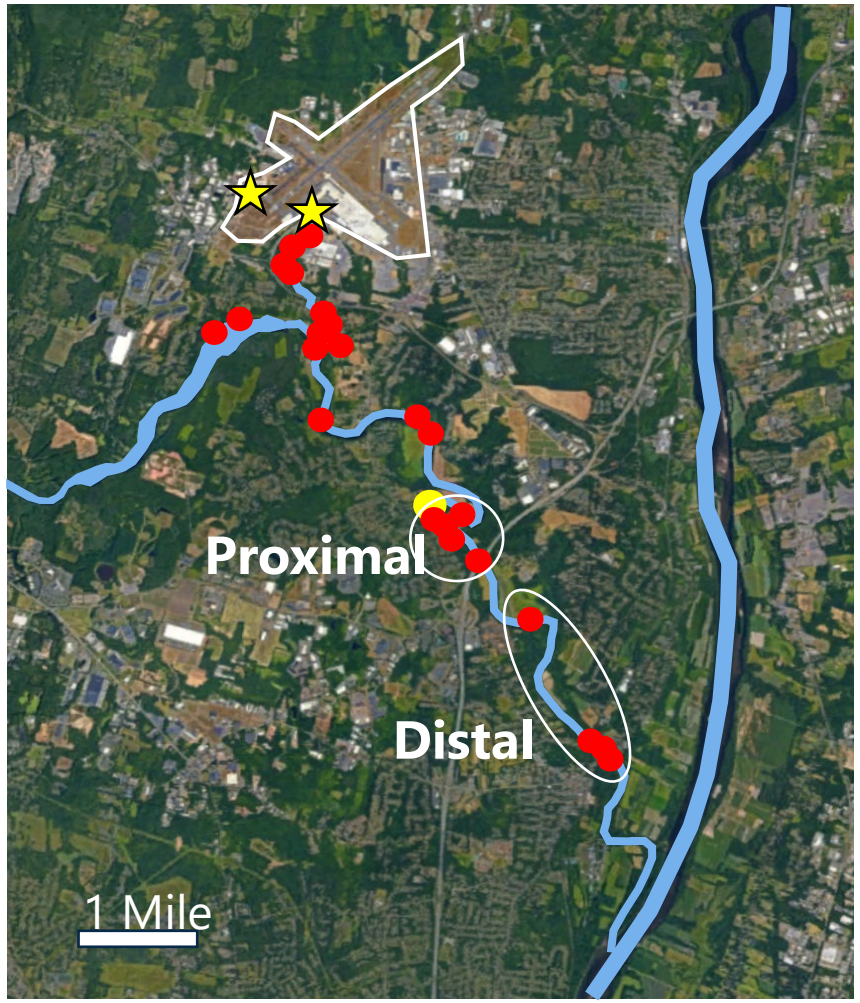
PFAS Analysis

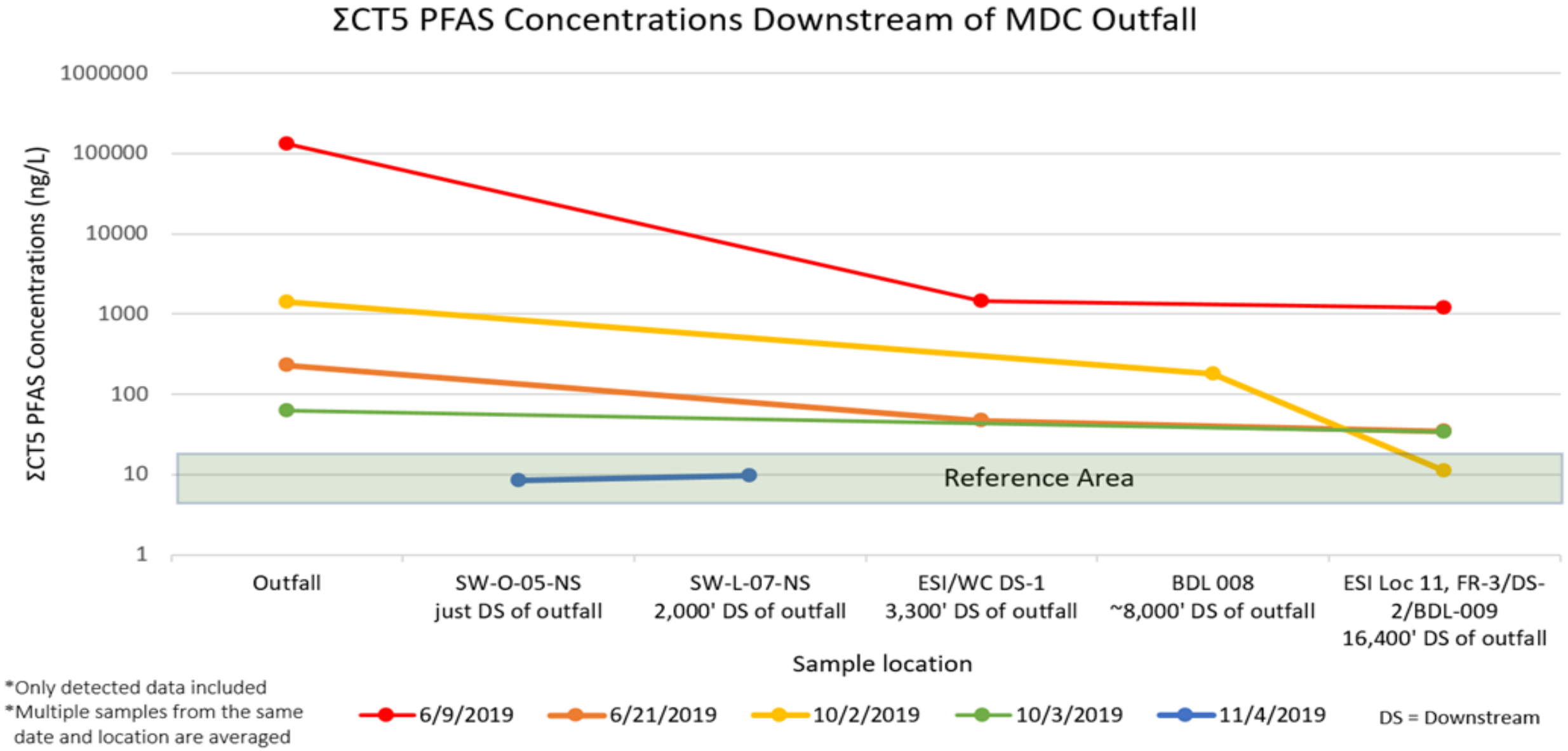
- Isotope dilution
- SPE LC-MS/MS

33 Target Analytes		
PFBA	PFBS	4:2 FTS
PFPeA	PFPeS	6:2 FTS
PFHxA	PFHxS	8:2 FTS
PFHpA	PFHpS	PFOSA (or FOSA)
PFOA	PFOS	N-MeFOSA
PFNA	PFNS	N-EtFOSA
PFDA	PFDS	N-MeFOSE
PFUnA	PFDoS	N-EtFOSE
PFDoA	N-MeFOSAA	HFPO-DA
PFTrDA	N-EtFOSAA	ADONA
PFTeDA	9Cl-PF3ONS	11Cl-PF3OUdS

