



NC DEQ 2023 PFAS Study on Wastewater and Biosolids

Secretaries' Science Advisory Board
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Study Goal



To improve our understanding of the sources of PFAS pollution and its occurrence in wastewater discharges and biosolids.

Study Objectives



1. Investigate the prevalence of PFAS in wastewater treatment systems at select sites in NC.

2. Examine PFAS in wastewater influent, effluent, biosolids, and soil from fields where biosolids have been repeatedly land applied.

3. Generate foundational knowledge of PFAS in wastewater and biosolids for public information, future minimization efforts and to inform regulatory decision making.

Purpose and Context of the Pilot Study

The intention of this study was to develop a preliminary dataset in collaboration with partners and stakeholders. These results represent early findings intended to inform future study design and identify opportunities for more comprehensive data collection and analysis. These findings are exploratory and not intended to serve as the basis for regulatory decisions.

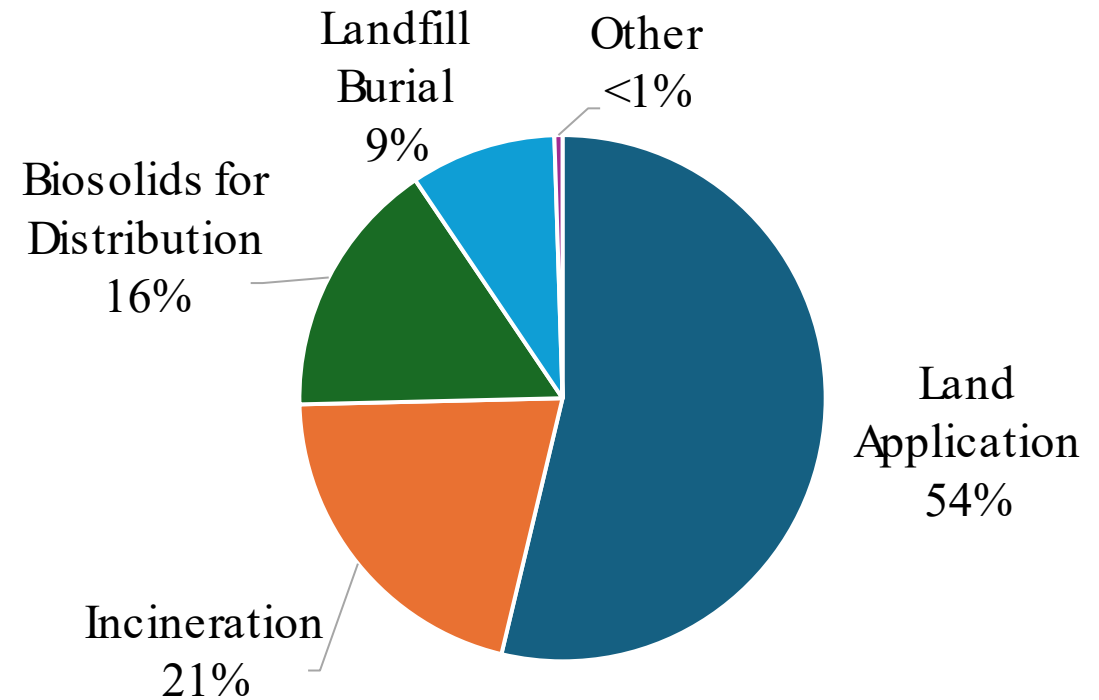
The data shown in this presentation includes the different types of permitted facilities sampled based on available resources in partnership with host sites. While the number and type of facilities were not intended to represent a statistically significant sample size, the findings do provide important information on the range of PFAS concentrations measured and highlight opportunities for more comprehensive study designs moving forward.

Note: Measurements related to PFAS chemicals unique to the Chemours Fayetteville Works facility are still under review and will be reported in the near future.

What are Biosolids?

- Biosolids refers to sewage sludge that has been treated to meet the requirements in the EPA's "Standards for the Use or Disposal of Sewage Sludge."
- Federal and state regulations require reductions in pathogens and the potential to spread disease.
- Uses:
 - Land application
 - Sold to public as soil amendment
 - Managed as waste (incineration, landfilled)

**North Carolina
Biosolids and Disposal in 2018
Total: 129,000 dry metric tons**



"Other" includes surface disposal and landfill alternative daily cover.

Data Source: National Biosolids Data Project. Ned Beecher; Juliana Beecher; Janine Burke-Wells; Maile Lono-Batura; Nora Goldstein; Greg Kester; and Bill Toffey. 2022. National Biosolids Data Project: Biosolids management in the U. S. From <https://www.biosolidsdata.org>, accessed 2025

Types of Treatment Facilities

37 facilities selected based on size (flow) and three operating characteristics:

100% Domestic wastewater treatment plants (n=3)

