



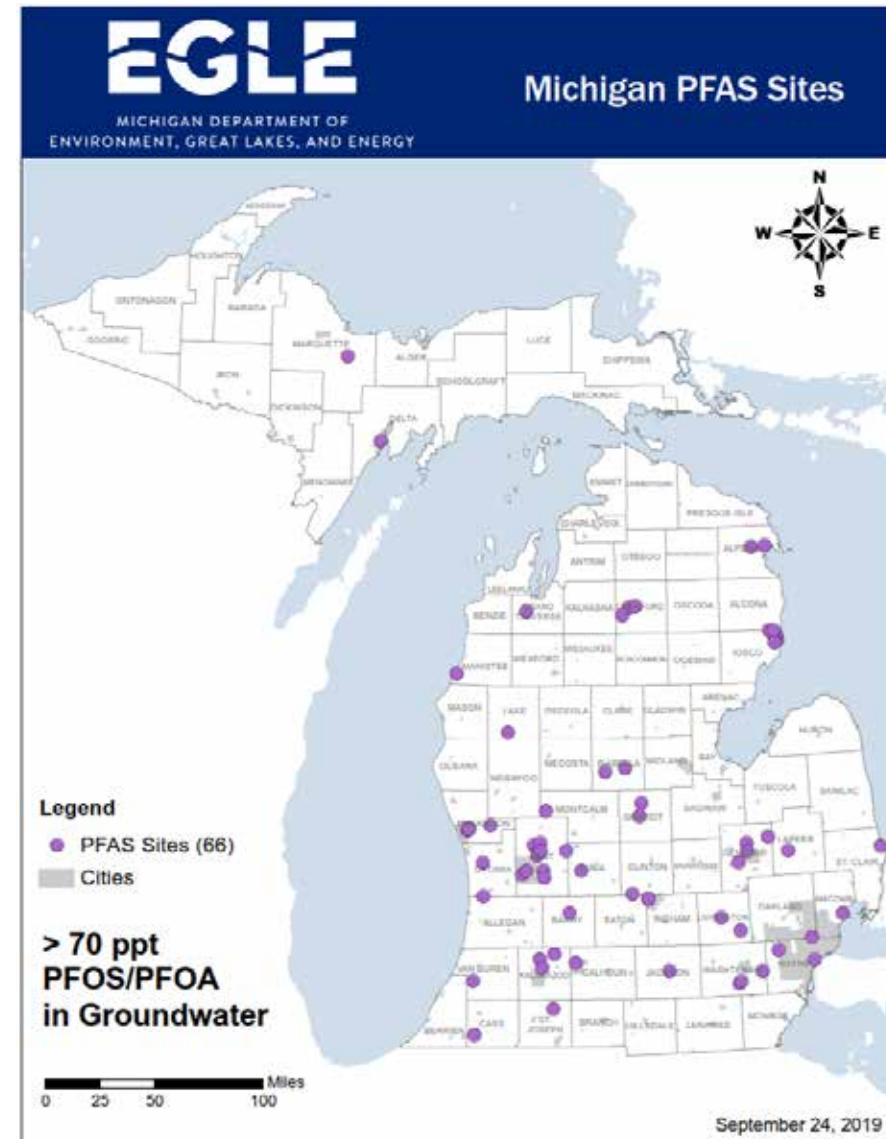
Are Wastewater Treatment Plants and Biosolids a Significant Source of PFAS?

Dorin Bogdan, Ph.D. and John Cuthbertson

October 17, 2019

Michigan PFAS Sites

- \ Department of Defense (DoD)
- \ Former Refineries
- \ Fuel Supplies
- \ Shoe Manufacturing
- \ Landfills
- \ Plastic Manufactures
- \ Chrome Platers
- \ Paper & Cardboard Manufacturing



Michigan Industrial Pretreatment Program (IPP)



RICK SNYDER
GOVERNOR

STATE OF MICHIGAN
DEPARTMENT OF ENVIRONMENTAL QUALITY
LANSING DISTRICT OFFICE



C. HEIDI GREYHER
DIRECTOR

February 20, 2018

Dear IPP Representative:

SUBJECT: PFAS Source Evaluation and Reduction Requirements

You may have heard news recently about perfluoroalkyl and polyfluoroalkyl substances (PFAS, also referred to as PFCs), especially the specific chemicals PFOS (perfluorooctane sulfonate) and PFOA (perfluorooctanoic acid). The Department of Environmental Quality (DEQ), Water Resources Division (WRD), is requiring Wastewater Treatment Plants (WWTP) with Industrial Pretreatment Programs (IPPs) to evaluate potential sources of PFAS, investigate probable sources, reduce/eliminate the sources found, and take other actions to protect surface water quality as needed.

As of 8-29-2019 – 93 WWTPs

Bin 1: 42
No sources
PFOS/PFOA found

Bin 2: 25
Sources found but
POTW Effluent \leq WQS¹

Bin 3: 26
Sources found and
POTW Effluent $>$ WQS¹

¹Ambient Water Quality Standard (WQS) (ng/L)

	PFOA	PFOS
Non-Drinking Water Source	12,000	12
Drinking Water Source	420	11

IPP PFAS Initiative

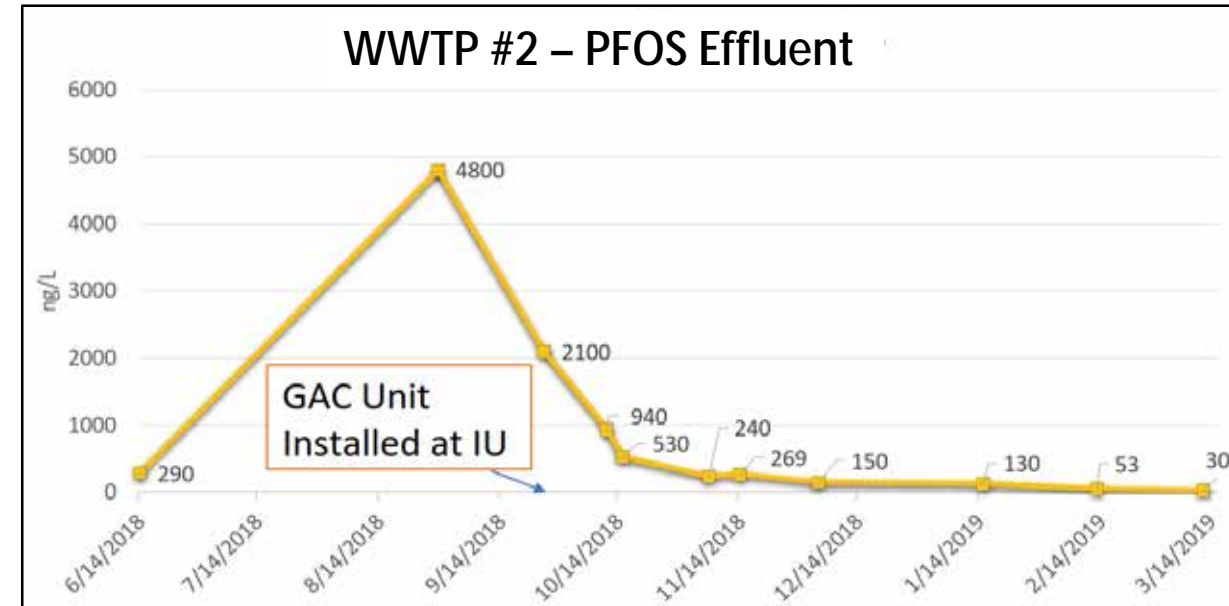
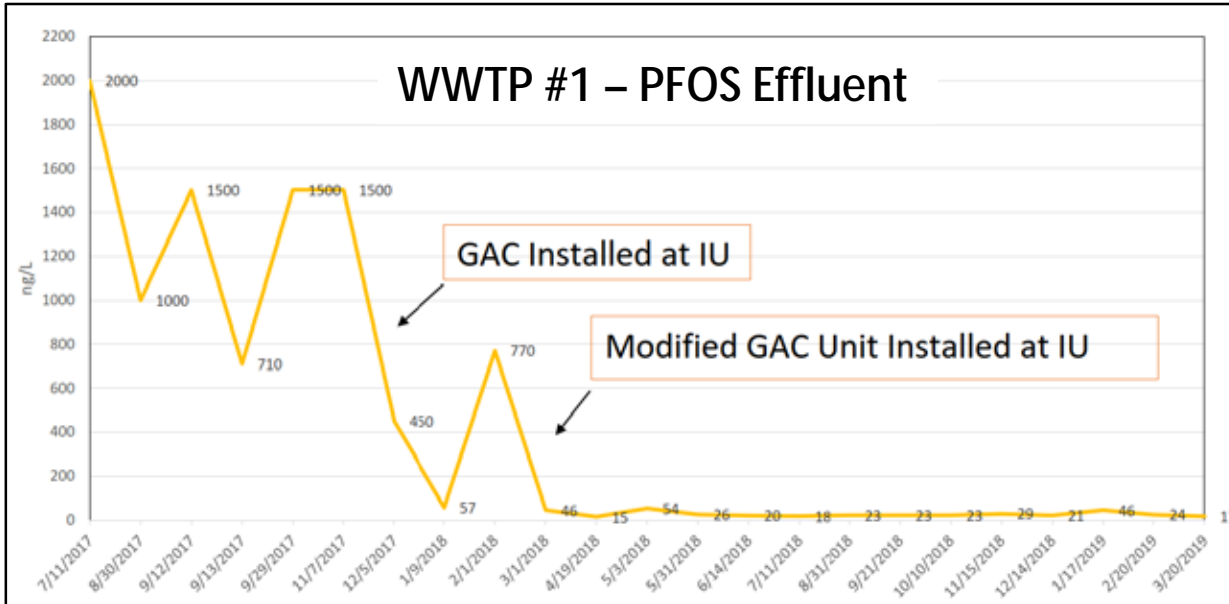
- \ Potential Source Screening
- \ Monitor Probable Sources
- \ If sources found:
 - Reduce/Eliminate PFOS & PFOA Sources
 - Monitor WWTP effluent; report if >WQS
 - Biosolids monitoring and potential restrictions
- \ Continue Source Reduction & Monitoring

