Characterization of Per- and Polyfluoroalkyl Substances (PFAS) in Biosolids

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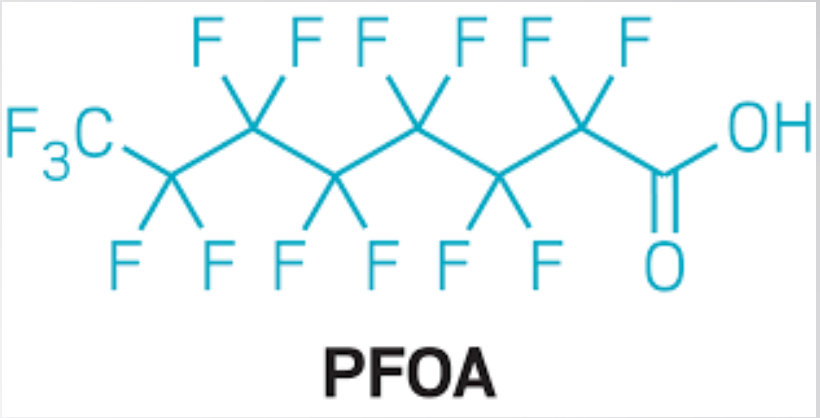
Project website: https://biosolids.fiu.edu/

Poly- and Perfluoroalkyl substances (PFAS)

- Synthetized over 60 years ago
- Hydrophobic and extremely stable
- Used on different applications → ubiquitous presence in the environment and humans.
- Show adverse health effects to animals and humans (potential carcinogenic).

