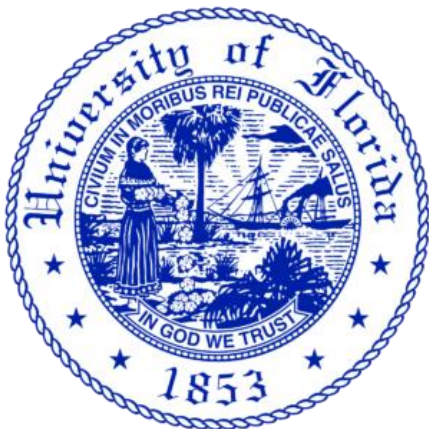


# PFAS Level of the Liquid Source in Different Landfills and Leachate Treatment Processes

—Yutao Chen  
University of Miami

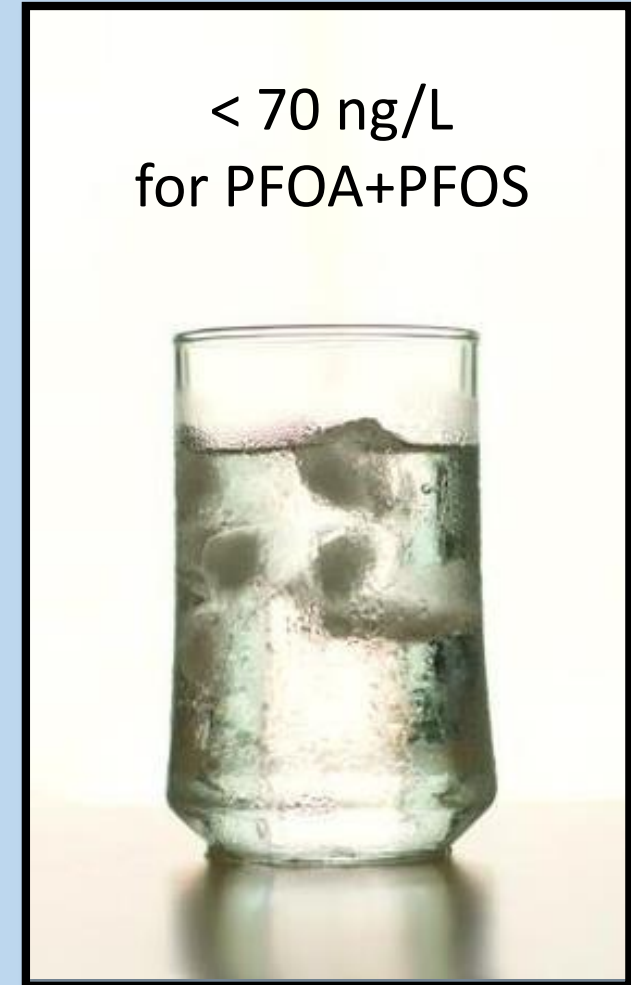


# Outline

- PFAS Background
- Sampling Method
- PFAS Results in Landfill Leachate
- PFAS Results in Leachate Treatments

# Some Facts

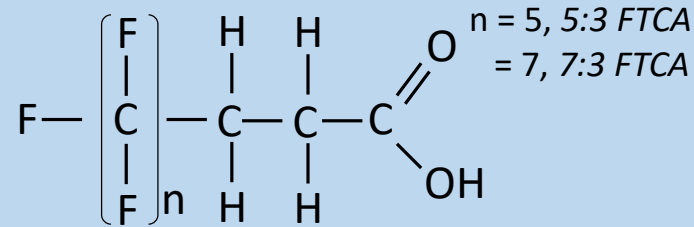
- Found in blood of 99.9% of U.S. Americans
- Cannot be degraded during the environmental processes
- Can be inhaled and ingested
- Associated with
  - Kidney, bladder cancer, and other cancers
  - Asthma, impaired lung function
  - Thyroid and immune response diseases
- EPA: Non-enforceable health advisory of 70 ng/L PFOA+PFOS in drinking water