Receive no industrial wastewater

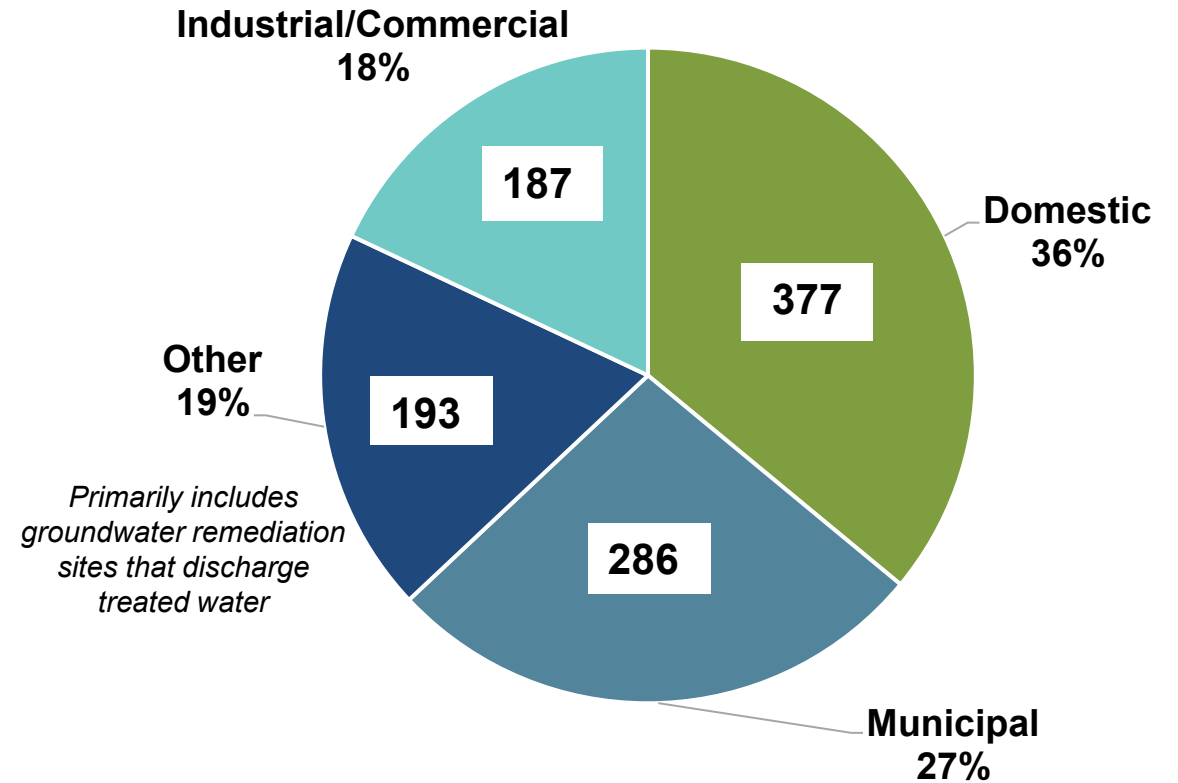
Industrial wastewater treatment plants (n=8)

Municipal wastewater treatment plants (n=26)

Receive wastewater from industrial users (some have SIUs), commercial, and residential sources

Also considered existing PFAS data and certain source characteristics for municipal systems

Individual NPDES Wastewater Permits in North Carolina - 2023



Land Application Fields

19 Land Application Fields (17 Non-Discharge Residual permits)

- **13** Municipal application fields (sources include WWTPs with industrial discharges)
- **3** Industrial application fields
- **3** Mixed use application fields (multiple sources)

Preferred factors for field selection:

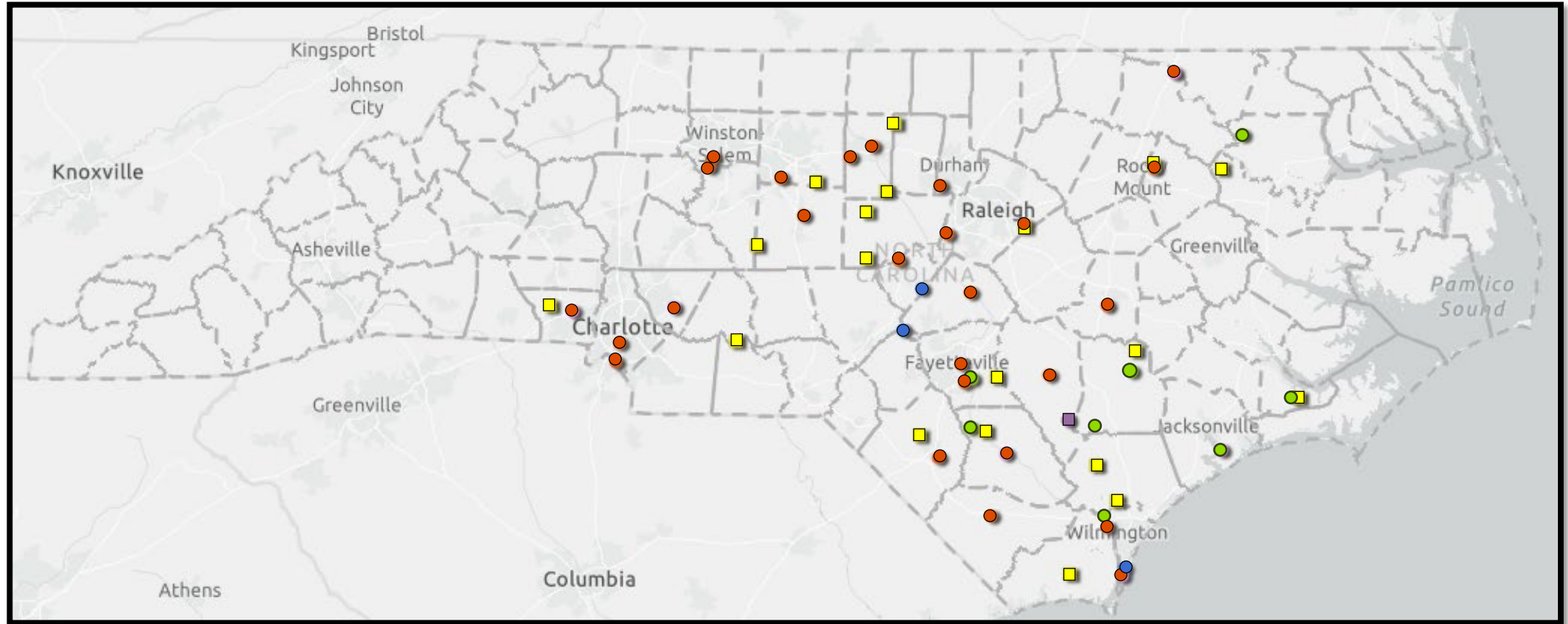
- >10 years in a permitted residuals land application program, with repeated applications
- Application(s) made to field within the previous 2 years
- Varied soil types

Crops grown on fields at the time of the study were grasses for hay/pasture, or other crops used for animal feed

1 Compost Distribution Facility

Class A municipal and industrial biosolids processed into finished compost for bulk distribution
(2 grab samples of finished compost collected)

Sampling Locations



Treatment Plants

- 100% Domestic
- Industrial
- Municipal
- Distribution facility
- Land application fields

Sampling Strategies

Internal sampling guidance and training for regional staff that conducted field sampling; included SOPs for appropriate sampling equipment and supplies, personal care items and clothing, decontamination procedures, collection of QC samples (blanks), shipping to laboratory, etc.

