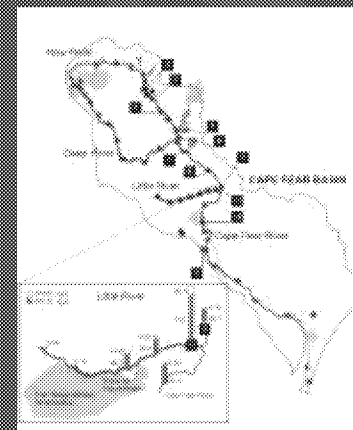
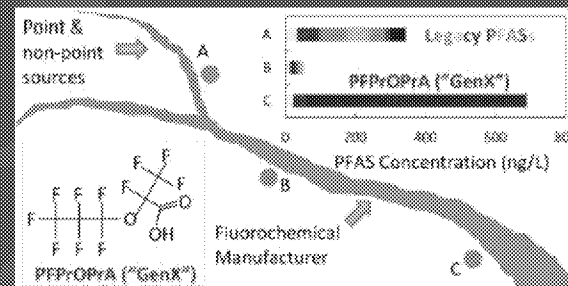


# PFAS: Responding to State and Regional Needs Related to Environmental Health Concerns

*Tim Buckley*

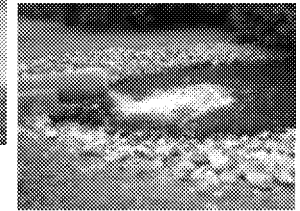


Region 4 State Commissioners' Visit to EPA RTP  
August 30, 2017

# Problem

## An Environmental Health Perfect Storm

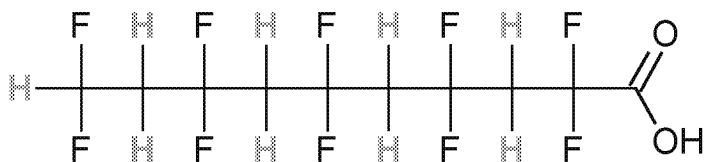
- **Environmental contamination/human exposure**
  - Chemical class includes thousands of different chemicals
  - Highly persistent
  - Leaky production and industrial application
    - Discharges to air
    - Discharges to water
    - Widespread contamination
  - Broad consumer product use: food packaging, stain resistant materials, non-stick cookware and firefighting foam
  - Conventional drinking water treatment ineffective (Rahman et al., 2014)
  - Lack methods for measurement of most new-generation PFAS
- **Human health effects for PFOA and PFOS well established based on human epidemiology and animal studies**
  - Low infant birth weights, effects on the immune system, liver effects, increased cholesterol levels, cancer, and thyroid hormone disruption
  - Largely unknown for other PFAS
- **Many states are dealing with PFAS issues; communities working to respond and asking for assistance include:**
  - Joint Base Elmendorf Richardson in Anchorage, AK
  - Decatur, AL
  - Wurtsmith Air Force Base, MI
  - Cape Fear Watershed, NC
  - Merrimack, NH
  - Hoosick Falls, NY



# What is a PFAS?

Thousands of PFAS in production of industrial and consumer products.

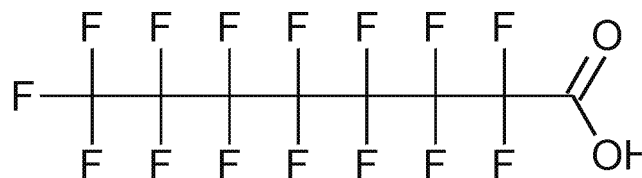
Poly fluorinated = many fluorines



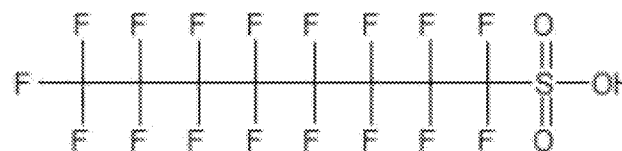
Polyfluorinated carboxylic acid from the production of polyvinylidene fluoride (PVDF) plastic

Newton et al., 2017. Novel polyfluorinated compounds identified downstream of manufacturing facilities near Decatur, AL using high resolution mass spectrometry