Surface Water Sampling Results



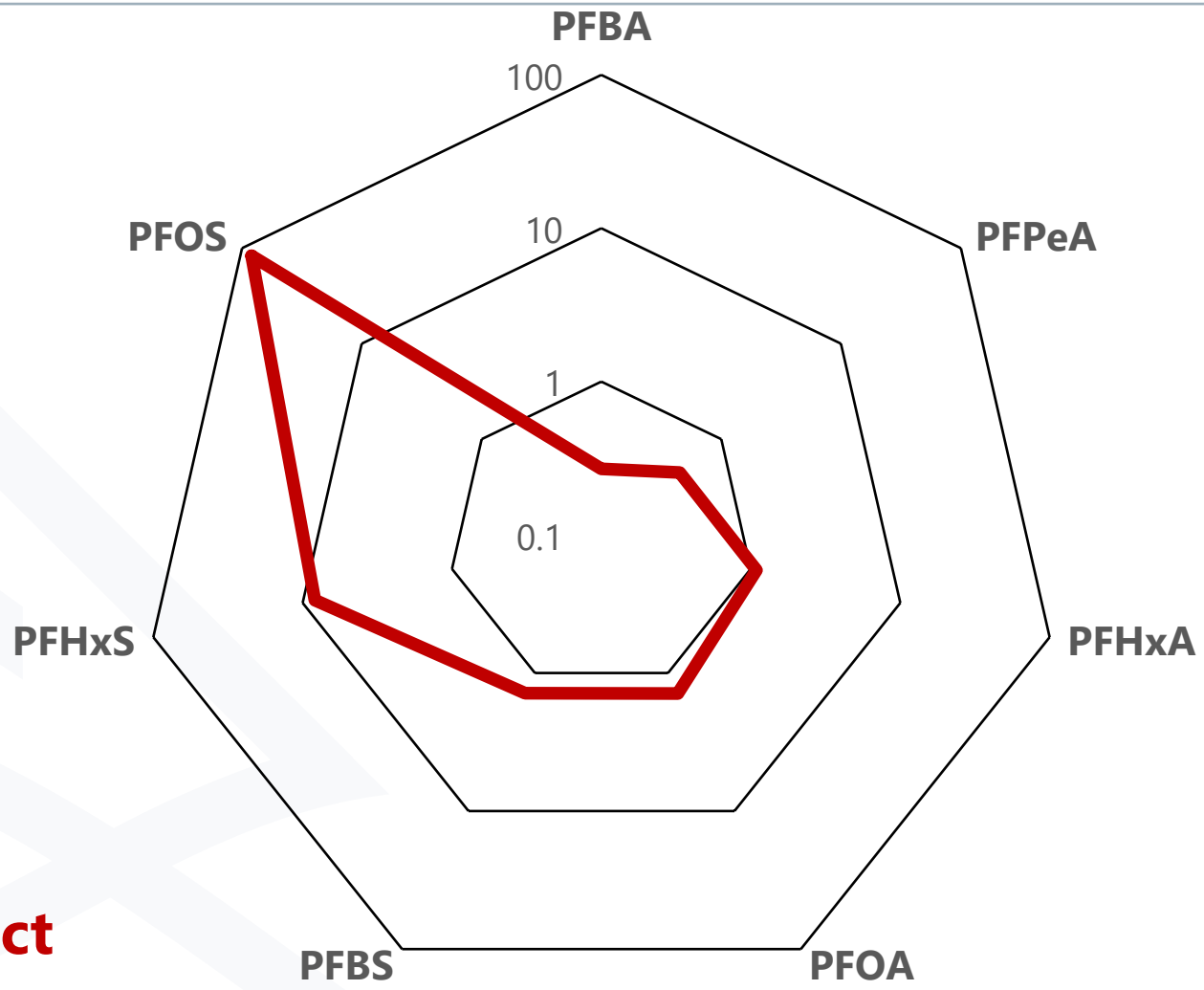




∑PFAS5 = sum of PFOA, PFOS, PFNA, PFHpA, and PFHxS

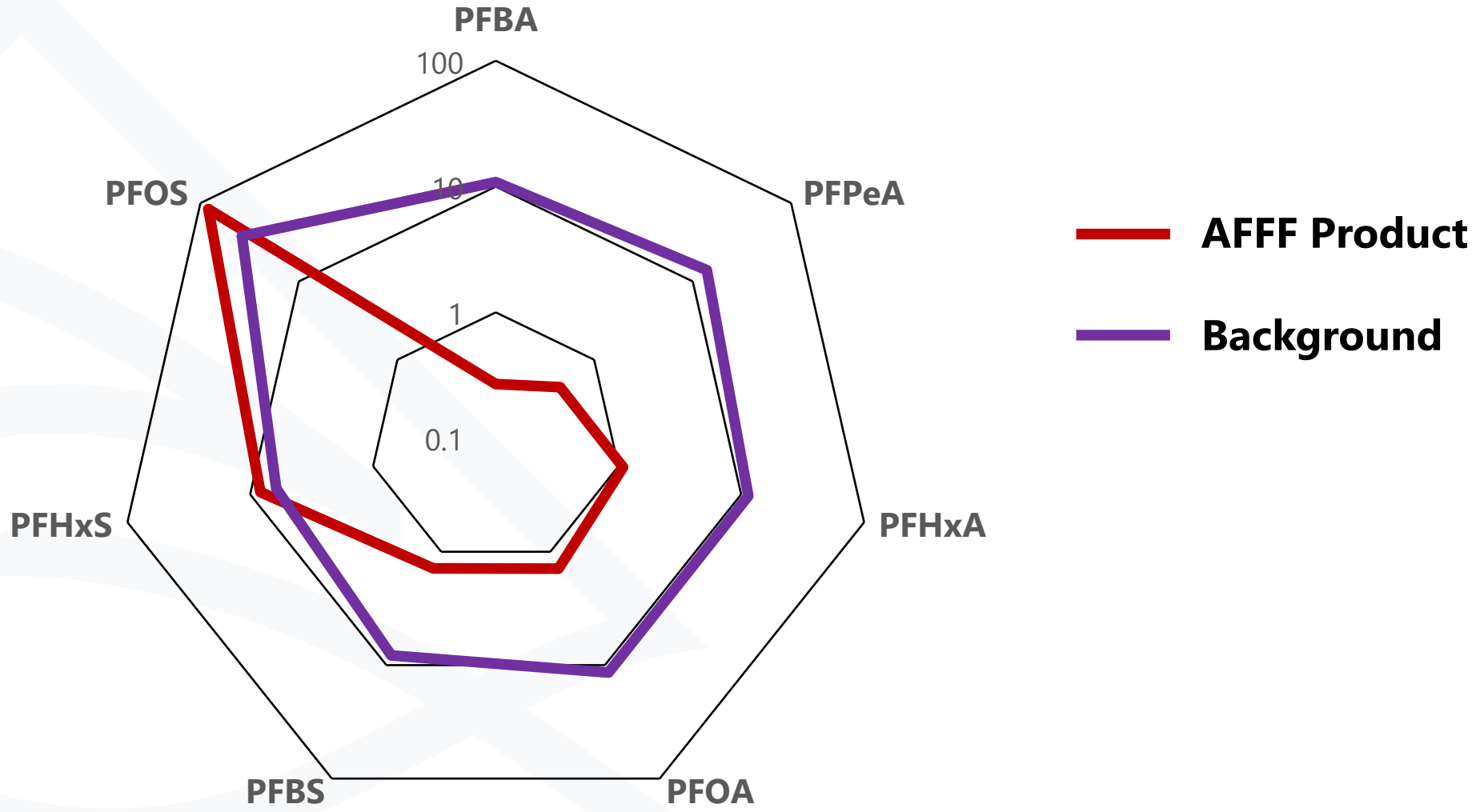
Radar plots assist visualization of PFAS signatures

