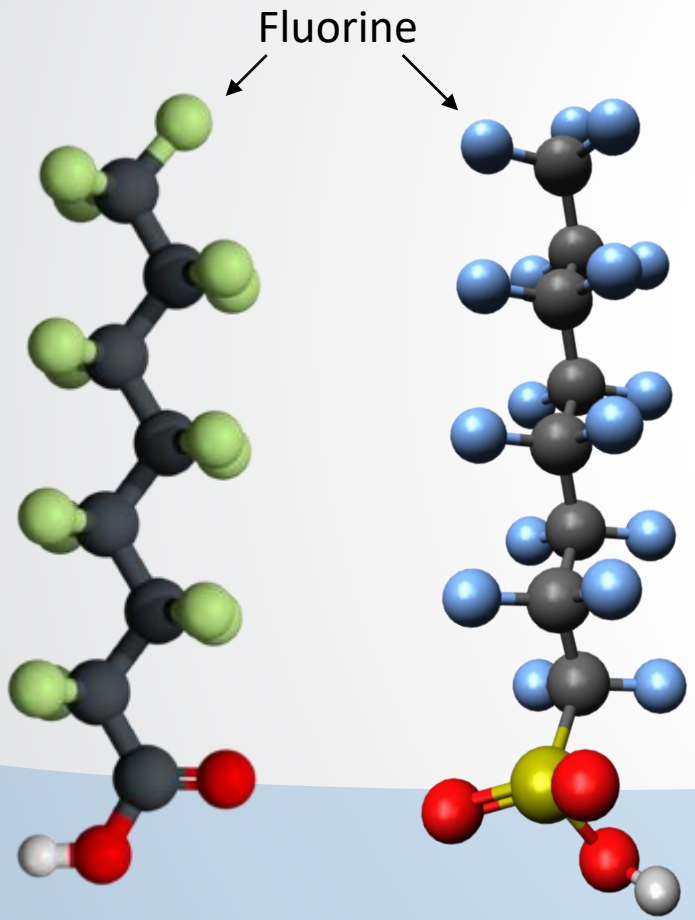
US EPA
PFAS Research and Development

Community Engagement in Fayetteville, North Carolina

August 14, 2018

Per- and Polyfluoroalkyl Substances (PFAS)



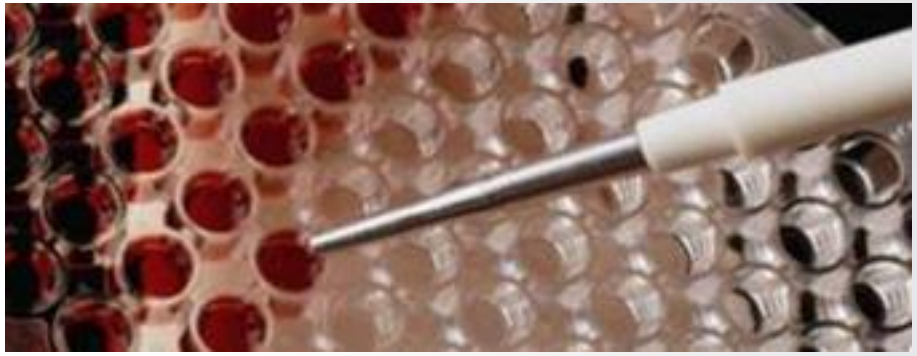
PFOA *PFOS*

A class of man-made chemicals

- **Chains** of carbon (C) atoms surrounded by fluorine (F) atoms, with different endings
- **Complicated chemistry** – thousands of different variations exist in commerce
- **Widely used** in industrial processes and in consumer products
- **Some** PFAS are known to be **PBT**:
  - **Persistent** in the environment
  - **Bioaccumulative** in organisms
  - **Toxic** at relatively low (ppt) levels

Current Per- and Polyfluoroalkyl Substances (PFAS) Research and Development Activities

- Analytical Methods
- Exposure
- Human Health/Toxicity
- Treatment/Remediation
- Technical Assistance



Research: Analytical Methods

- **Problem**: Lack of standardized/validated analytical methods for measuring PFAS
- **Action**: Develop and validate analytical methods for detecting, quantifying PFAS in water, air, and solids
- **Results**:
  - Testing current drinking water method for 6 additional PFAS (20 total, including GenX)
  - Developing and testing method for 20 PFAS in surface water, ground water, and solids
  - Initial development of method for air emission sampling and analysis
  - Continued development of non-targeted methods to discover unknown PFAS
- **Impact**: Stakeholders will have reliable analytical methods to test for known and new PFAS in water, solids, and air

Research: Exposure

- **Problem**: Lack of knowledge on sources, site-specific concentrations, and exposure
- **Action**: Develop and test methods to characterize PFAS sources and exposures
- **Results**:
  - Developing exposure models for identifying, quantifying PFAS exposure pathways and relative source contribution
  - Developing and evaluating sampling and site characterization approaches to identify sources and extent of contamination.
- **Impact**: Stakeholders will be able to assess potential PFAS sources and exposures, and identify key exposure pathways for risk management

Research: Human Health/Toxicity

- **Problem**: Lack of toxicity values for many PFAS compounds
- **Action**:
  - Literature review of published toxicity data for 31 PFAS of interest
  - Conduct assessments, fill gaps through computational toxicology
- **Results**:
  - Literature review complete, ~21 PFAS with some in vivo data to support assessment
  - Toxicity assessment underway for GenX, PFBS
  - Computational assays underway for 75 PFAS representative of PFAS chemical space
- **Impact**: Stakeholders will have PFAS toxicity values to support risk management decisions and risk communication

Research: Drinking Water Treatment

- **Problem**: Lack of water treatment technology performance and cost data for PFAS removal
- **Action**:
  - Review PFAS performance data from available sources (industry, DoD, academia, international)
  - Test commercially available granular activated carbons (GACs) and ion exchange (IE) resins for effectiveness over a range of PFAS under different water quality conditions
  - Evaluate a range of system sizes – large full-scale utility options to home treatment systems
- **Results**:
  - Update EPA's **Drinking Water Treatability Database**, a public database for treatment performance data for regulated and unregulated contaminants
  - Use state-of-the-science models to extrapolate existing treatment studies to other conditions
- **Impact**: Utilities will be able to identify cost effective treatment strategies for removing PFAS from drinking water

Research: Contaminated Site Remediation

- **Problem**: PFAS-contaminated sites require remediation and clean up to protect human health and the environment
- **Action**:
  - Characterize sources of PFAS such as fire training and emergency response sites, manufacturing facilities, production facilities, disposal sites
  - Evaluate treatment technologies for remediating PFAS-impacted soils, waters, and sediments
  - Generate performance and cost data with collaborators to develop models and provide tools to determine optimal treatment choices
- **Results**: Tools, data and guidance regarding cost, efficacy, and implementation for remedy selection and performance monitoring
- **Impact**: Responsible officials will know how to reduce risk of PFAS exposure and effects at contaminated sites, and to repurpose sites for beneficial use

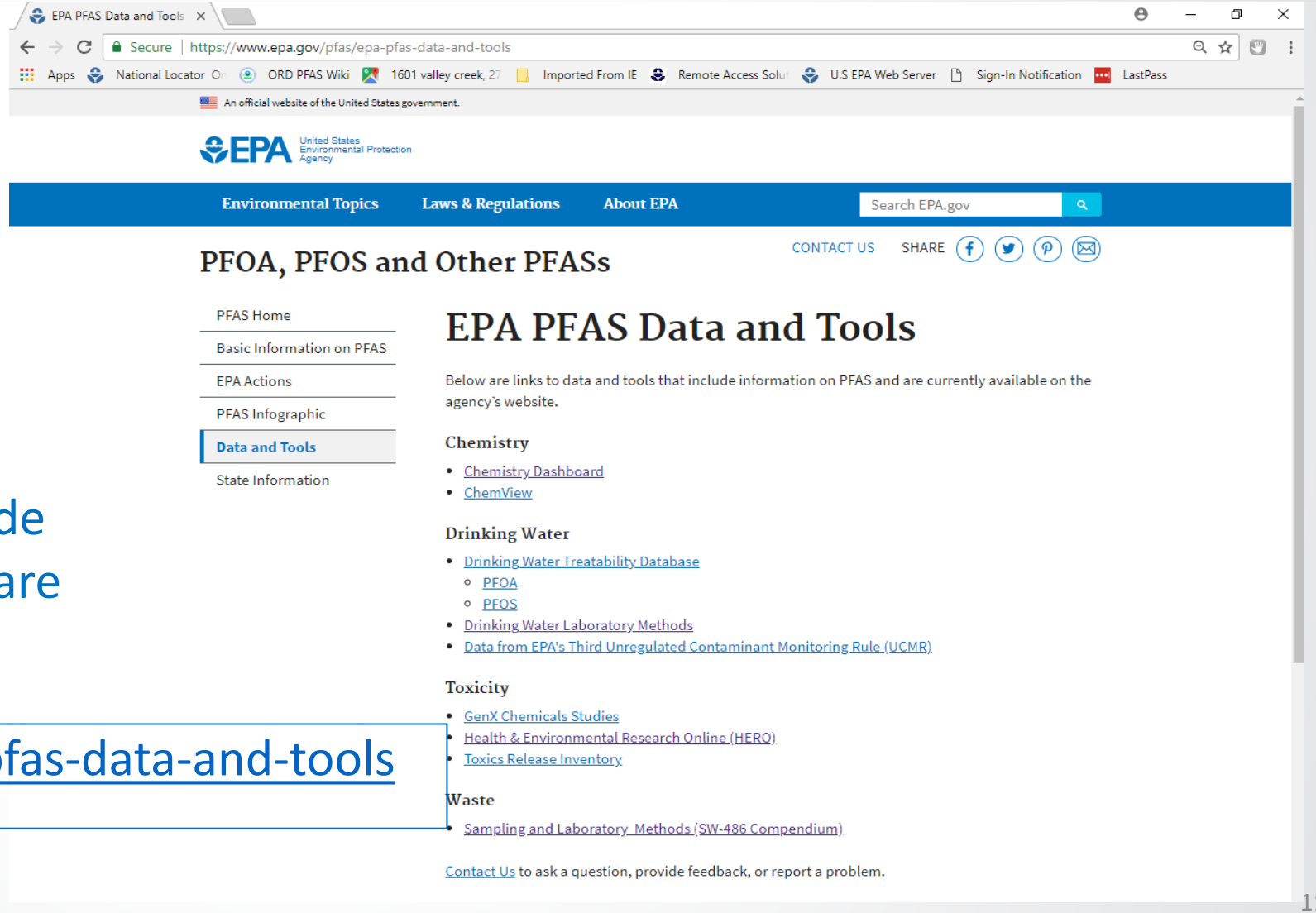
Research: Materials Management

- **Problem**: Lack of knowledge regarding end-of-life management (e.g. landfills, incineration) of PFAS-containing consumer and industrial products
- **Action:**
  - Characterize various end-of-life disposal streams (e.g. municipal, industrial, manufacturing, landfills, incinerators, recycled waste streams) contributing PFAS to the environment
  - Evaluate efficacy of current and advanced waste management technologies (e.g. landfilling, thermal treatment, composting, stabilization) to manage PFAS at end-of-life disposal
  - Evaluate performance and cost data with collaborators to manage these materials and manage PFAS releases to the environment
- **Results**: Provide technologies, data and tools to manage these end of use streams
- **Impact**: Responsible officials will be able to manage effectively end-of-life disposal of PFAS-containing products

Technical Assistance for States, Tribes and Communities

- **Problem**: State, tribes and communities sometimes lack full capabilities for managing PFAS risk
- **Action:**
  - Make EPA technical staff available to consult on PFAS issues
  - Utilize applied research at impacted sites to develop new research solutions while also providing technical support to site managers
  - Summarize reoccurring or common support requests to share lessons learned from technical support activities
- **Results**: Many examples of past and ongoing technical assistance
  - **Cape Fear River, NC** – Significant reductions in PFAS in source and finished drinking water
  - **Manchester, NH** – Collaboration on air and water sampling
  - **Newport, RI** – Review and support to DOD PFAS sampling at Naval Station Newport
- **Impact**: Enable states, tribes and communities to 'take action on PFAS'

EPA PFAS Data and Tools



Links to data and tools that include information related to PFAS and are available on EPA's website:

https://www.epa.gov/pfas/epa-pfas-data-and-tools

Fayetteville PFAS Meeting
August 14, 2018
Fayetteville, NC

Office of Land and Emergency Management

PFAS Activities Update

Laurence Libelo, Ph.D., P.G.
Office of Superfund Remediation and Innovative Technology
U.S. Environmental Protection Agency

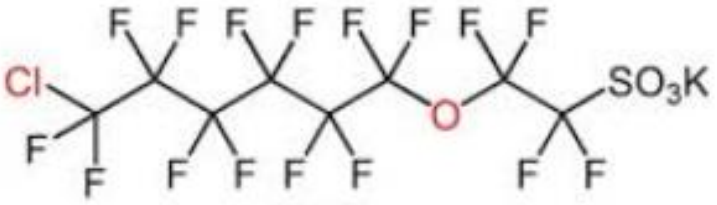
Fluorochemicals - Background

- The chemistry of fluorocarbons, including PFAS, is very extensive, complex, and confusing
- Fluorocarbon chemicals are all interrelated
- Thinking of them as “single” chemical or classes of chemicals can be problematic

Fluorochemicals - Background

- Fluorinated Molecule
  - Some of the hydrogens have been replaced by fluorine

- Perfluorinated Molecule
  - All of the hydrogens have been replaced by fluorine
  - Perfluoro alkyl substances (PFAS)
    - "PFASs are aliphatic substances containing one or more C atoms on which all the H substituents present in the nonfluorinated analogues from which they are notionally derived have been replaced by F atoms, in such a manner that PFASs contain the perfluoroalkyl moiety C_nF_{2n+1}"



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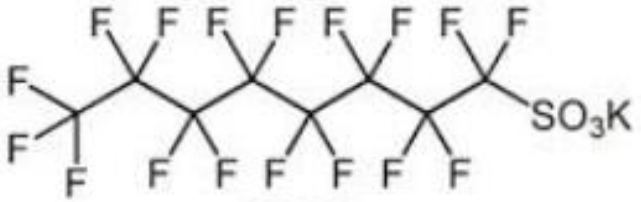
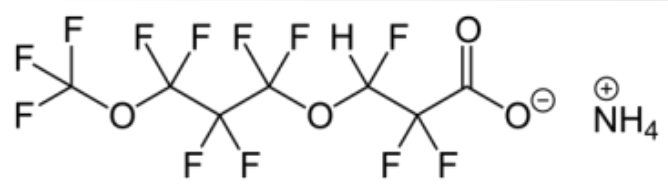


PFOS

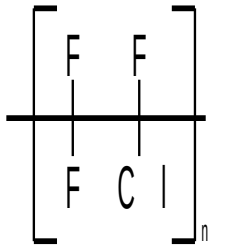
Buck et al., 2011 Integr Environ Assess Manag. 7(4): 513–541

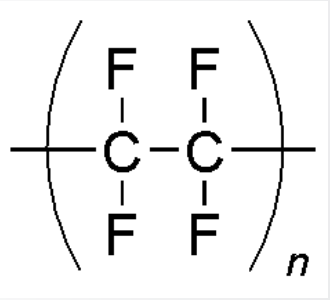
Fluorochemicals - Background

- Monomers
  - Shorter chain molecules with no repeating units

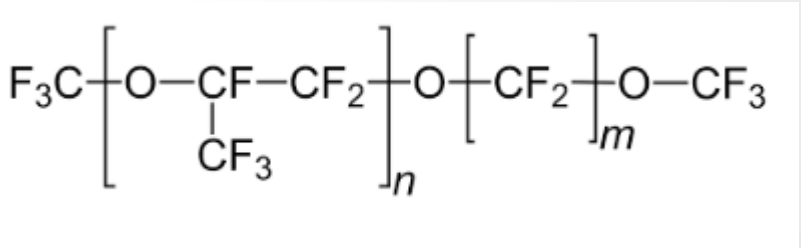


- Polymers
  - Bigger molecules with repeating sections

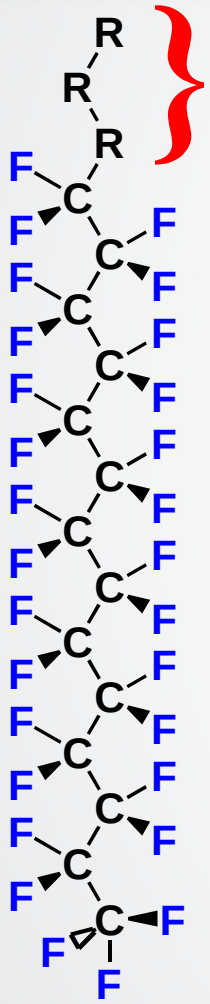




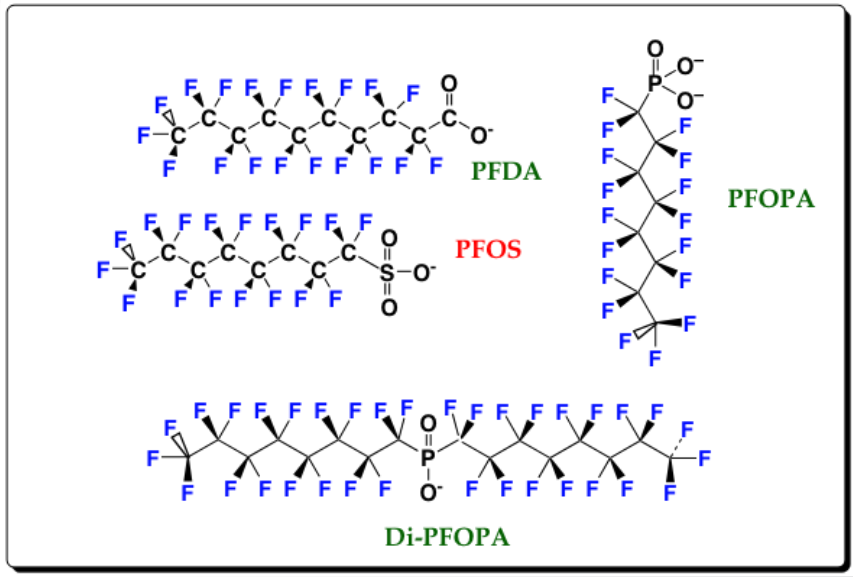
- Oligomers
  - "Small" polymers
    - n = 2 (Dimer), 3 (trimer) etc



Fluorocarbon Chemical Structure



- R can be organic or inorganic
  - CF3
  - COOH
  - OH
  - Chains
  - etc
- Can be monomer or polymer
- Chain can contain only carbon or other atoms
- Perfluoro chain length 2- > 40 and longer
- “Every “R” group that is potentially reactive and tested to date has yielded Perfluoro acids”



(Mabury, 2010)

Fluorochemical Uses

- Anti stain products and water proofing
- Lubricants
- Refrigerants
- Chemical intermediates
- Chemical synthesis processing aids
- Pyrotechnics
- Cosmetics
- Fire suppressants and Fire Fighting Foams (AFFF)
- Paper coatings
- Photoacid generators
- Medical gasses
- Drugs
- Pesticides
- Surfactants
- Etc,

How many PFAS chemicals are there?