# 26 Targeted PFAS Species

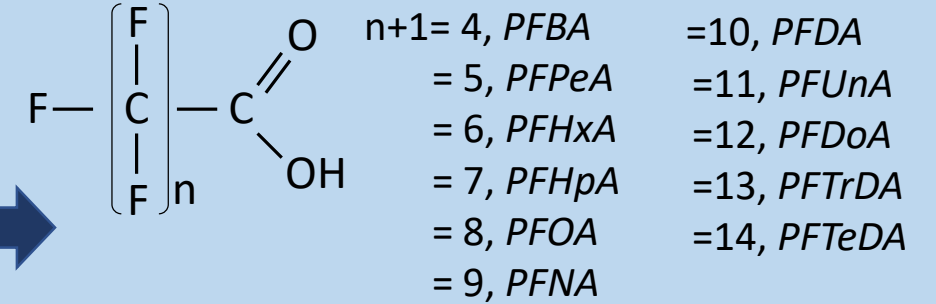
## Precursors

### Fluorotelomer carboxylic acids



**2 FTCA**

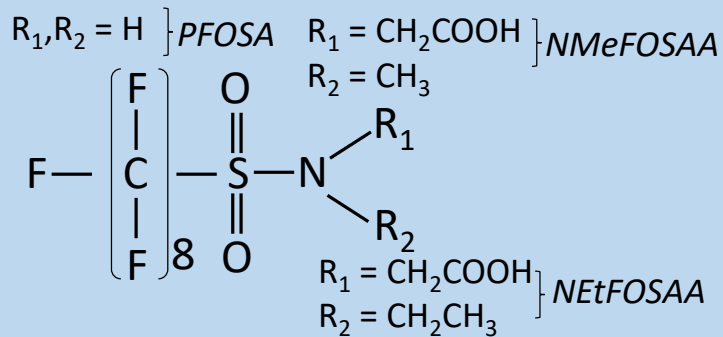
### Perfluoroalkyl carboxylic acids



**11 PFCA**

## Precursors

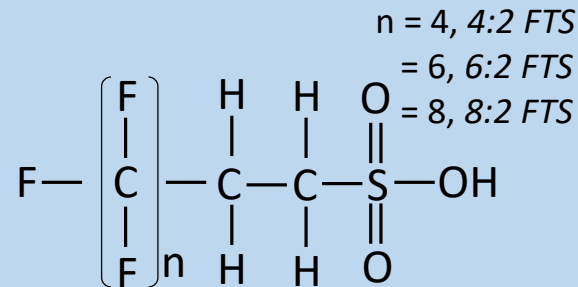
### Perfluorooctane sulfonamides



**3 FOSA**

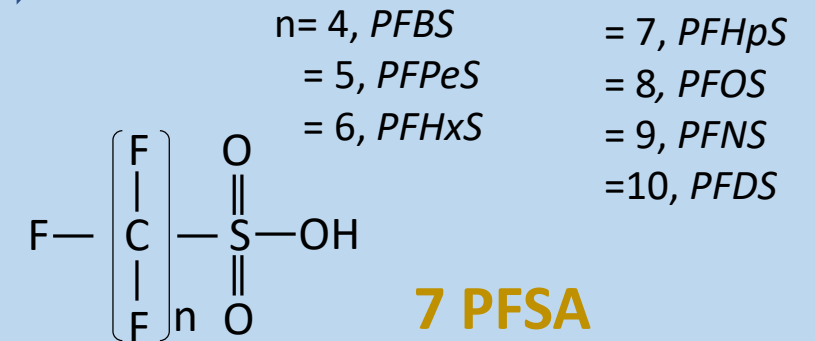
## Precursors

### Fluorotelomer sulfonic acids



**3 FTSA**

### Perfluoroalkyl sulfonic acids



**7 PFSA**

# PFAS Products

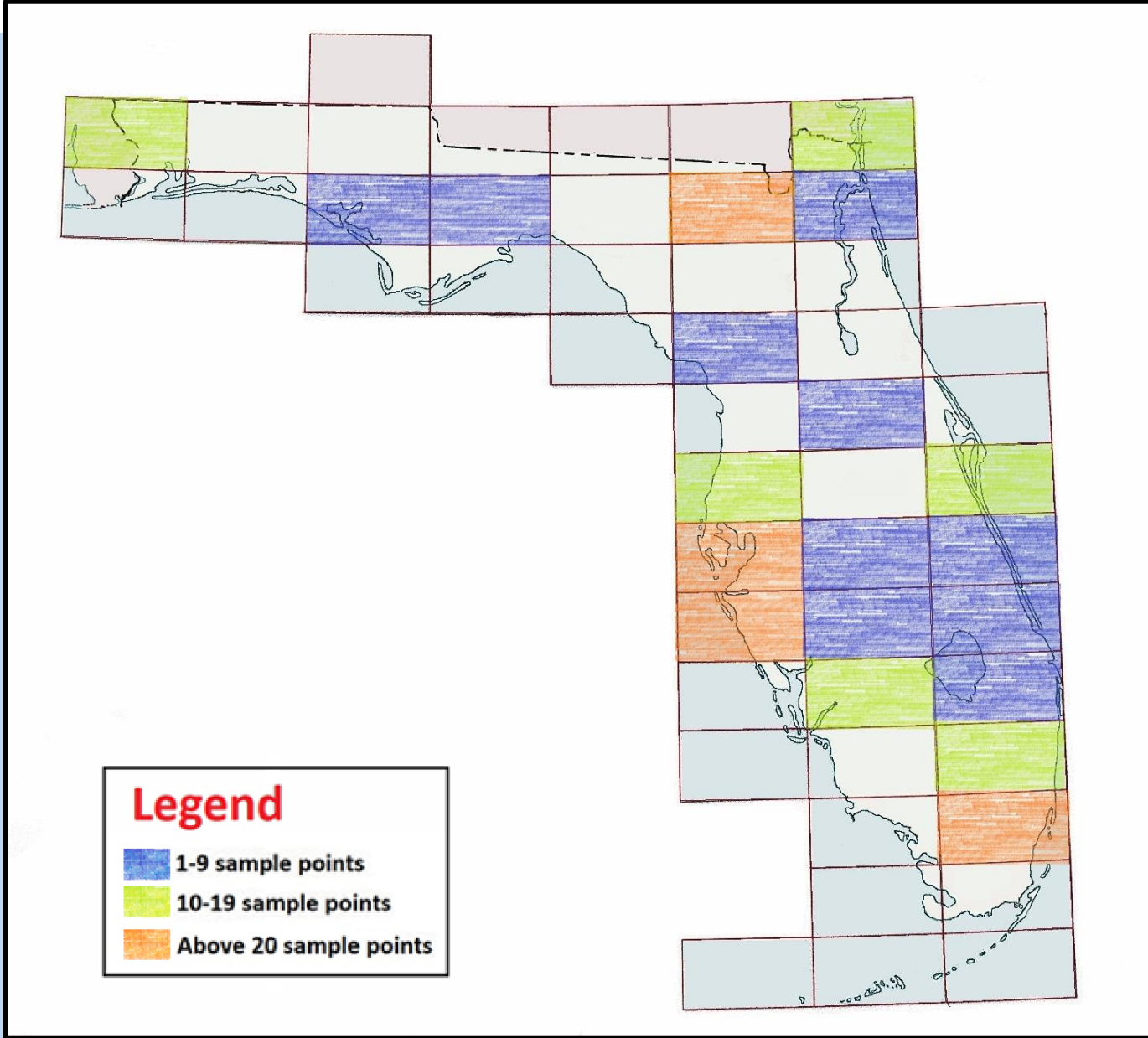
| PFAS Species | Products and Function   |
|--------------|---|
| PFCA         | In all PFAS products, especially for paper-based food contact materials |
| PFSA         | Textiles, leather, and carpet   |
| FTCA         | Intermediates degraded from FTOH, usually exist in landfills            |
| FTSA         | Intermediates degraded from firefighting foams                          |



# Sampling Method

# Sampling Points

|                    | Number of Landfills | Number of Leachate Treatments |
|--------------------|---------------------|-------------------------------|
| Sampling Locations | 33                  | 12                            |
| PFAS Results       | 27                  | 11                            |



# Sampling Type

| Name | Sample Type                       | General Sampling method |
|------|-----------------------------------|-------------------------|
| IN   | Influent of leachate treatment    | Spigot/ Bottle on Chain |
| OUT  | Effluent of leachate treatment    | Spigot/ Bottle on Chain |
| MS   | Leachate of Municipal Solid Waste | Spigot/ Bottle on Chain |
| C3   | Leachate of C&D Waste             | Spigot/ Bottle on Chain |
| AH   | Leachate of Ash Waste             | Spigot/ Bottle on Chain |
| GC   | Gas Condensate                    | Spigot/ Bottle on Chain |
| ST   | Storm Water                       | Swingarm Sampler        |
| GW   | Groundwater                       | Peristaltic Pump        |