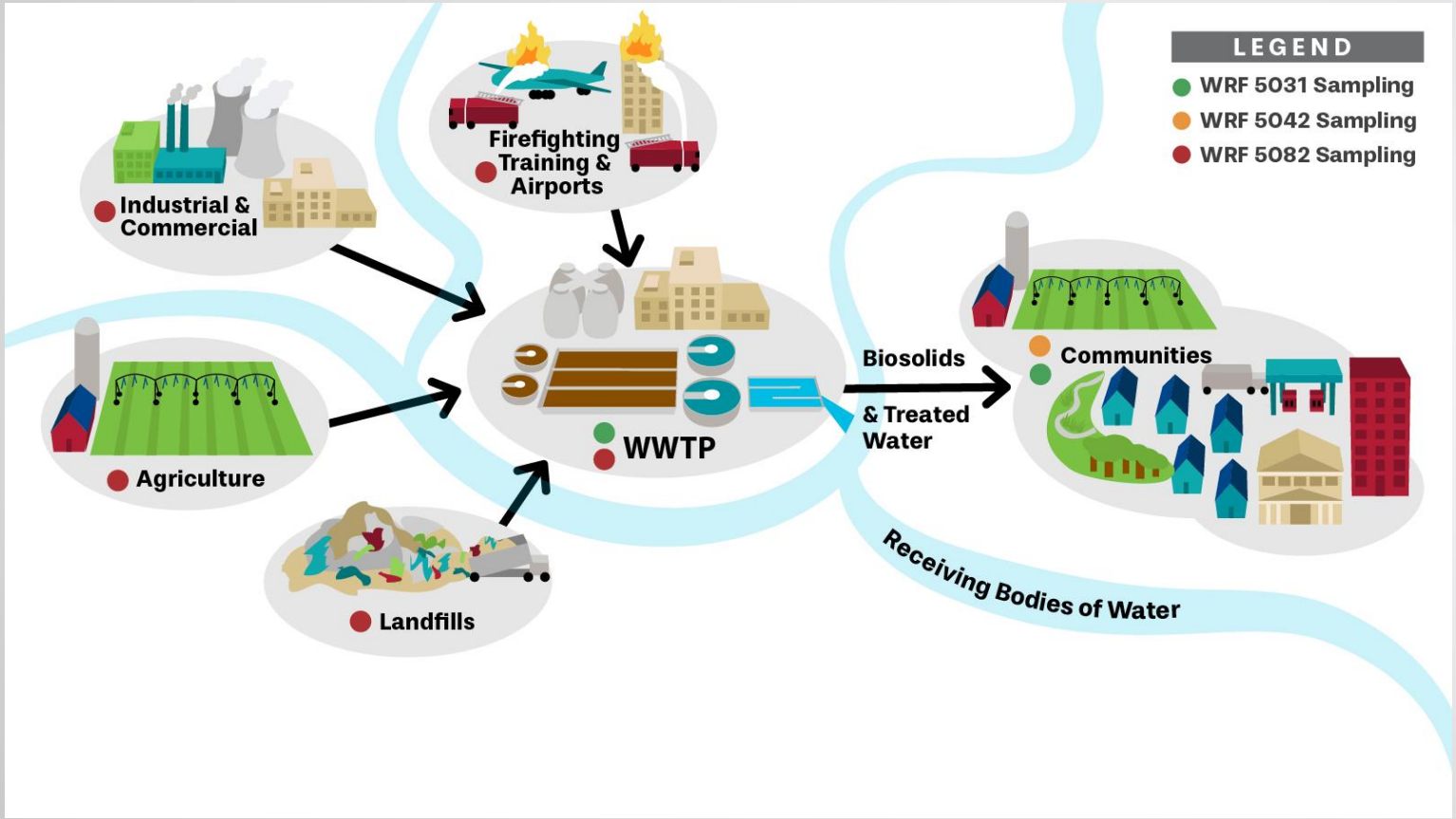


kidney & testicular cancer

infertility & low birth weight

thyroid & heart issues

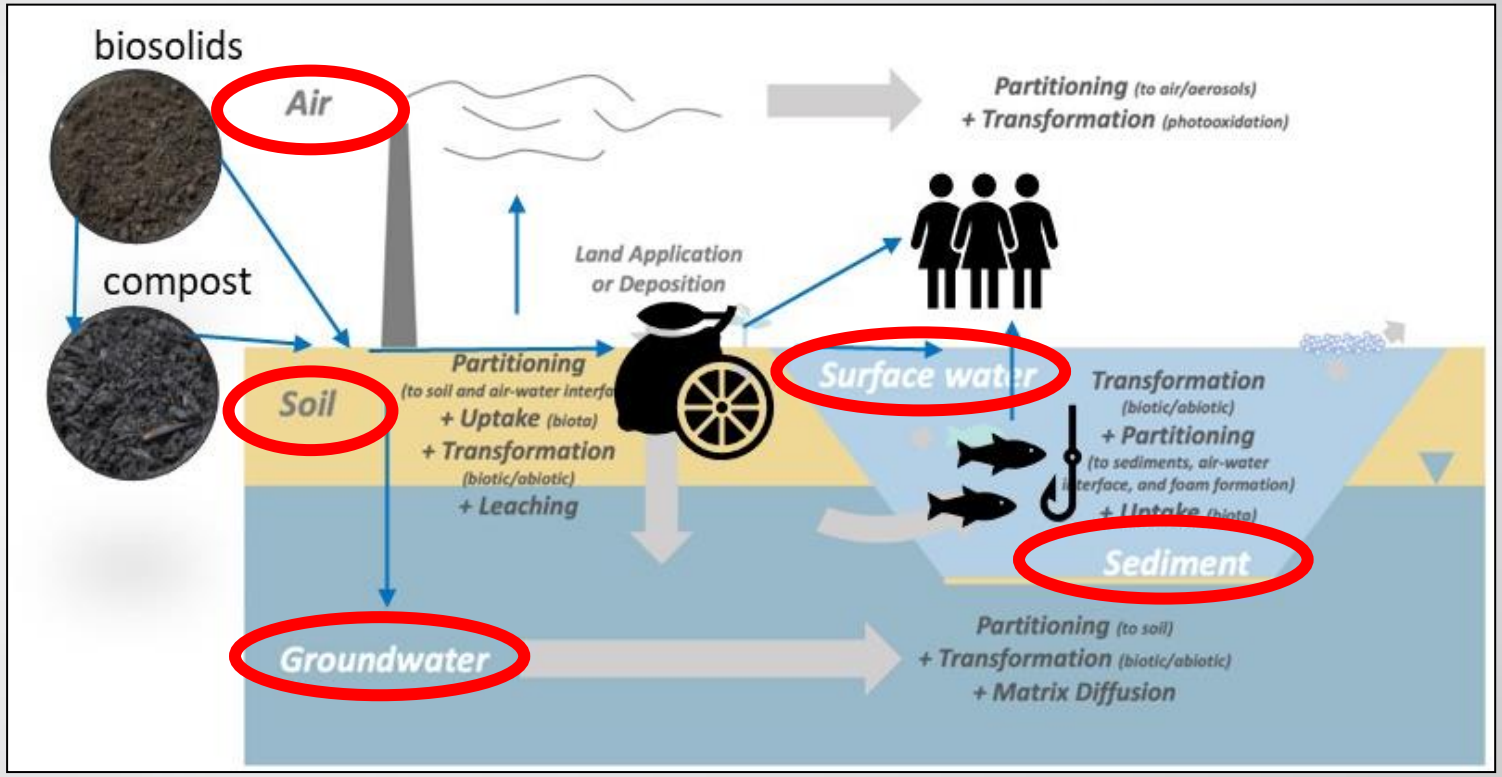
Where are PFAS in biosolids coming from?



- About 7.18 million tons per year (6.51 million kg/year) biosolid produced at wastewater treatment plants.
- 60% land-applied
- 20% landfilled
- 20% incinerated
- Land application of biosolids can result in uptake of perfluoroalkyl acids into edible crops

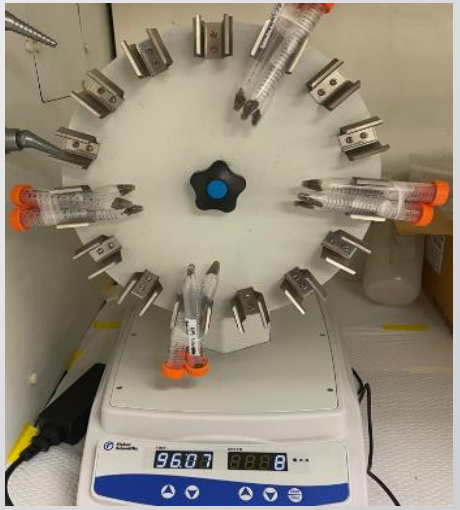
Should we be concerned?

- Potential exposure and threats to human health and the environment.
- Exposure routes: ingestion, inhalation and dermal
- Health risk assessment process depends on PFAS characteristics (water solubility, organic carbon partition coefficient, and volatility).
- MCL in drinking water for PFOA and PFOS: 4 ppt, but no MCL for soil/biosolids