- Probably 5000-10,000s
- 1230+ chemical with CF_2-CF_2 reviewed as new chemicals in EPA/OPPT PMN program since about 1980
- Chemical Abstract Service lists 33,469,312 fluoro compound
  - 4730 Perfluoro-related CAS numbers
- TSCA Inventory - 10,619 fluoroethers

- Several hundred being found in environmental samples

PFAS History

- Fluoro organic and PFAS chemicals have been known since the 1920s-30s
- The synthesis processes have been in use for 50+ years
- PFAS chemicals have been in widespread use in a wide variety of applications the 1950s or 60s
- Increasing understanding of the potential risks to human health and the environment have lead to action across EPA to understand and deal with releases

Office of Land and Emergency Management (OLEM)

- Provides policy, guidance and direction for the Agency's emergency response and waste programs. At OLEM, we:
- Develop guidelines for the land disposal of hazardous waste and underground storage tanks;
- Provide technical assistance to all levels of government to establish safe waste management practices;
- Support state and local governments in redeveloping and reusing potentially contaminated sites through the Brownfields program;
- Respond to abandoned and active hazardous waste sites, as well as accidental chemical releases through the Superfund program; and
- Encourage innovative technologies to address contaminated soil and groundwater.

PFAS Contamination

- Contamination routes vary
  - AFFF usage, testing, storage – groundwater, soil, wastewater
  - Biosolids application – soil to groundwater
  - Landfills – leachate to groundwater or wastewater
  - Manufacturing sites – wastewater and air deposition
- PFAS found at sites
  - AFFF sites: PFCA C4-14; PFSA C4-10; FtS 4:2, 6:2, 8:2; PFOSA, NEtFOSAA, NMeFOSAA
  - Non AFFF sites: PFCA C4-13; PFSA C4-8; FtS 6:2, NMeFOSAA

PFAS National Leadership Summit

- EPA will initiate steps to evaluate the need for a maximum contaminant level (MCL) for PFOA and PFOS. We will convene our federal partners and examine everything we know about PFOA and PFOS in drinking water.
- EPA is beginning the necessary steps to propose designating PFOA and PFOS as “hazardous substances” through one of the available statutory mechanisms, including potentially CERCLA Section 102.
- EPA is currently developing groundwater cleanup recommendations for PFOA and PFOS at contaminated sites and will complete this task by fall of this year.
- EPA is taking action in close collaboration with our federal and state partners to develop toxicity values for GenX and PFBS by this summer.

Additional OLEM PFAS Efforts

Developing Analytic Methods for Land Cleanup Programs

- Draft SW-846 Method 8327 Direct Inject (DI) LC/MS/MS for non-potable waters (surface water, groundwater, waste water)
  - Screening method
  - Currently in development and validation
- Draft SW-846 Method 8328 Solid Phase Extraction (SPE) isotopic Dilution Method for non-potable waters and solid matrices (soils, sediments, waste)
  - Currently being drafted
  - R3 and ORD/NRML performing single lab validation
  - DoD has offered to help with external validation

Other PFAS activities

- Groundwater Sampling Best Practices recommendations
  - In final technical review
- Updating draft list of uses and industries and manufacturing and use sites
- Evaluating Draft and Updated (PFBS) Toxicity Assessments from ATSDR, EPA (ORD, OW) and others
- Working with science community, states, other agencies, etc. to understand PFAS science
- Providing Technical Support

EPA Research to Support Source/Site Characterization and Cleanup

Community Engagement Meeting in Fayetteville, North Carolina

U.S. Environmental Protection Agency

EPA's Research Areas

Source/Site Characterization and Cleanup

1. **PFAS Analytical Methods Development** - Develop analytical methods for measuring PFAS in environmental matrices.

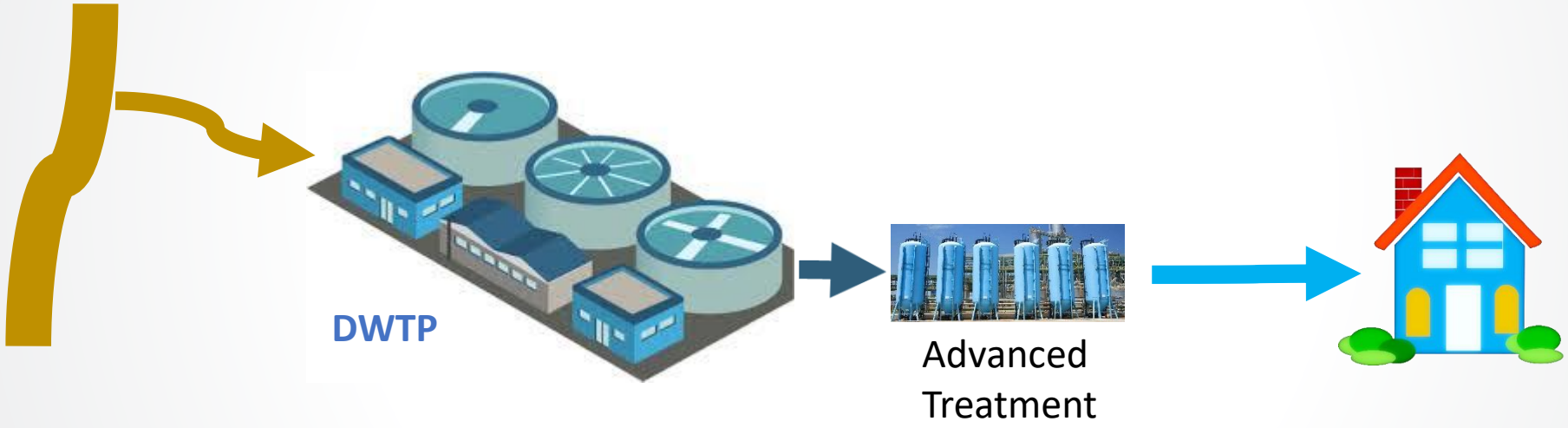
2. **Site Characterization and Source Identification** - Collecting data on PFAS environmental concentrations and sources to support state, regional, and federal partners.

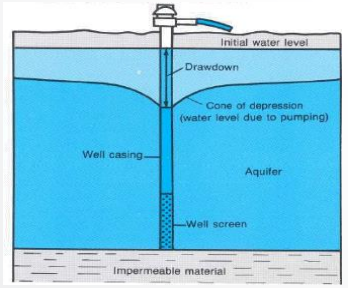
3. **Treatment and Remediation Technologies for PFAS Contaminated Media** - Develop and evaluate risk management options (treatment or remediation) for PFAS-contaminated environmental media.

4. **Technical Support for PFAS Contaminated Sites** - Supporting state, regional, tribal, community, and federal partners to (1) evaluate analytical methods, (2) characterize sites/sources, and (3) assess treatment/remediation options for PFAS contaminated environmental media. This support leads to well-informed risk management decisions by EPA and its partners.

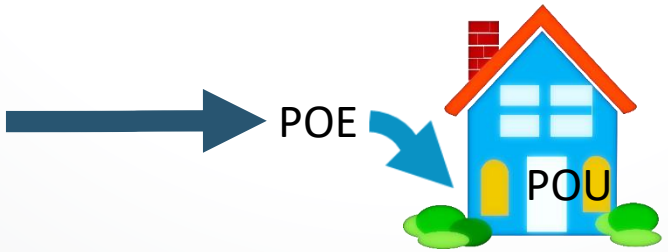
Mitigation Needs

Treat the drinking water to cut off the exposure route





https://pubs.usgs.gov/gip/gw_ruralhomeowner/



POE = Point of Entry Treatment

POU = Point of Use Treatment

Mitigation Needs

Manage the sources

Primary and Secondary Manufacturing

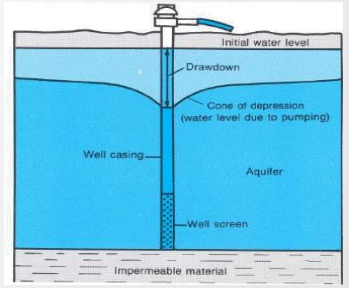
Consumer products use/disposal

Wastewater plants

Industrial processes

Landfills

Direct use in the environment



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Manage the sources

Primary and Secondary Manufacturing

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Direct use in the environment

Methods and Site Characterization Research…

Site Characterization Research

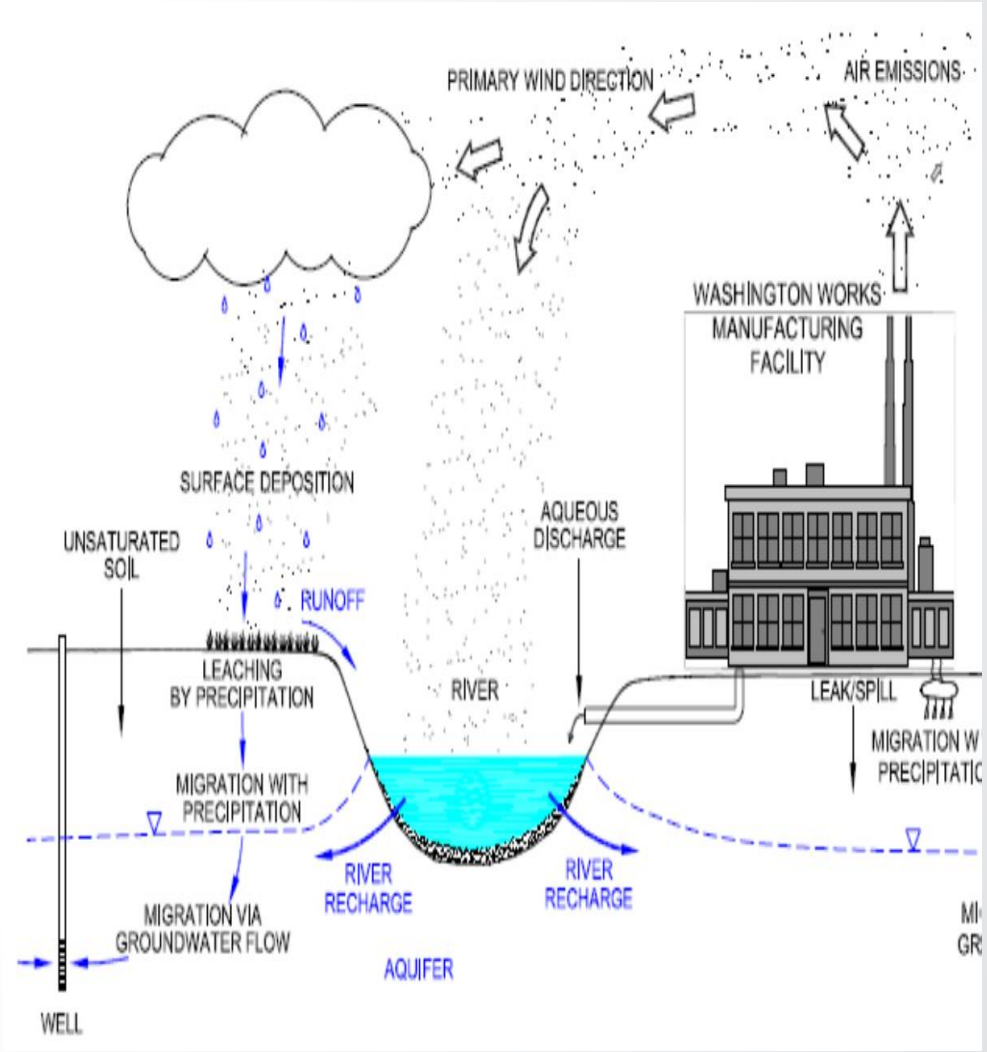
Research needed to fully understand the appropriate conceptual site model to drive site investigations

- Needed: mechanistic understanding of the physical, chemical, and biological processes acting on PFAS
- With well defined mechanisms, modeling of fate and transport will allow for characterizing site impacts which will lead to the evaluation and implementation of remedies

Common specific needs from regions, states, tribes, communities, and responsible parties:

Standard sampling methods and approaches needed to assure integrity of the samples and data, such as…

1. What PFAS do we measure…
   2, 12, 22 analytes …more? Precursors?
2. Need EPA SOPs for PFAS in water, solids, and tissues to assure quality data is used for decision making
3. What are the impacts of co-contaminants?
4. Need models to predict fate and transport



EPA's Site Characterization research…

Analytical methods for complex environmental matrices

1. **PFAS methods**
   - Developing non-potable water and solids methods
   - Evaluating extraction and lab automation for higher throughput and allowing for smaller sample volumes
2. **Precursor methods**
   - Draft analytical methods for a limited number of known precursors of PFAS
   - Evaluating the Total Oxidizable Precursor assay to attempt to capture total precursor
3. **Non-targeted analysis to characterize degradation pathways, precursors, and unknown PFAS**

EPA is also working with outside organizations on standardizing sampling protocols for field collection

Sampling and Analytical issues for Site Characterization

Observations from preliminary site investigations:

- Limited sampling to characterize sites
- Sampling approach and equipment not evaluated for PFAS
- Site characterization and source identification affected by:
  - Many PFAS-products have varying formulations, chemistries, etc
  - Lengthy time in environment can result in transformations
  - Co-contaminants present but not sampled simultaneously
  - Remediation technologies used for other contaminants may impact PFAS concentrations and distributions

Manage the sources

Primary and Secondary Manufacturing

Consumer products use/disposal

Wastewater plants

Industrial processes

Landfills

Direct use in the environment

Remediation Research and Technical Assistance…

EPA's Remediation Research Activities…

Wastewater Treatment

- **PFAS treatment in model wastewater treatment reactors**
  Evaluating PFOS fate during activated sludge treatment
- **PFAS in wastewater residuals and effluent**
  Evaluating nine wastewater treatment facilities for treatment of PFAS (+ CECs)
- **Fate of PFAS during land application of biosolids**
  Evaluating the fate of common wastewater related contaminants including PFAS
- **PFAS occurrence and fate during direct potable reuse (DPR)**
  Evaluating of the fate of PFAS (+ CECs) during wastewater treatment plants in three DPR facilities
- **PFAS from source water to drinking water**
  Evaluating the impact of wastewater treatment on downstream drinking water treatment including PFAS (+ CECs)

EPA 's Remediation Research Activities…

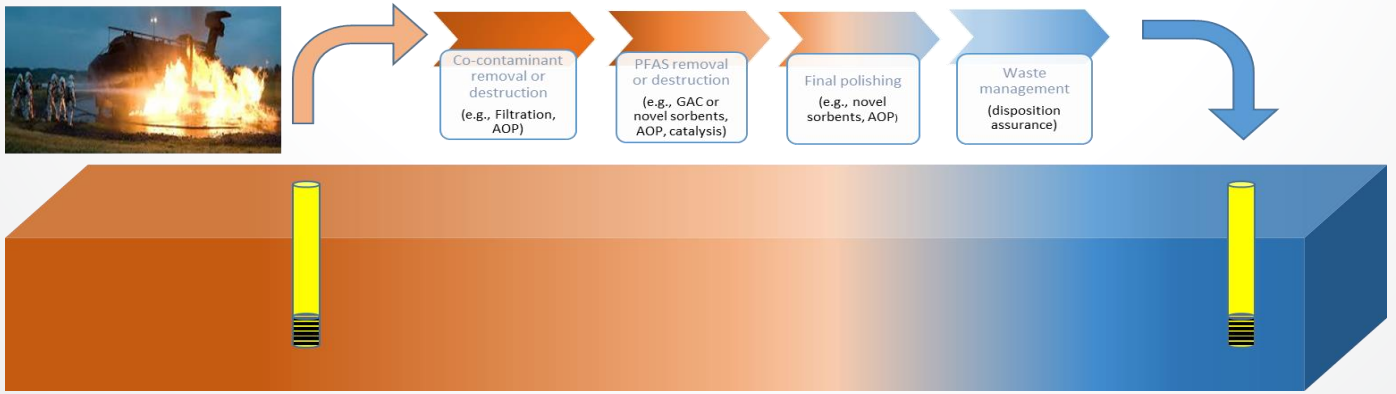
Occurrence and impacts of PFAS in complex mixtures

- **Emerging Contaminants in Surface Waters**
  - Evaluating 40 impacted surface water bodies to evaluate complex mixtures of CECs, including PFAS
  - Collaboration with USGS
- **Emerging Contaminants in the Great Lakes and their impacts on wildlife**
  - Evaluating forensic approach for source allocation or identification
  - Evaluating passive sampling approaches
  - Includes bioassays and adverse outcome pathway related studies
  - Collaboration with GLNPO (GLRI), USFW, USGS, USACE, NOAA, and academia
- **PFAS along the Ohio River**
  - Evaluating PFAS in the Ohio River
  - Anticipated to start in Spring 2019 to capture low- and high-flow events
  - Collaboration with ORSANCO