# Sampling Methods



Bottle on Chain



Peristaltic Pump

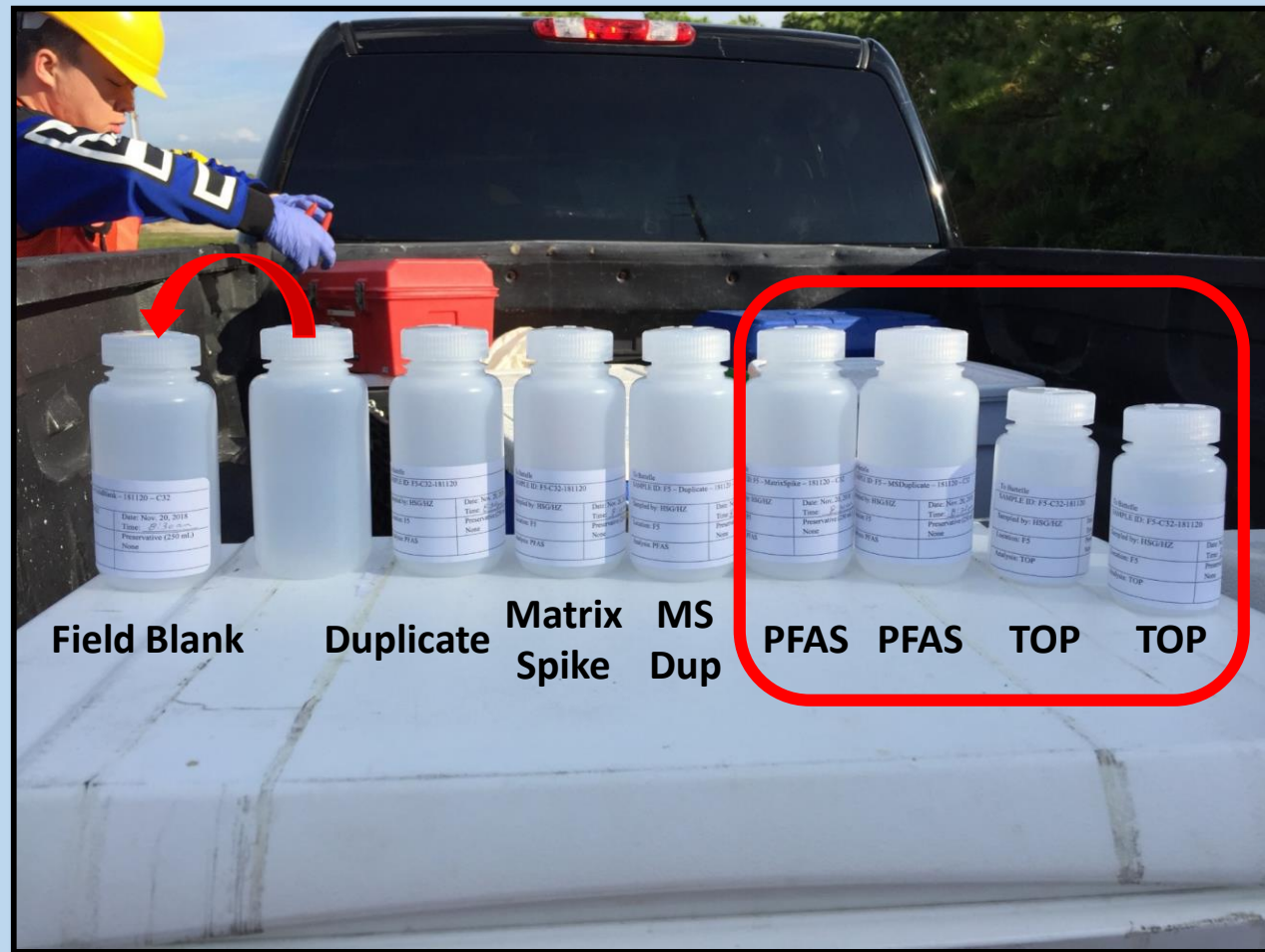


Spigot

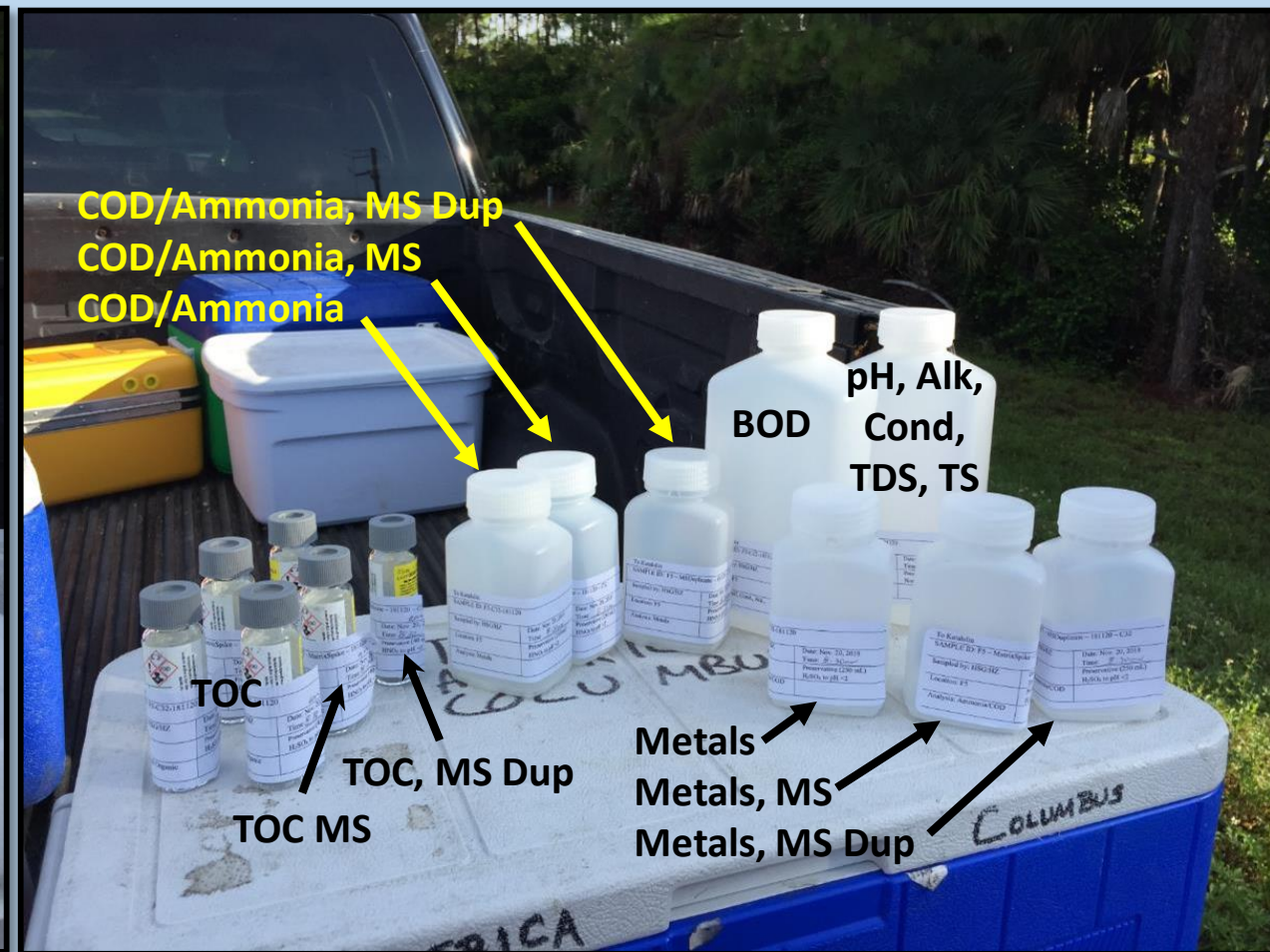


Swingarm Sampler

# Full Suite of PFAS Samples



Bottles for PFAS Analysis



Bottles for Physical Chemical Analysis

# Measurements

## PFAS

- 26 Targeted Species – LC-MS/MS (Liquid Chromatography/ Mass Spectrometry)