Wastewater Treatment Facilities (1 or 2 rounds of grab samples from each facility)

- Influent sampled at the headworks, before any treatment
- Effluent sampled at or near the outfall to surface water
- Biosolids generally sampled from storage units for collection of final product prior to field application, distribution, or landfilling (e.g. liquid mixtures for spray or injection, cake material, dried pellets)

Land Application Fields (most fields sampled once)

- ~1 acre representative section identified within each field, to include lower elevation areas and exclude staging areas
- 10-15 soil cores (0-6" depth) collected from each field, combined into one composite sample

Note: background soil samples were not collected as part of this study

Analytical Method

- Modified version of EPA Method 537.1 used for all matrices
 - Drinking water method adapted for non-potable aqueous matrices, biosolids, and soil
 - Expanded to include additional PFAS compounds related to the Chemours facility in Fayetteville, NC
- 57 PFAS analytes
- Biosolids samples homogenized and extraction performed on combined liquids and solids.
- Soils, finished compost, and biosolids results reported on a dry weight basis (ng/g)

Project Detection Limits for PFOS and PFOA

	Influent ng/L (ppt)	Effluent ng/L (ppt)	Biosolids ng/g (ppb)	Soil ng/g (ppb)
PFOS	0.676 – 200.0*	0.638 - 17.4	0.209 - 92.6	0.196 - 1.99
PFOA	0.676 – 200.0*	0.638 - 8.79	0.209 - 92.6	0.193 - 0.311

*A single early influent sample had a high detection limit of 200 ng/L for both PFOA and PFOS; most DL's for influent samples were 20 ng/L or less for both PFOA and PFOS for influent samples

Influent Data Summary

PFOS (min-max; mean)

- **100% Domestic** (4 – 14; 9 ppt)
- **Municipal** (3 – 38; 16 ppt)
- **Industrial** (3 – 121; 55 ppt)

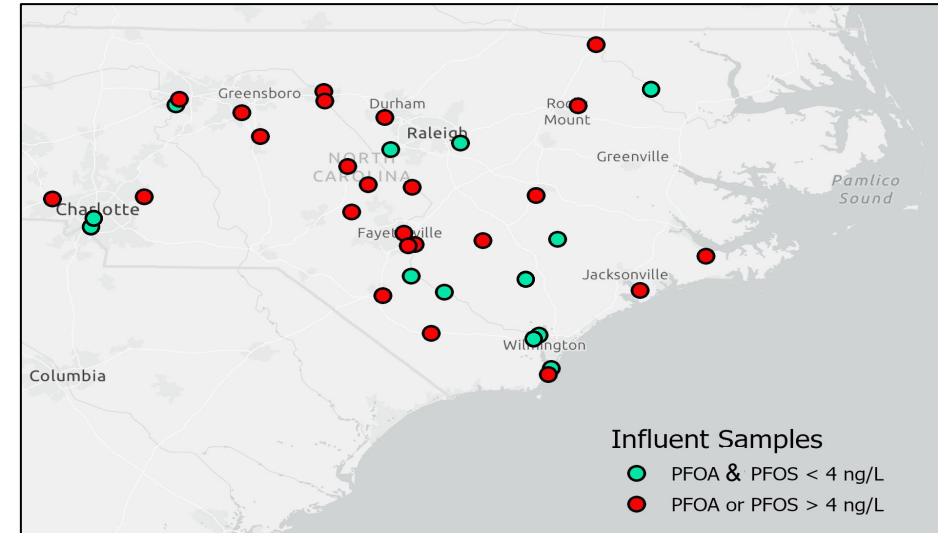
PFOA

- **100% Domestic** (3 – 8; 6 ppt)
- **Municipal** (2 – 88; 13 ppt)
- **Industrial** (3 – 51; 21 ppt)

Total PFAS¹

- **100% Domestic** (61 – 112; 80 ppt)
- **Municipal** (10 – 4124; 380 ppt)
- **Industrial** (5 – 508; 276 ppt)

¹ range of (summed) 57 PFAS quantified at each facility, mean of totals from all facilities in permit category



Observations

- Domestic WWTPs had lower mean PFAS levels **entering** the plant
- Municipal and industrial WWTPs had similar incoming mean Total PFAS concentrations.
 - Municipal measurements had a greater variance.
- Some municipal facilities receive discharges from industries associated with PFAS.