EPA Remediation Research activities…

Treatment/Remediation technology evaluations

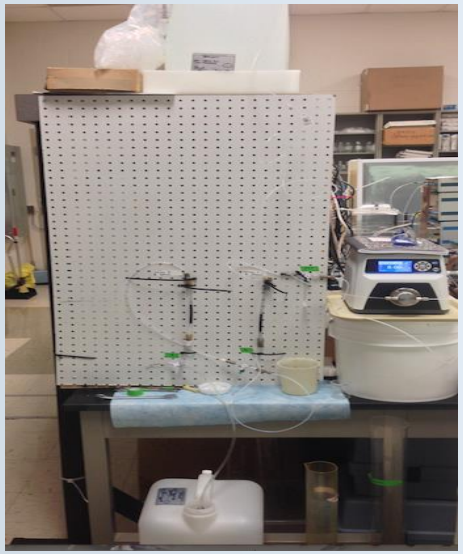
- **Treatment trains for treating PFAS at DOD and emergency response sites**
  - Evaluating technologies to apply in a treatment train approach to manage PFAS in complex matrices and with difficult co-contaminants
  - Collaboration with USACE, Purdue University, and Air Force Institute of Technology (AFIT)
- **Immobilization Technologies for PFAS Contaminated Soils**



Bench- to Full-Scale Treatment of PFAS Contaminated Water

Collaboration between EPA and DOD

- You just don't treat PFAS – you treat the entire matrix – there are many different waters and challenges
- Need "Toolbox" of technologies to implement "Treatment Trains" for specific sites
- DOD real world applications: Air Force Institute of Technology, Idaho National Laboratory, Joint Base Elmendorf Richardson (Alaska), Rhode Island sites, and SERDP



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

Water Security Test Bed Video: https://youtu.be/olCs_kbegBA

FULL Scale Studies at EPA's Water Security Test Bed at Idaho National Laboratory

APPLIED at DOD facilities with hangar/building fire suppression systems

Immobilization Technologies for PFAS-Contaminated Soils

Existing technologies have limitations

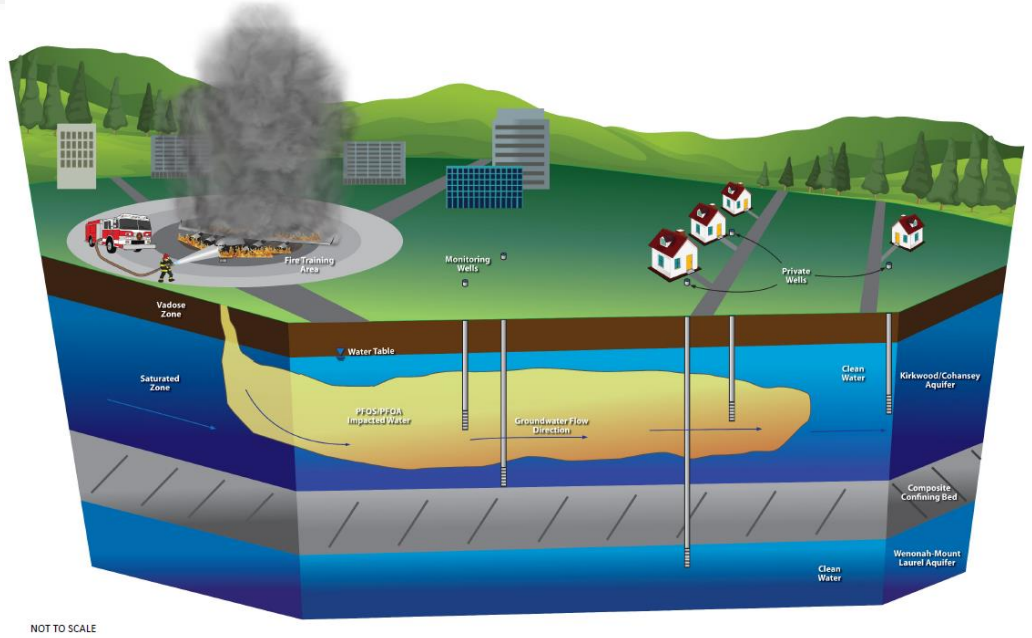
- Excavation and incineration
- Capping

In-situ strategies are preferred under Superfund

- Treatment
- Stabilization/Immobilization

There has been limited research on PFAS stabilization

- Stabilization well studied for some contaminants
- No comparable data available for PFAS



Technical Assistance for PFAS Contamination:

Example at Joint Base Elmendorf Richardson (JBER):

- Direct support to Regional Project Managers (RPMs)
  - Providing technical review of the preliminary site investigation at JBER
- Evaluation of Analytical Methods
  - Provided technical review of analytical methods
  - Utilized EPA developed methods and provided PFAS and PFAS precursor data
  - Comparing results with other analytical methods from outside laboratories

EPA's Research Areas

Source/Site Characterization and Cleanup

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EPA PFAS Community Meeting – Science Panel

Division of Water Resources

Linda Culpepper, Interim Director

August 14, 2018

Current Water Sampling by DEQ, and Analysis by EPA Athens Laboratory

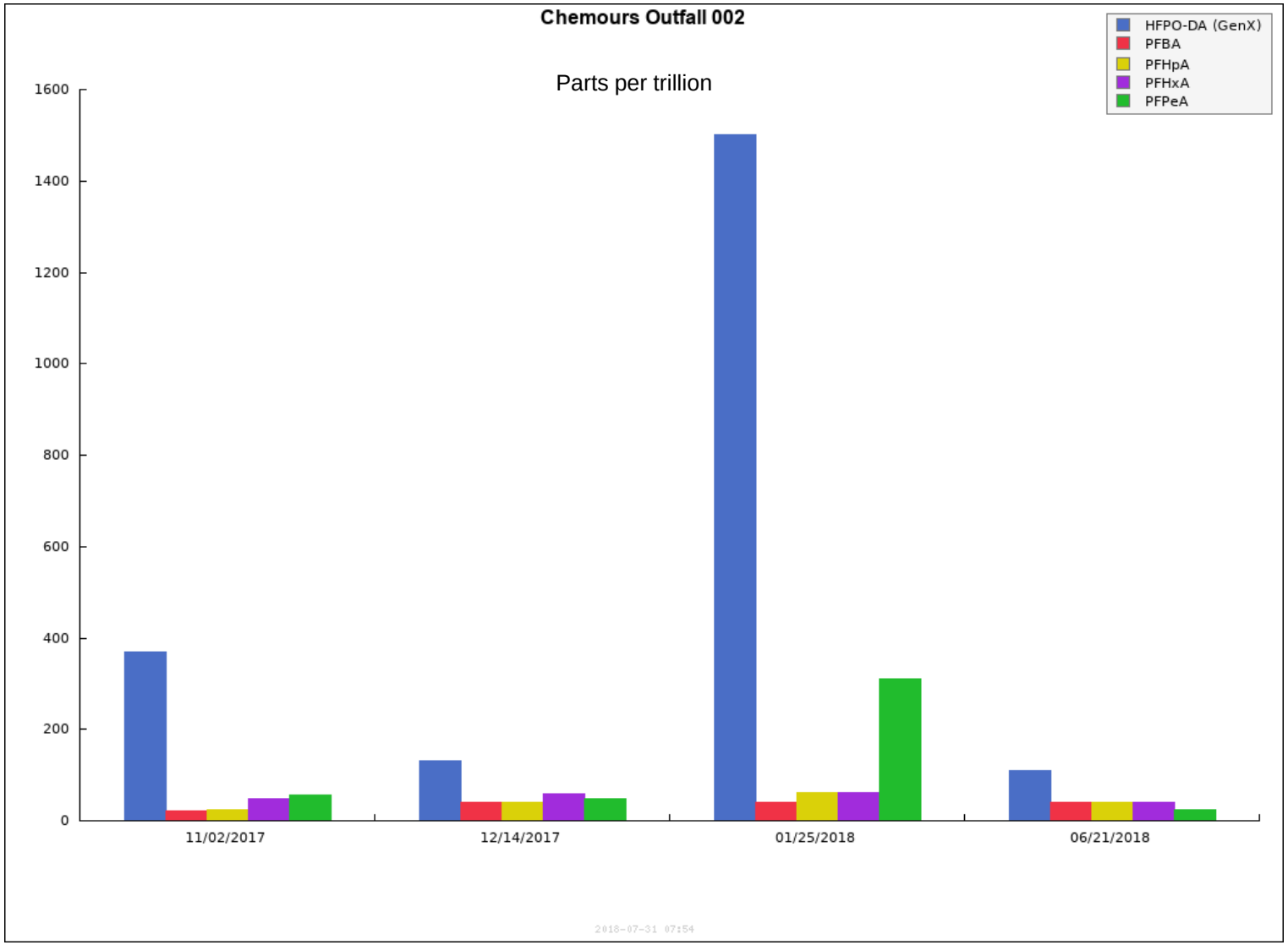
- Two composite samples weekly at Chemours wastewater outfall into the Cape Fear River:
  - Monday–Thursday and Friday-Sunday

- Drinking water facilities downstream are sampled weekly:
  - Bladen Bluff
  - International Paper
  - NW Brunswick
  - Pender County
  - CFPU Sweeney

- Starting ambient monitoring for PFAS across North Carolina
  - Jordan Lake watershed monthly Jan – June 2018
  - Falls Lake watershed monthly May – October 2018

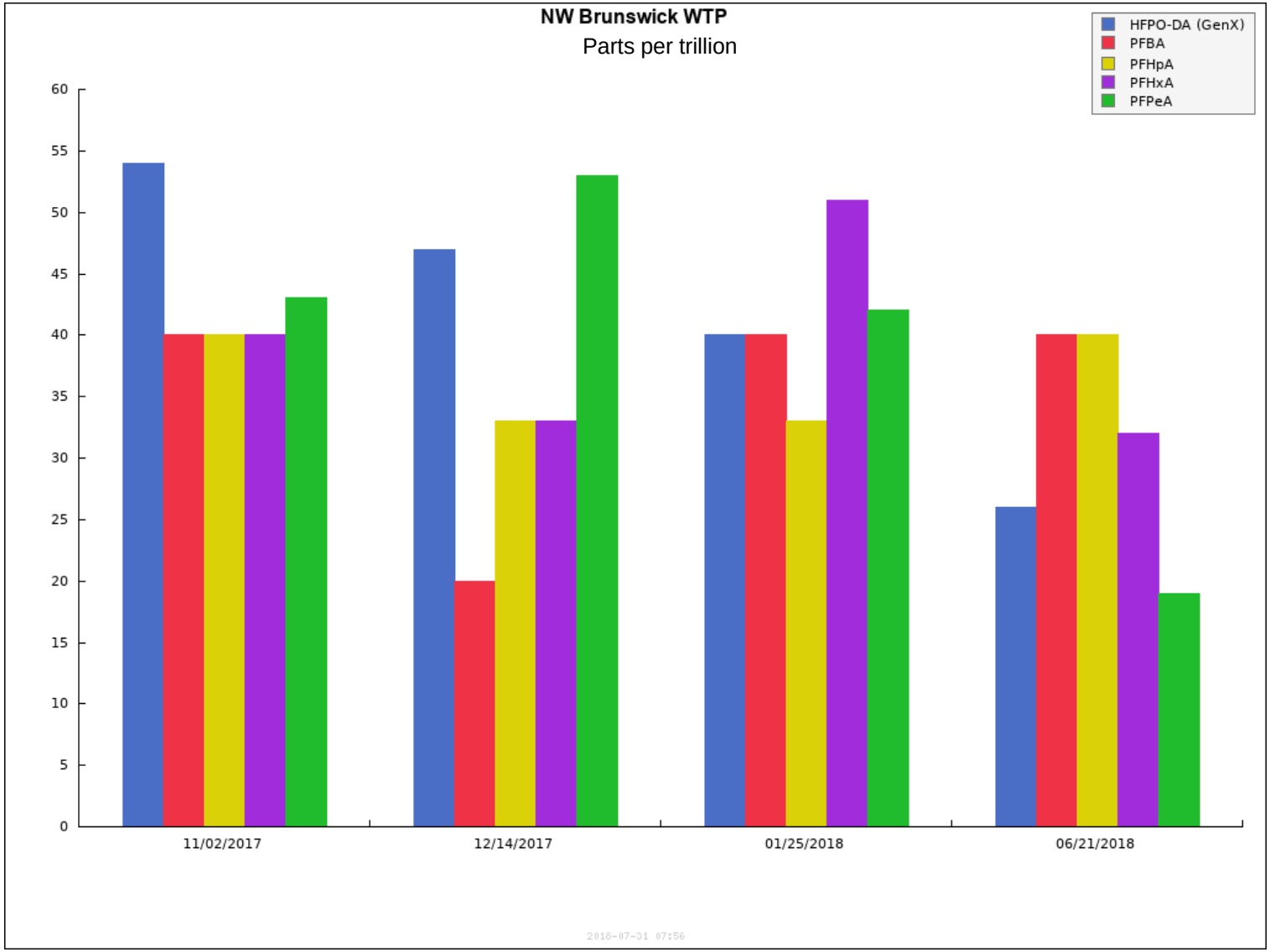
NORTH CAROLINA
Department of Environmental Quality

Data from Chemours Wastewater outfall (parts per trillion)



Example of Data from Drinking Water Facility (parts per trillion)

Note: scale is different from prior slide



NORTH CAROLINA
Department of Environmental Quality

GenX Private Well Data Summary

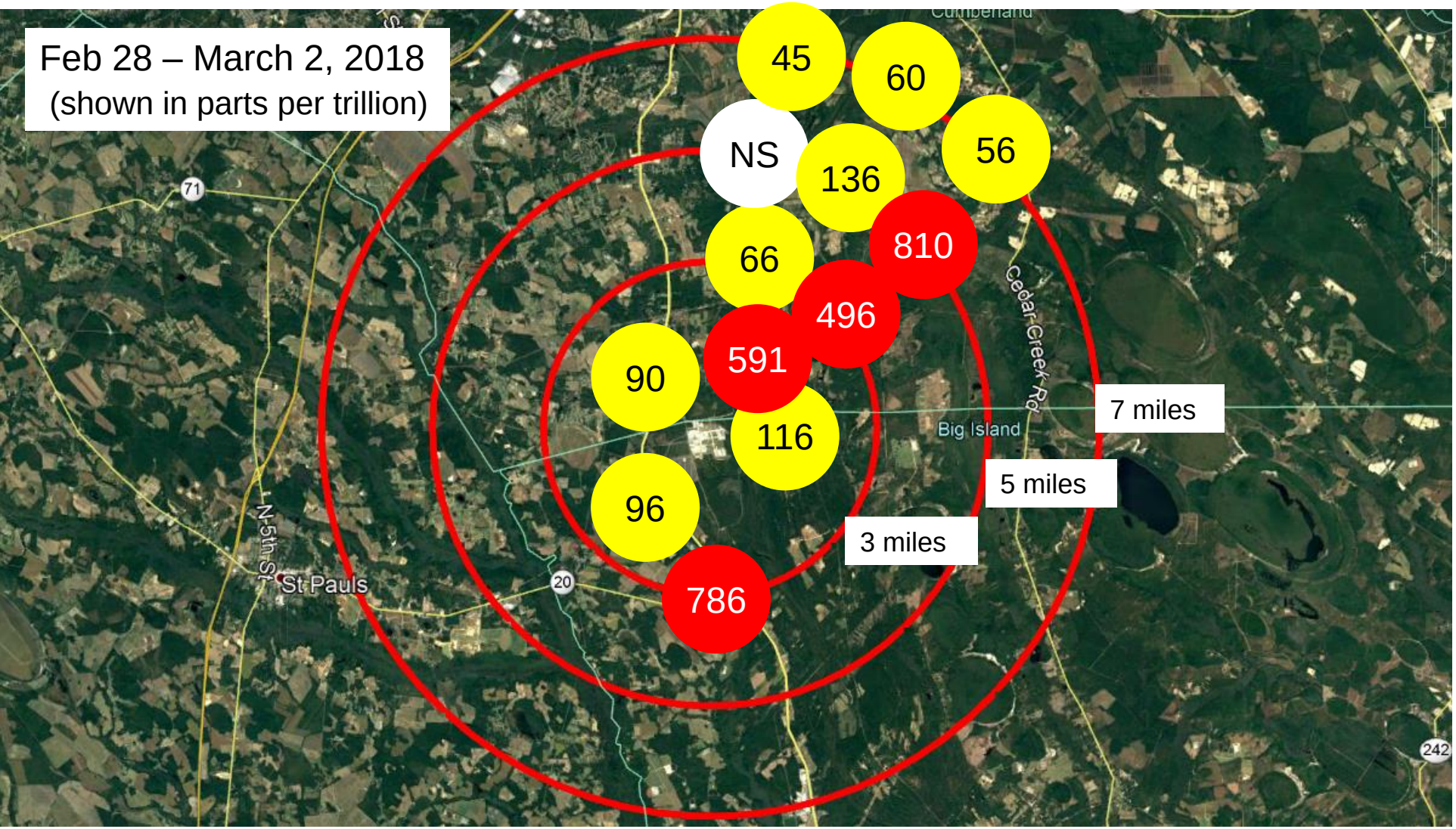
Combined Phase I, II, III , IV (partial) Private Well PFAS Data, also includes Robeson Co. and DEQ-collected Data

Private Well Water GenX Summary	Combined Well Data
Distance from Chemours' border	Up to 5.5 miles
Well Collection Dates	9/6/2017 – 6/13/18
Number of Wells tested	823
Number of Exceedances of the GenX Provisional Health Goal	164
Number of Not-Detected ("ND") GenX Analyses	220
Number of GenX Detections Less than the Health Goal [a]	439
Maximum Detected GenX Concentration	4000 ng/L

a. The NC DHHS Provisional Drinking Water Health Goal for GenX is 140 ng/L (July 2017)

NORTH CAROLINA
Department of Environmental Quality

GenX Rainwater Data around Chemours



Path Forward

- Chemical analysis – develop and harmonize existing test methods
  - Wastewater, sediment, soil, food, air emissions, blood serum, urine
  - Reporting limits and throughput

- Research on human health and ecological toxicity
  - Rapid bioassays
  - Chemical mixtures – evaluate additive and synergistic effects
  - Evaluate the need for new wastewater Whole Effluent Toxicity methods for aquatic toxicology (add new organisms for surrogate testing)
  - Evaluate bioaccumulation in food chain
  - Toxicity bench marks (Reference Dose, similarity in chemical families, cumulative exposure)

- NC is using the Secretaries' Science Advisory Board to make recommendations on health values and to prioritize chemicals for evaluation

NORTH CAROLINA
Department of Environmental Quality

Human and Ecological Health-Effect Needs

- A suite of toxicity assays providing a comprehensive database of translatable human and ecosystem health endpoints, that can be generated in a time period (<1-2 years) suitable for emerging contaminant issues, such as newly identified PFAS and PFAS mixtures
  - Prioritize PFAS for study on the prevalence of human and ecological exposures, exposure concentrations, and anticipated toxicity potency
- Guidance on human and ecological health risk assessment for combined exposures to PFAS mixtures
- Fate and bioaccumulation studies to evaluate the mobility and bioavailability of different chemical classes of PFAS across varied abiotic environmental matrices and biotic ecosystem components, including human food sources
- Widely accessible, cost effective analytical methods to identify and quantify environmentally relevant concentrations of known and unknown PFAS

NORTH CAROLINA
Department of Environmental Quality

Reference material:

Department of Environmental Quality GenX information:
https://deq.nc.gov/news/hot-topics/genx-investigation

Division of Water Resources: https://deq.nc.gov/about/divisions/water-resources/

Thank you for joining us today.