- Identified seven most common PFAS in AFFF and Reference
- Express [PFAS] as % of total for the seven common PFAS
- Plot on logarithmic scale to emphasize similarities and differences

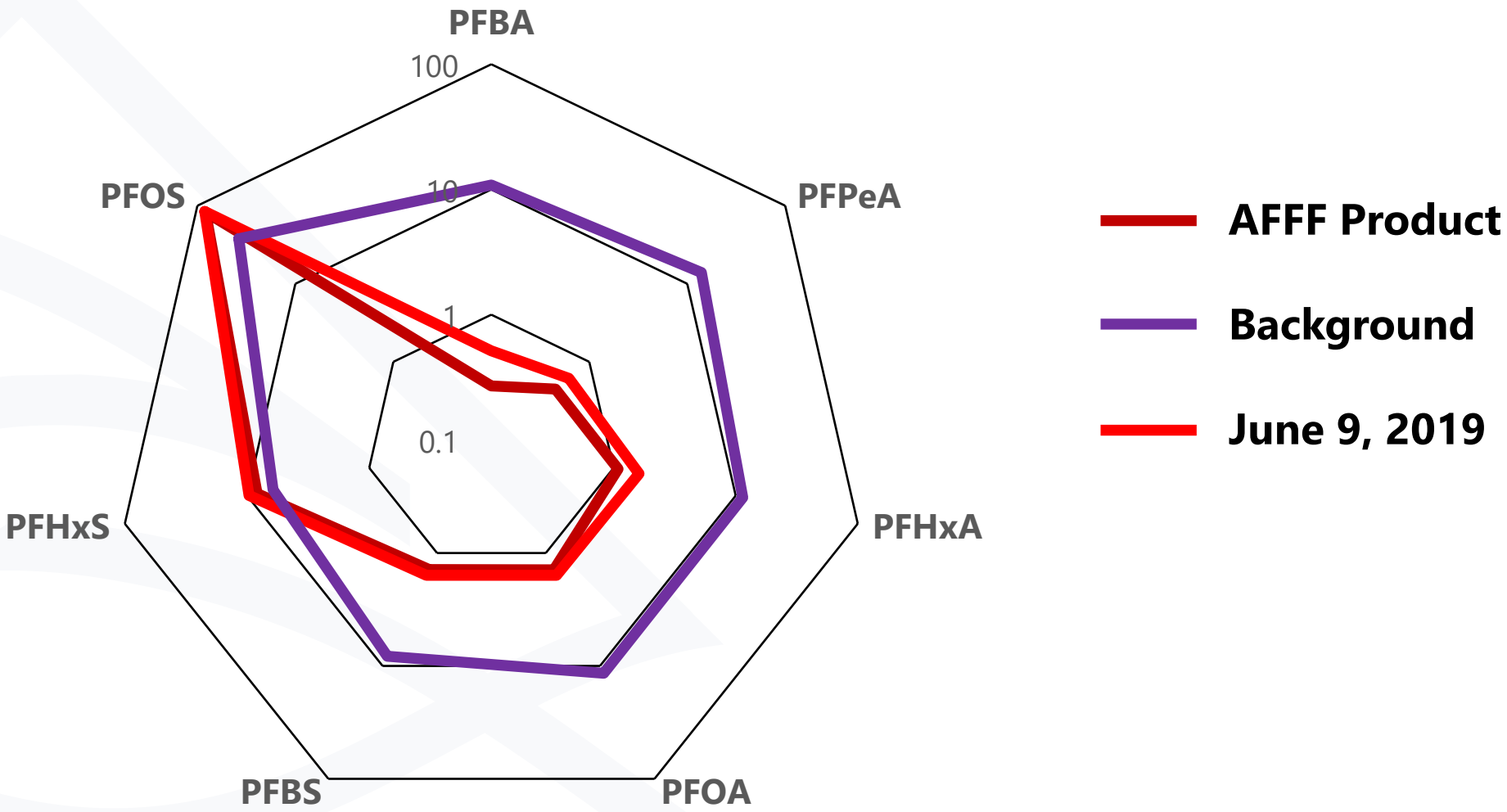


AFFF Product

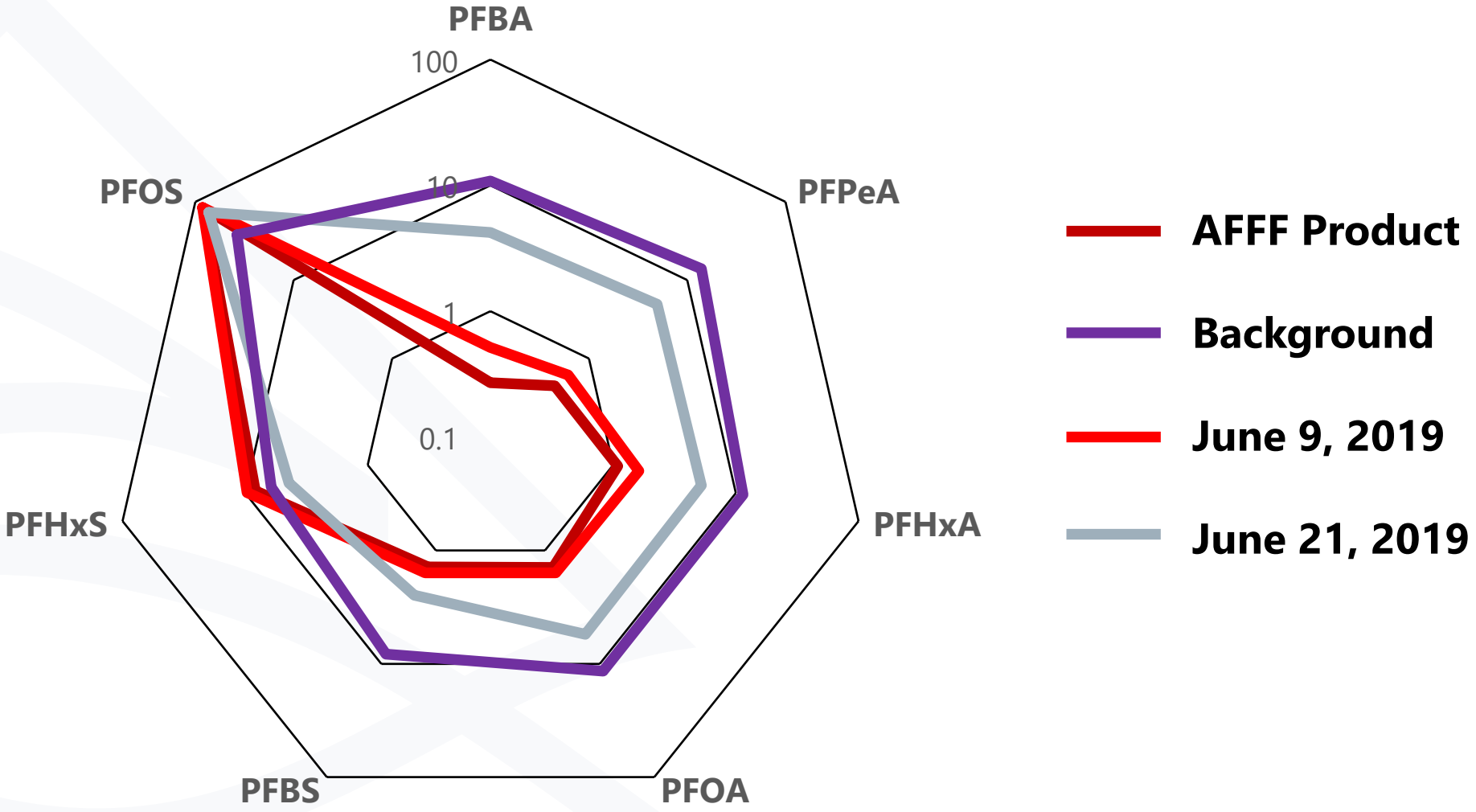
AFFF and background surface water have very different PFAS signatures