Effluent PFAS Data Summary

PFOS (min-max; mean)

- **100% Domestic** (3 – 16; 10 ppt)
- **Municipal** (2 – 39; 13 ppt)
- **Industrial** (2 – 86; 36 ppt)

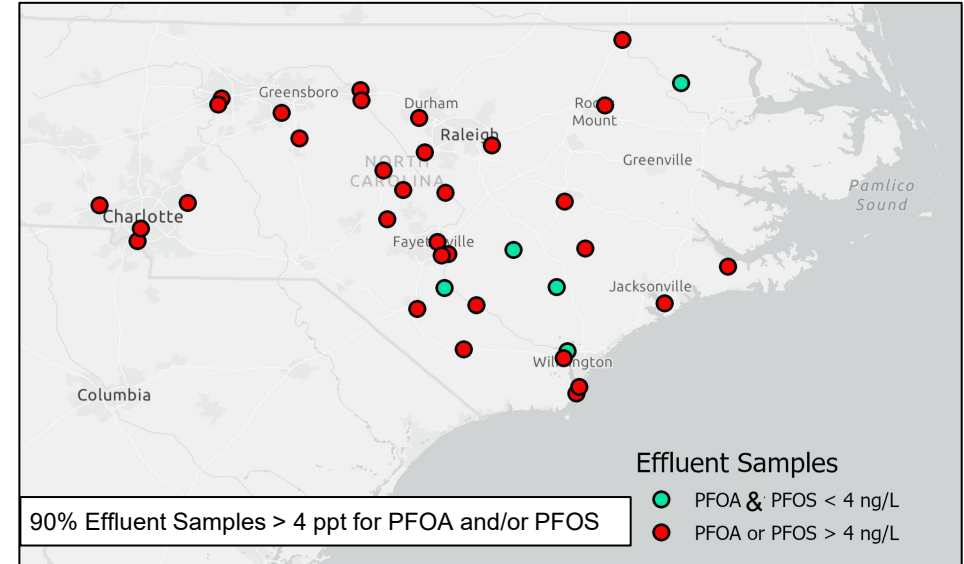
PFOA

- **100% Domestic** (8 – 28; 18 ppt)
- **Municipal** (2 – 95; 15 ppt)
- **Industrial** (1 - 50; 20 ppt)

Total PFAS¹

- **100% Domestic** (94 – 217; 192 ppt)
- **Municipal** (90 – 7828; 533 ppt)
- **Industrial** (3 – 1419; 663 ppt)

1. range of (summed) 57 PFAS quantified at each facility, mean of totals from all facilities in permit category