Sources of PFOS to WWTPs

- \ **Metal Finishers:** 16 – 240,000 ppt
- \ **Sites with AFFF**(AF Bases, Refineries, fire stations): 240 – 45,000 ppt
- \ **Landfill Leachate:** ND – 4,000 ppt
- \ **Centralize Waste Treaters (CWTs):** 13 – 650 ppt
- \ **Industrial Laundry facilities:** 29 – 50 ppt

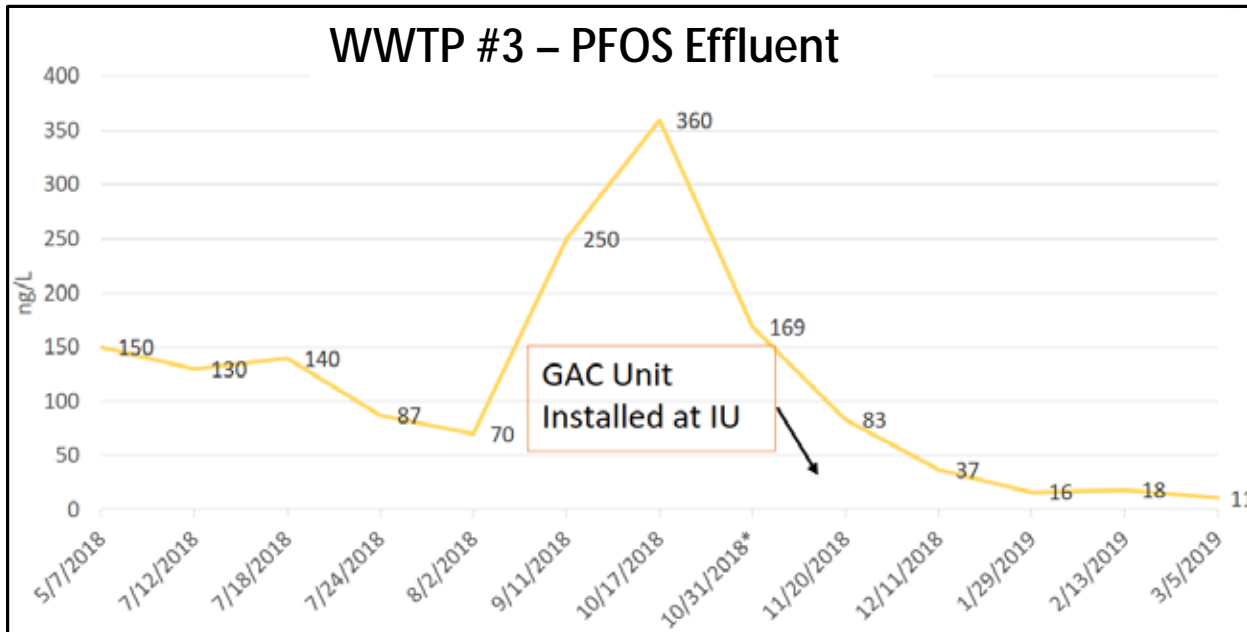


Source Reduction Effectiveness to WWTP Effluent

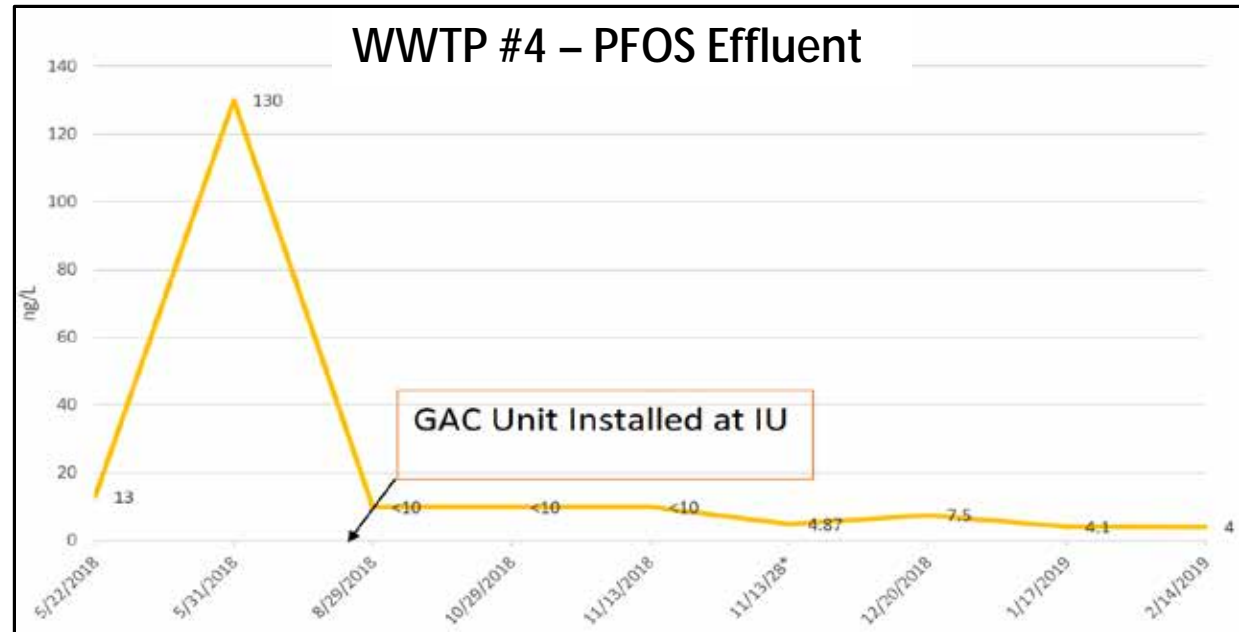


Source Reduction Effectiveness to WWTP Effluent cont.