Objectives

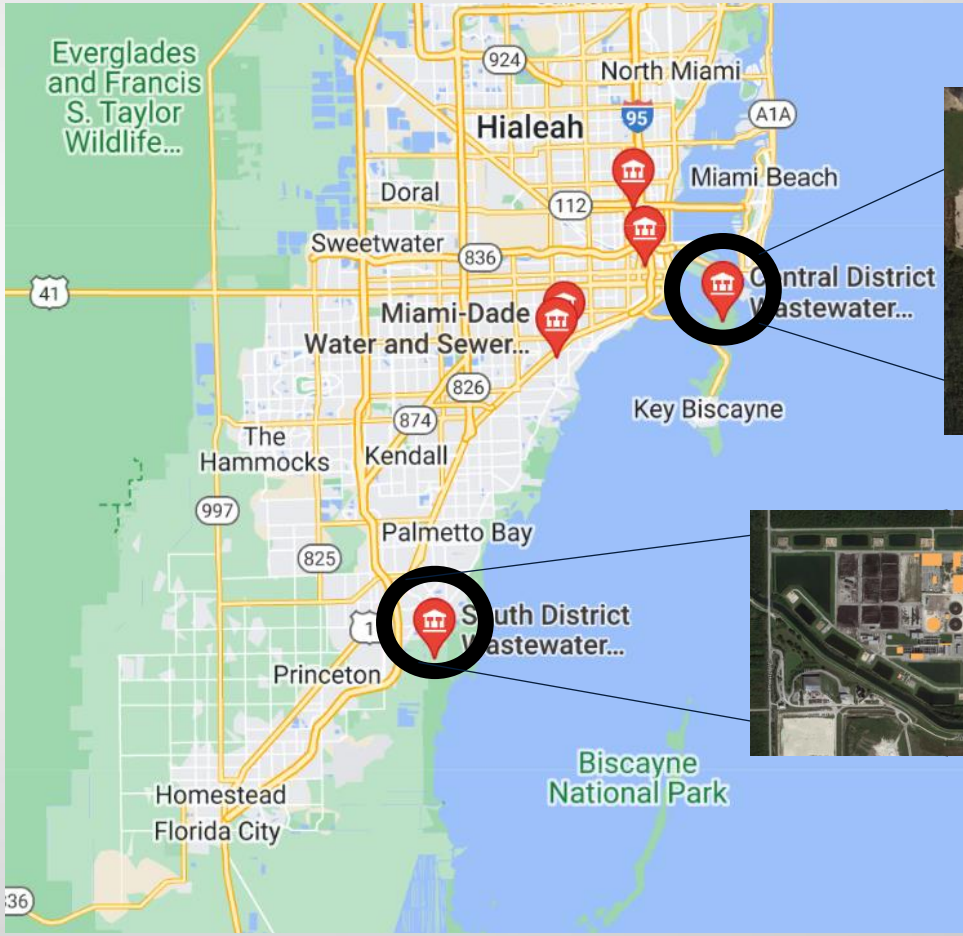
- Sampling of biosolids after dewatering and drying processes at two Miami-Date wastewater treatment plants (South District and Central District Wastewater Treatment Plants).
- Conduct leaching experiments to evaluate the release of PFAS from biosolids under site-specific conditions.
- Analyze biosolids leachate samples for PFAS content and component profile; determine the prevalent PFAS compounds.



Sampling Locations
MDWASD Central District and South District WWTPs

- **Central District Wastewater Treatment Plant**
  - MDWASD's oldest and largest plant with a treatment
  - Capacity: 143 million gallons per day (MGD)
  - Ave daily flow: 101 MGD
  - Effluent discharged via outfalls

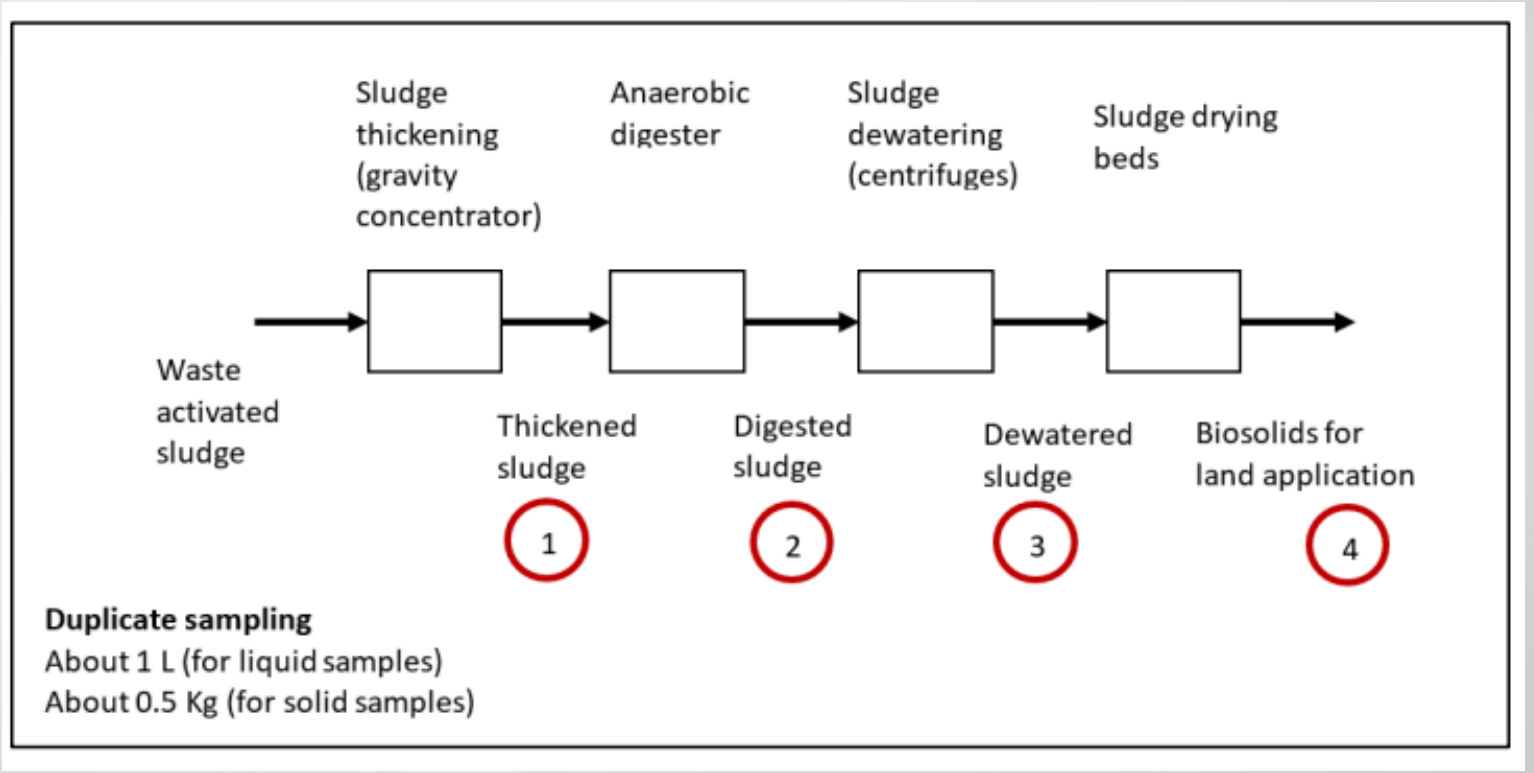
- **South District Wastewater Treatment Plant**
  - Wastewater Treatment Water Reclamation plant
  - Receives leachate from South Dade Landfill
  - Capacity: of 112.5 MGD
  - Ave daily flow: 93.2 MGD
  - Effluent discharged via injection wells