## Physical Chemical

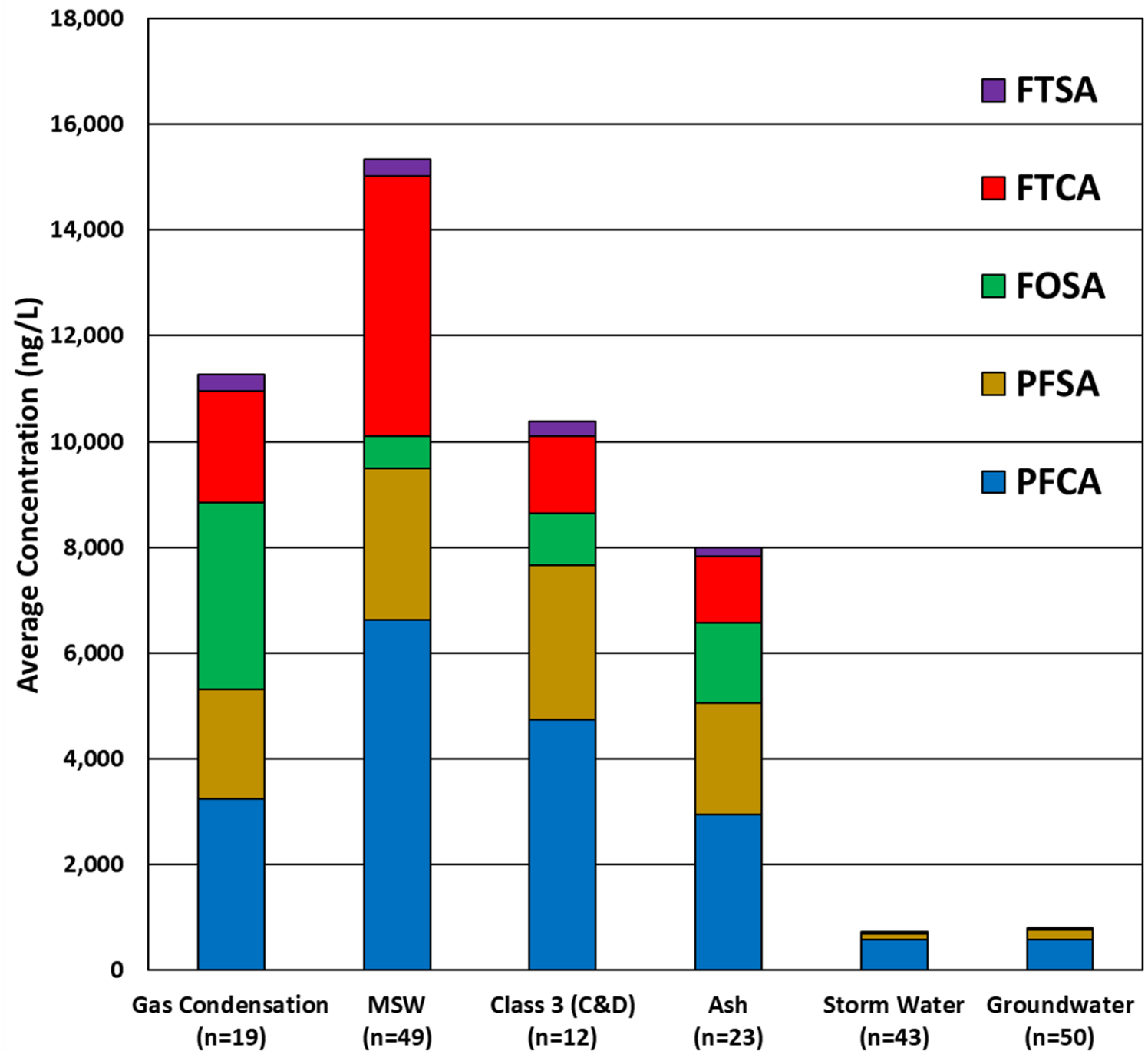
- Field (pH, Temperature, Conductivity)
- Lab
  - pH, Conductivity, Alkalinity
  - COD, BOD, TOC, TDS, TS, Ammonia
  - 23 Metals