WWTP #3 – PFOS Effluent



WWTP #4 – PFOS Effluent



Statewide WWTP and Agricultural Fields Evaluation



\ WWTPs

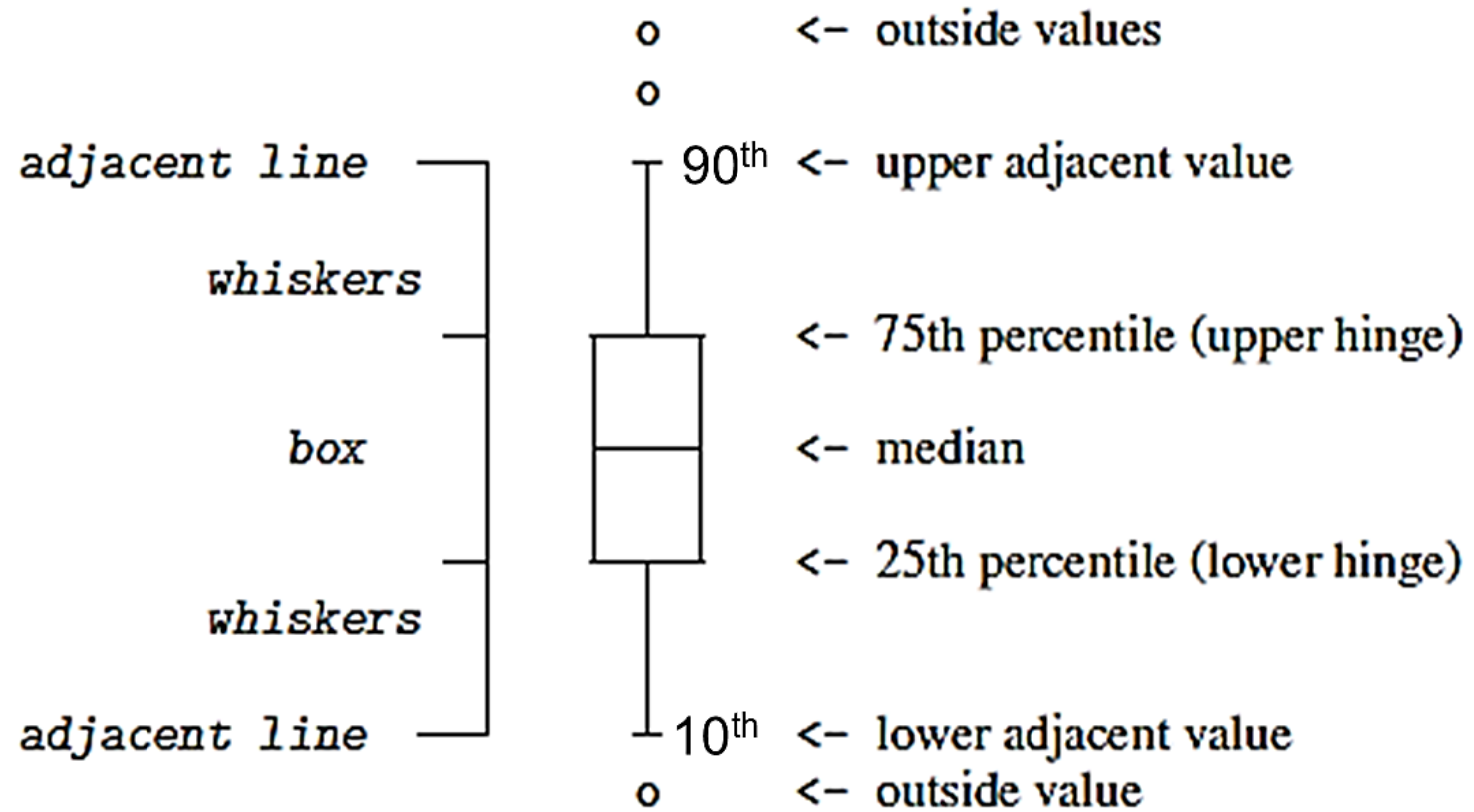
- 20 Largest (10-930 MGD)
- 22 Various Treatment Processes (0.2-9 MGD)
- Influent, effluent, and biosolids



\ Agricultural Fields

- Associated with 7 WWTPs
- Soil, surface water, and groundwater sampling
- Biosolids PFOS Concentrations
- Dates of Land Application
- Application Rate (dT/Acre)