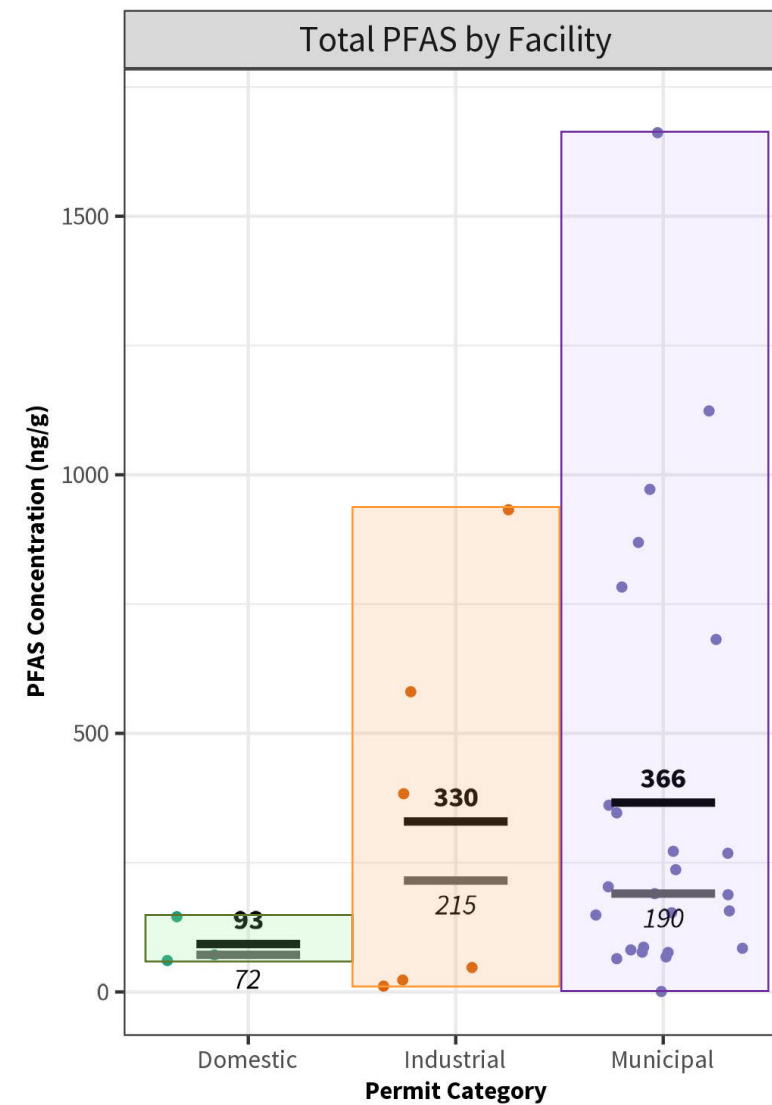
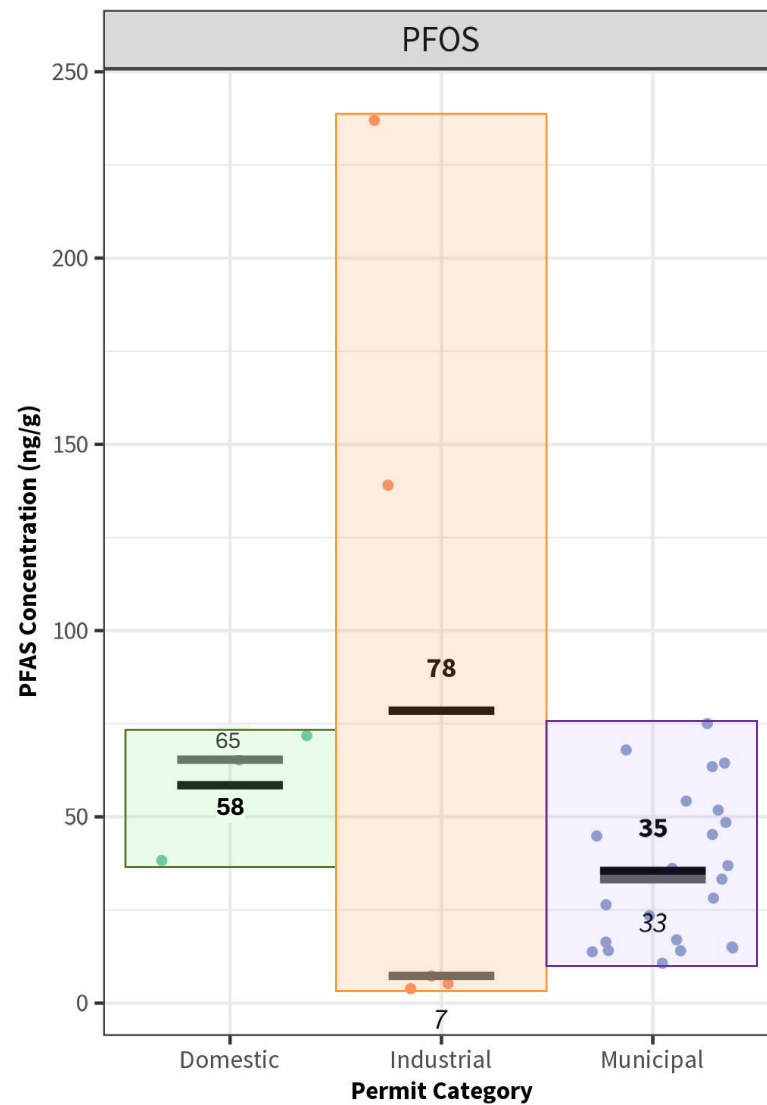
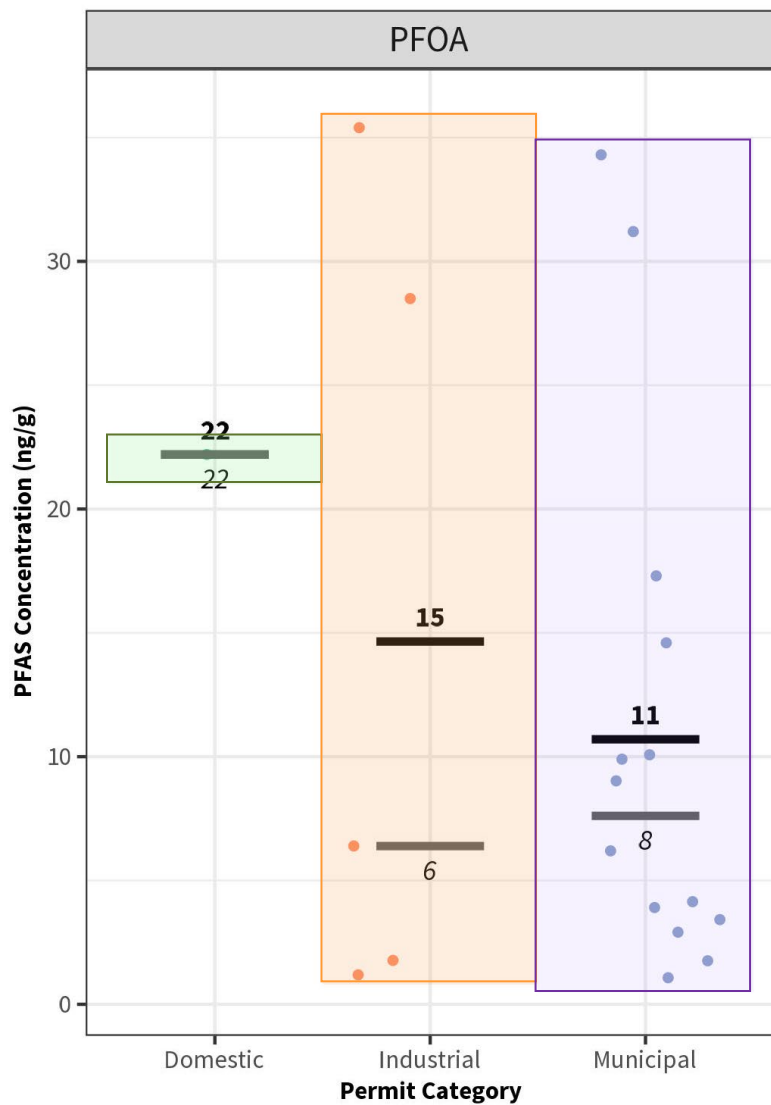