Sampling Strategy:

Sampling locations (collected as duplicate samples):
Total 8 samples

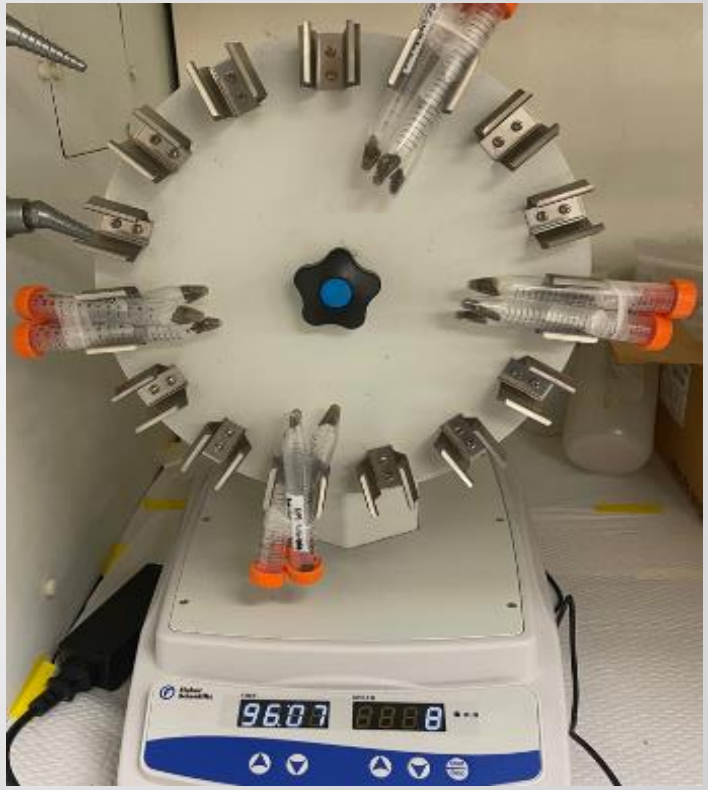
1. **After thickening**
2. **After digestion**
3. **After centrifugation**
4. **After drying**



PFAS free Polypropylene containers!!

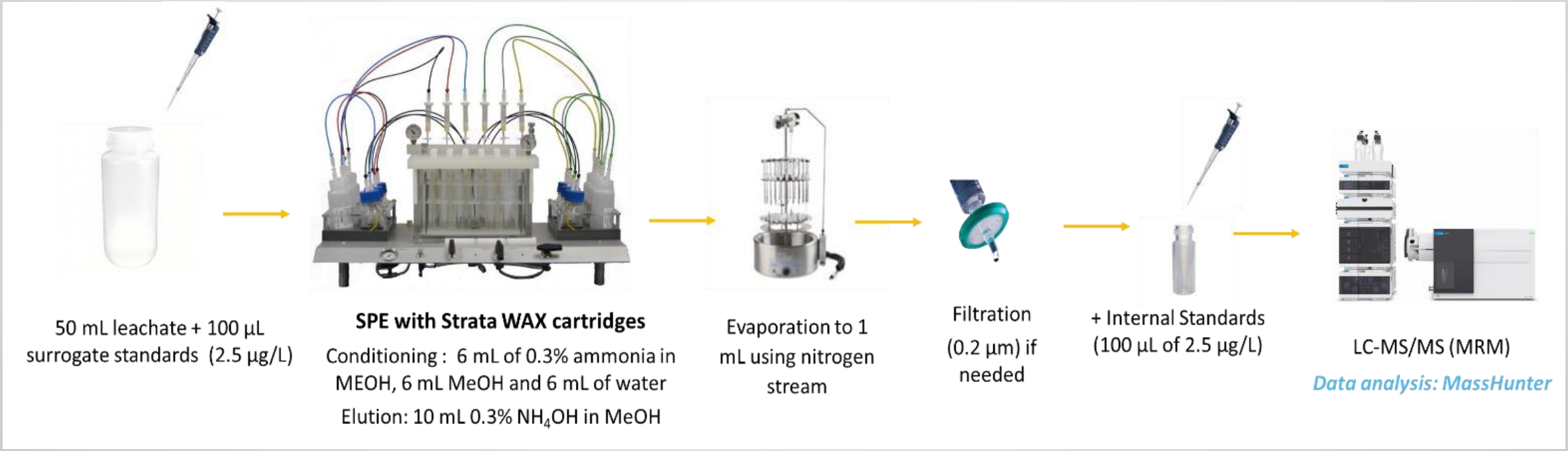
Leaching Experiment

- Laboratory batch experiments at biosolids/water ratio as 1:1 using a sacrificial approach. Homogenized and air dried biosolids
- Centrifuge tubes were placed on an end-over-end tube revolver at 10 rpm.
- Control sample: water spiked with PFAS to observe PFAS stability over the experimental period.
- Samples were sacrificed at certain times to evaluate for the release of PFAS after 1 day, 3 days, 7 days, 14 days, and 30 days.