Data Legend



PFBA
PFPeA
PFHxA
PFHpA
PFOA
PFNA
PFDA
PFUnDA
PFDoDA
PFTTrDA
PFTeDA

PFBS
PFPeS
PFHxS
PFHpS
PFOS
PFNS
PFDS

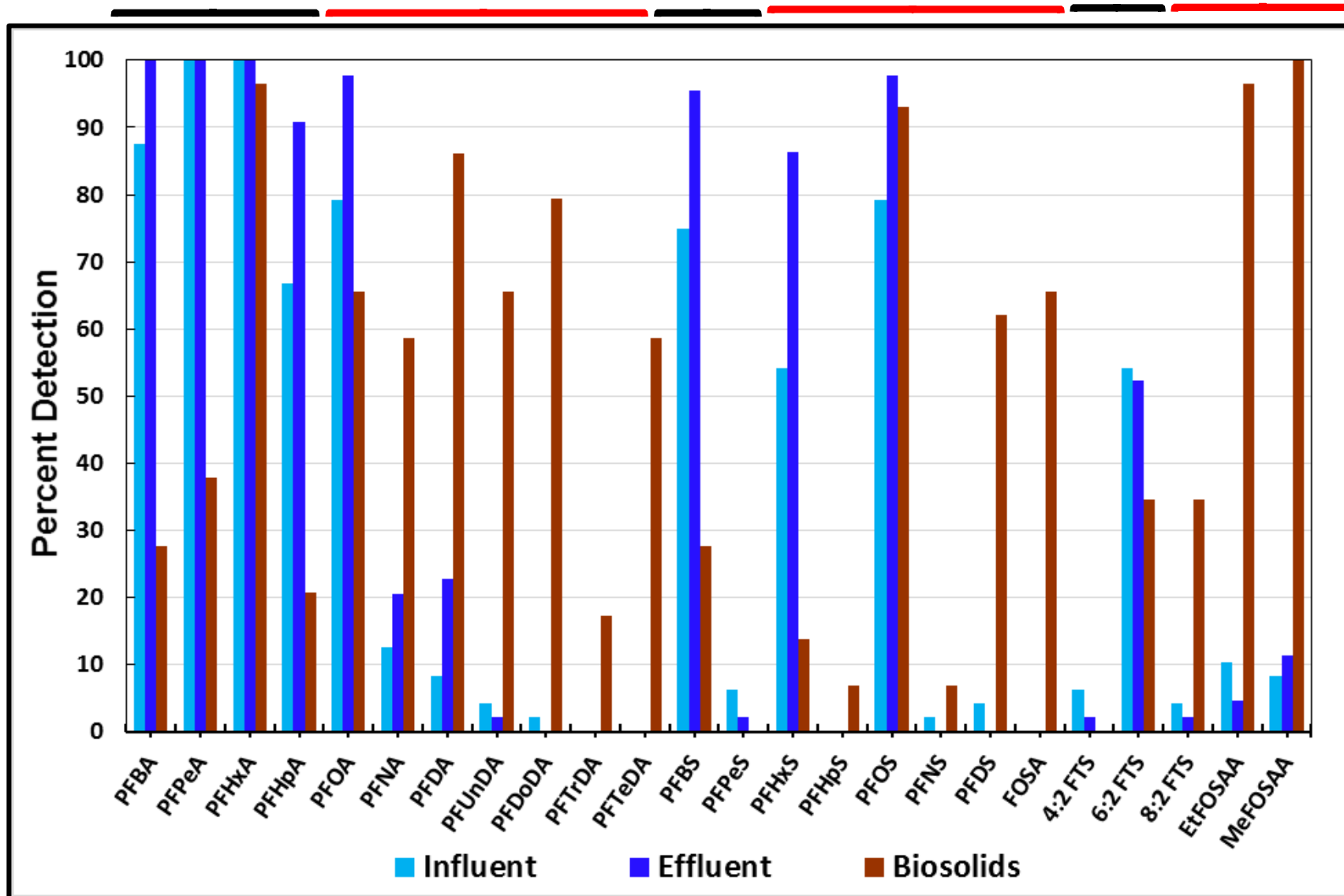
FOSA

4:2 FTS
6:2 FTS
8:2 FTS

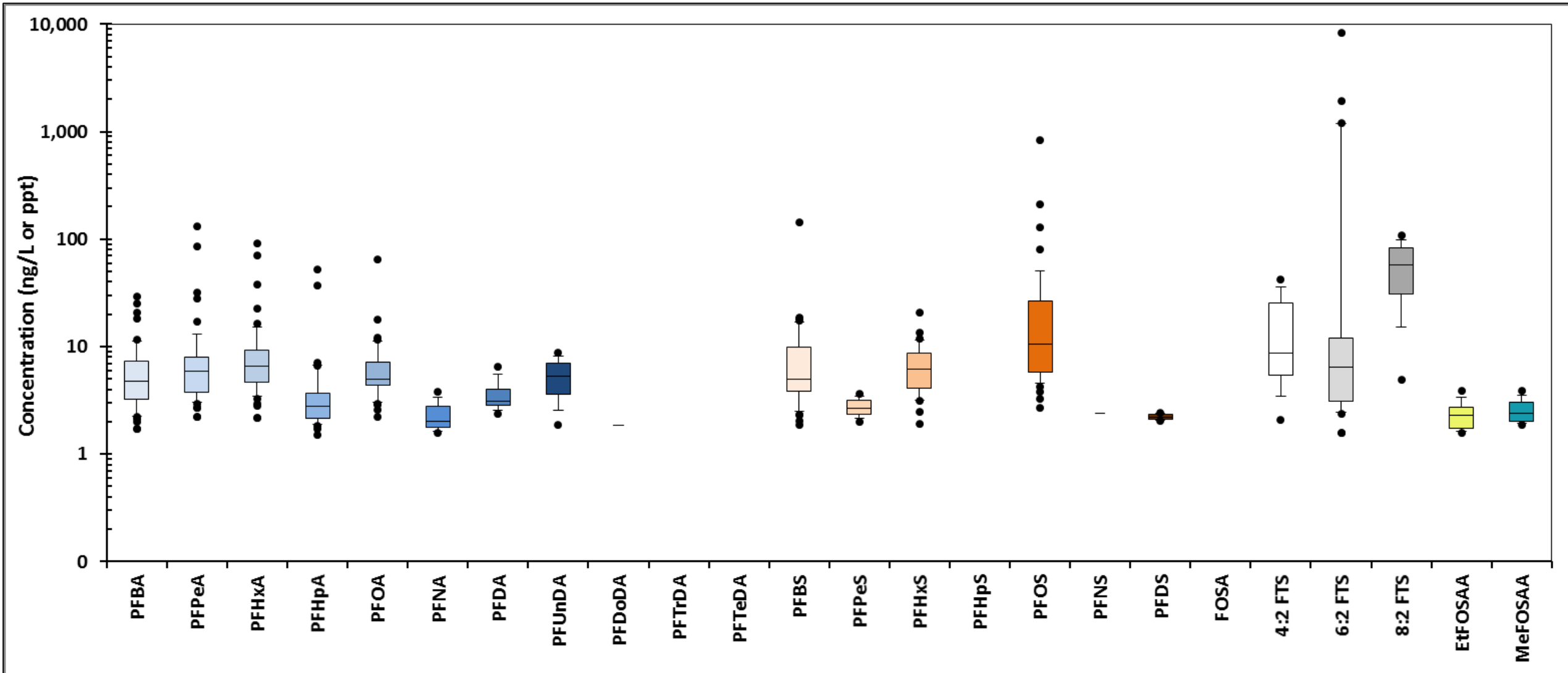
EtFOSAA

MeFOSAA

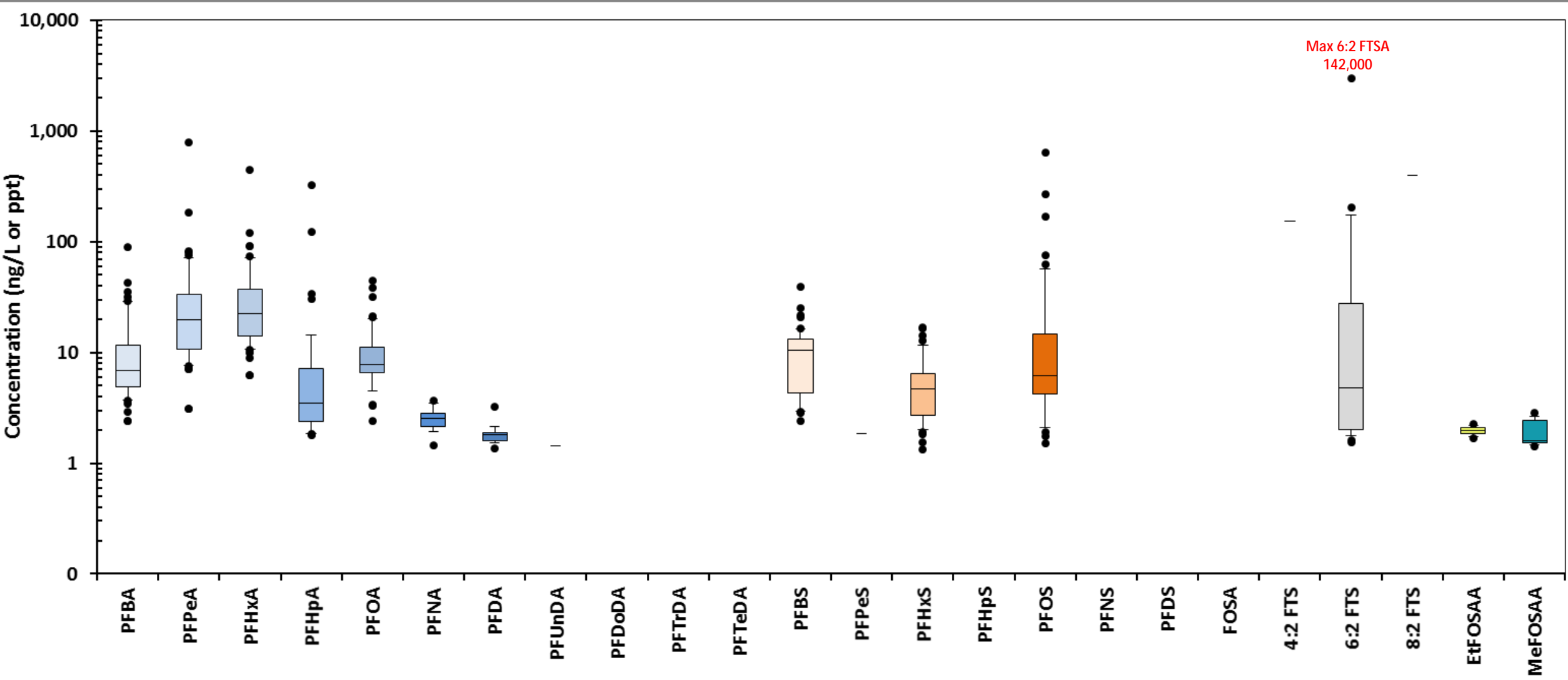