Observations

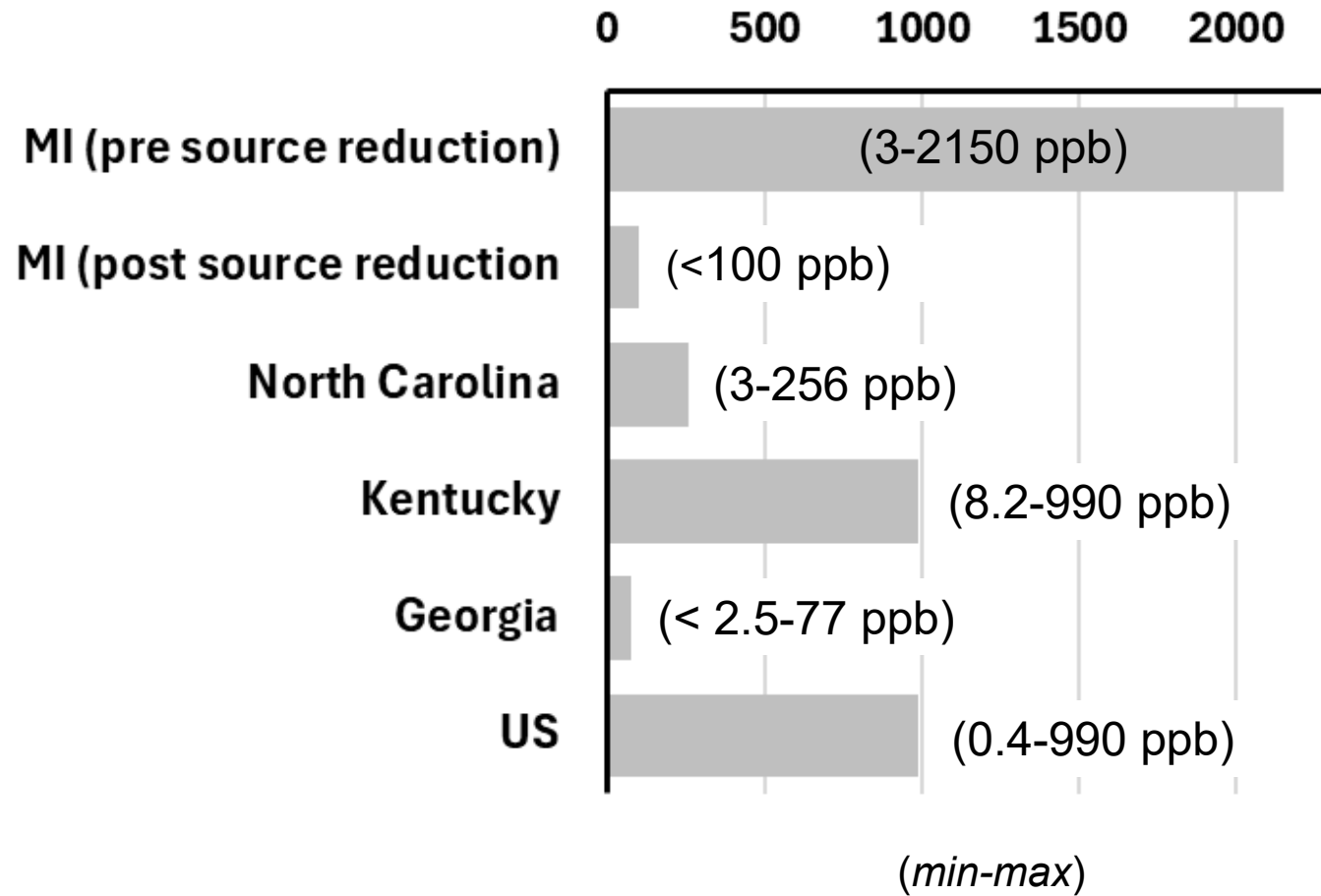
- The 3 domestic WWTPs had lower average Total PFAS **leaving** the plant than industrial and municipal
- Mean PFOA, PFOS, and Total PFAS concentrations were highest in industrial discharges
- Mean Total PFAS effluent concentrations were greater than influent concentrations for all WWTP types.

Biosolids PFAS Data Summary

(Results reported on a dry weight basis; black line with **bold** value = average, gray line with *italicized* value = median)
note the different vertical scales for each graph