ATSDR National PFAS Activities

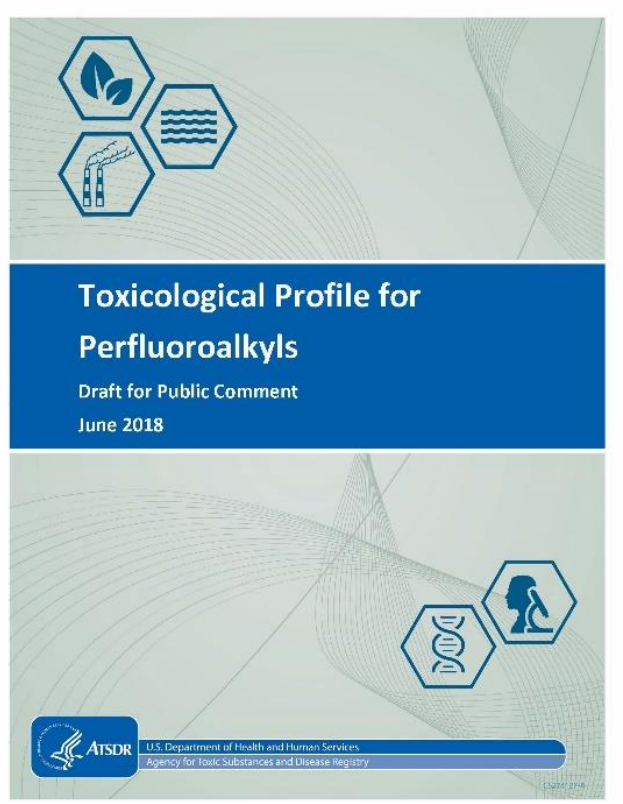
August 14, 2018

Bill Cibulas, PHD
Acting Director
Division of Toxicology and Human Health Sciences

Marian Pavuk, MD, PHD
Study PI
Division of Toxicology and Human Health Sciences

Perfluoroalkyls Toxicological Profile (ToxProfile)

- **Released for public comment on June 20, 2018**
  - Considered draft until finalized following public comment period
- **What's new in this ToxProfile**
  - Updates minimal risk level values for PFOA and PFOS
  - Sets new minimal risk level values for PFHxS and PFNA
- **Minimal risk level values**
  - Estimate of the amount of a chemical a person can eat, drink, breathe each day without detectable risk to health
  - Developed for health effects other than cancer
  - Derived for different exposure periods: acute, intermediate, and chronic
  - Used as screening tool to help identify exposures that could be potentially hazardous to human health



New Opportunities

- **2018 National Defense Authorization Act & 2018 Omnibus Appropriations**
  - Statistically-based PFAS biomonitoring exposure assessments (EAs) at no less than 8 current or former DOD sites (short term – completed within two years)
    - 10 million dollars for FY2018
    - EAs will include measurement of PFAS in serum and urine, as well as limited environmental (dust and tap water) sampling
  - Multi-site PFAS health study (long term – completed over next 5-7 years)
    - 10 million dollars anticipated for FY2019 for this effort, with possibility of additional funds in subsequent years
    - Study design will be informed by data from PFAS EAs

Multi-Site PFAS Health Study

- **ATSDR published feasibility assessment of possible future drinking water epidemiological studies at Pease, NH in November 2017**
  - Pease International Tradeport is former Air Force base
    - In 2014, one of three wells that serve Pease showed elevated levels of PFOS
    - Level above provisional health advisory set by EPA
    - NH DHHS conducted human biomonitoring program (over 1,500 participants)
  - ATSDR reviewed epidemiological studies that evaluated health effects of PFAS exposures
  - Based on literature review and sample size calculations, report concluded that cross-sectional epidemiological studies of children and adults at only one site (e.g., Pease)
    - Feasible for some health endpoints (e.g., lipids, kidney function)
    - Insufficient sample size for other health endpoints (e.g., thyroid, liver and immune function, autoimmune diseases)
  - Highlighted need for multi-site study

Multi-Site PFAS Health Study (cont.)

- **Study communities impacted by PFAS-contaminated public drinking water supply wells and/or private wells**
- **Cross-sectional study at multiple locations with separate evaluations of children (ages 4–17) and adults (ages ≥18)**
  - Case-control study not feasible; difficulties in enumerating cases
  - Cohort, follow up design aspects considered; funding uncertain
- **Site considerations**
  - Documented past or present PFAS drinking water concentrations at the tap,
  - The magnitude of past or present PFAS concentrations at the tap,
  - Size of population exposed,
  - Amount of information available on the contaminated drinking water system or private wells, and
  - If biomonitoring for PFAS has previously occurred at the site.

Multi-Site PFAS Health Study (cont.)

- **Expected sample size: 8,000 total participants**
  - 2,000 children
  - 6,000 adults
  - Based on review of scientific literature to study health outcomes of interest
- **Categorized participants based on measured or modeled serum concentration levels of PFAS compounds**
  - Referent or low, medium, high

Multi-Site PFAS Health Study (cont.)

Health Outcomes to be Studied						
Outcome	**Children**	**Adults**		**Outcome**	**Children**	**Adults**
Lipids	X	X		Neurobehavioral	X	
Cardiovascular	X	X		Osteoarthritis/ Osteoporosis		X
Kidney function/ Disease	X	X		Endometriosis		X
Liver function/Disease	X	X		Immune function	X	X
Thyroid	X	X		Vaccine response	X	
Sex hormones/ maturation	X			Autoimmune disease		X

Multi-Site PFAS Health Study (cont.)

- **Biomarkers to be studied**
  - Total cholesterol, low density lipoprotein, high density lipoprotein, total triglycerides
  - Uric acid, creatinine
  - Thyroxine (T4), T3, thyroid stimulating hormone (TSH)
  - Glucose, insulin, glycosylated hemoglobin (HbA1c), auto-antibodies (GAD-65 and IA-2), C-peptide, pro-insulin
  - Alanine transaminase (ALT), γ-glutamyltransferase (GGT), direct bilirubin, and cytokeratin-18 (CK-18)
  - Immunoglobulin G (IgG), IgA, IgE and IgM; (C reactive protein, and antinuclear antibodies (ANA) – adults; antibodies to measles, mumps, rubella, tetanus, and diphtheria – children)
  - Testosterone, estradiol, sex hormone-binding globulin (SHBG), follicle stimulating hormone, insulin-like growth factor
  - Cytokines and adipokines (e.g., IL-1β, IL-6, IL-8, MCP-1, TNFα, leptin, adiponectin, resistin, PAI-1)

Multi-Site PFAS Health Study (cont.)

- **Questionnaire data will collect information on**
  - Demographics
  - Water consumption and residential history
  - Medical history and family history of disease
  - Occupational history
  - Reproductive history in women
- **Neurobehavioral testing in children will include**
  - Measures of intelligence, hyperactivity, inattention, emotional conduct, peer relationship, and executive function.

Multi-Site PFAS Health Study (cont.)

- **Historical reconstruction of serum PFAS concentrations by estimating half-lives and elimination rates to inform physiologically based pharmacokinetic (PBPK) modeling**
  - Historical serum PFAS reconstruction based on water contamination data will enable evaluation of exposure lags and vulnerable periods as well as statistical analyses that can control for reverse causations

Thank you

https://www.atsdr.cdc.gov/pfas

For more information, contact NCEH/ATSDR
1-800-CDC-INFO (232-4636)
TTY: 1-888-232-6348 www.atsdr.cdc.gov www.cdc.gov
Follow us on Twitter @CDCEnvironment

Fayetteville PFAS Meeting
August 14, 2018
Fayetteville, NC

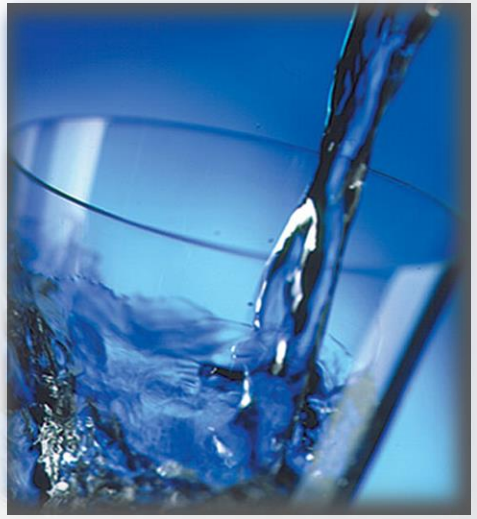
Removing PFAS from Drinking Water

Community Engagement Meeting in Fayetteville, North Carolina

U.S. Environmental Protection Agency

Overview: EPA Drinking Water Research

- **Problem**: Utilities lack treatment technology cost data for PFAS removal
- **Action**:
  - Gather performance and cost data from available sources (DOD, utilities, industry, etc.)
  - Conduct EPA research on performance of treatment technologies including home treatment systems
  - Update EPA's Treatability Database and Unit Cost Models
  - Connect EPA's Treatability Database to EPA's Unit Cost Models for ease of operation
  - Model performance and cost, and then extrapolate to other scenarios
    - Variable source waters
    - Variable PFAS concentrations in source water
    - Different regeneration/disposal options
    - Document secondary benefits
    - Address treatment impact on corrosion
- **Impact**: Enable utilities to make informed decisions about cost-effective treatment strategies for removing PFAS from drinking water



Drinking Water Treatability Database

Publically Available Database

- Interactive literature review database that contains over 65 regulated and unregulated contaminants and covers 34 treatment processes commonly employed or known to be effective (thousands of sources assembled on one site)
- **PFOA & PFOS:** Pages currently available
- **PFNA, PFHxA, PFHxS, PFBS, Gen-X:** Pages were added (June, 2018) for activated carbon, ion exchange, and membrane separation
- **Other PFAS and technologies to follow**

Search: EPA TDB
http://iaspub.epa.gov/tdb/pages/general/home.do

https://www.epa.gov/pfas/epa-pfas-data-and-tools

Treatability Database

http://oaspub.epa.gov/tdb/pages/general/home.do — Water Treatability Database...

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U.S. ENVIRONMENTAL PROTECTION AGENCY

Drinking Water Treatability Database

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You are here: EPA Home » Drinking Water Treatability Database » Welcome to the Drinking Water Treatability Database

- Home
- About the TDB
- Find a Contaminant
- Find a Treatment Process
- Help

Welcome to the Drinking Water Treatability Database

The Drinking Water Treatability Database (TDB) presents referenced information on the control of contaminants in drinking water. It allows drinking water utilities, first responders to spills or emergencies, treatment process designers, research organizations, academicians, regulators and others to access referenced information gathered from thousands of literature sources and assembled on one site. Over time, the TDB will expand to include over 200 regulated and unregulated contaminants and their contaminant properties. It includes more than 25 treatment processes used by drinking water utilities. The literature includes bench-, pilot-, and full-scale studies of surface waters, ground waters and laboratory waters. The literature includes peer-reviewed journals and conferences, other conferences and symposia, research reports, theses, and dissertations. By adding new contaminants and by upgrading references on existing contaminants, the TDB will always be a current source of information on drinking water contaminant control. Visit the About the TDB page for more information.

The TDB offers many features leading to the Data tab which is the heart of the TDB. After selecting a contaminant (Find a Contaminant), you will find a Treatment Processes tab that will present the list of treatment processes for which literature on the control of the contaminant was located. Selecting a treatment process, you will find a Data tab, like that shown below, that presents reference information, log or percent removal, water quality conditions and treatment process operational parameters. The Help page will aid you in navigating the TDB.

Getting Started

Find a Contaminant - Click here to find a contaminant within the TDB.

Find a Treatment Process - Click here to find a treatment process within the TDB.

Data Tab Example: Arsenic/Ion Exchange (Click on the image to view this Data tab)

Quick Links

- EPA Drinking Water Standards
- EPA Water Contaminant Information Tool (WCIT)
- EPA Contaminant Candidate List
- EPA Analytical Methods
- EPA Integrated Risk Information System (IRIS) (Risk Documents)

Future Upgrades to the Drinking Water Treatability Database

Each year, as resources allow, the number of contaminants in the TDB will increase to include other regulated and unregulated drinking water contaminants. It will also upgrade information on contaminants already in the TDB to keep it current. The bottom of each page indicates when additions and upgrades were last incorporated into the TDB. Each contaminant Overview page indicates the most recent literature search date for the contaminant. View a List of Future Contaminants anticipated for the next upgrade and the anticipated upgrade date.

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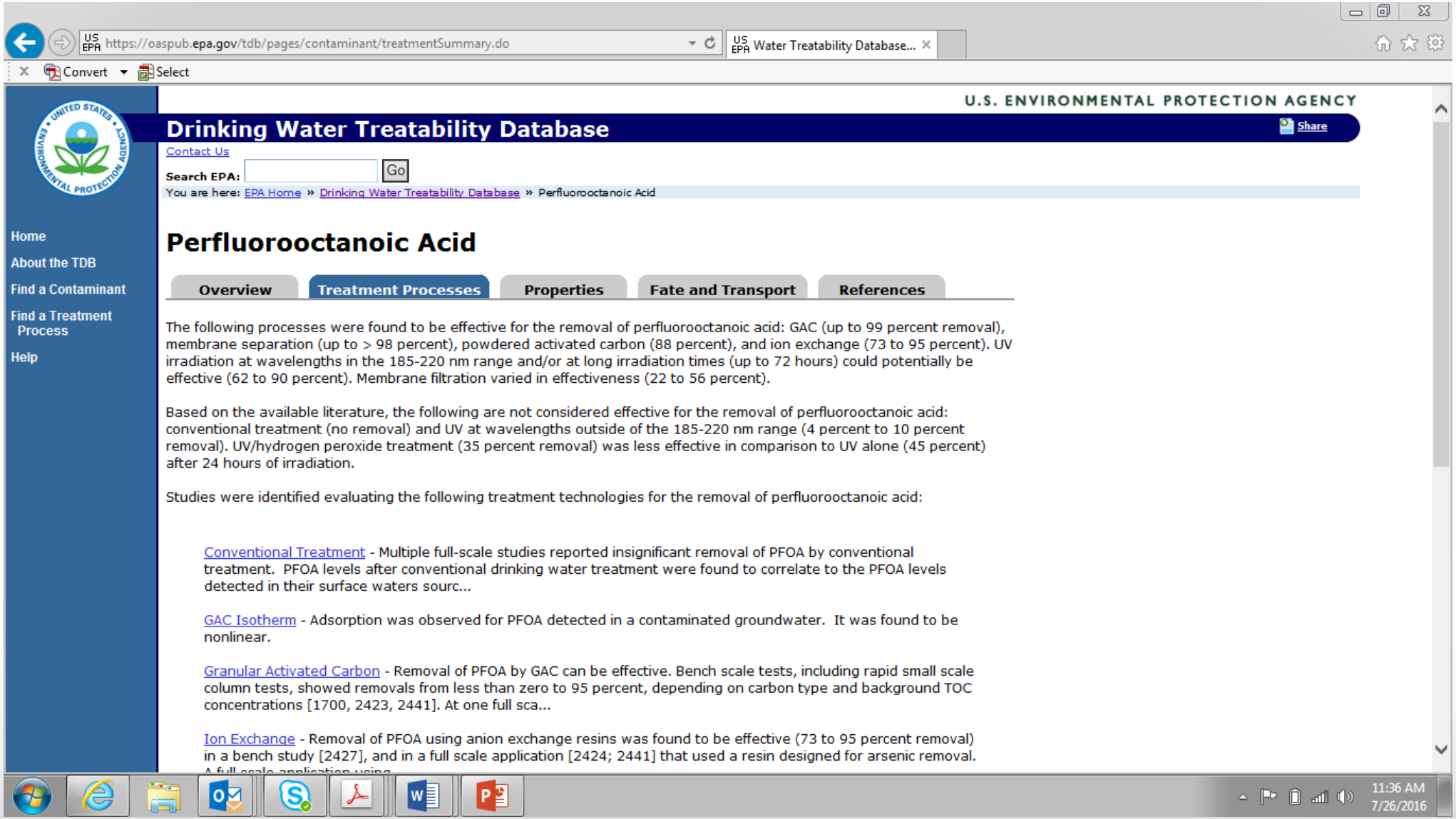
Treatability Database



Drinking Water Treatment for PFOS

Ineffective Treatments

Conventional Treatment
Low Pressure Membranes
Biological Treatment (including slow sand filtration)
Disinfection
Oxidation
Advanced oxidation