PFAS Detection Frequency – WWTP Study



WWTP Influent PFAS Concentrations

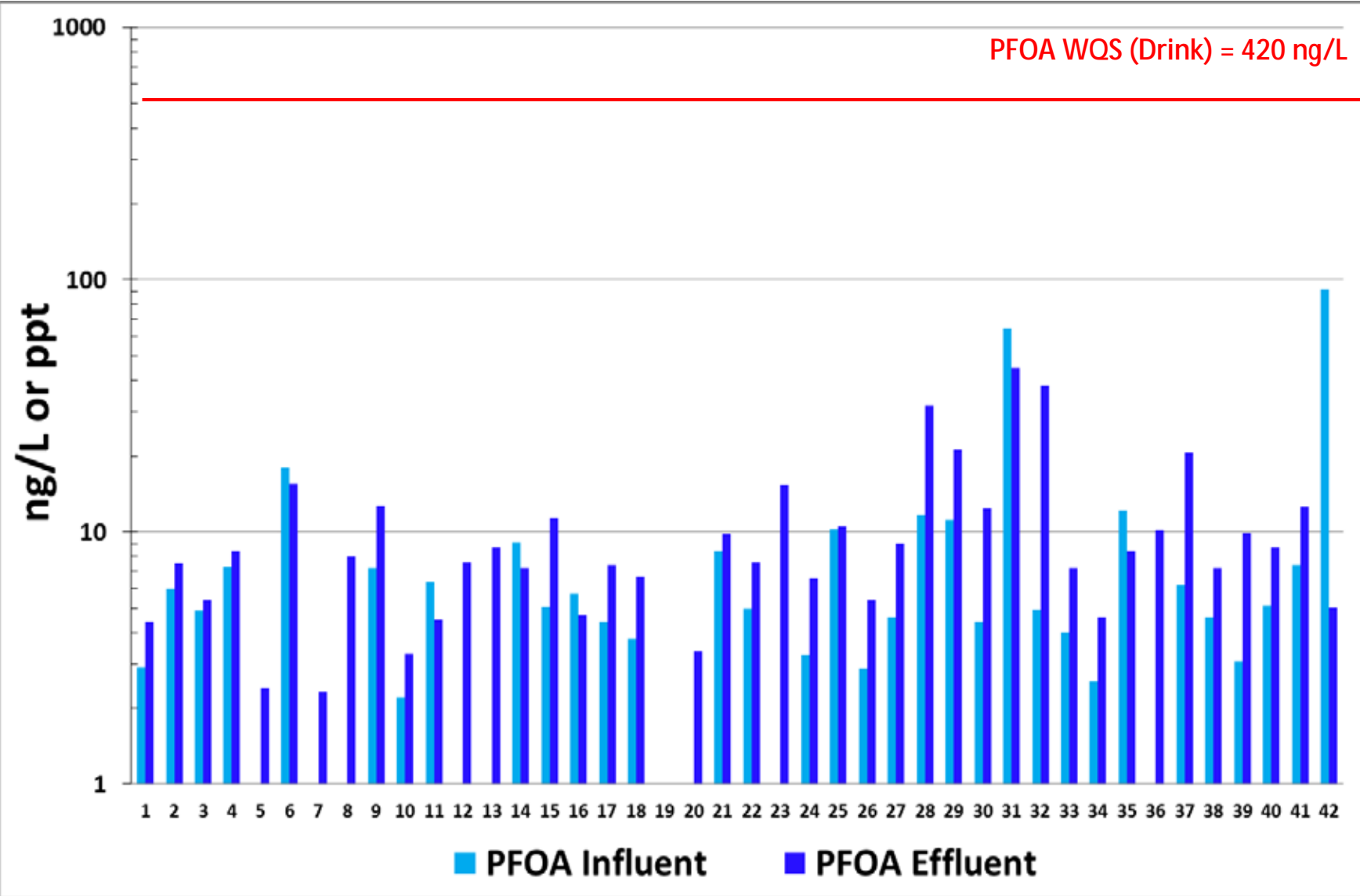


WWTP Effluent PFAS Concentrations

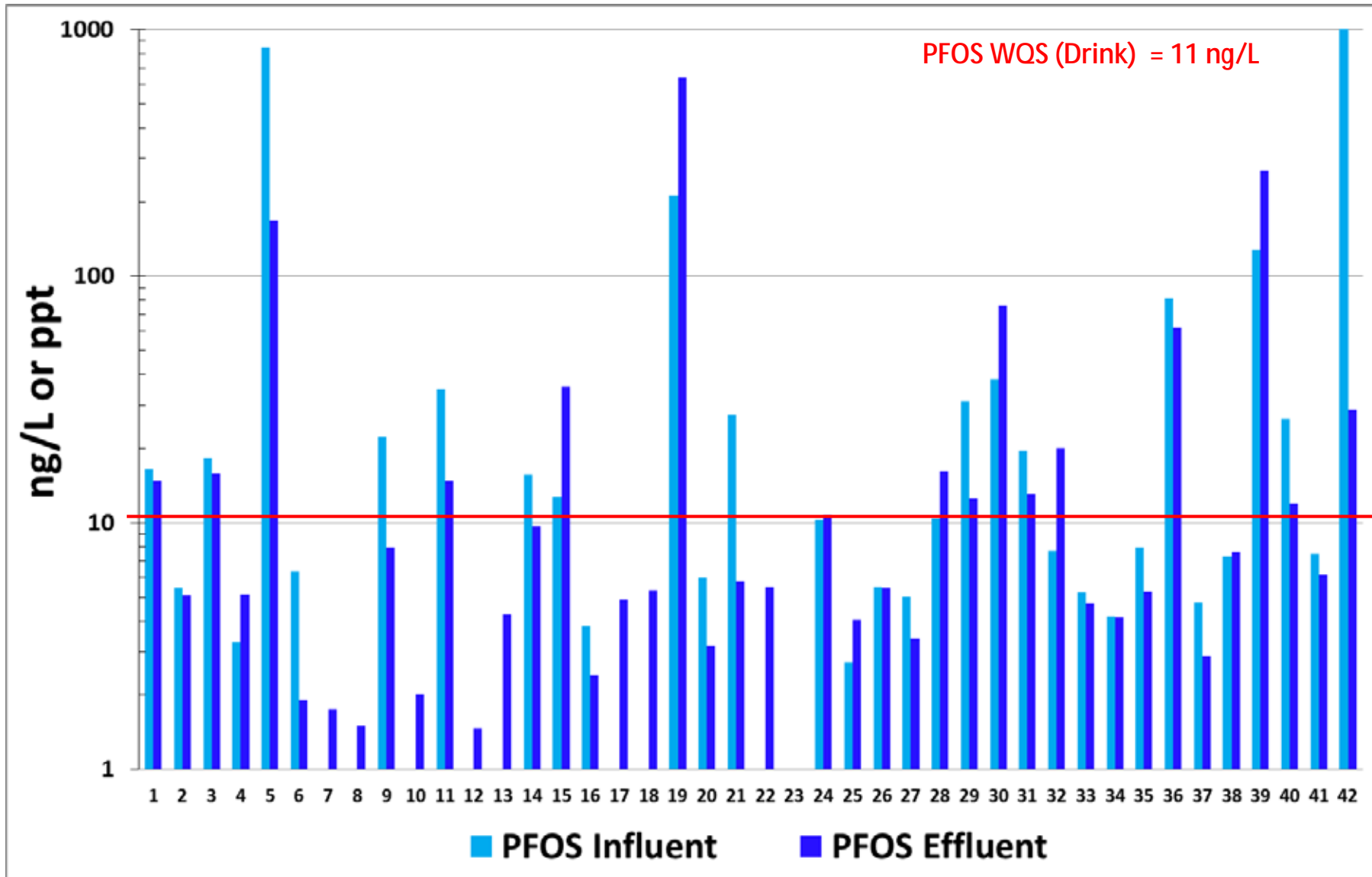


Max 6:2 FTSA
142,000

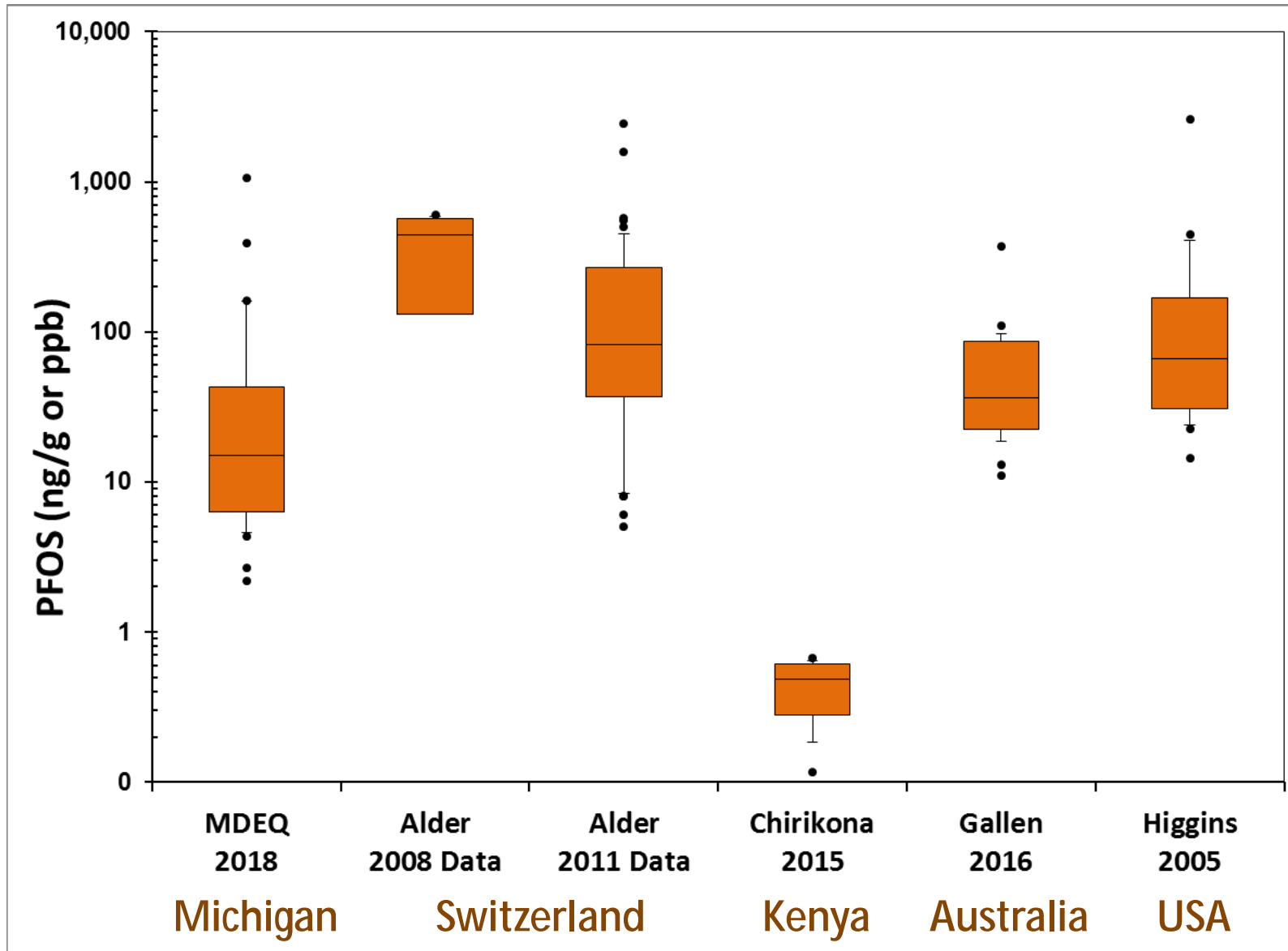
Influent vs. Effluent PFOA Concentrations