PFAS Methodology

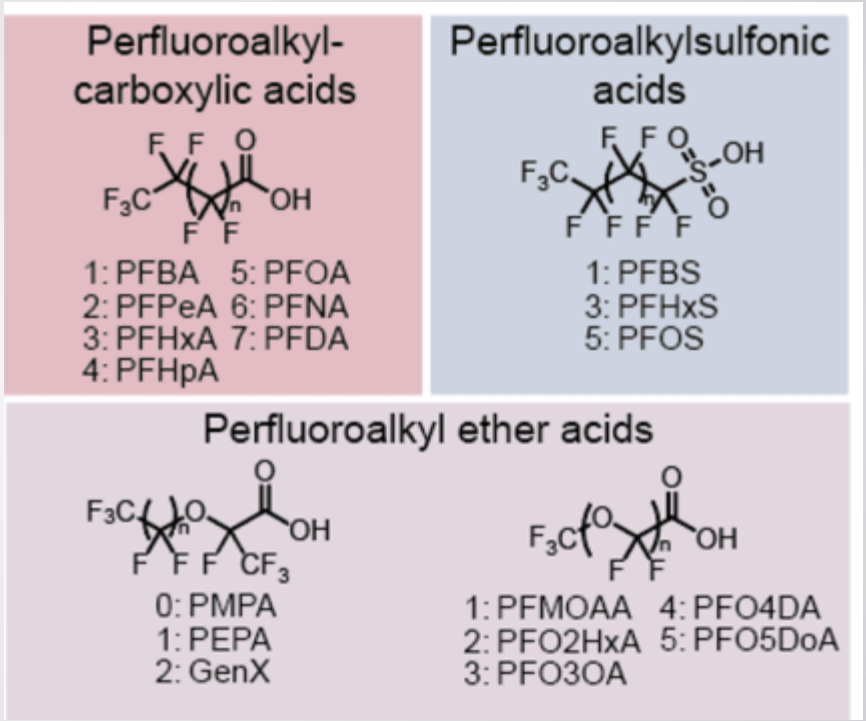
EPA Method 1633 – 40 PFAS



FIU LC-MS/MS system for PFAS biosolids leachate analyses

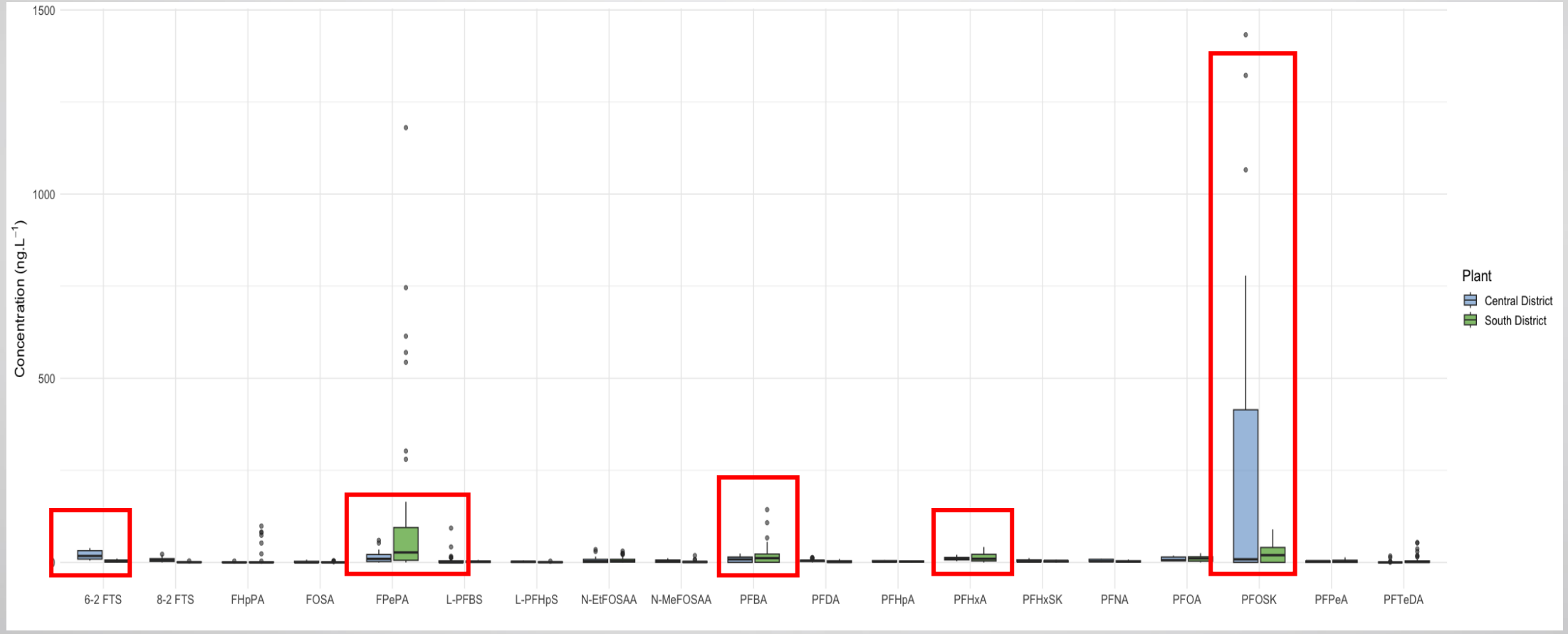
Investigated PFAS

- Perfluoroalkyl carboxylic acids,
- Perfluoroalkyl sulfonic acids,
- Fluorotelomer sulfonic acids,
- Perfluorooctane sulfonamides,
- Perfluorooctane sulfonamidoacetic acids,
- Perfluorooctane sulfonamide ethanols,
- Per- and Polyfluoroether carboxylic acids,
- Ether sulfonic acids, and
- Fluorotelomer carboxylic acids