PAC Dose to Achieve	
50% Removal	16 mg/l
90% Removal	>50 mg/L

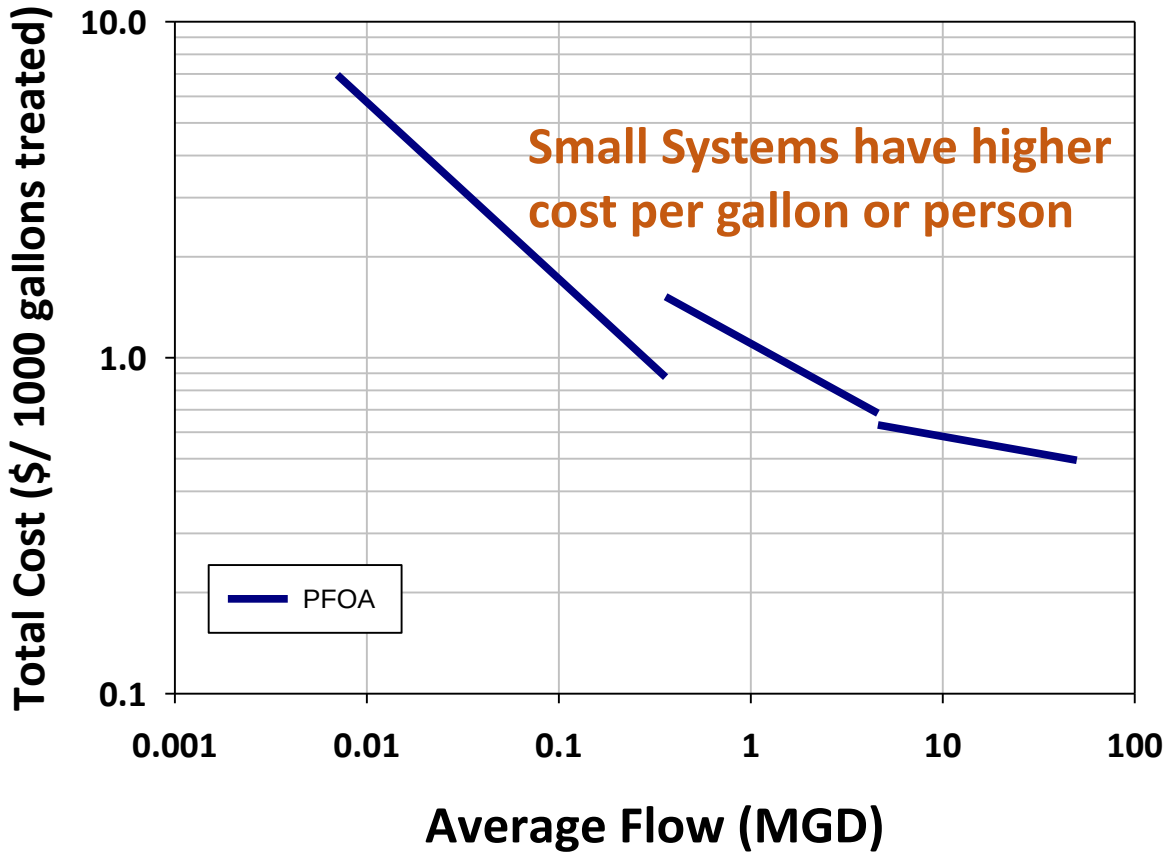
Dudley et al., 2015

Effective Treatments

	Percent Removal	
Anion Exchange Resin (IEX)	90 to 99	- **Effective**
High Pressure Membranes	93 to 99	- **Effective**
Powdered Activated Carbon (PAC)	10 to 97	- **Effective for only select applications**
Granular Activated Carbon (GAC)		
Extended Run Time	0 to 26	- **Ineffective**
Designed for PFAS Removal	> 89 to > 98	- **Effective**

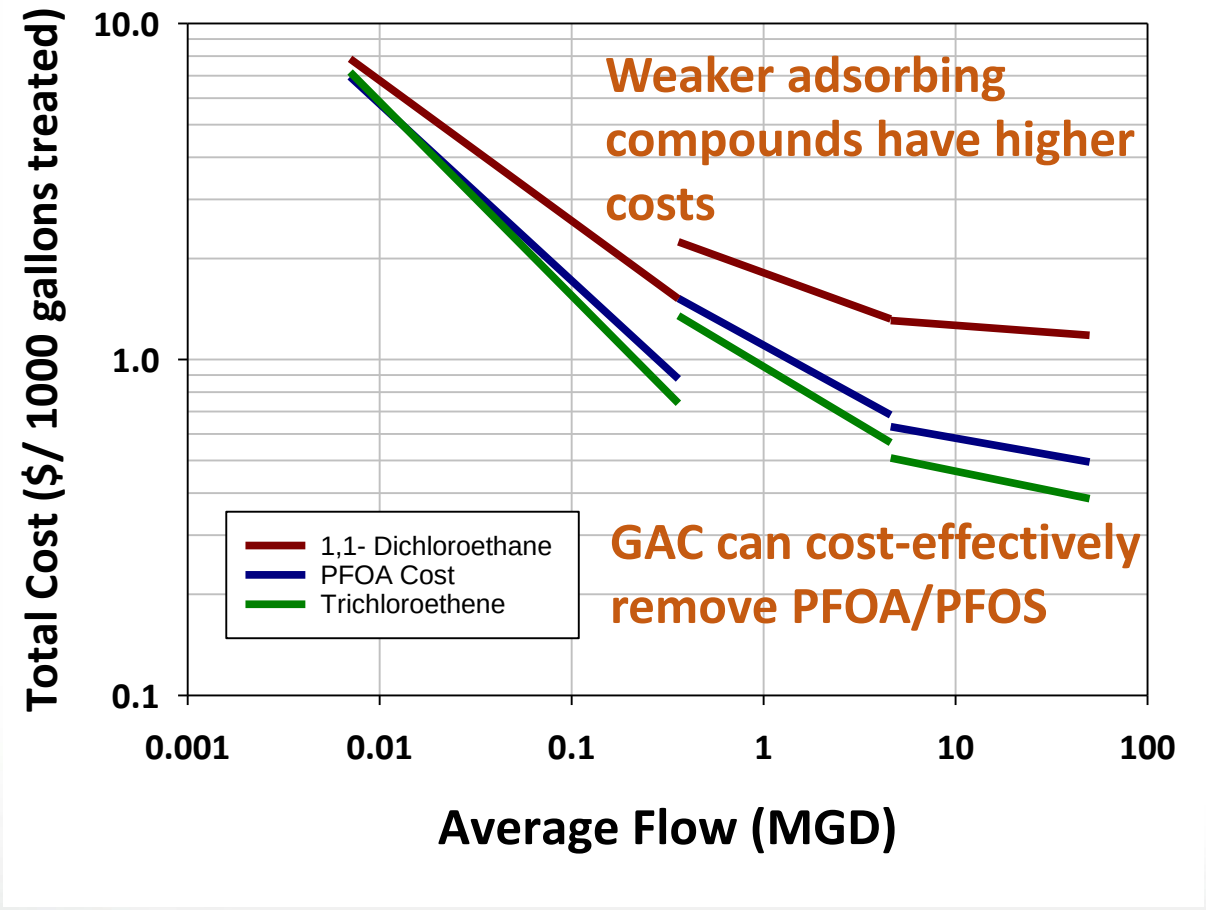
GAC Treatment Cost: PFOA

Cost of treatment varies on a number of factors including system size



- Full Scale
- 26 min EBCT
- Lead-Lag configuration
- F600 Calgon carbon
- 1.5 m^3/min flow
- Full automation
- POTW residual discharge
- Off site regeneration
- 70,000 bed volumes to breakthrough for PFOA

GAC Treatment Cost: PFOA, TCE, 11 DCA



EPA will be evaluating additional water qualities and designs

- Full Scale
- 26 min EBCT
- Lead-Lag configuration
- F600 Calgon carbon
- 1.5 m^3/min flow
- Full automation
- POTW residual discharge
- Off site regeneration
- 135,000, 70,000, and 11,000 bed volumes to breakthrough for TCE, PFOA, and 11DCA, respectively.

Advantages of Select Treatments

Granular Activated Carbon (GAC)	**Most studied technology** **Will remove 100% of the contaminants, for a time** **Good capacity for some PFAS** Will remove a significant number of disinfection byproduct precursors Will help with maintaining disinfectant residuals Will remove many co-contaminants Likely positive impact on corrosion (lead, copper, iron)
Anion Exchange Resin (PFAS selective)	**Will remove 100% of the contaminants, for a time** **High capacity for some PFAS** **Smaller beds compared to GAC** Can remove select co-contaminants
High Pressure Membranes	**High PFAS rejection** Will remove many co-contaminants Will remove a significant number of disinfection byproduct precursors Will help with maintaining disinfectant residuals

Issues to Consider

EPA is evaluating these issues to document where and when they will be an issue

Granular Activated Carbon (GAC)	**GAC run time for short-chained PFAS (shorter run time)** **Potential overshoot of poor adsorbing PFAS if not designed correctly** **Reactivation/removal frequency** Disposal or reactivation of spent carbon
Anion Exchange Resin (PFAS selective)	**Run time for select PFAS (shorter run time)** **Overshoot of poor adsorbing PFAS if not designed correctly** Unclear secondary benefits Disposal of resin
High Pressure Membranes	**Capital and operations costs** Membrane fouling Corrosion control Lack of options for concentrate stream treatment or disposal

Drinking Water Goals

For utilities that have PFAS in their source water at concentrations of health concern

1) Eliminate source of PFAS to the source water
2) Either choose a new source of water or choose a **technology, design, and operational scheme** that will reduce PFAS to safe levels at the lowest possible cost in a **robust, reliable, and sustainable manner** that avoids unintended consequences

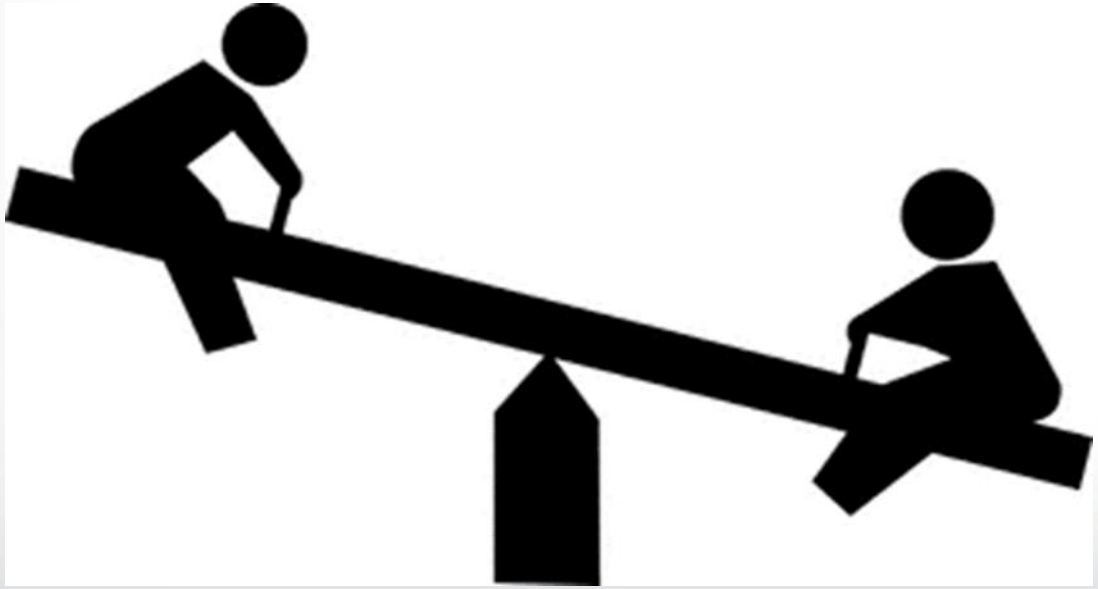
Issues to address (not inclusive)

1) Capital and operating costs are affordable
2) Staff can handle operational scheme over the long term
3) Technology can operate long term under a reasonable maintenance program
4) Technology and treatment train can handle source water quality changes
5) Any waste stream generated can be treated or disposed in a sustainable and cost-effective manner over the long term

Avoiding Unintended Consequences

Choice of technology, design, and operations can lead to…

1) Negative impacts on the performance of the rest of the **treatment system** for other parameters (e.g., decreased control of particulates/pathogens, taste & odor compounds, other source water contaminants)
2) Negative impacts on the **distribution system** (e.g., increased lead, copper, or iron corrosion; disinfection residual maintenance difficulties)

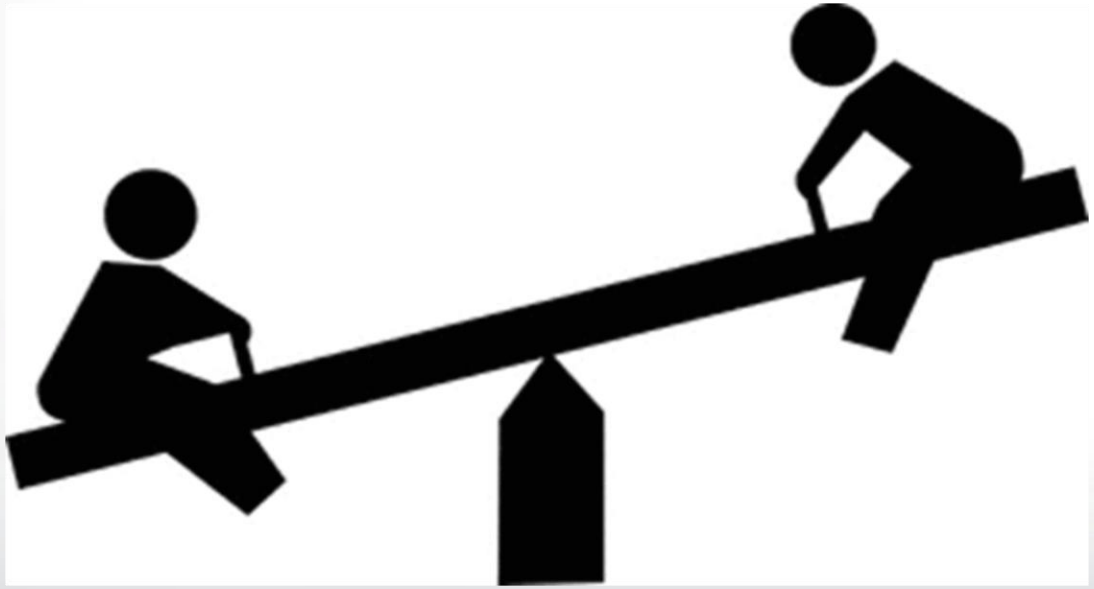


EPA is conducting research on optimizing PFAS treatment

To Achieve other Positive Benefits

Choice of technology, design, and operation can have…

1) **Positive impacts** on the performance of the rest of the **treatment system** for other parameters (e.g., improved control of particulates/pathogens, taste & odor compounds, industrial contaminants, pesticides, pharmaceuticals, personal care products, endocrine disruptors)
2) **Positive impacts** on the **distribution system** (e.g., decreased lead, copper, or iron corrosion; better disinfection residual maintenance; fewer disinfection byproducts)



Improved Treatment

Improved Disinfection

Decreased Corrosion

EPA is a resource for communities, states, and regions

Water Treatment and the Challenge of PFAS

Community Engagement in Fayetteville, North Carolina

Carel Vandermeyden, P.E.

Cape Fear Public Utility Authority

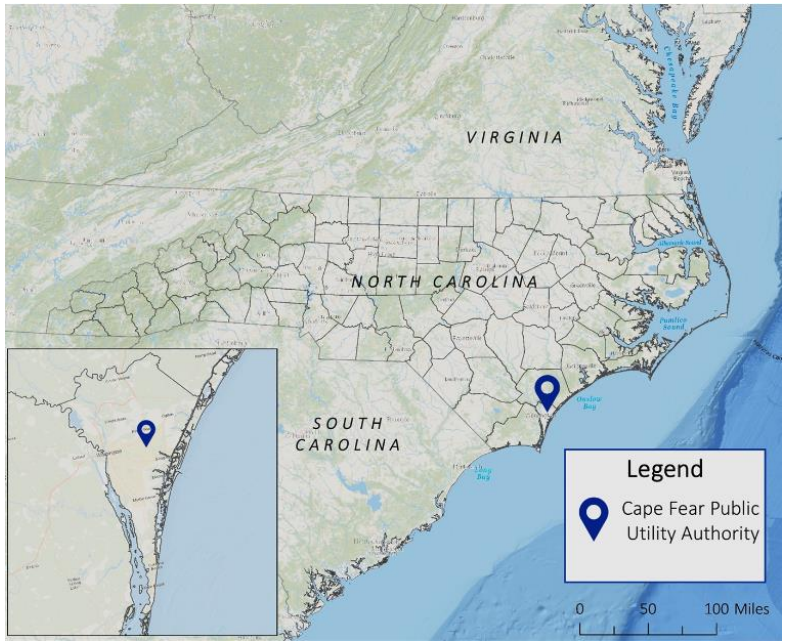
August 14, 2018

Cape Fear Public Utility Authority

Stewardship. Sustainability. Service.

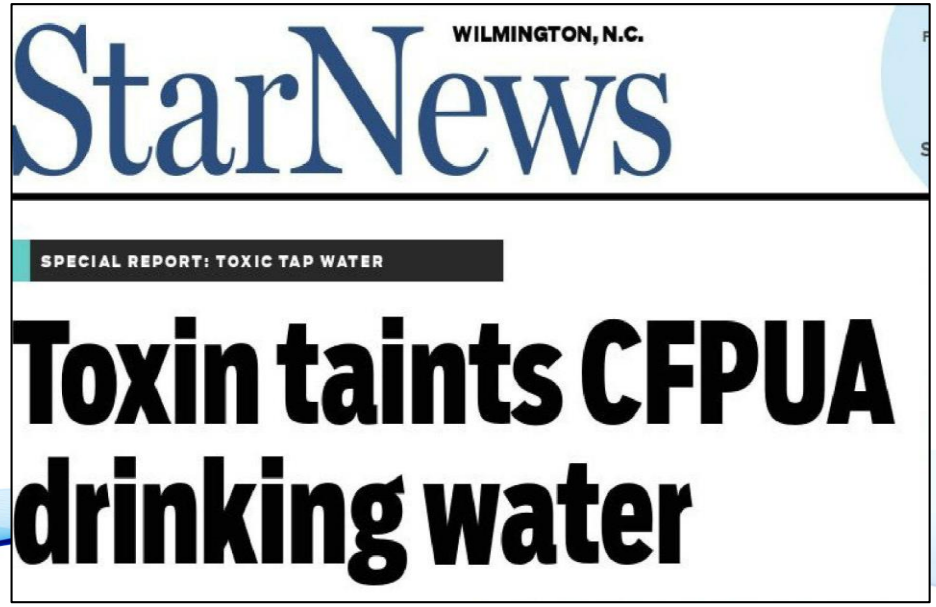
Cape Fear Public Utility Authority

- Located in Wilmington, North Carolina
- 200,000 customers
- Two groundwater systems (7 mgd)
- One surface water system (35 mgd) - Cape Fear River raw water supply
- PFAS compounds detected in source and drinking water, including GenX and Nafion biproducts
- Conventional treatment, ozonation, biofiltration, UV disinfection do not remove PFAS
- More advanced treatment methods required to address PFAS compounds, including GenX and Nafion biproducts



PFAS Compounds in the Cape Fear River

- June 2017 - *Wilmington StarNews* article on the presence of GenX in the Cape Fear River and in CFPUA drinking water.
- GenX is only about 12% of all PFAS quantified in source water.
- No MCL for GenX or other PFAS.
- NC-DHHS issued a preliminary health advisory level of 140 ppt for GenX.
- Customer Concerns:
  - Thousands of calls from concerned customers.
  - Numerous public forums, media interviews. Weekly press releases by CFPUA.
  - 9,800 people are members of the on-line “North Carolina Stop GenX in our Water” community organizing group.
  - Awareness of emerging contaminants has decreased consumer confidence in drinking water.
  - Utilities (ratepayers) should not bear the cost to address source water contamination by others.