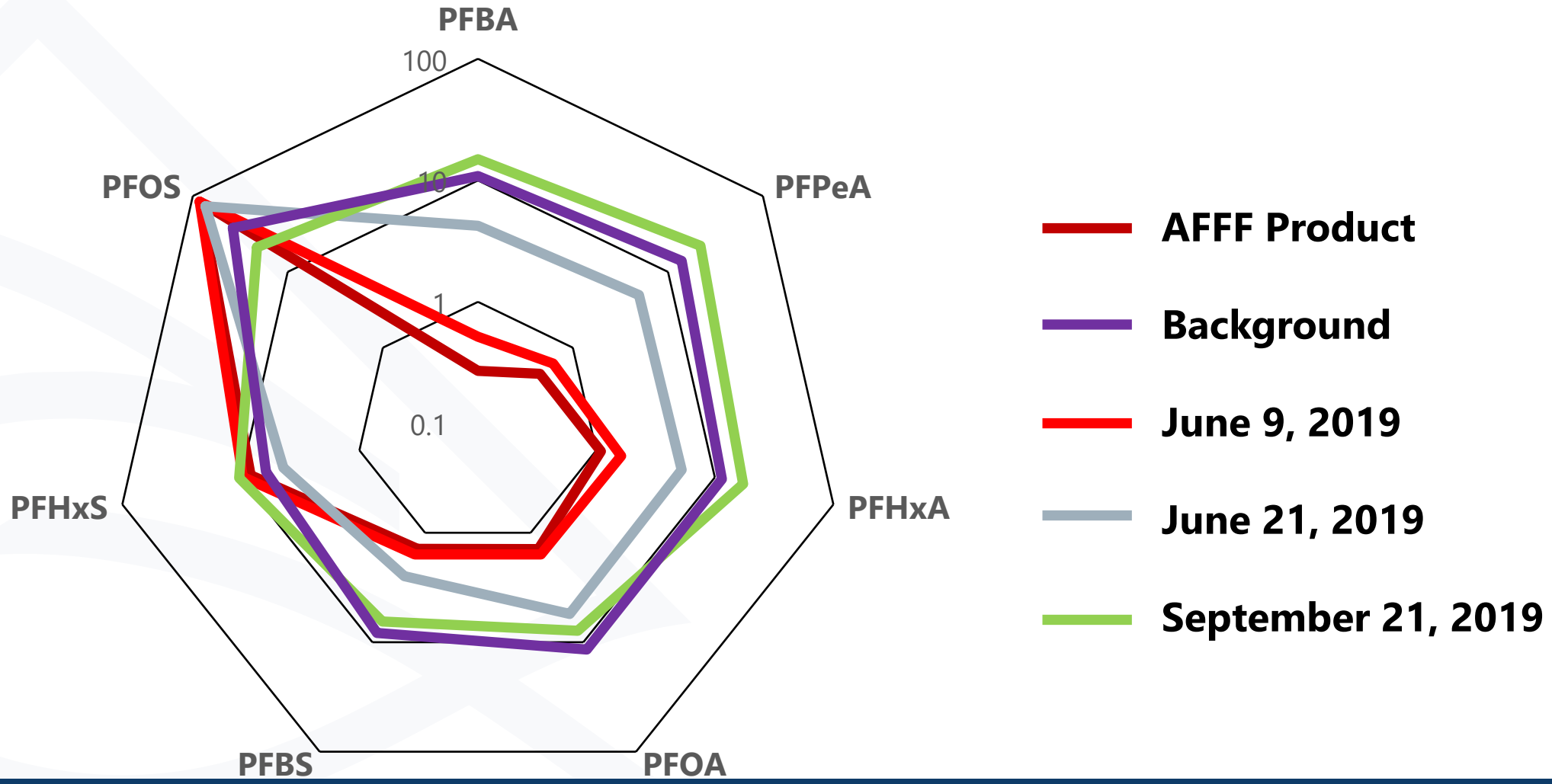
Surface water collected the day after the discharge has PFAS distribution similar to AFFF



Surface water PFAS signature approaching background signature by June 21 (13 days)