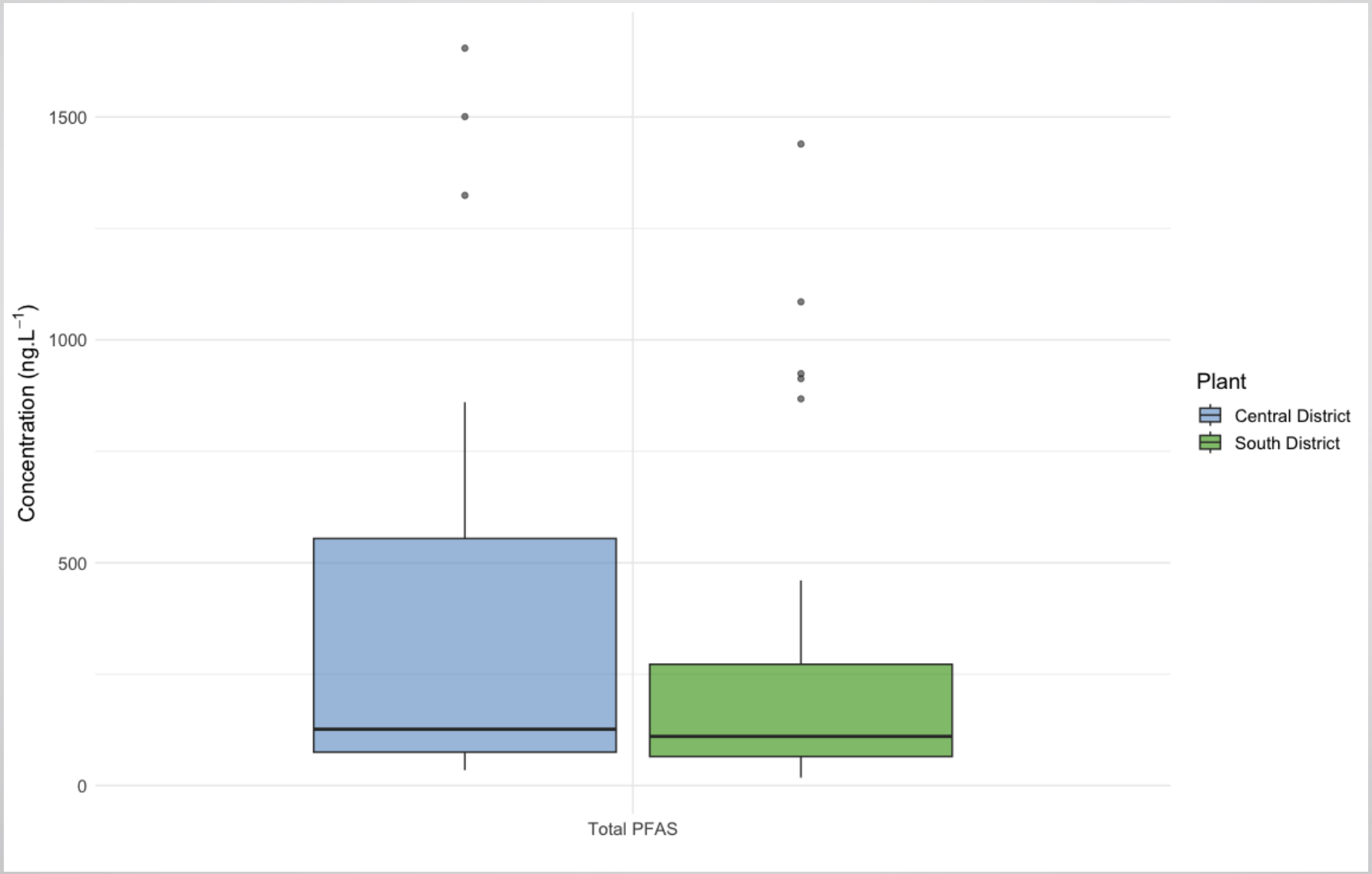


Results- What do we know so far?