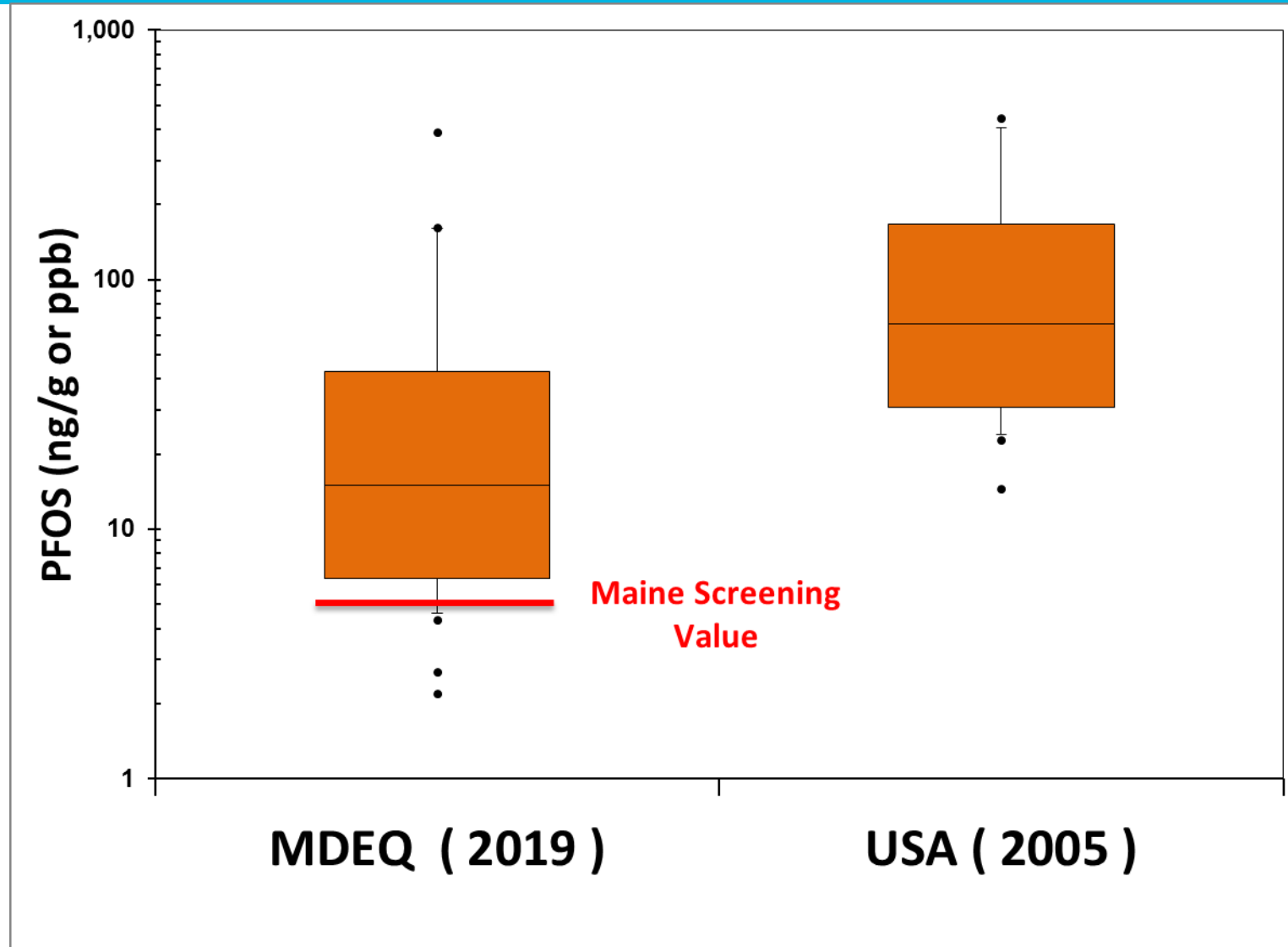
Influent vs. Effluent PFOS Concentrations



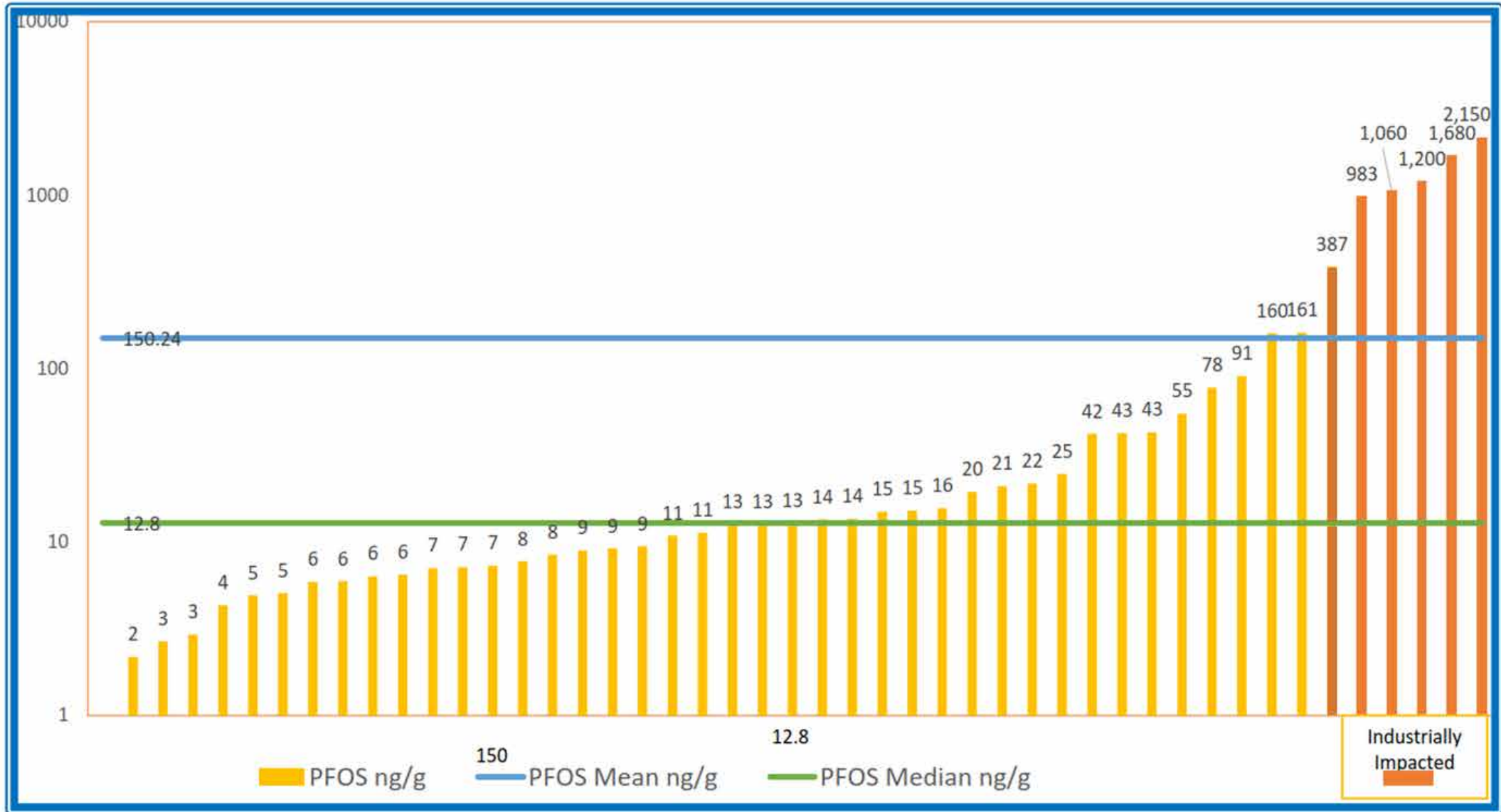
Michigan vs. Published Biosolids Studies



PFOS Concentrations in Biosolids - USA



Biosolids/Sludge PFOS Concentrations



Agricultural Fields Evaluation

WWTP Concentrations		Total dT Applied	Average dT /Acre	Weighted Use Ratio (Total dT/Site Acres)	Soil	Groundwater	Surface Water
Effluent	Biosolids						
2-5	3-90	176 - 400	2-10	6 - 23	ND – 9	N/A	ND – 5
169 - 2,000	1,060 - 2,100	39 – 1,422	1 - 4	4 - 28	1 – 145	ND - 18	ND – 2,080