PFOS in Biosolids - Comparison with Other States

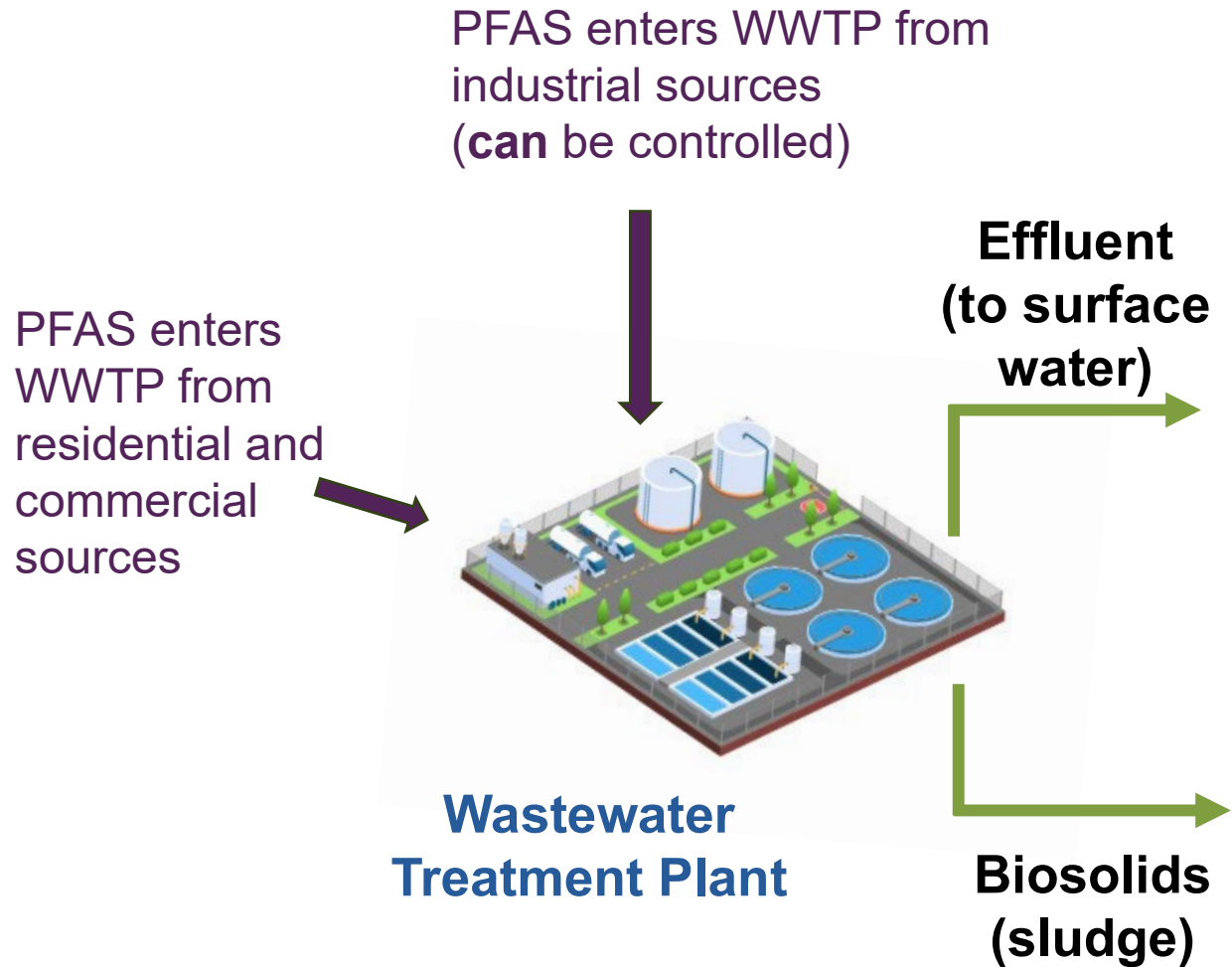


Kentucky, Georgia, and US data from [EPA 2025](#); Michigan data from [EGLE^{1,2}](#)

1 ng/g = 1000 ppt = 1 ppb

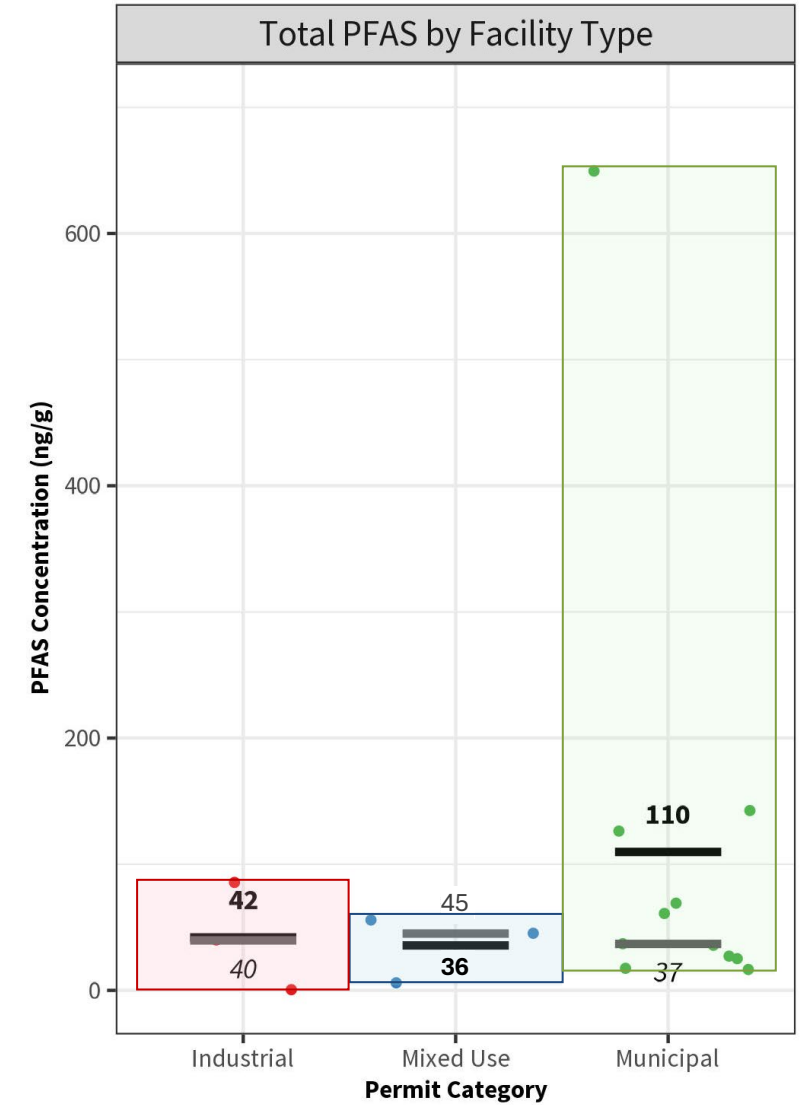
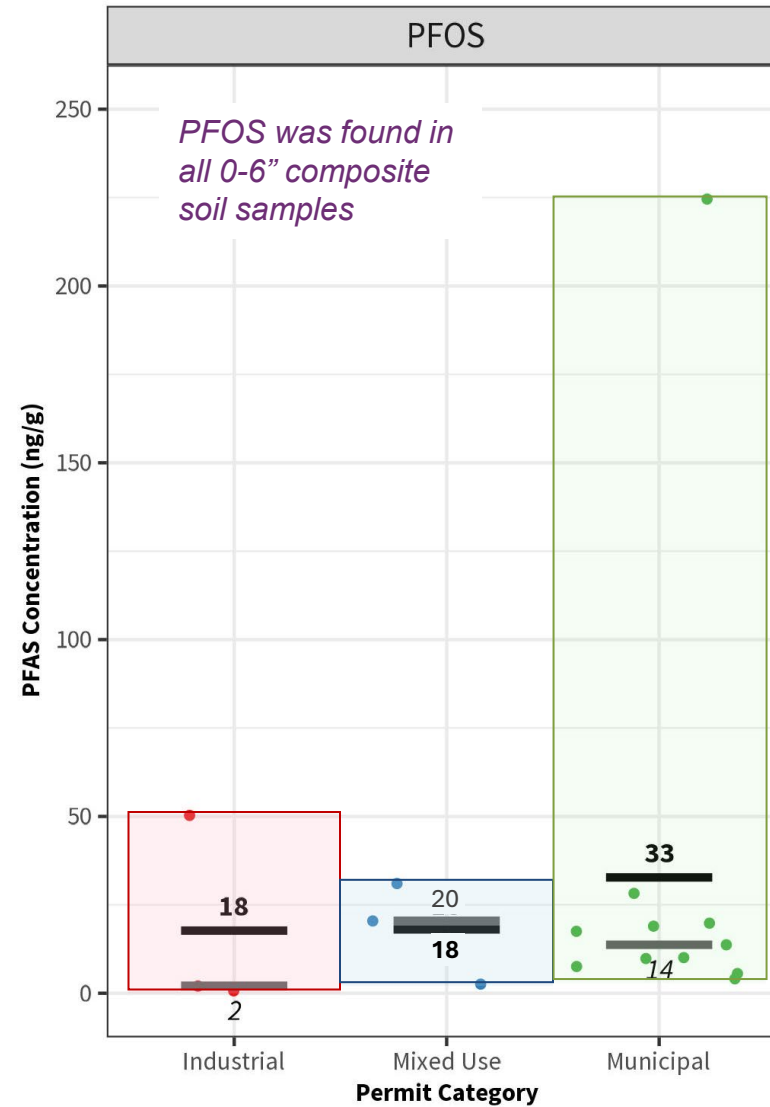
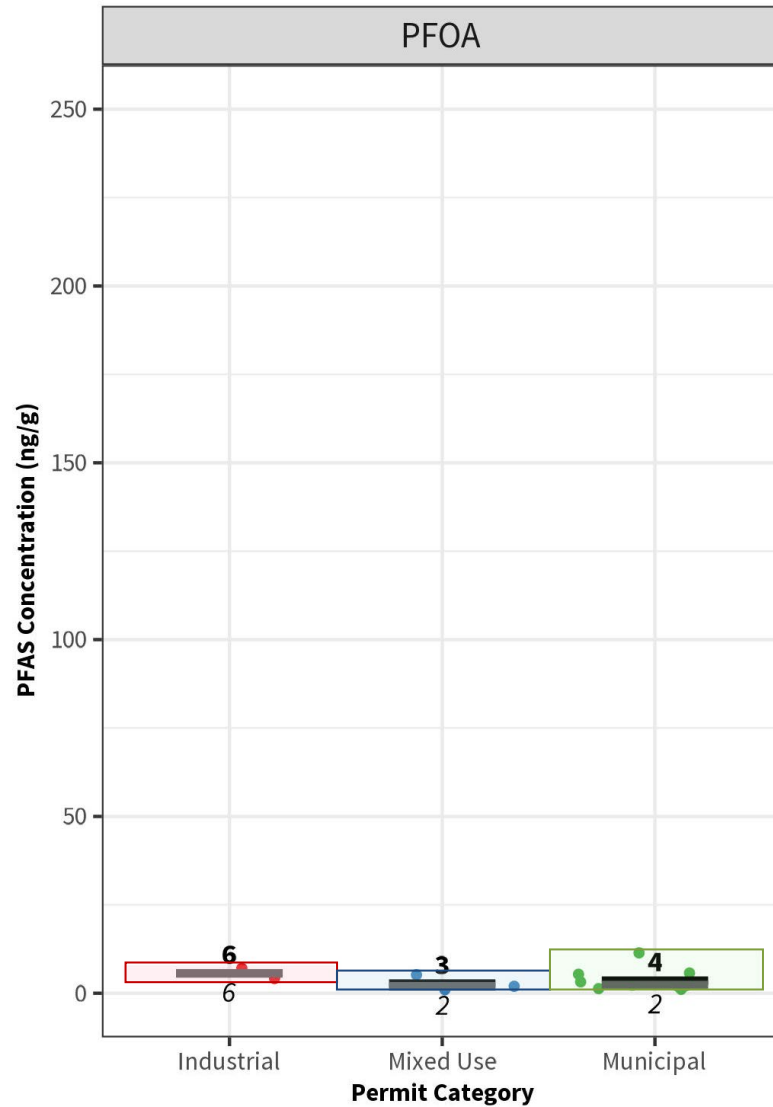
Estimated Mass of PFAS Leaving Sampled WWTPs