Per fluorinated = fully fluorinated



Perfluorooctanoic acid (PFOA, C-8)



Perfluorooctanesulfonate (PFOS)

Very stable (C-F bond energy 485 kJ/mol)  
(C-C 346, C-N 305, C-O 358, C-Cl 327 kJ/mol)

# Agency Response

- **Intra-Agency Coordination**

- Coordination led by Office of the Science Advisor
- Focal areas
  - Filling data gaps in human health toxicity
  - Establishing validated methods for measuring PFAS chemicals
  - Reducing exposure by limiting production and assisting in remediation
  - Ensuring accurate and timely communication to the public and partners
- Workgroups established
  - Human health toxicity
  - Analytical methods
  - Data quality

- **Inter-Agency Coordination**

- Broad participation (CENRS/T&R, CDC, NIEHS, DoD, USGS, DOE, NASA, CPSC)
- Focal areas: toxicity, remediation, communication

- **Support to Regions and States**



# Agency Actions

- **Analytical Methods/Exposure Assessment**
- **Toxicity**
- **Risk Management**

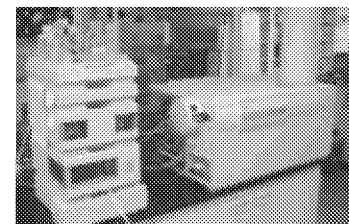
# Agency Actions: Measurements/Exposure

- **PFAS Method Development & Validation Workgroup** (C. Impellitteri)

- Internal Validation
  - 24 PFAS analytes
  - Evaluating data from 6 internal EPA labs on direct inject method for waters other than finished drinking water
  - Preliminary results suggest ready for external validation
- External Validation: 5-8 state laboratories, instrument manufacturers/vendors and contract labs
- Groundwater sampling SOP: Anticipate completing EPA review by late Sept/early Oct
- Future method evaluation: Solid-phase extraction (SPE) method with options for isotopic dilution or internal standards for 24 PFAS analytes

- **Environmental and Biological Matrices** (M. Strynar, A. Lindstrom, J. Washington)

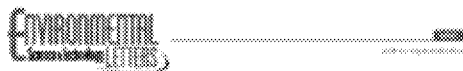
- Water (industrial effluent, surface, source, well, drinking, Brita® filters)
- Soil & sediment
- Animal tissue (fish, mouse)
- House dust
- Food packaging
- Ambient & indoor air (gearing up)
- Dispersions
- Char



Non-targeted  
LC/MS/MS

# Example of Actionable Exposure Research

- Non-targeted analysis reveals previously unknown PFAS drinking water contamination
- ↓
- GenX quantified in drinking water
- ↓
- Local news media picks up research reports
- ↓
- Chemours mitigates GenX discharge to Cape Fear River
- ↓
- NC DEQ, EPA (including Region 4 and ORD) partner to monitor mitigation effectiveness



Legacy and Emerging Perfluoroalkyl Substances Are Important Drinking Water Contaminants in the Cape Fear River Watershed of North Carolina

Shirley A. Healy,<sup>1</sup> Elise Kneib,<sup>2</sup> Mark Slinger,<sup>3</sup> Andrew Ludemann,<sup>4</sup> Michael Stubbins,<sup>5</sup> Rex Suter,<sup>6</sup> Adam Huber,<sup>7</sup> Brian Bost,<sup>8</sup> and Deborah D. Everett<sup>9</sup>

CHEMOURS SAYS IT WILL TAKE ADDITIONAL STEPS TO KEEP GENX FROM CAPE FEAR RIVER AS EPA, STATE BEGIN INVESTIGATIONS

12/10/2016 10:00 AM

12/10/2016 10:00 AM

12/10/2016 10:00 AM



Identification of Novel Perfluoroalkyl Ether Carboxylic Acids (PFECAs) and Sulfonic Acids (PFESAs) in Natural Waters Using Accurate Mass Time-of-Flight Mass Spectrometry (TOFMS)