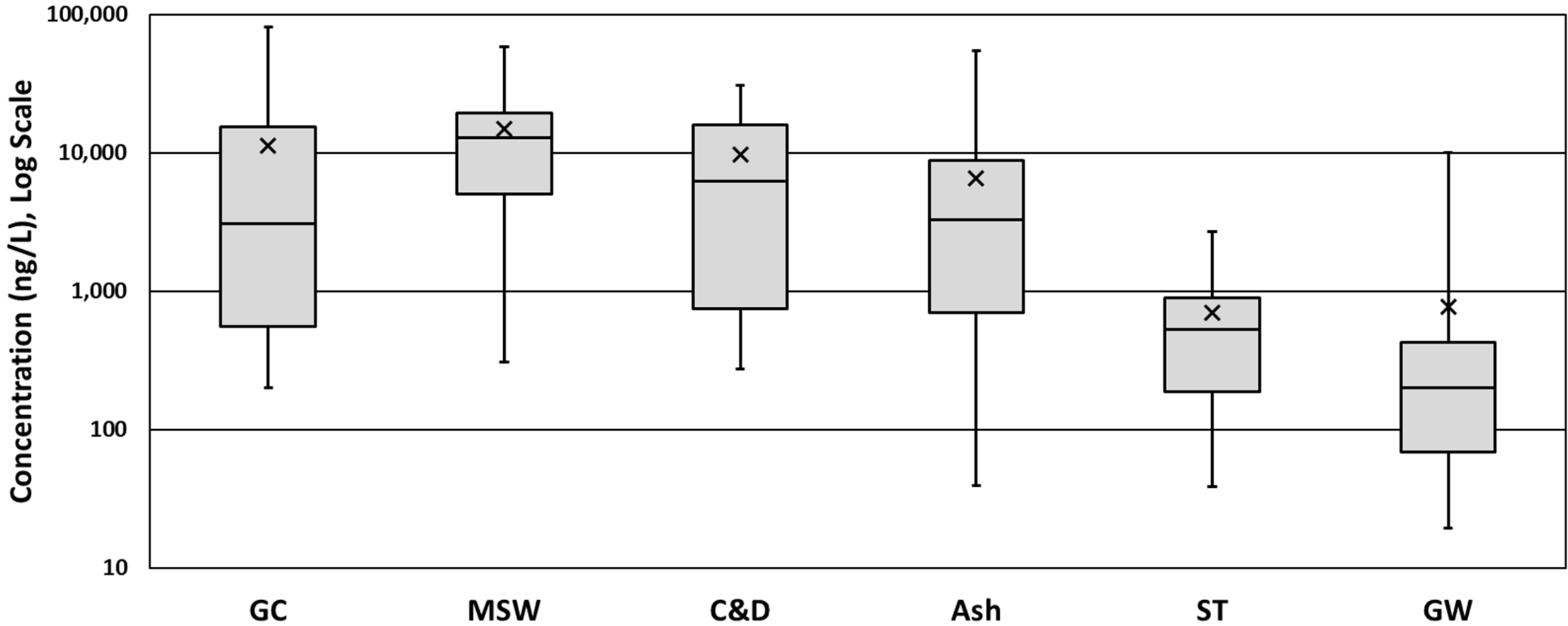
# **PFAS Results in Landfill Leachate**

# Detected PFAS Concentration

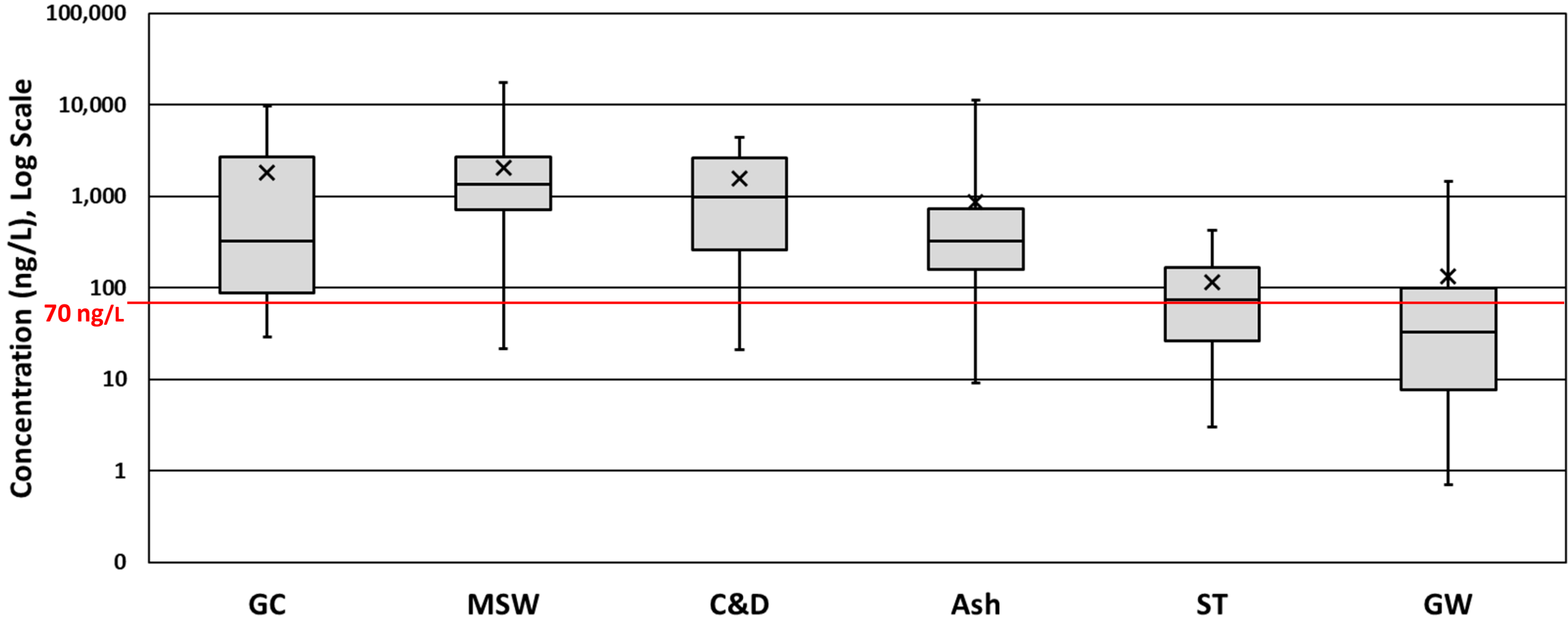
- Source: 27 Landfills & 11 On-Site Leachate Treatments
- Relation to Waste Type
- PFCA: Dominant in Landfill Leachate
- PFSA: Lower Concentration in Leachate
- FTCA: Higher Concentration in MSW
- FOSA: Higher Concentration in GC
- FTSA: Lowest Concentration