Surface water PFAS signature returned to reference signature within three months



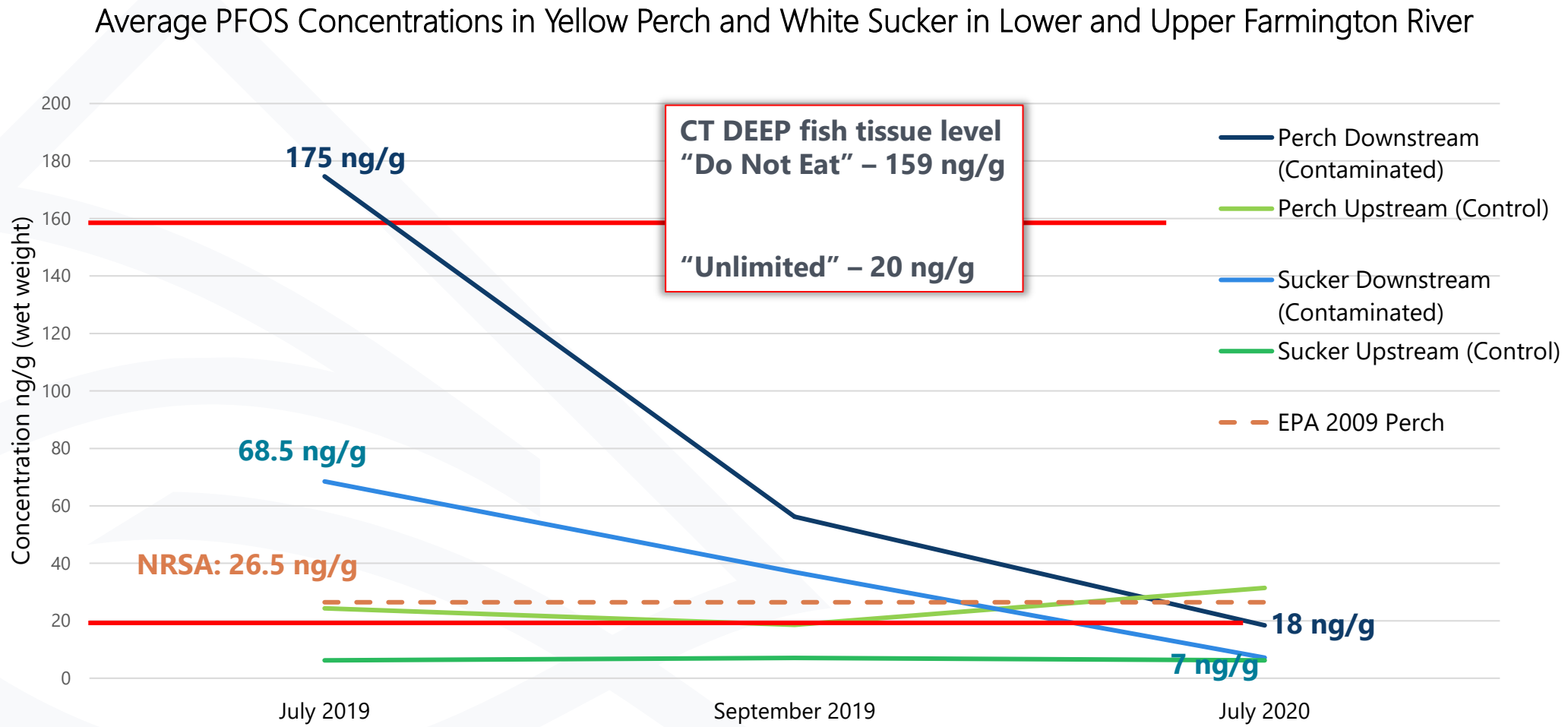
Fish Tissue Sampling Results

- Fillet
- skin on
- descaled

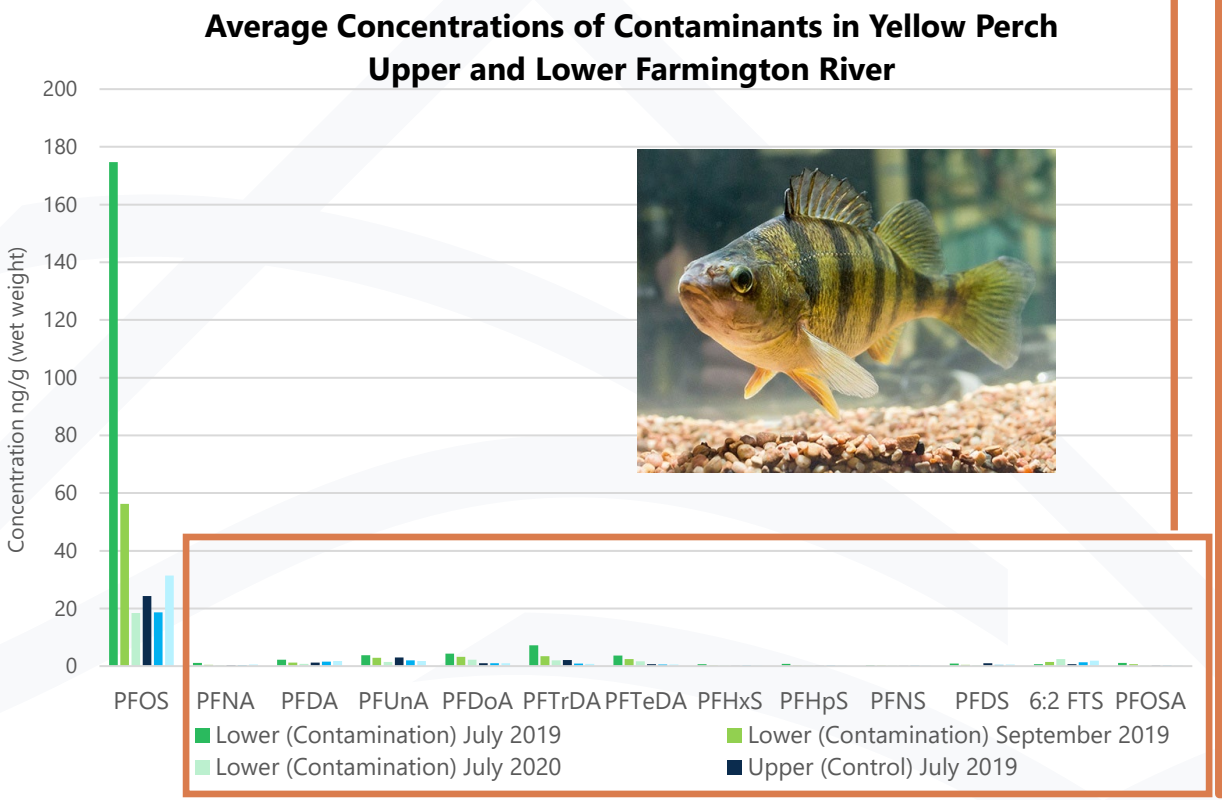
Perca flavescens
Yellow Perch
Predator

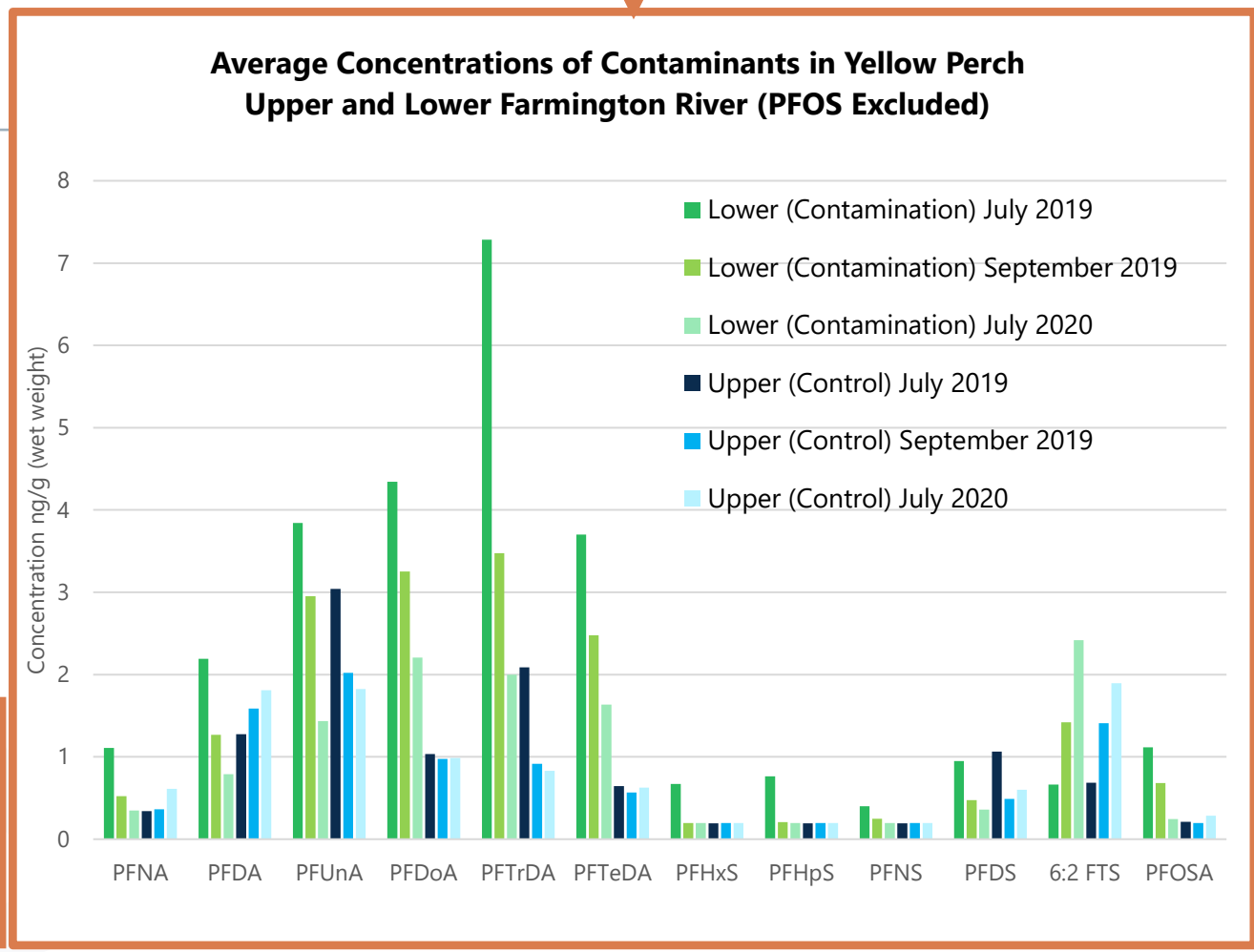
Catostomus commersonii
White Sucker
Bottom Dweller