(annual basis)



Soil PFAS Data Summary

(Results reported on a dry weight basis; black line with **bold** value = average, gray line with *italicized* value = median)
 please note different vertical scale for Total PFAS graph



1 ng/g = 1000 ppt = 1 ppb

Conclusions

Facility type

- PFAS were detected in all facilities across wastewater, biosolids, soil, & compost samples.
- The majority of treatment facilities had influent and effluent detections above 4 ppt for PFOA and/or PFOS.
- Average Total (quantified) PFAS concentrations were lower for Domestic influent and effluent relative to municipal and industrial wastewaters.

What moves into surface water?

- 87-98% of Total (quantified) PFAS is leaving the sampled WWTPs in effluent discharged to surface water.

What was found in biosolids?

- PFOS was detected in a majority of the biosolids samples (83.3% of facilities tested)
- PFOS concentrations were consistent with other states (NC: 3-256 ppb, US: 0.4-990 ppb).
- 2-13% of Total (quantified) PFAS from WWTP plants estimated to be associated with biosolids.

Soils

- PFOS was found in all soil samples from the land application fields (0.7 - 348 ppb).

Continuing Efforts

- Continued data analysis beyond PFOA, PFOS, and Total PFAS to investigate presence of compounds unique to the Chemours facility
- Final technical report in preparation
- The proposed PFOA, PFOS, and GenX Monitoring and Minimization Rules (15A NCAC 02H .0923 and NCAC 02B .0512) to reduce PFAS in wastewater from direct and indirect dischargers have been advanced for public comment

Three public hearings will be held:

Asheville – Apr 7, 2026

Raleigh – Apr 20, 2026

Wilmington – Apr 23, 2026



[Public Hearing Info](#)

- Continued collaboration with academic researchers and utilities to identify and understand challenges associated with PFAS in wastewater and biosolids.

Thank you for your time!

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We greatly appreciate the contributions of the study participants, and the NC DEQ staff members who supported this effort.

Project website:

<https://www.deq.nc.gov/deq-study-pfas-wastewater-and-biosolids>