# Detected PFAS in Different Leachate Type

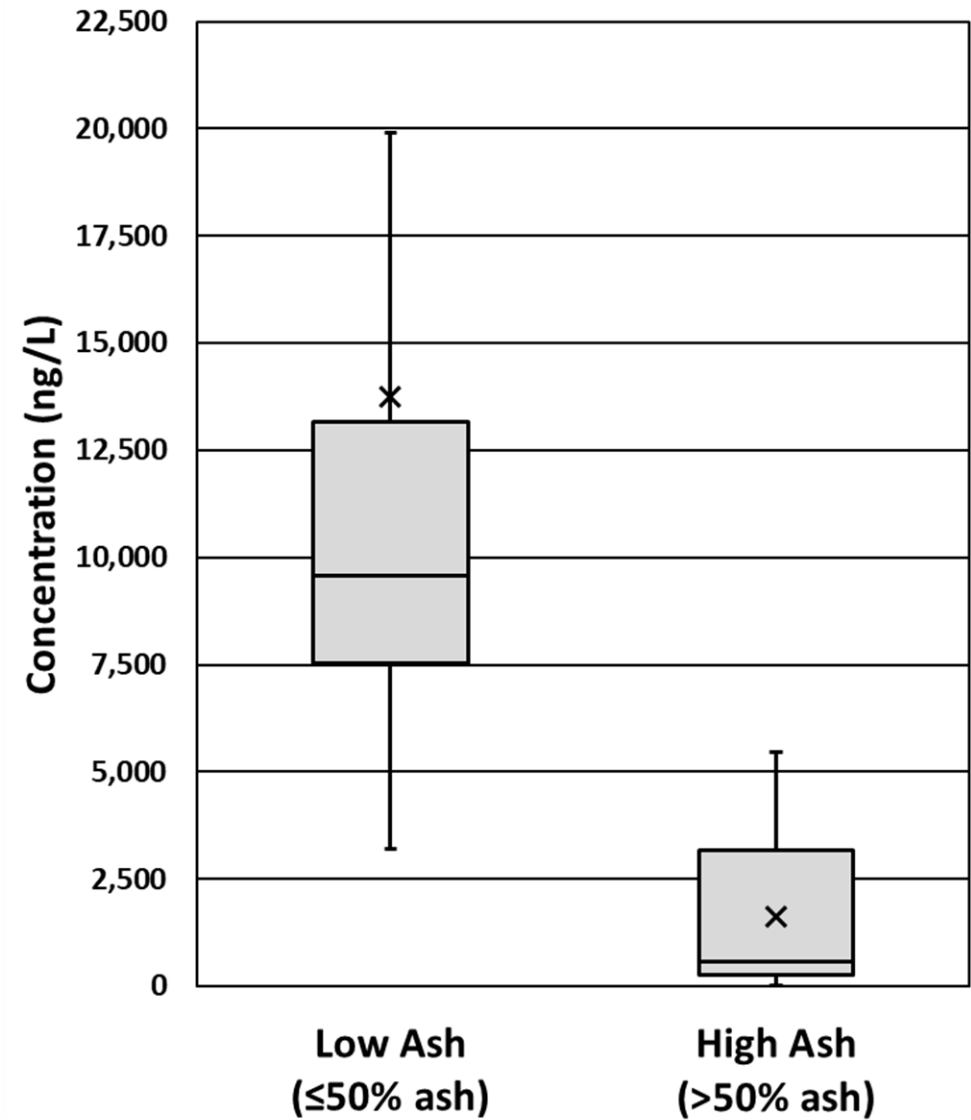
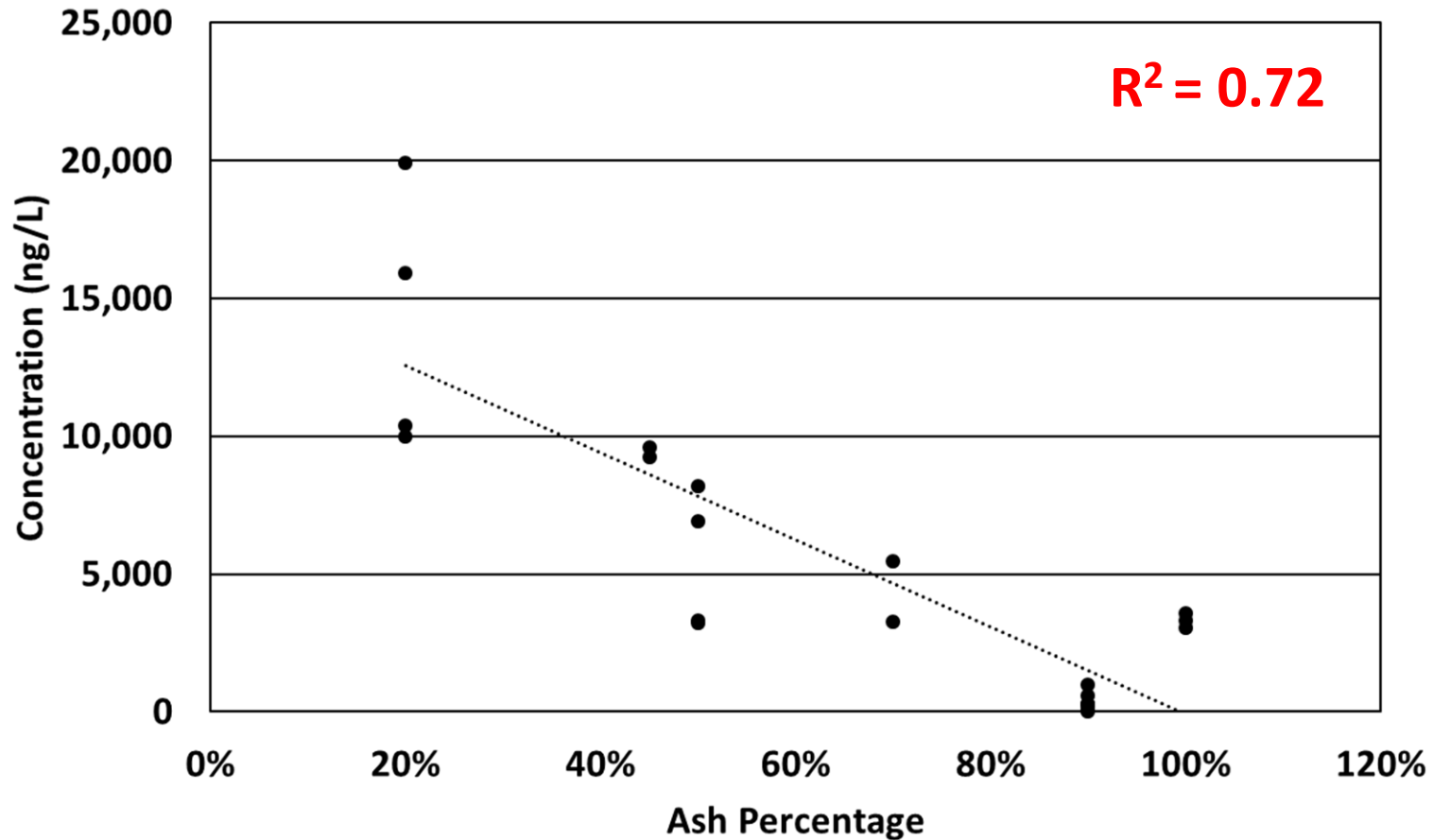


# PFOA+PFOS in Different Leachate Type



EPA issued a non-enforceable health advisory of **70 ppt (ng/L) PFOA+PFOS** concentration in drinking water

# Detected PFAS in Ash Leachate



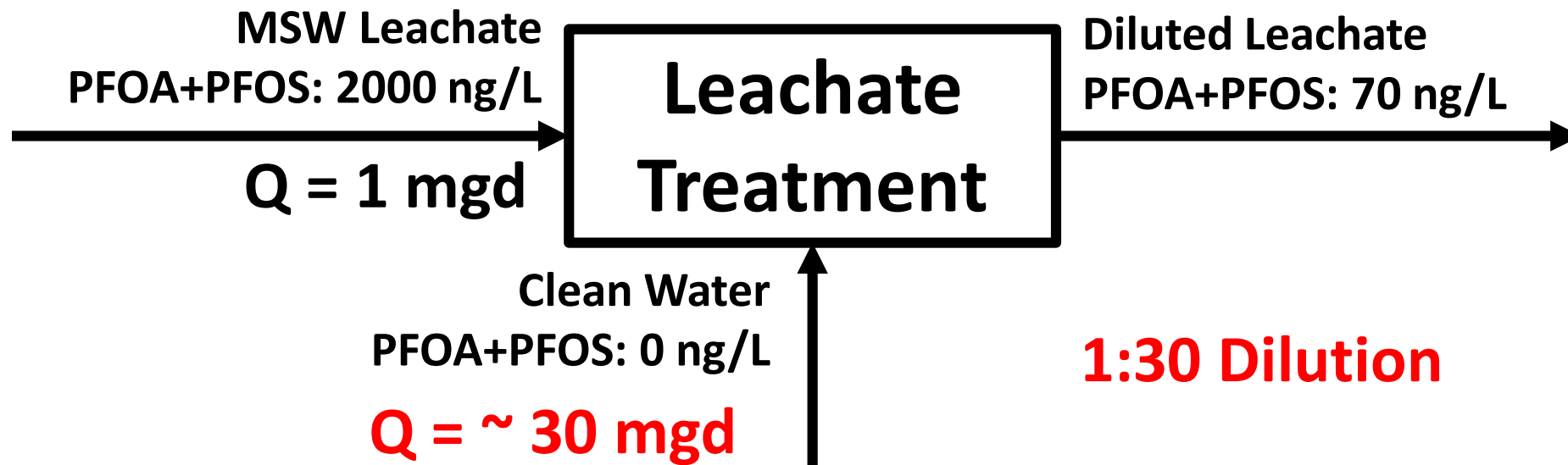


# Implications

## Incineration:

- Ash%  $\uparrow$  Detected PFAS  $\downarrow$
- Destroys some species of PFAS ?