Average Fish PFOS Concentrations declined with time



Fish Tissue Signatures

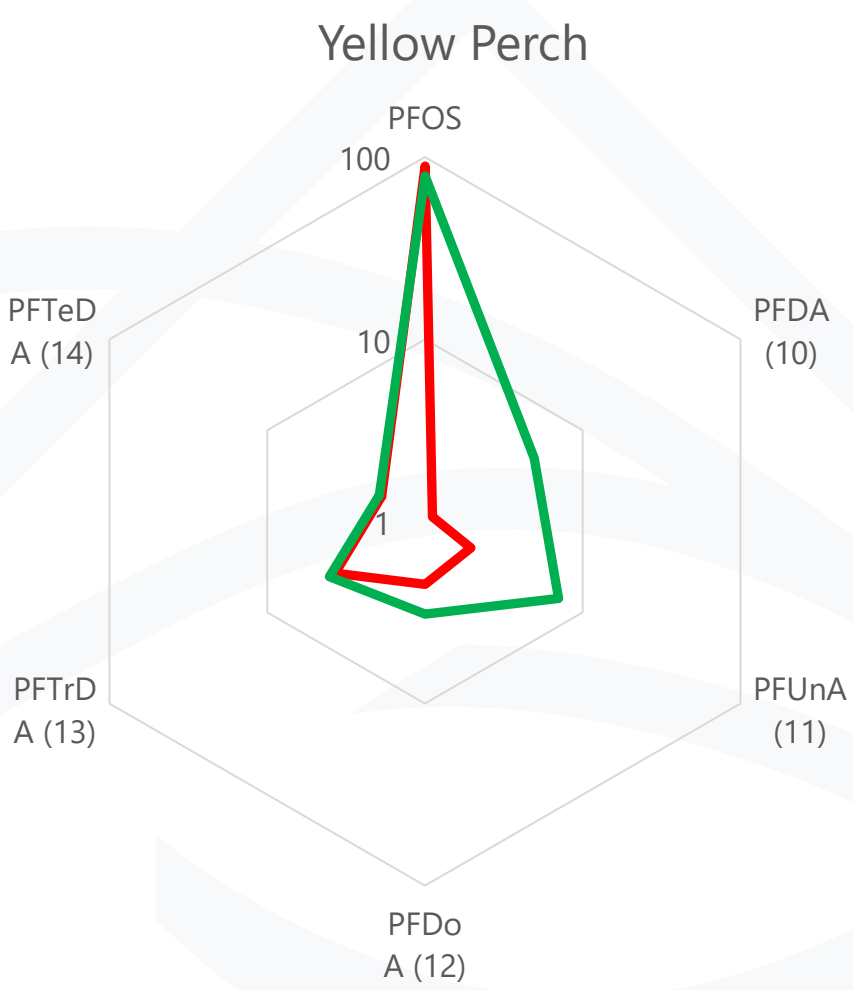


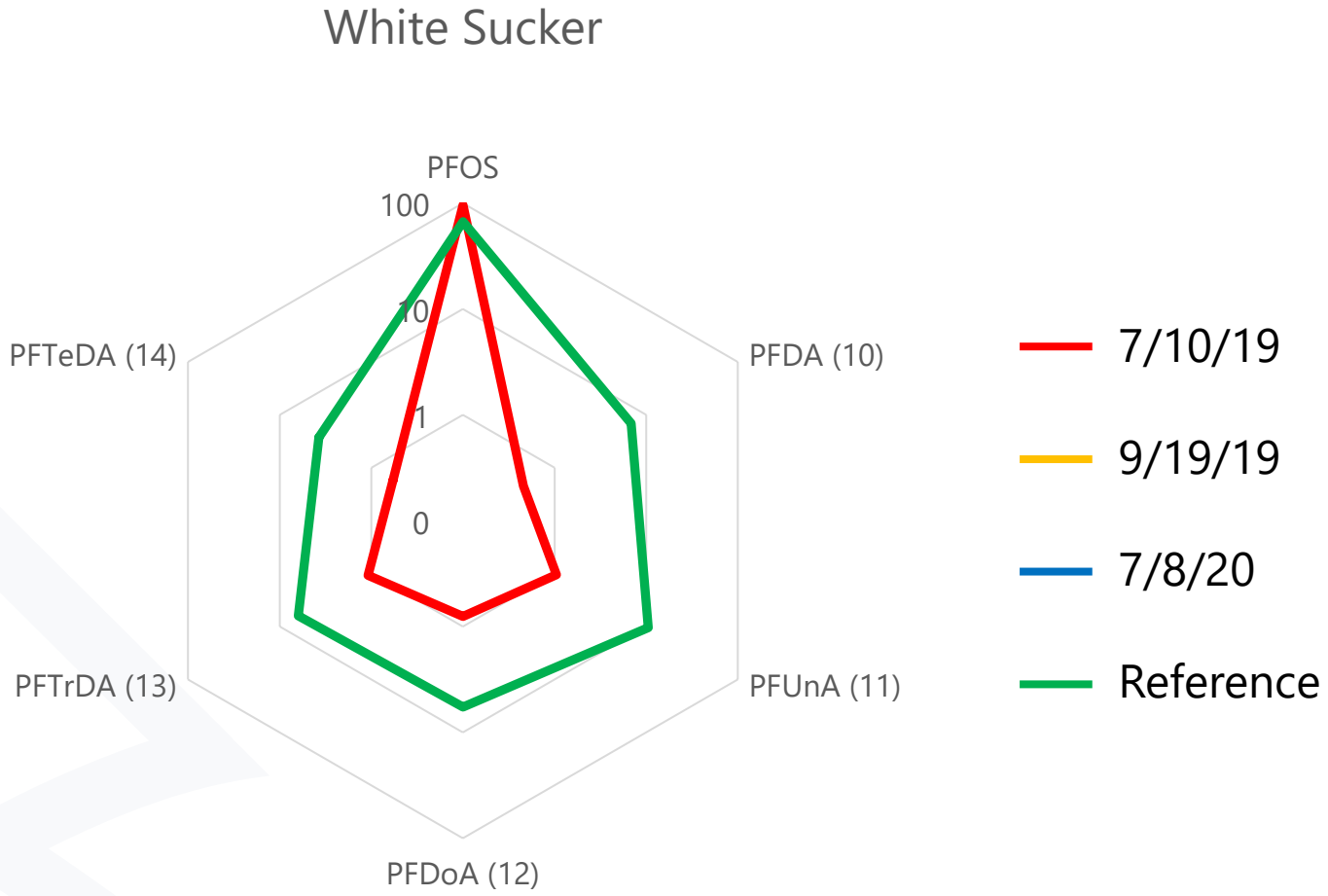


→ Similar pattern observed for sucker

- Lower concentrations

Fish Tissue PFAS Characterization





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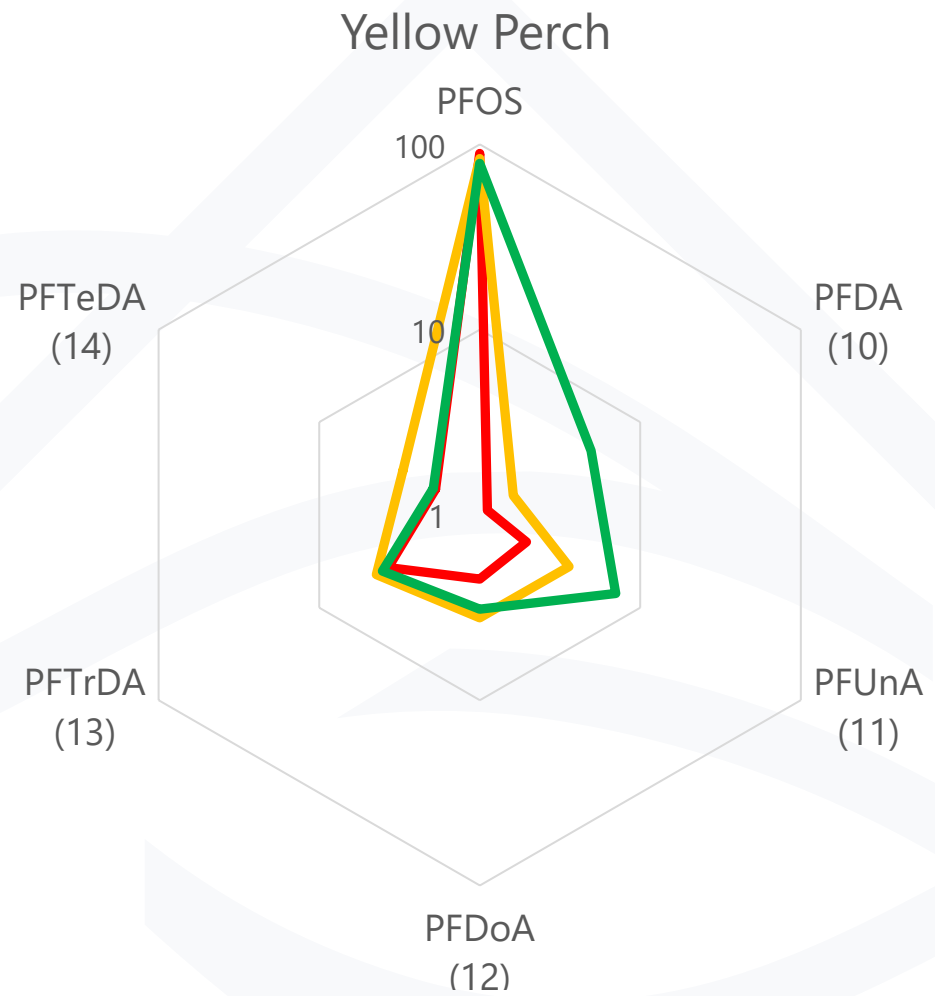