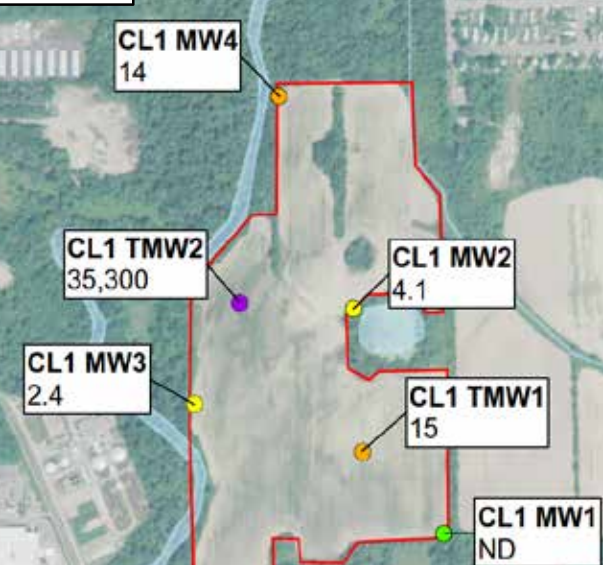
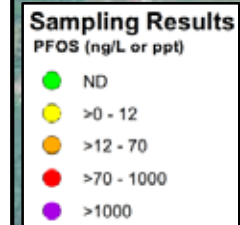
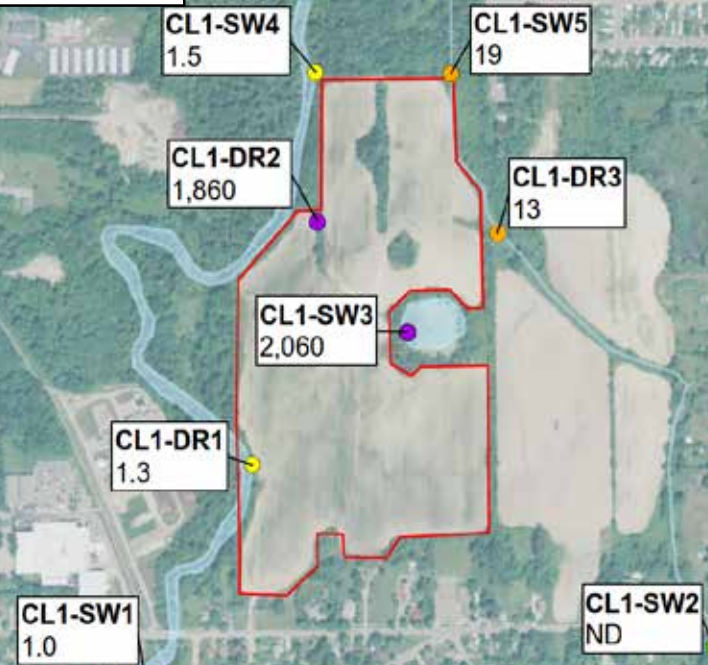
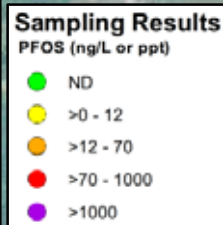
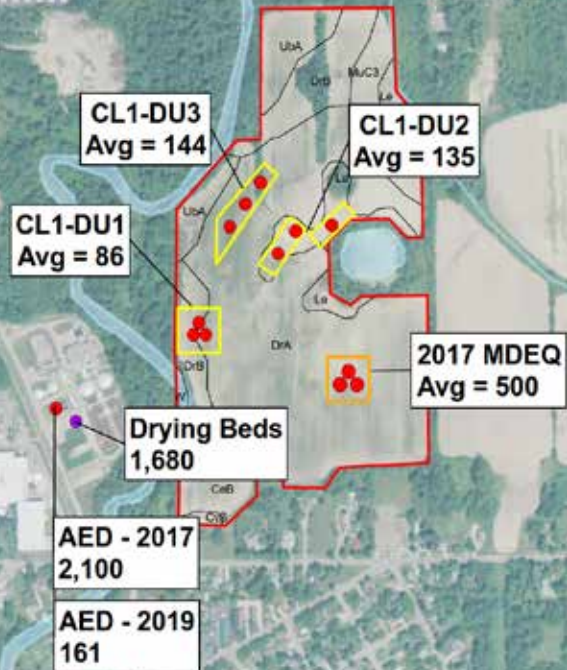
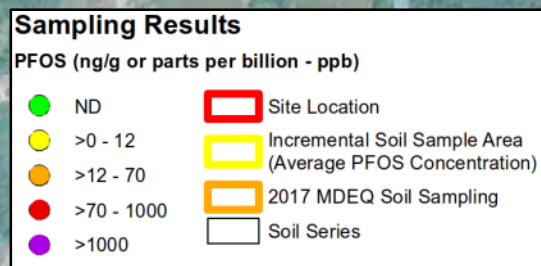
PFOS: Aqueous = ng/L or ppt
 Solid = µg/Kg or ppb