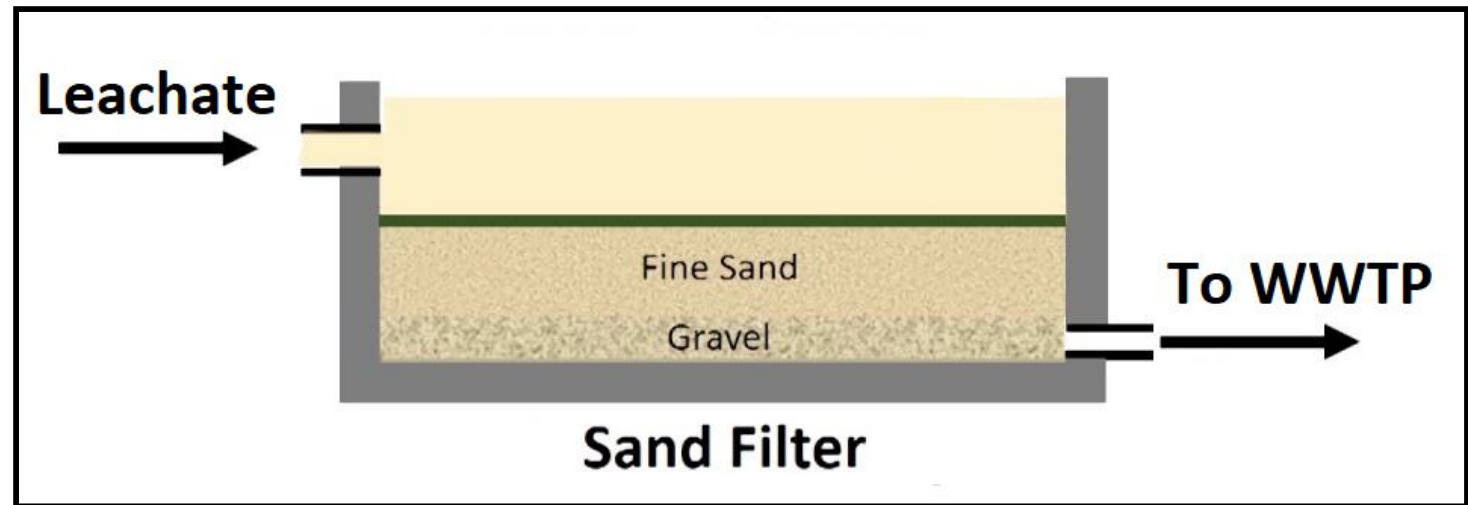
## Dilution:



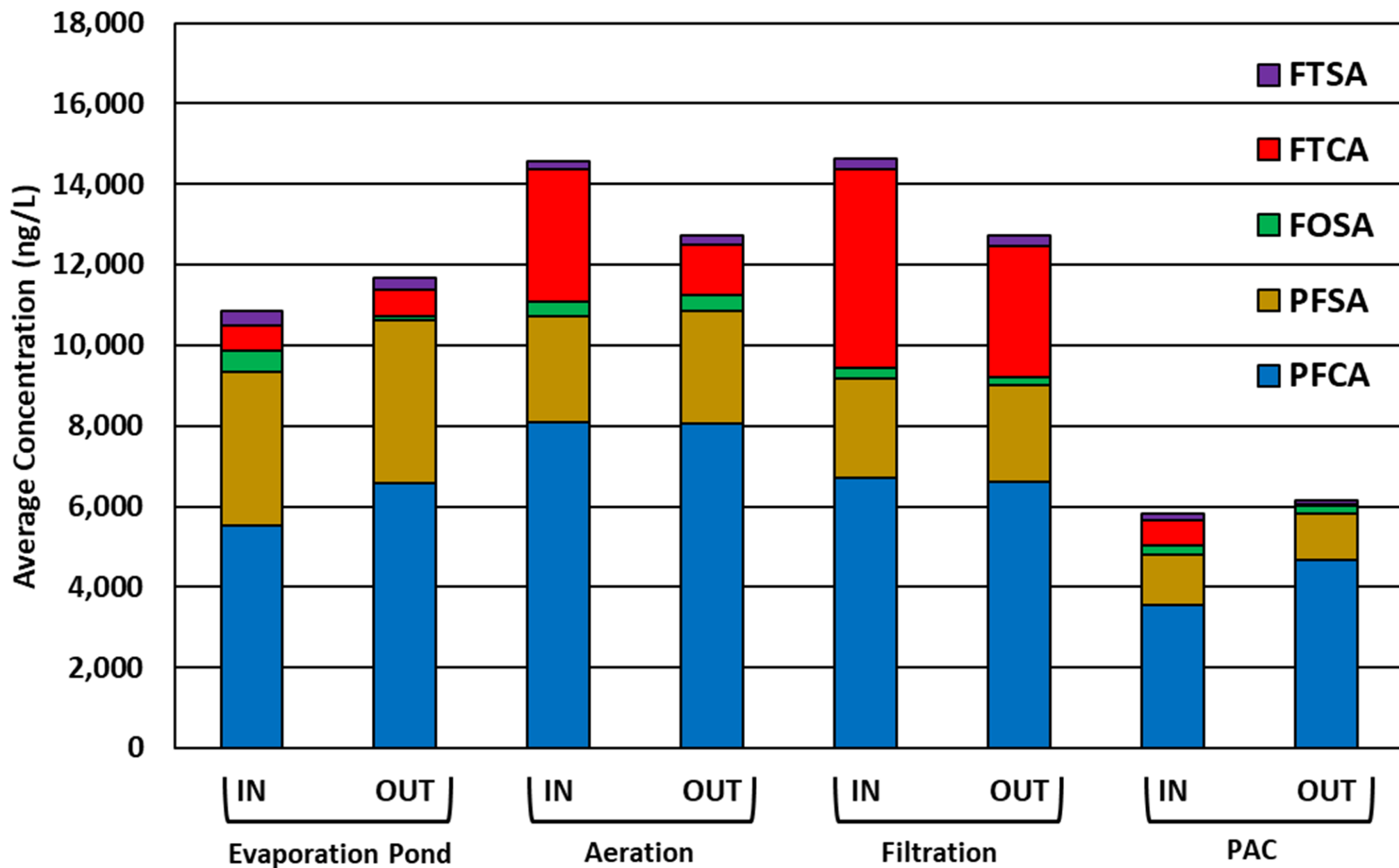
# **PFAS Results in Leachate Treatments**