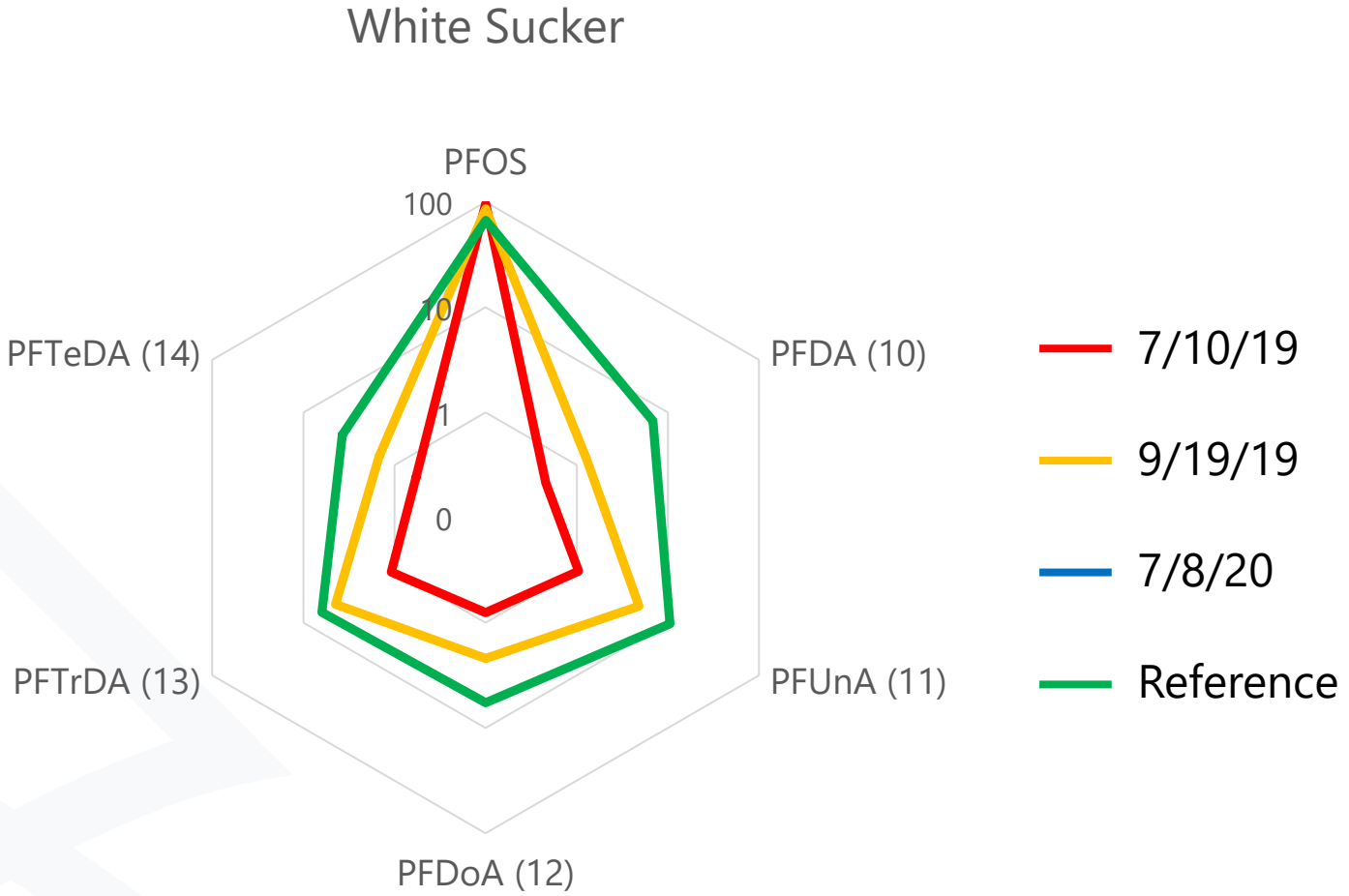

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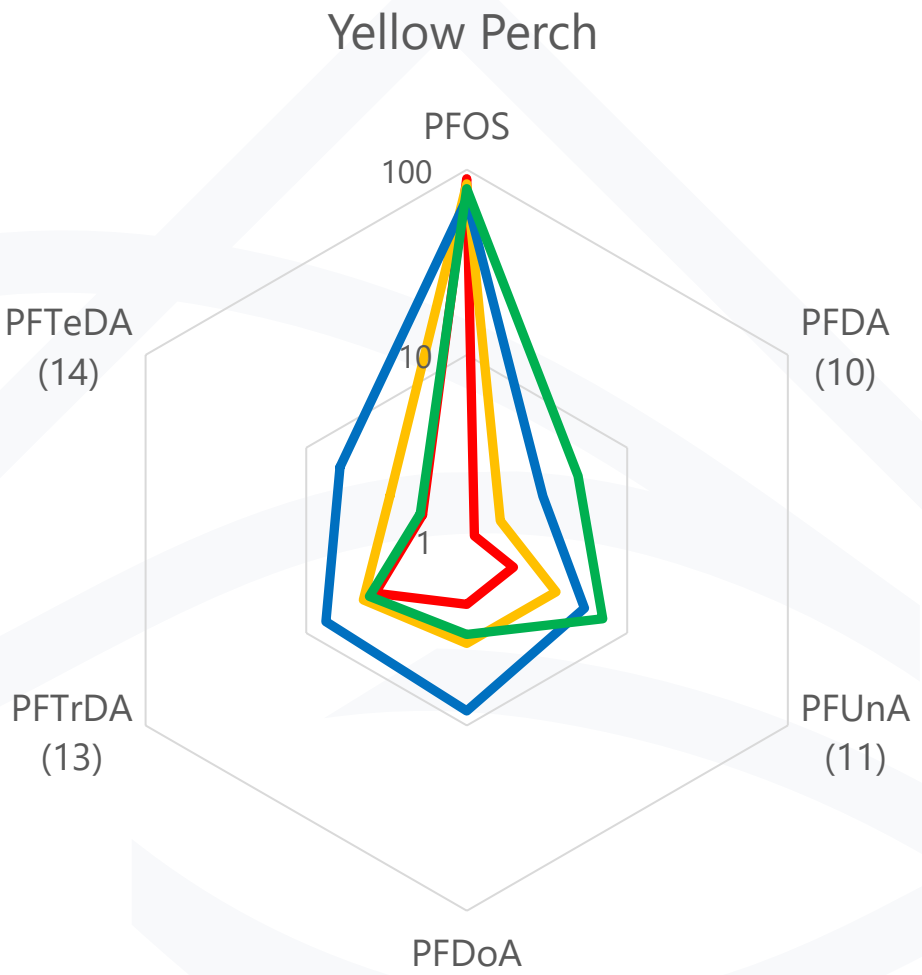

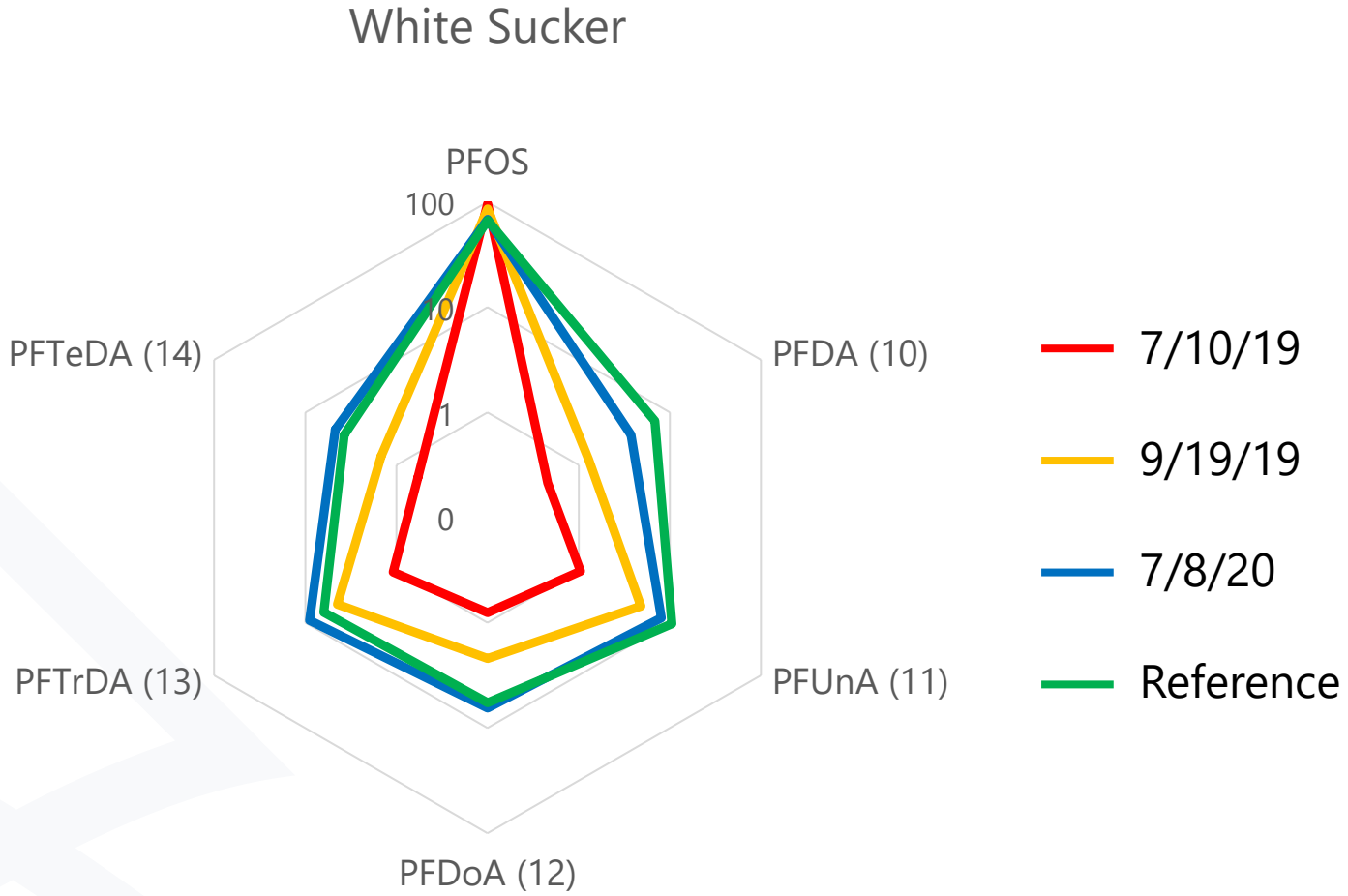

Summary

→ Pulsed release of AFFF shows immediate impacts

→ Rapid decrease in [PFAS] for surface water within months

→ [PFOS] decreased in fish muscle to baseline within one year

Implications

→ Rapid response critical

→ Clear pattern of PFAS impacts from other sources

→ Importance of establishing baseline

→ Value of conducting multimedia study, expanded analyte list

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Thank you!!