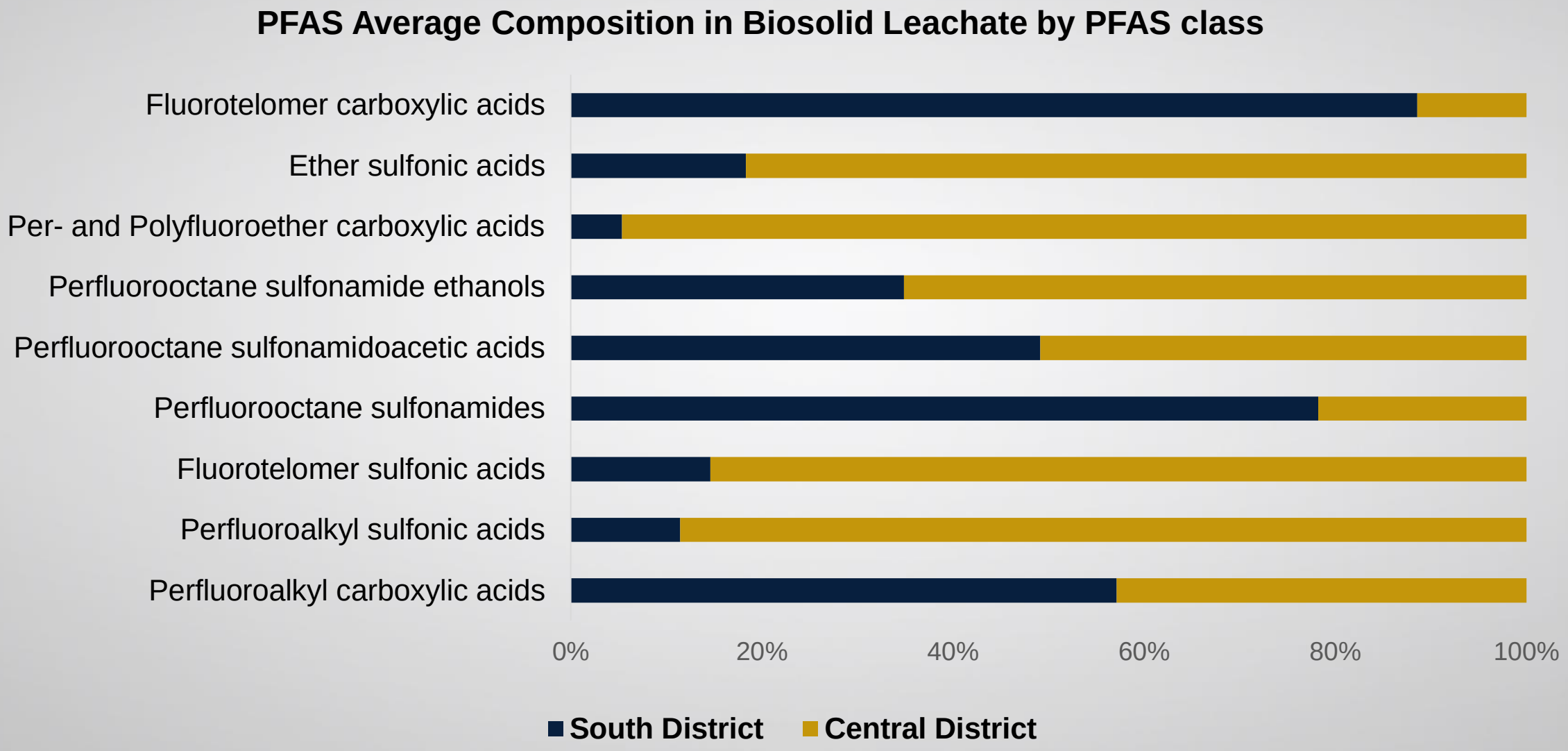
Predominant PFAS in Biosolids Leachate



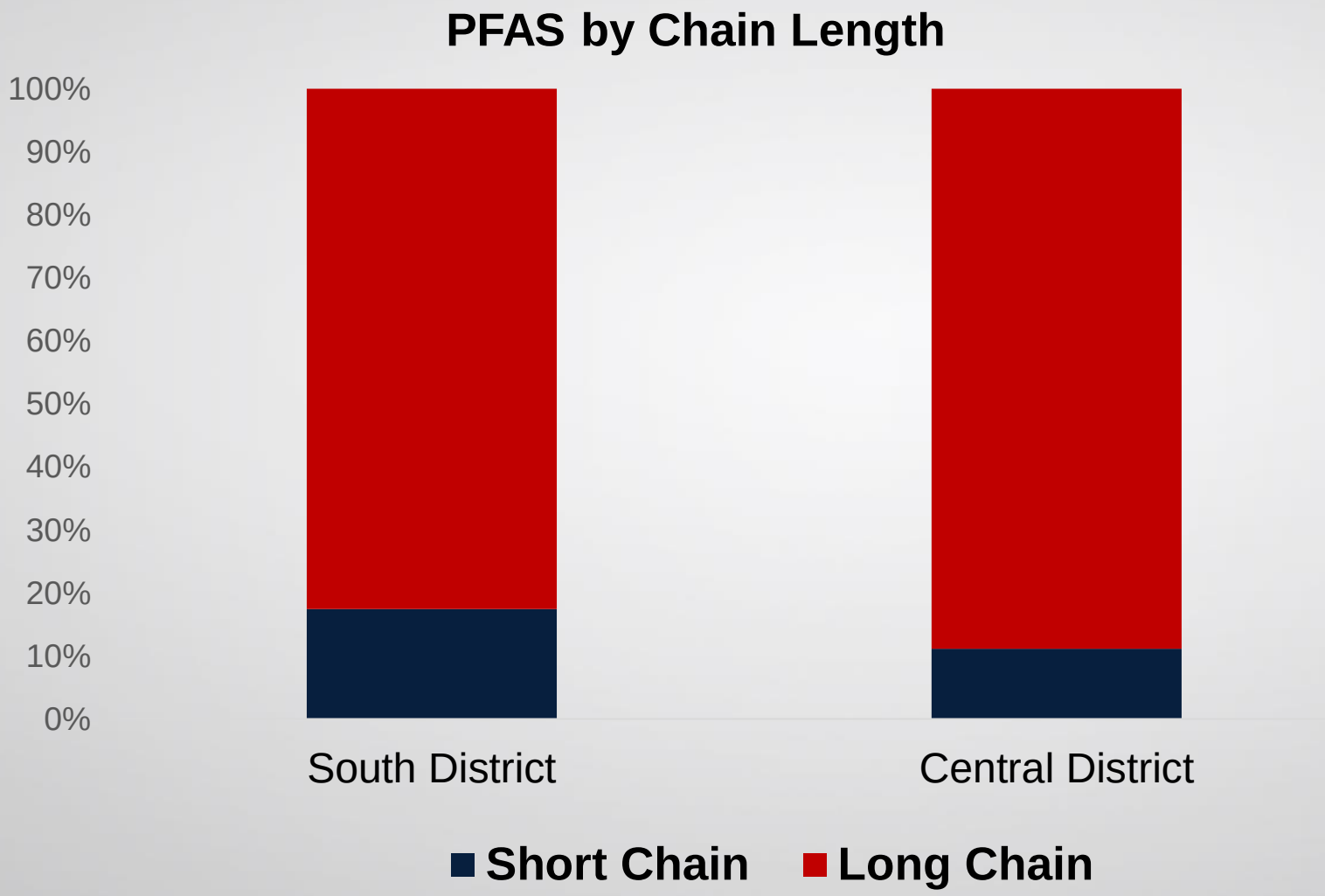
Total PFAS- South District vs Central District