Biosolids - Application Site Evaluation

Soil / Biosolids

Surface Water / Tile Drain

Groundwater

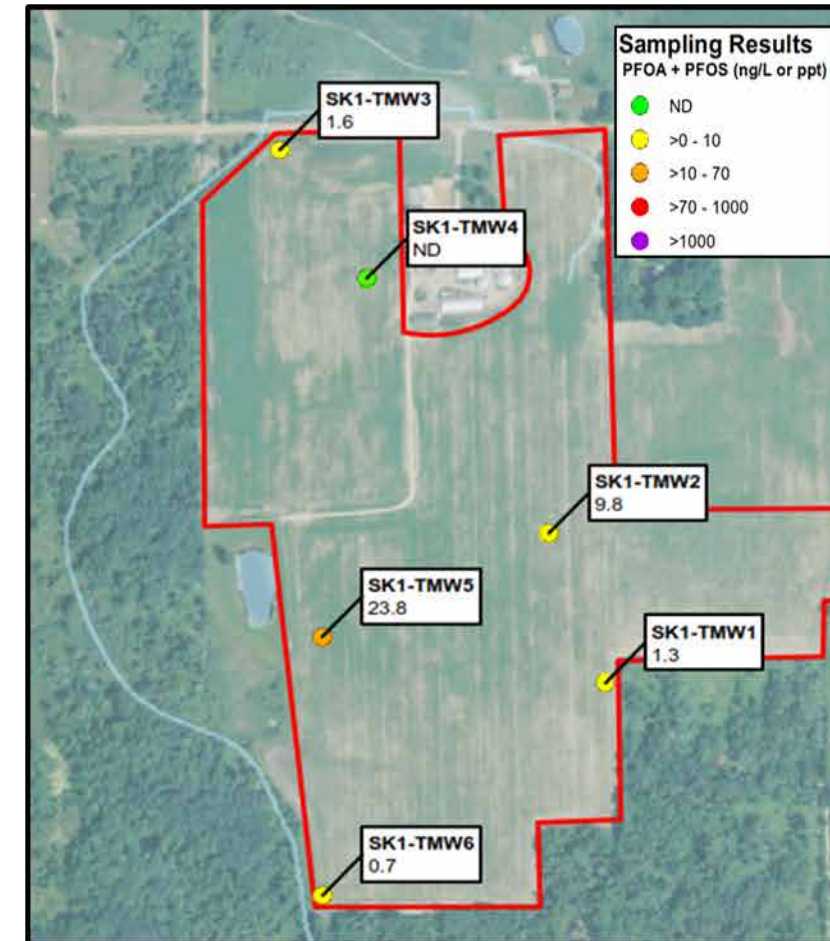
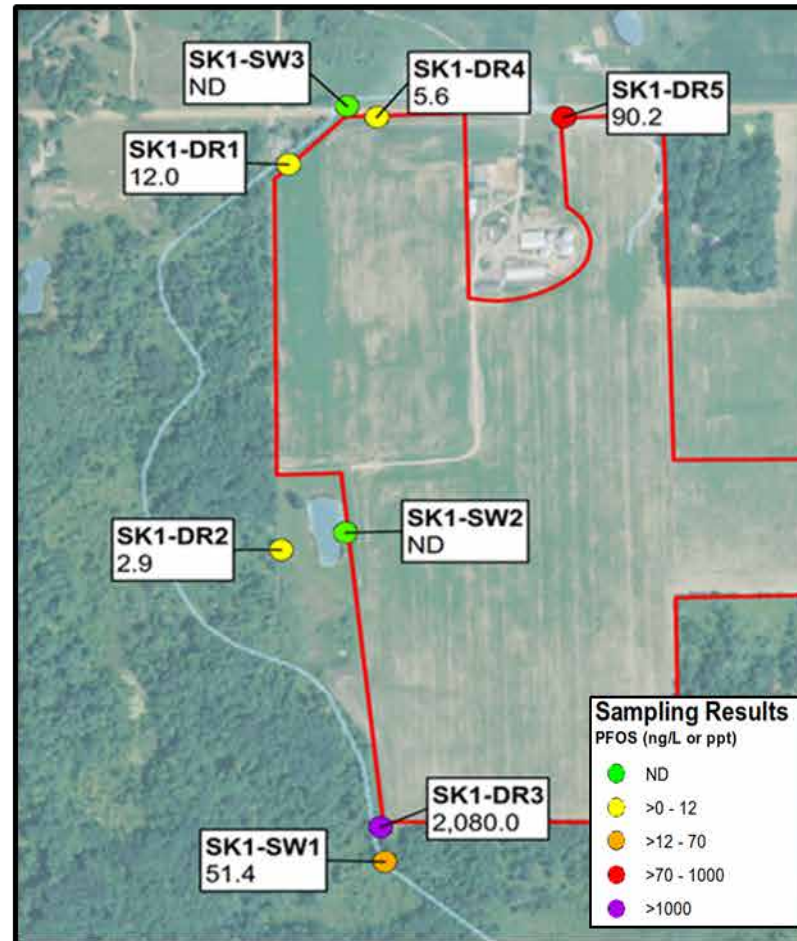
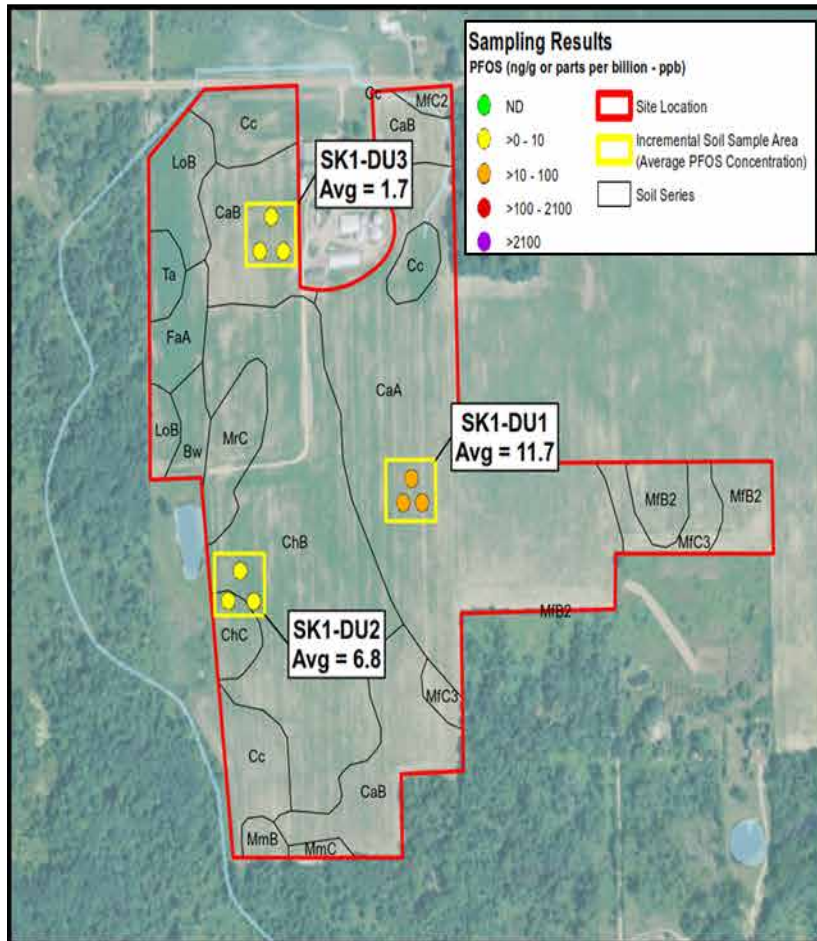


Biosolids - Application Site Evaluation cont.

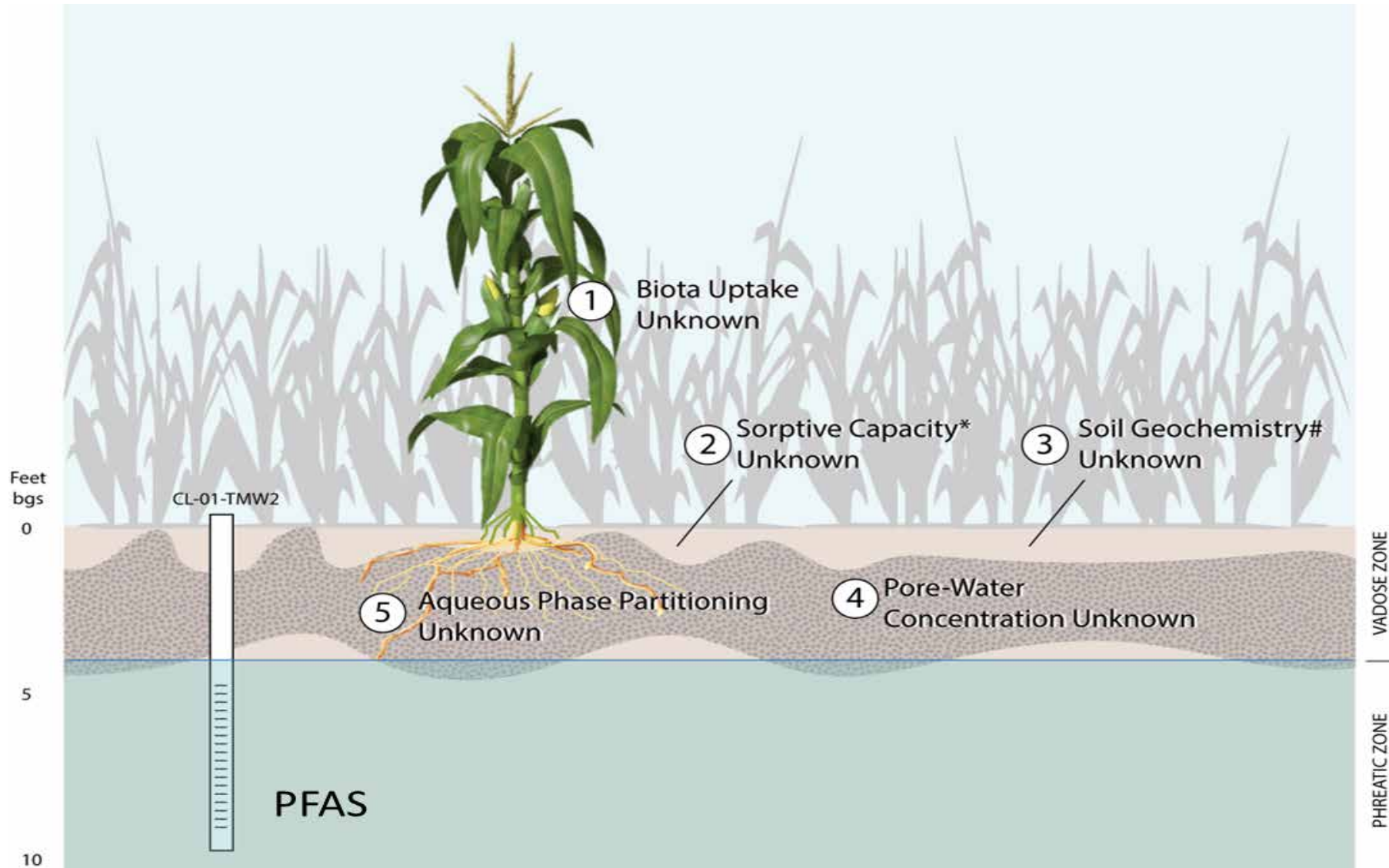
Soil

Surface Water / Tile Drain

Groundwater



Potential PFAS Plant Uptake



Conclusions

- \ PFAS were detected in all WWTPs.
- \ Long-chain PFAS has high affinity to the sludge/biosolids.
- \ MI Biosolids have lower PFOS concentrations than other previously published studies.
- \ Industrial effluents can be a significant source of PFAS to the WWTPs.
- \ Evaluation of potential impact from land application of biosolids is on-going.





Image credit: iStock

Thank You!

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