# Treatment Processes

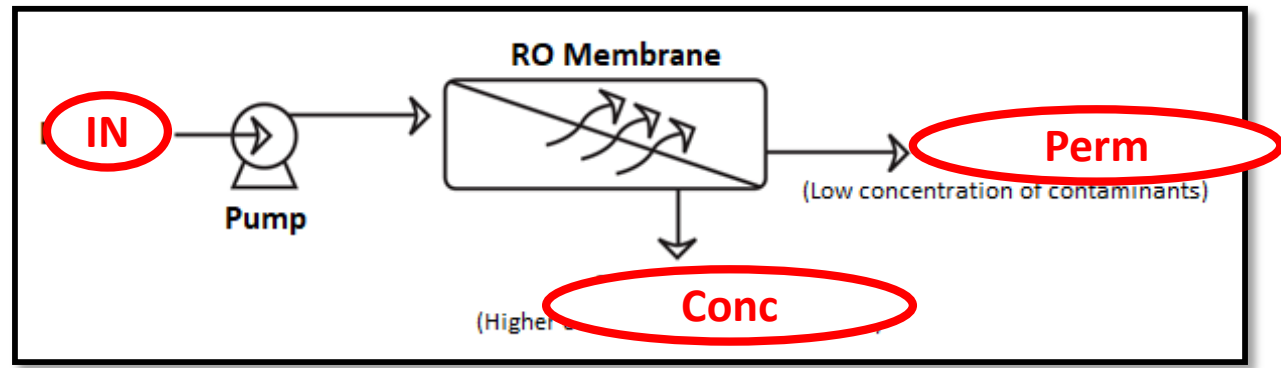
- Evaporation Pond (n=5)
- Aeration (n=2)
- Sand Filtration (n=1)
- Powdered Activated Carbon (n=1)
- Reverse Osmosis (n=2)



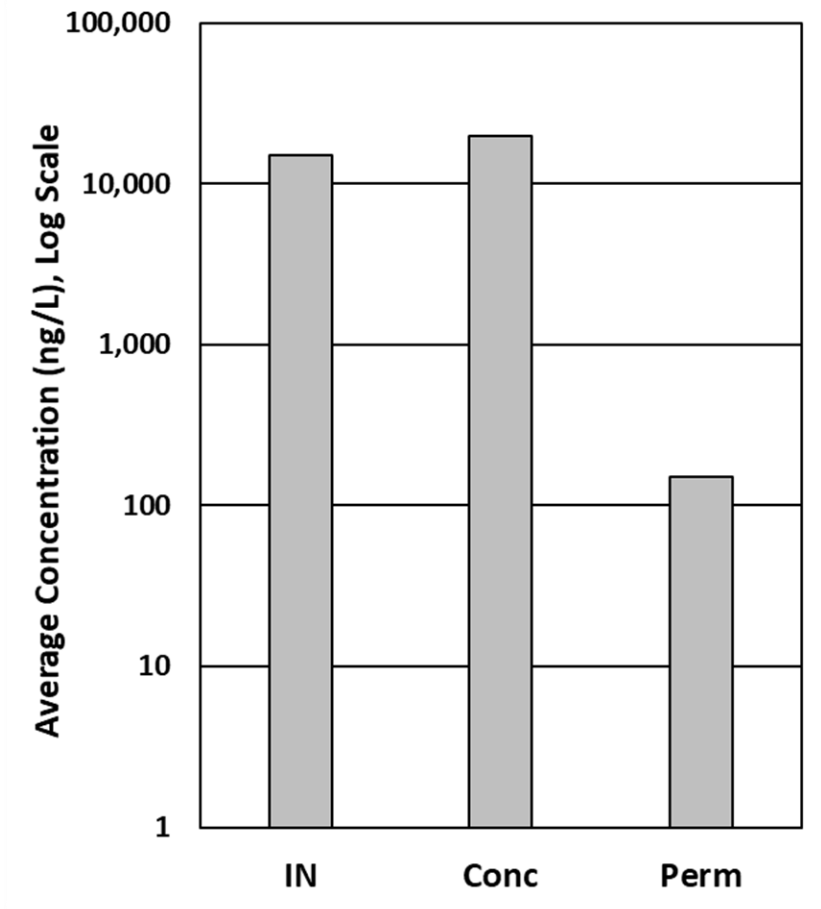
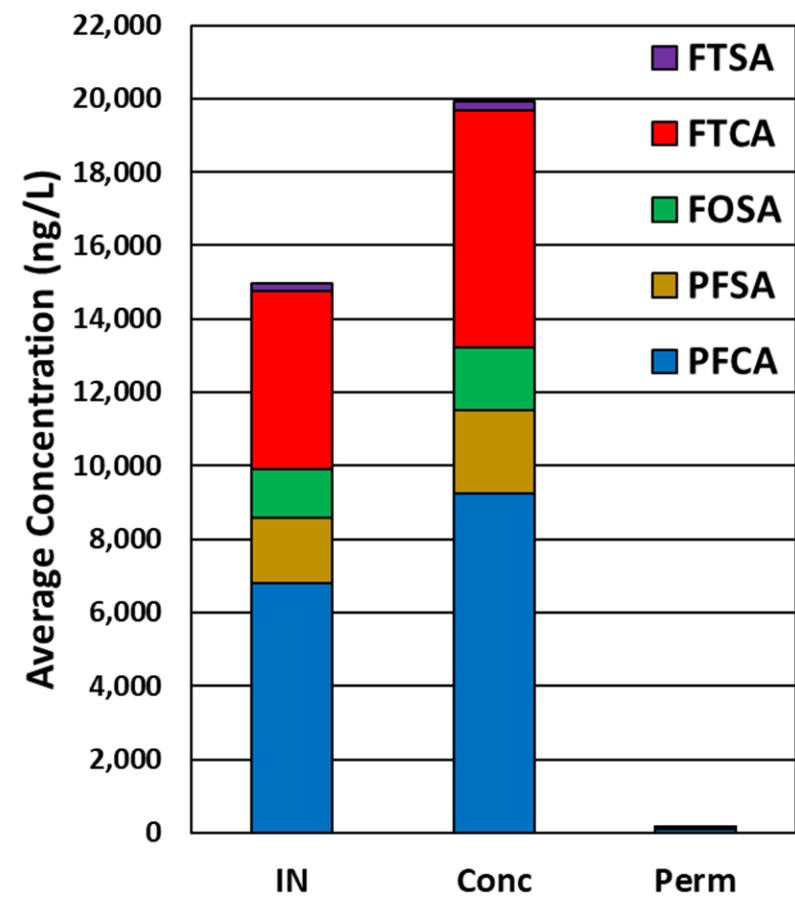
## Detected PFAS in Different Treatments



# Reverse Osmosis



- Volume of Permeate & Concentrate is about 30% & 70% of influent
- PFOA+PFOS in Permeate is less than 30 ng/L



# Implications

## Conventional Treatment:

- May change the PFAS species during the treatment
- Does not reduce the detected PFAS level in the leachate

## Reverse Osmosis:

- Can remove **over 90%** PFAS in the permeate
- PFAS level become higher in the concentrate
- Concentrate can be recycled back into the landfill

**Thank You!**