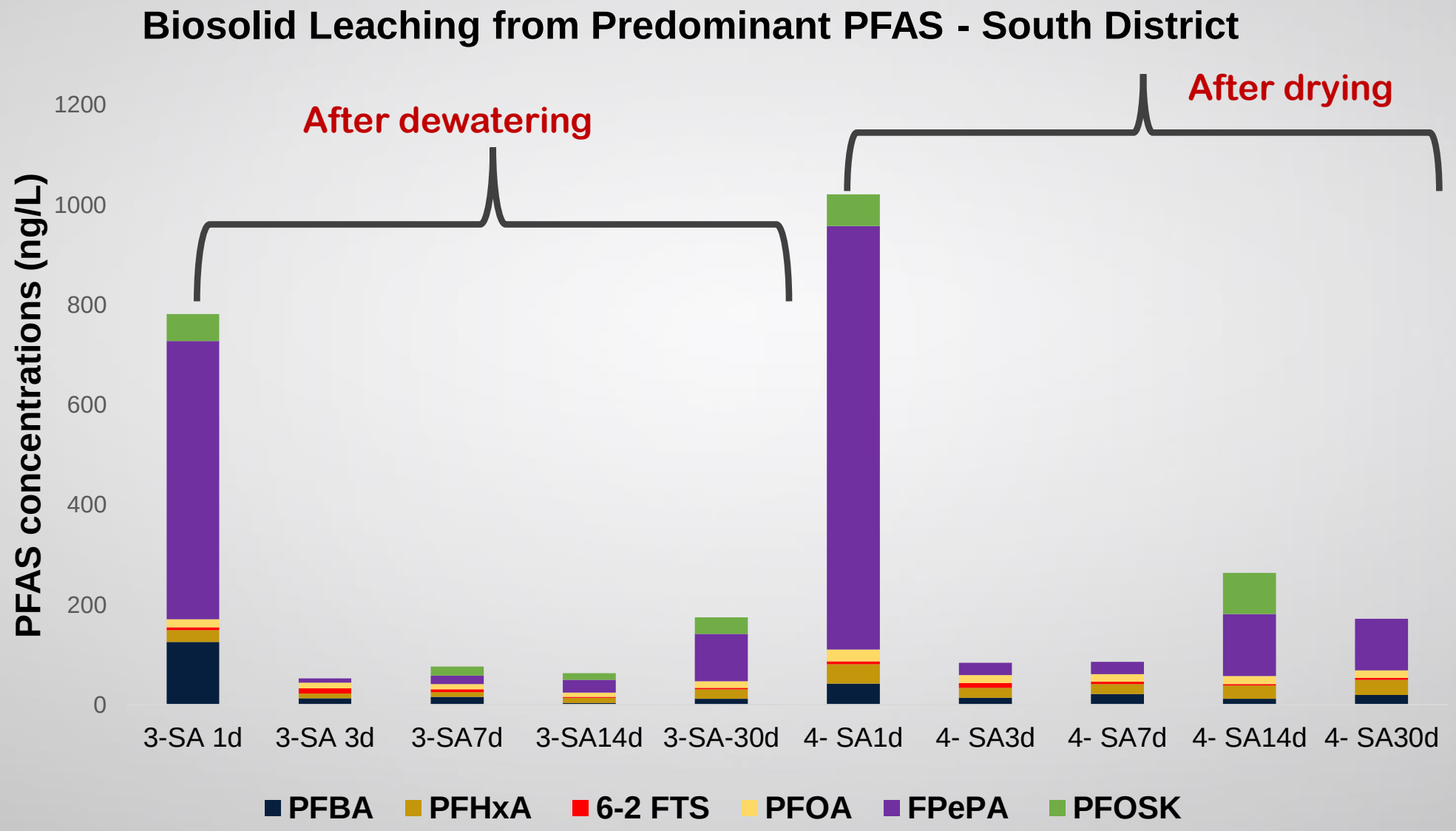
PFAS composition in Biosolid Leachate



PFAS composition in Biosolid Leachate



PFAS Leaching from Biosolids - up to 1 month



Conclusions and Future work

- We have identified predominant PFAS in biosolid leachate: PFOS, FPePA, PFBA, PFHxA and 6-2 FTS.
- Distinct PFAS composition between South District and Central District plants, but overall predominance of long-chain PFAS over emerging short-chain PFAS
- Leaching experiments have led to the highest PFAS concentrations after 1 day.
- Next steps: Method development for assessment of 40 PFAS on biosolids samples used for leachate experiments
- Study of potential exposure pathways for human health and ecological effects.
- Recommendations for appropriate testing and land application practices of biosolids in Florida.

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Any further questions?
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