WILMINGTON, N.C.

StarNews

SPECIAL REPORT: TOXIC TAP WATER

Toxin taints CFPUA drinking water

CFPUA Actions to Address PFAS in Drinking Water

Cape Fear Public Utility Authority
Stewardship. Sustainability. Service.

- Protecting public health is top priority for water systems
- Performed regular sampling of the water to monitor levels of PFAS compounds with testing standards
- Partnered with UNC-Wilmington to identify and quantify other per-fluorinated compounds in the River
- Opened two water stations to provide water from the groundwater systems to customers at no cost
- Removed 50 million gallons of water containing per-fluorinated compounds from aquifer storage/recovery well
- Conducted pilot study (GAC and Ion Exchange) to investigate feasibility to remove PFAS compounds from the drinking water

Cost Impacts on CFPUA Ratepayers

Cape Fear Public Utility Authority
Stewardship. Sustainability. Service.

- Expended $2.2M to date, including $185,000 from the State of North Carolina for testing and research
- Fiscal Year 2019 operating budget includes additional $650,000 for legal fees and water quality testing
- Recommended design of advanced treatment to address PFAS compounds, including GenX and related contaminants
  - Capital cost = $46 million
  - Annual operating cost = $2.9 million
- Projected 7% rate increase in total water & sewer bill (14% for water only)

PFAS Regulatory Gaps: What Do Utilities Need?

Cape Fear Public Utility Authority
Stewardship. Sustainability. Service.

To protect drinking water quality, we need:

- Stricter source control
- Improved NPDES permitting and enforcement
- Stronger PFAS regulations
- Environmental remediation
- More advanced water treatment (this cannot be the only answer)

There is no single solution to this problem

Greensboro NC Response to PFC's

Tuesday, August 14, 2018

Michael Borchers, PE
Assistant Director Water Resources

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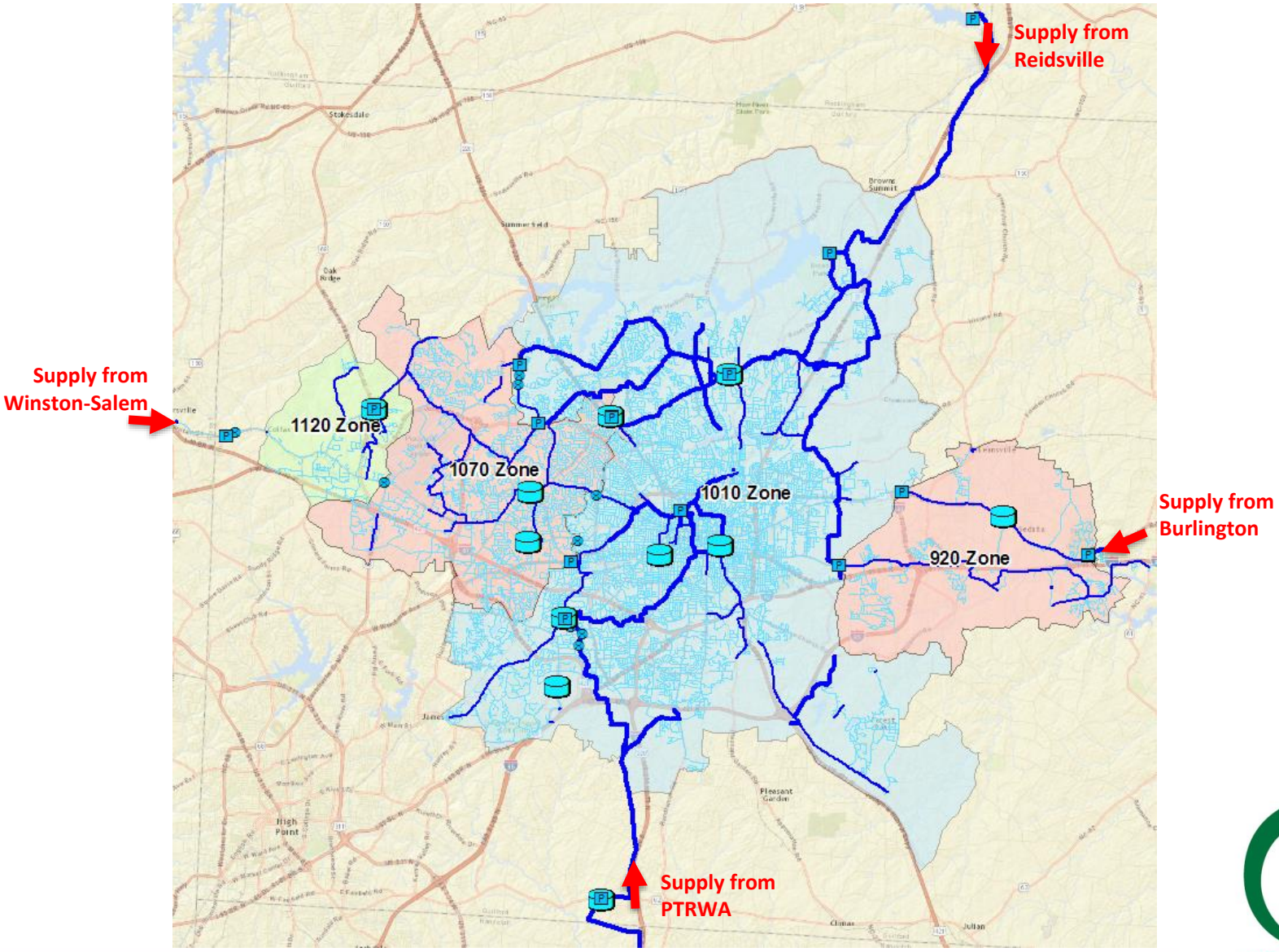
Greensboro's Distribution System



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Mitchell and Townsend Water Treatment Plants

GREENSBORO

Greensboro's Contaminants of Emerging Concern

PFOS / PFOA

- Detected in 2014 as part of UCMR 3 study
  - Three out of four quarters tested above the reporting detection limit of 40 ng/l
  - Testing revealed 10 distribution samples with PFOS concentration > 40 ng/L
- Council approved investigation in 2015
  - HDR Engineers and NC State University
  - Field investigation started in 2016
  - Subsequent testing in watershed revealed PFOS concentration's > 1,000 ng/L
  - Primary Source - Area surrounding and including PTIA

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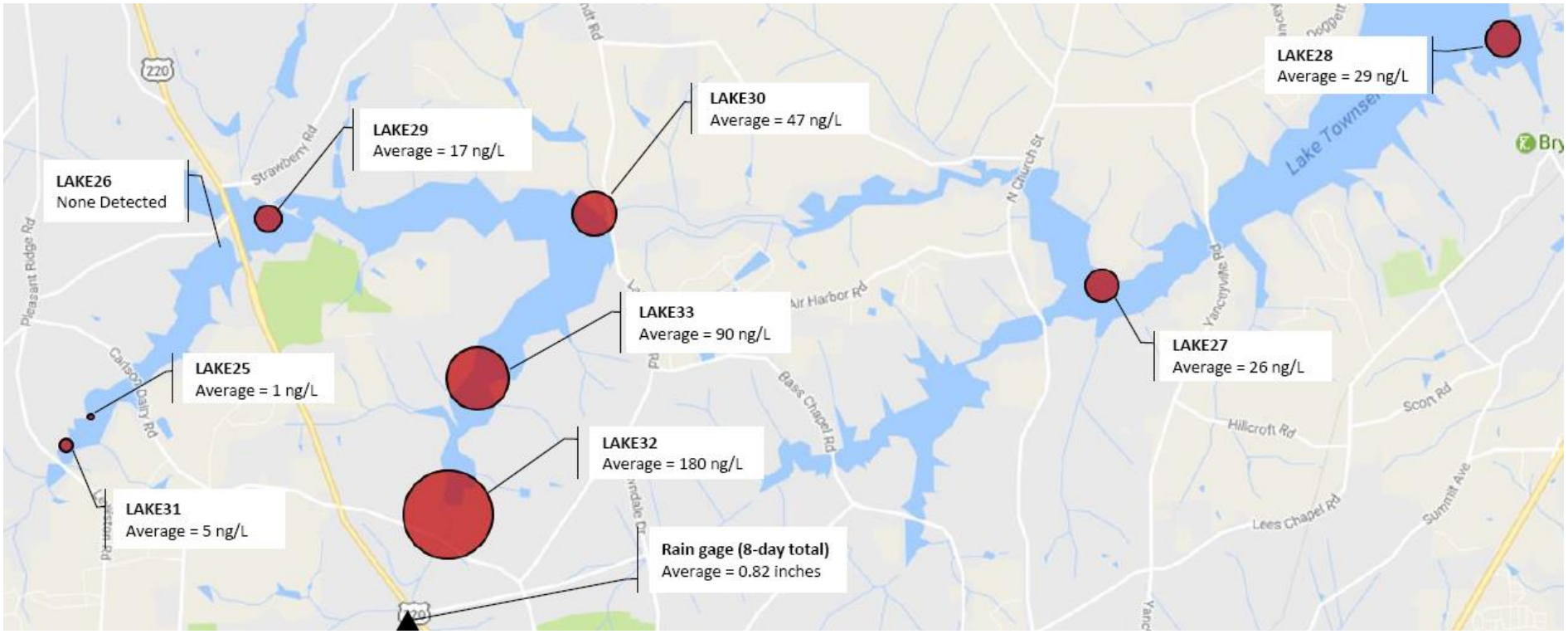
Lake Results – PFOS Sampling



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Emerging Contaminants Cont.

Public Notification – HAL Exceedance

- July combined PFOS and PFOA sample results for Mitchell WTP POE - 80 ppt
  - First exceedance of an HAL since monitoring began in 2014
- State PWS contacted
  - Encouraged public notification
- Press Release and Memo to CMO / City Council
  - Background / History
  - Investigation
    - Stakeholder Engagement
  - Immediate and Long Term Proactive Measures

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Public Trust / Transparency

Proactive Response Measures

- Operational Response Protocol Developed
  - Utilization of Townsend WTP and interconnects to minimize / curtail flow from Mitchell WTP
  - Resampling and maintain external communications
  - Temporary Powdered Activated Carbon (PAC) feed system
    - Bench Testing – 10 to 30 mg/l feed rate
    - System online by end of August

- Sampling
  - Drinking water quarterly sampling (including interconnects) since 2016
  - May 2018 – Began monthly sampling and posting results online - monthly water quality report

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Emerging Contaminants Cont.

Other Proactive Measures

- Granular Activated Carbon (GAC) Pilot Testing
  - Final report received 4/2018
  - Treatment effective for removing PFOS and PFOA
- Source identification Stakeholder Meetings
  - Voluntary Chemical Inventory
  - Identify alternative product for training purposes
  - Contact city and contain / treat releases due to emergency response
- Potential Predictive Model
  - Consultant evaluation of correlation between upper watershed samples and treatment plant intake

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Next Steps

Watershed Investigation

- Investigation wrap-up and final report by year end

Treatment

- Short-Term PAC System
- Long Term CIP Planning for GAC System

Uphold Consumer Confidence & Trust

- Informed decisions based on data
- Transparency and Follow Through
- Leadership in Water Science with Innovation & Collaboration
- Staff availability regarding concerns
  - Townsend Water Quality Lab – (336) 373-7527

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EPA PFAS Community Engagement Meeting

Community Panel Presentation:
North Carolina Nonprofit Environmental Advocacy Groups

Fayetteville, NC
August 14, 2018

Thank you EPA

- To the regional office of research and development (ORD) for the support of our state and specifically our DEQ during this contamination crisis

- For providing communities a forum to learn and be heard on the impacts of PFAS contamination on people and the environment

Organizations Represented

The Cape Fear River

Credit: Alan Cradick

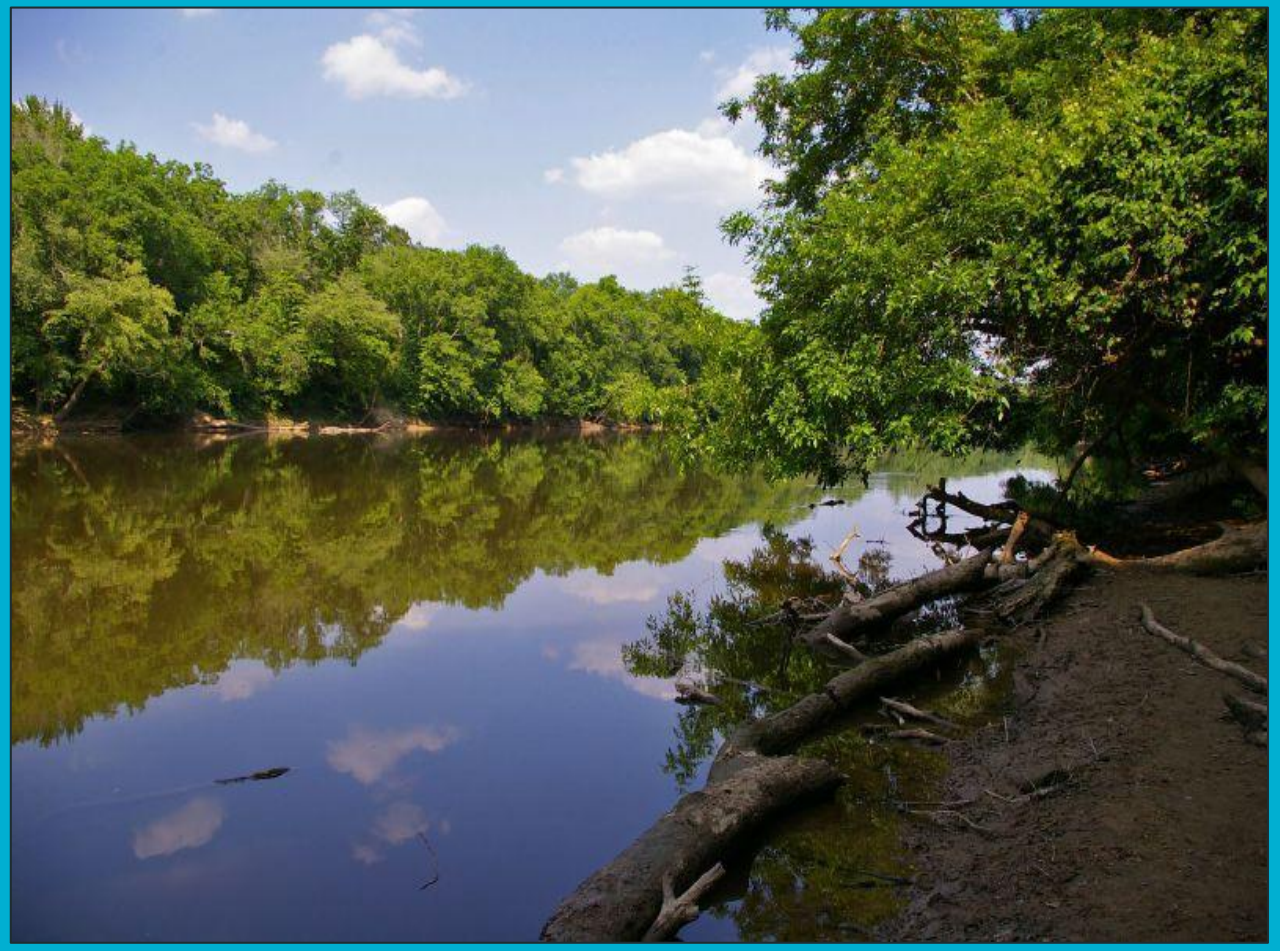
Wilmington Star News, June 7, 2017

Toxin taints CFPUA drinking water

WILMINGTON -- A chemical replacement for a key ingredient in Teflon linked to cancer and a host of other ailments has been found in the drinking water system of the Cape Fear Public Utility Authority (CFPUA), which cannot filter it.