Mark Slinger,<sup>1</sup> Jesse Higgins,<sup>2</sup> Rebecca McAllen,<sup>3</sup> Wang Liang,<sup>4</sup> Andrew Ludemann,<sup>5</sup> Erik Anderson,<sup>6</sup> Lynn McMillan,<sup>7</sup> Michael Thomas,<sup>8</sup> Isaac Foster,<sup>9</sup> and Carol Bell<sup>1</sup>



NEW TEFLON TOXIN FOUND IN NORTH CAROLINA DRINKING WATER

Mark Slinger  
12/10/2016 10:00 AM

The Teflon Toxin  
Part 2.2

12/10/2016 10:00 AM



# Agency Actions: Tox Testing

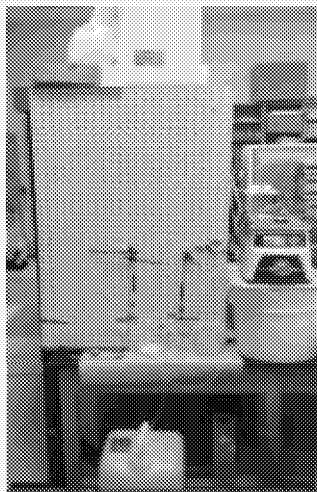
- **Animal studies related to legacy PFAS effects** (Chris Lau)
  - Liver toxicity (fatty liver)
  - Liver toxicity influenced by chain length, functional group, and genomic signature to identify modes of action
  - Species comparison on toxicokinetics of short-chain PFAS replacement
  
- **Comprehensive literature review of ~31 PFAS** (Lynn Flowers)
  
- **Initiatives being considered**
  - Screen using computational tox methods including read-across
    - Near-term: 31 PFAS of interest due to occurrence
    - Longer-term: >3,000 PFAS reported in the environment
  - In vitro testing of Cape Fear water extracts (Chemours upstream vs downstream)
  - Apply *in vitro* assays and toxicogenomic investigation
  - Coordination with cross-agency workgroups on human and ecological health risk assessment of legacy PFAS and their replacements

# Agency Actions: Risk Management

(NRMRL - POC Alice Gilliland)

## Bench to Full- Scale Treatment of PFAS Contaminated Water

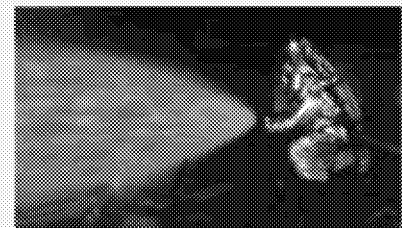
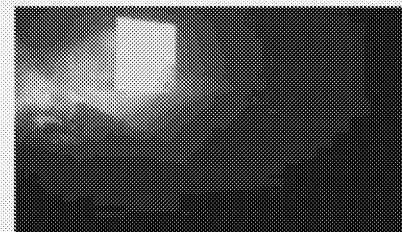
- You just don't treat PFAS – you treat the water – there are many waters/challenges
- Need “Toolbox” of technologies to implement “Treatment Trains” for specific sites
- DOD collaborations are real world applications: Air Force Institute of Technology, Little Rock AFB, Joint Base (Alaska), Rhode Island, SERDP (proposed)



**BENCH** Scale Studies at Air Force Institute of Technology to work out conditions



**FULL** Scale Studies at EPA's Water Security Test Bed at Idaho National Laboratory (Summer 2016 and 2017)



**APPLIED** at Little Rock Air Force Base hangar/building fire suppression systems (planned Fall 2017)

## PFAS at Contaminated Sites

**Analytical methods** for PFASs, precursors and intermediates

**Site characterization** approaches for sampling, analytical methods, QA/QC and data review

**Treatment** in drinking water, wastewaters, biosolids, groundwaters and emergency response wastes

**Site remediation and risk management** approaches at PFAS-impacted sites (e.g. DOD fire training areas, manufacturing sites, legacy waste management sites, co-contaminants)



# Additional Information

- **PFAS in Your Environment**
  - <https://www.epa.gov/pfas>
- **EPA Method 537**
  - <https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockkey=P100EQ6W.txt>
- **Drinking Water Health Advisories for PFOA and PFOS**
  - <https://www.epa.gov/ground-water-and-drinking-water/drinking-water-health-advisories-pfoa-and-pfos>



# Contact Information

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