History

- 1980 - Contamination begins with Dupont – GenX released as a byproduct
- Around 2000 - DuPont begins manufacture of Teflon using C8 (PFOA); GenX will be its replacement
- 2009 consent order requires all wastewater from GenX manufacture is captured; it's still being released as a byproduct



Credit: WUNC

“Discovery”

- 2012 - GenX first discovered in Cape Fear River, study published 2015
- 2016 - Sun et. al paper published, confirms GenX & 6 other PFAS in Cape Fear River
- 2017 - The public learns of near 40-year contamination of drinking water of 250,000 residents
- As of July 2018 - DEQ is analyzing 25 PFAS found in our water

ENVIRONMENTAL Science & Technology LETTERS

Letter

pubs.acs.org/journal/estlcu

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

Mei Sun,[*,†,‡] Elisa Arevalo,[‡] Mark Strynar,[§] Andrew Lindstrom,[§] Michael Richardson,[∥] Ben Kearns,[∥] Adam Pickett,[⊥] Chris Smith,[#] and Detlef R. U. Knappe[‡]

[†]Department of Civil and Environmental Engineering, University of North Carolina at Charlotte, Charlotte, North Carolina 28223, United States

[‡]Department of Civil, Construction, and Environmental Engineering, North Carolina State University, Raleigh, North Carolina 27695, United States

[§]National Exposure Research Laboratory, U.S. Environmental Protection Agency Research, Triangle Park, North Carolina 27711, United States

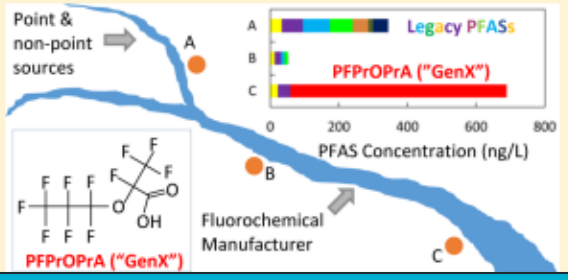
[∥]Cape Fear Public Utility Authority, Wilmington, North Carolina 28403, United States

[⊥]Town of Pittsboro, Pittsboro, North Carolina 27312, United States

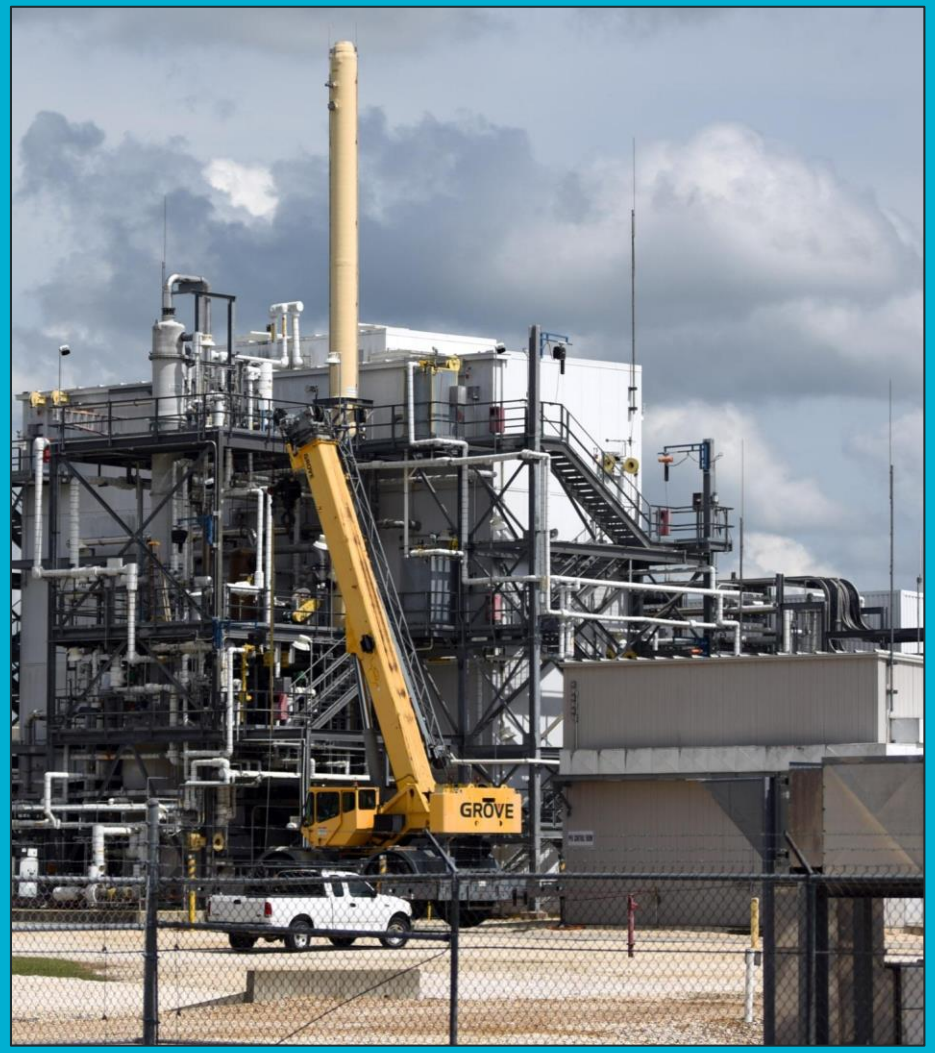
[#]Fayetteville Public Works Commission, Fayetteville, North Carolina 28301, United States

Supporting Information

ABSTRACT: Long-chain per- and polyfluoroalkyl substances (PFASs) are being replaced by short-chain PFASs and fluorinated alternatives. For ten legacy PFASs and seven recently discovered perfluoroalkyl ether carboxylic acids (PFECAs), we report (1) their occurrence in the Cape Fear River (CFR) watershed, (2) their fate in water treatment processes, and (3) their adsorbability on powdered activated carbon (PAC). In the headwater region of the CFR basin, PFECAs were not detected in raw water of a drinking water treatment plant (DWTP), but concentrations of legacy PFASs were high. The U.S. Environmental Protection Agency's



Widespread Impacts



Credit: Wilmington Star News

- Surface water discharge contaminated the drinking water supply for 250,000 people
- Airborne pollutants further impact surface water, groundwater, agriculture, fish, and even honey
- Well testing to date shows 763 private wells are contaminated
- Rainwater contaminated as far away as Wilmington (>70 miles)

Corporate Misconduct

- Long history of mismanagement by DuPont and spin-off, Chemours
- Long-term and ongoing inaccurate reporting of air and water discharge
- Failure to report spills, upsets, accidents, etc.
- Unwillingness to acknowledge impacted communities
- Corporate interference in federal and state policy making

Community Awareness

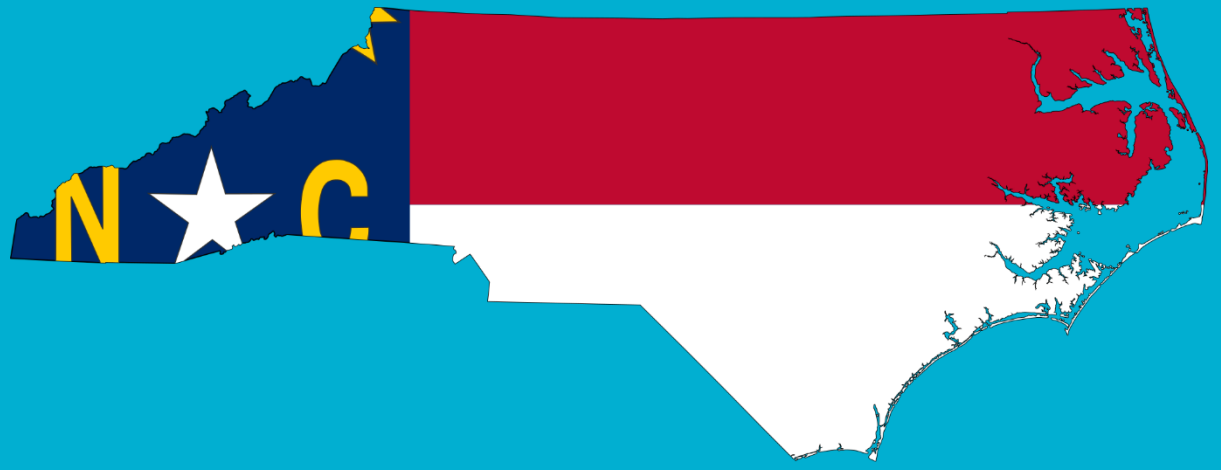
- Community forums including local scientists, utility representatives, DEQ / DHHS, academia, and public health experts
- Intensive media coverage, including state-wide and national attention
- Considerable interest by local, state, and national elected officials

Community Action

- Multiple community action groups form in Wilmington and Fayetteville areas
- Several lawsuits filed
- Environmental advocates lobby for legislative support of underfunded DEQ and for DEQ action
- Numerous community meetings and rallies held
- Hundreds of stories published in local, national media
- Participation in human health exposure study

What NC Needs from the EPA

1. Provide interim support to states
2. Require industry accountability
3. Prevent PFAS use in military and civilian firefighting foam and gear
4. Apply the Precautionary Principal



So what does that mean?

Provide Interim Support to States

- Consider all compounds in PFAS family as a class when determining regulatory action
- Provide states with standardized PFAS test methods for surface and wastewater
- Lower the standard detection level to 10 ppt in accordance with health protective levels recommended by the Agency for Toxic Substances and Disease Registry (ATSDR) and the EPA

Provide Interim Support to States

- Fully disclose extent of the PFAS problem to the public and state regulatory bodies, including:
  - Sources of known or potential PFAS contamination, including waste water treatment sludge
  - Potential health effects of PFAS contamination
  - PFAS prevalence in the environment
  - Industrial processes that may create PFAS as a byproduct
- Conduct a national PFAS health study

Provide Interim Support to States

- Ban any new PFAS manufacturing requests
- Add PFAS chemicals to the Toxics Release Inventory
- List PFAS as hazardous substances under the Clean Water Act
- Make TSCA conditions on manufacture of a PFAS applicable to byproducts

Demand Industry Accountability

- History shows voluntary compliance is not realistic or effective
- Require FULL disclosure of ANY and ALL PFAS discharges into the environment
- Require full disclosure of all animal and human toxicological studies conducted/contracted by industry
- Eliminate the ability of industry to substitute one PFAS with another PFAS in production

Polluter Pays

- Industry must be held financially responsible for environmental contamination, including:
  - Remediation on and off site
  - Effective filtration systems at individual or utility scale when drinking water impacted
  - Human health studies
  - Environmental sampling
  - Ongoing monitoring

Protect Firefighters and Families

- Halt use of all PFAS in Aqueous Film Forming Foam and firefighting gear for military and civilian use
- Adopt the safe, effective alternatives used abroad
- Remediate contaminated practice facilities where PFAS contamination threatens communities
- Eliminate industry influence in selection of firefighting materials

Implement the Internationally Recognized Precautionary Principle

"When an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically. In this context the proponent of an activity, rather than the public, should bear the burden of proof."

--Wingspread Conference Statement on the Precautionary Principle, Jan. 1998


Mr. Kemp Burdette
Cape Fear Riverkeeper
Cape Fear River Watch


WATER SHOULD BE TRANSPARENT
Wilmington Organizing for Wilmington (WoW) Protest Outside City Hall on June 19


CAPE FEAR SURFRIDER PRESENTS
What's in Our Water?
DANA SARGENT
Cape Fear River Watch
Campaign Head
JIM FLECHTNER
Executive Director of Cape Fear
Public Utility Authority
DR. JANE HOPPIN
NC State Biological
Sciences Professor
DR. JAMIE DEWITT
ECU Pharmacology &
Toxicology Professor
DR. LARRY CAHOON
UNCW Biology &
Marine Biology Professor
DR. SUSANNE BRANDER
OSU Environmental Toxicology
& Chemistry Professor
A panel discussion at CFCC Union Station Auditorium, 6.7, 6:30pm


CLEAN CAPE FEAR &
CFCC SUSTAINABILITY COMMITTEE
PRESENTS
WATER WEDNESDAY
DR. ROBERT SMART
CENTER FOR HUMAN HEALTH & THE ENVIRONMENT
DR. JAMIE HOPPIN
CENTER FOR HUMAN HEALTH & THE ENVIRONMENT
CAPE FEAR COMMUNITY COLLEGE

CLEAN CAPE FEAR

Cape Fear River PFAS Contamination: A Community Perspective

EPA Region 4 PFAS Summit | Fayetteville, NC | August 14, 2018

Emily Donovan, Jessica Cannon, Lynn Shoemaker, Dana Sargent

www.cleancapefear.org

Meet Clean Cape Fear

100% grassroots, concerned citizens taking action.
Established in June 2017.
Building public awareness.
Pushing for stronger regulations surrounding PFAS use/contamination.

We Are Also Parents

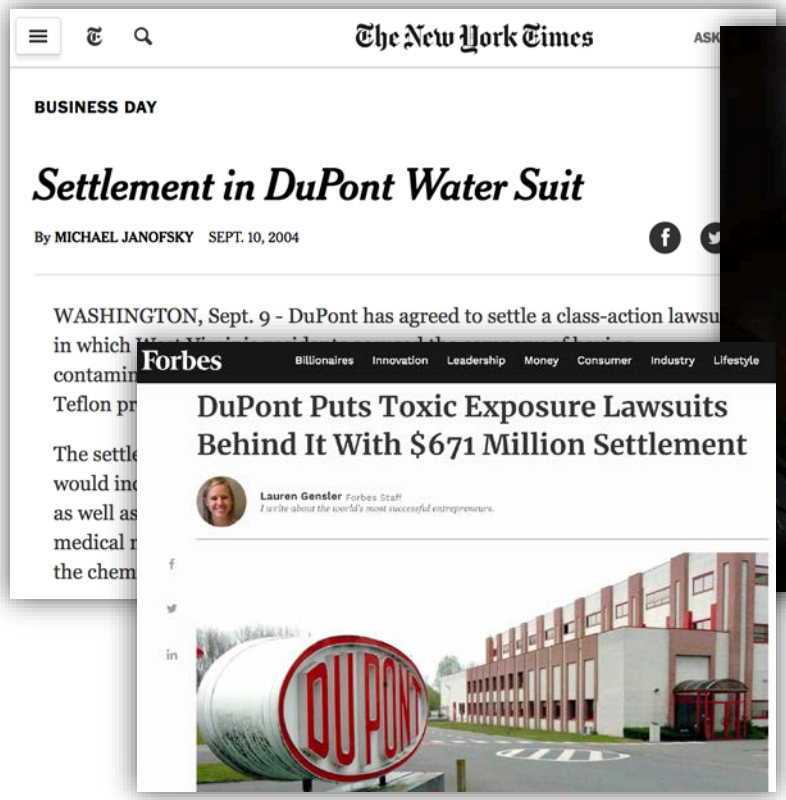
Moved to Brunswick Co. in 2009

Moved to New Hanover Co. in 2012

Moved to New Hanover Co. in 2000

Déjà vu: New State, New Name, Same Problem

DuPont
PFOA (C8)



SEP 2001 - 2017:
Parkersburg, WV

DuPont spinoff (Chemours)
C8 replacement (GenX)

JUN 2017:
Wilmington, NC

A Community In Shock

Downtown Wilmington

New Hanover Co. Government Center

June 15, 2017:
8 days after StarNews article Chemours meets federal, state, local leaders behind closed doors. Protests erupt all over Wilmington, NC.

Same Problem, Same Players

June 15, 2017 Closed Door Meeting with Chemours – same players gave regular depositions for DuPont's Parkersburg, WV lawsuits

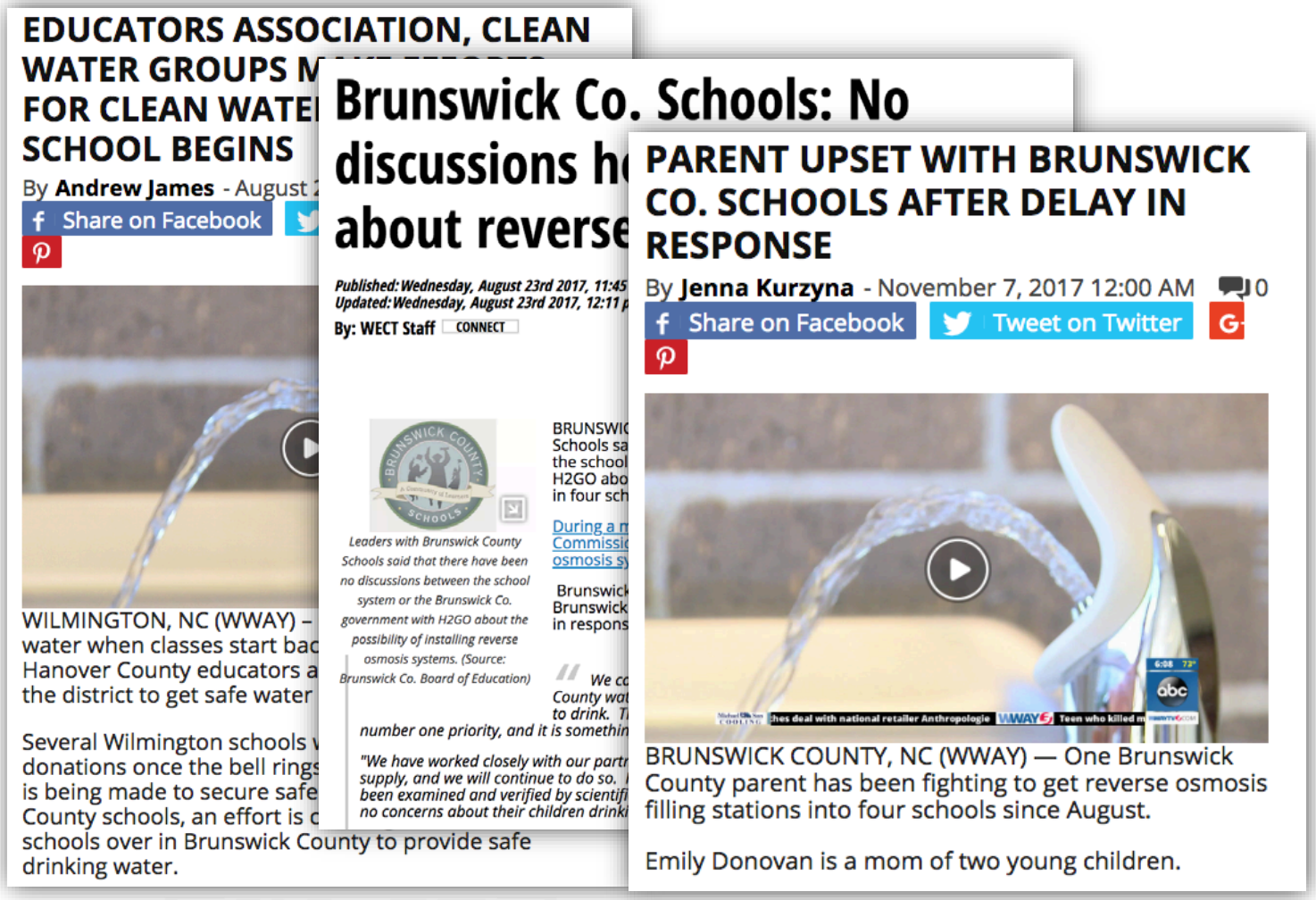
Water Wednesday Public Forums

June 21, 2017:
What is in our water?

July 5, 2017:
Reaching Diverse Communities

July 26, 2017:
PFAS Science Panel

Toxic Taps In Public Schools



EDUCATORS ASSOCIATION, CLEAN WATER GROUPS M... FOR CLEAN WATE... SCHOOL BEGINS

By **Andrew James** - August 2

Share on Facebook

WILMINGTON, NC (WWAY) – water when classes start bac... Hanover County educators a... the district to get safe water...

Several Wilmington schools w... donations once the bell rings... is being made to secure safe... County schools, an effort is c... schools over in Brunswick County to provide safe drinking water.

Brunswick Co. Schools: No discussions h... about reverse...

Published: Wednesday, August 23rd 2017, 11:45...
Updated: Wednesday, August 23rd 2017, 12:11 p...

By: WECT Staff CONNECT

Leaders with Brunswick County Schools said that there have been no discussions between the school system or the Brunswick Co. government with H2GO about the possibility of installing reverse osmosis systems. (Source: Brunswick Co. Board of Education)

BRUNSWI... Schools sa... the school... H2GO abo... in four sch...

During a m... Commissi... osmosis sy...

Brunswick... Brunswick... in respons...

"We co... County wat... to drink. T... number one priority, and it is somethin...

"We have worked closely with our partn... supply, and we will continue to do so. ... been examined and verified by scientifi... no concerns about their children drinki...

PARENT UPSET WITH BRUNSWICK CO. SCHOOLS AFTER DELAY IN RESPONSE

By **Jenna Kurzyna** - November 7, 2017 12:00 AM 0

Share on Facebook Tweet on Twitter

BRUNSWICK COUNTY, NC (WWAY) — One Brunswick County parent has been fighting to get reverse osmosis filling stations into four schools since August.

Emily Donovan is a mom of two young children.

47,700 children attend public schools in Brunswick, New Hanover, and Pender Co.

Chronic Chemical Cocktail For Children

October 31, 2017:

19 different PFAS found in Brunswick Co. elementary school water FOUR months after learning about GenX.

Total mixture is 167 ppt for that day.

16 PFAS have zero health advisories.

Chronically Drinking 631ppt Of GenX

GenX is

- Endocrine disruptor
- Immune System impacted
- Bioaccumulates

GenX dumped in Cape Fear water supply

Highest level found
4.5ppb
Average level found
0.631 ppb

EPA lifetime health advisory level for PFOA & PFOS
0.07ppb

Yet, NC DHHS claims:
Based on ONE single cancer study, using rats, and undisclosed calculations, that GenX is safe to drink at levels up to 70ppb. Really?

Source Data: Madi Polera MSMB, Marine Biologist & Sun et. al 2016

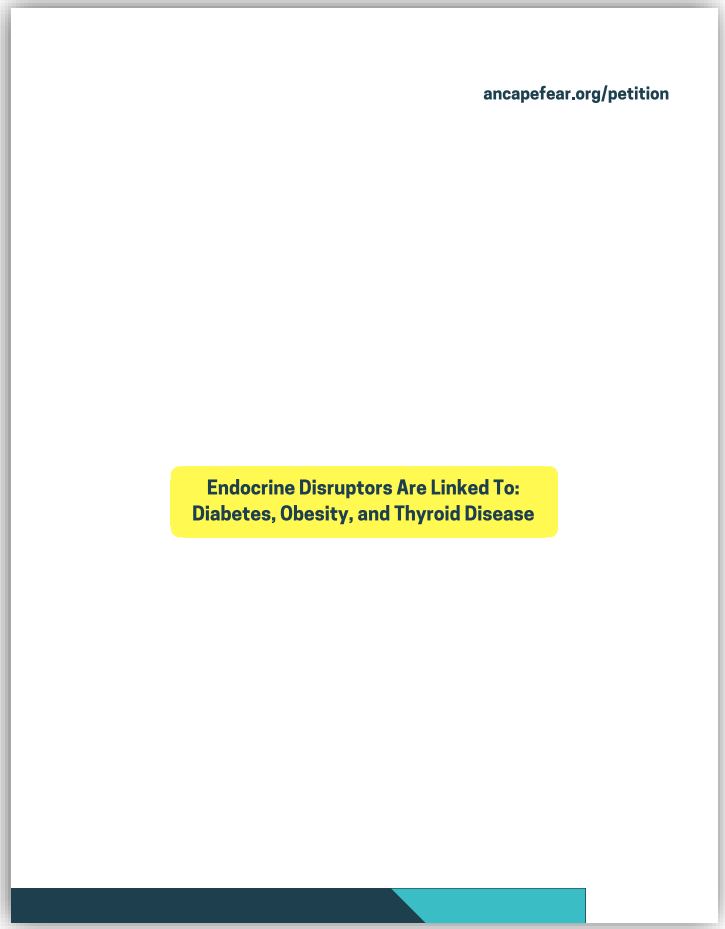
Should you drink the tap water if you are pregnant and/or nursing?

"I get a little anxious when I hear endocrine disruptor. I would advise pregnant and nursing mothers to avoid tap water until the contamination has stopped."

Dr. David L. Hill, MD
KidzCare Pediatrics

PFAS are:
Endocrine disrupting | Bioaccumulate | Persistent

Lack Of Information ≠ Safe To Drink



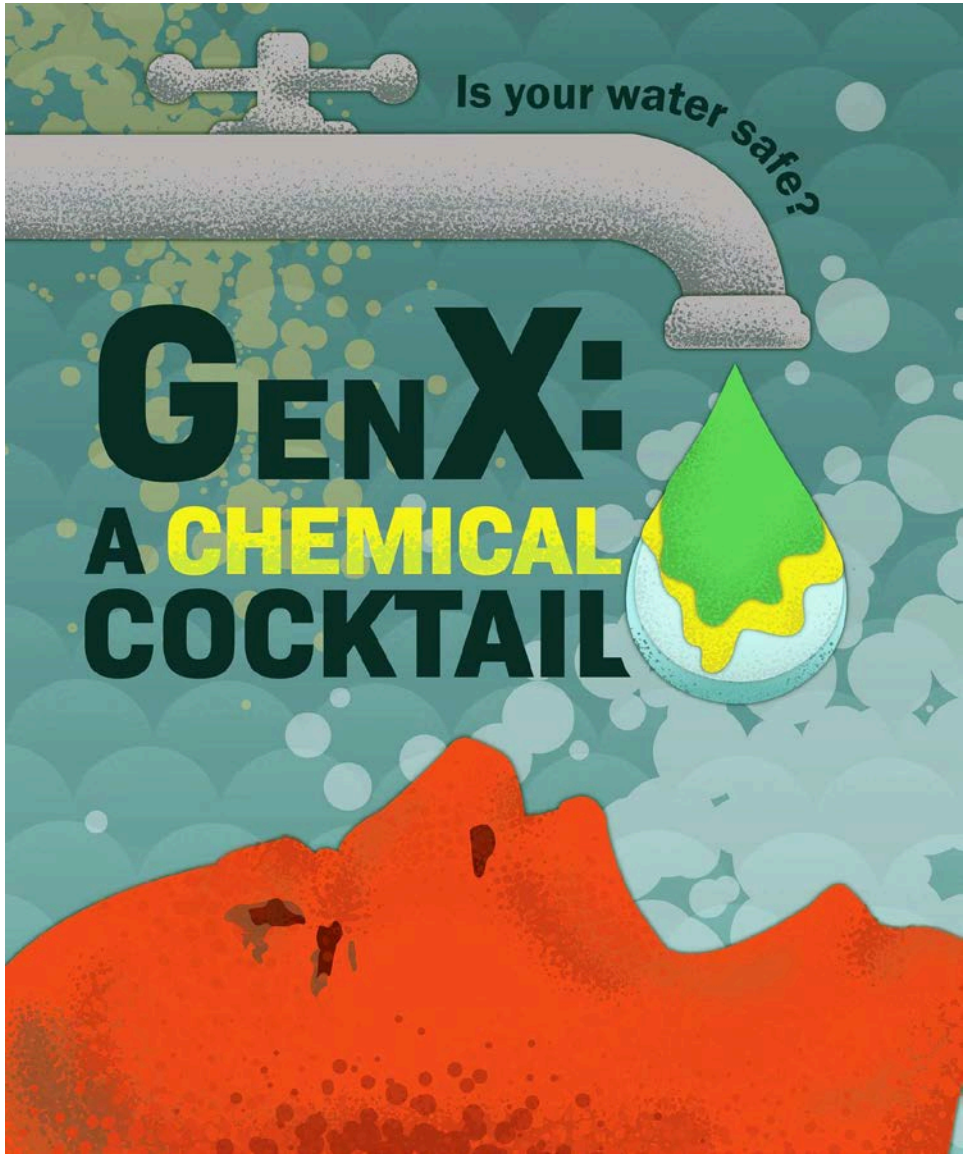
Is the Water Safe To Drink?

NC Dept. of Health & Human Services has set a health advisory level of 140ppt. That is the concentration where no adverse effects can be expected in the most vulnerable of the population, including infants and pregnant, or nursing, mothers. However, this health goal does not address people who've consumed large quantities of GenX for the past 37 years. If you grew up drinking local tap water your margin of exposure – your chronic level of exposure from consuming GenX every day for the last 37 years – could be greater than this health goal. Also, the GenX "health goal" does not address all the other PFASs in the water, some found at 50 - 100 times greater than GenX. Basically, setting a health goal of 140 ppt for one of 17 PFASs detected by scientist in our water does not make the water safe to drink.

"Although convenient, highly fluorinated chemicals are associated with serious health problems and they can remain in the environment forever."
- Green Science Policy Institute

What is the margin of exposure for chronic consumption of PFAS? What is the acceptable dose of various PFAS toxic mixtures?

Real People. Real Stories.



Educating A Nation

January 18, 2018:

Clean Cape Fear & Cape Fear River Watch partner with local film crew to education the nation on PFAS drinking water contamination.

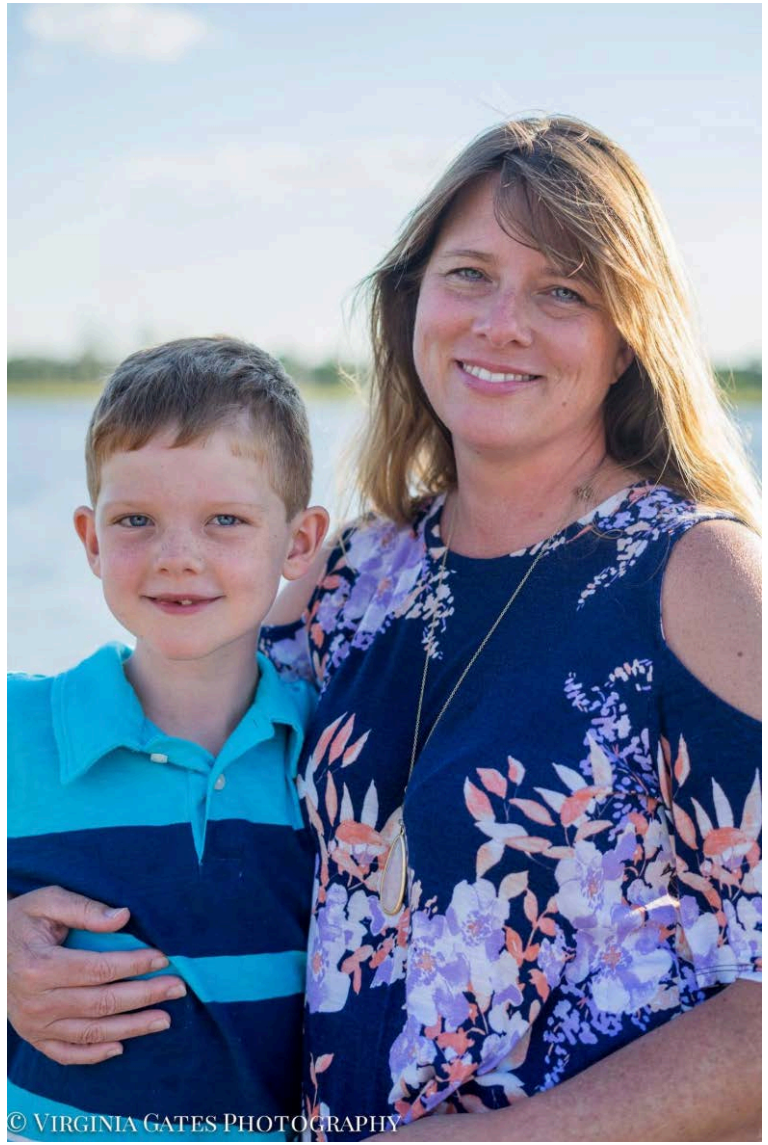
Abigail
4 years old
bilateral
Wilm's tumor

"We know it's not genetic. It's environmental. Why couldn't it be the water? I would beg our representatives to make these companies stop dumping in our water. It's water. It's a basic necessity of life. These are our lives."

- Abigail's Mom

Nathan
4 years old
Wilm's tumor

" I worry about his ability to have children and the fact that statistics prove childhood cancer survivors have a great shortened life span and a lifetime of chronic illness.
I would like to tell our reps that plain and simply, it is their job to protect our kids and to put the interests of the citizens above those of billion dollar businesses that would turn a blind eye to safety in the interest of better stock prices and increased sales."
- Nathan's Mom



Carter
9 months old
Extrarenal metastatic rhabdoid tumor

”Carter’s cancer is specifically a kidney cancer. We will never know if me drinking water when I was pregnant was the cause. Or if mixing his formula with tap water would have caused it. There should not be any chemicals in our water at all. No matter the specified limit. We should have been able to trust our water source.

- Carter’s Mom

Maddie
5 years old
Rhabdomyosarcoma

”Our experience with Maddie's cancer was brutal and heartbreaking. She was robbed of her childhood and adulthood. She passed away just one month after her 9th birthday. I already live in fear of losing another child to cancer, but now I have to worry about something as essential as our drinking water.

- Maddie’s Mom

Jacob
8 years old
Leukemia

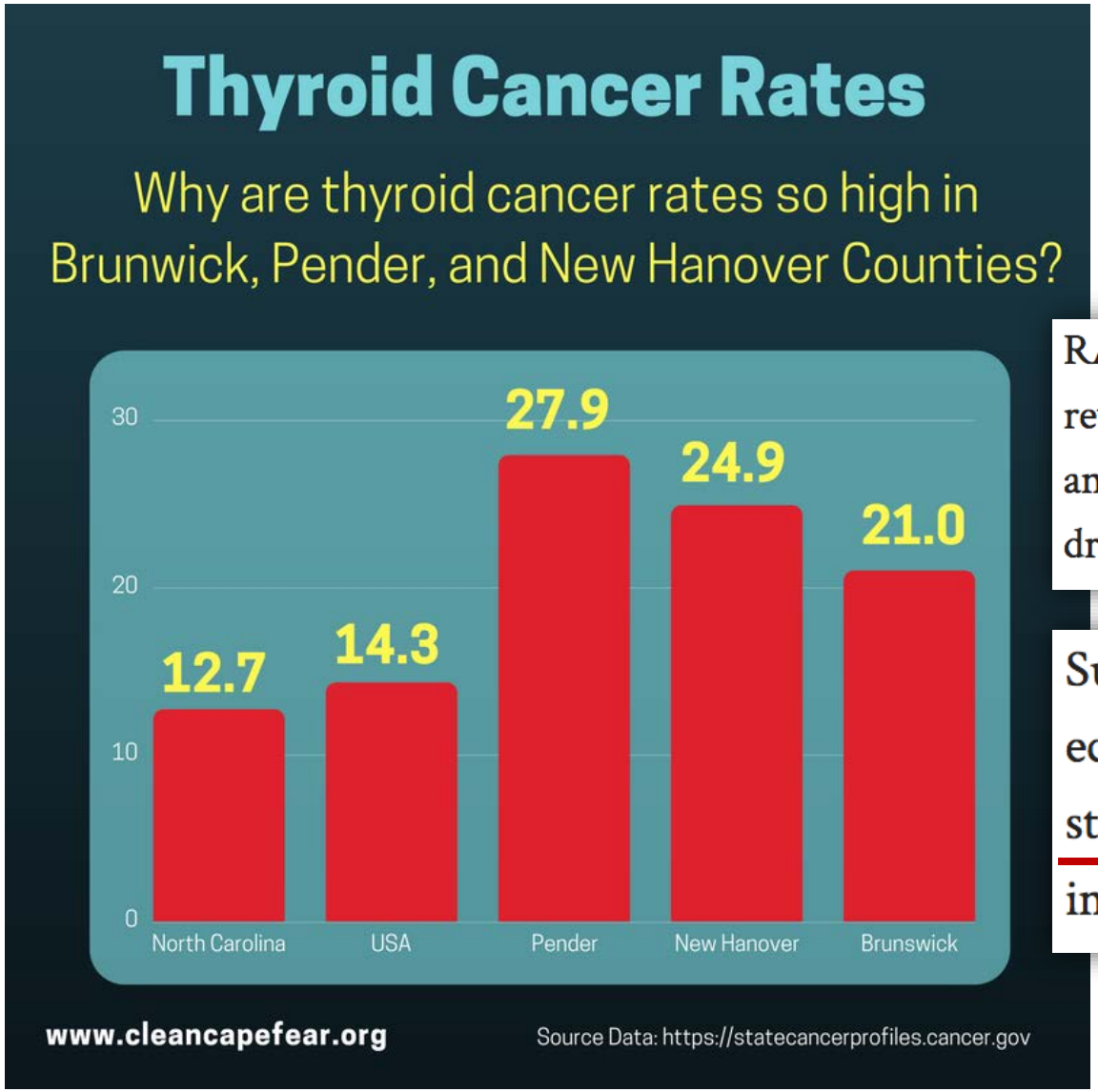
” Jacob had 1180 days straight of chemo. For me I think the hardest part was watching the light go out in his eyes. I think our leaders failed miserably. We count on them to protect our drinking water. We count on them to protect the river since it is the source of our drinking water. There are many more families in Wilmington like ours - so many kids who have been diagnosed with cancer.”
- Jacob’s Mom

“Cancer Takes Time to Reveal Itself In Humans”

Jamie DeWitt, an East Carolina University professor of pharmacology and toxicology, said the DHHS results are encouraging, but that the true impacts of GenX may take years to become known because cancer takes time to reveal itself in humans.

StarNews article, June 29, 2017 “NC Study: No Cancer Spikes In Lower Cape Fear”

Rising Health Concerns: It's Time For Answers



RALEIGH -- Testicular cancer is the main point of concern for researchers reviewing data from a state cancer incidence study during many of the years an unregulated chemical was believed to be in the Lower Cape Fear area's drinking water.

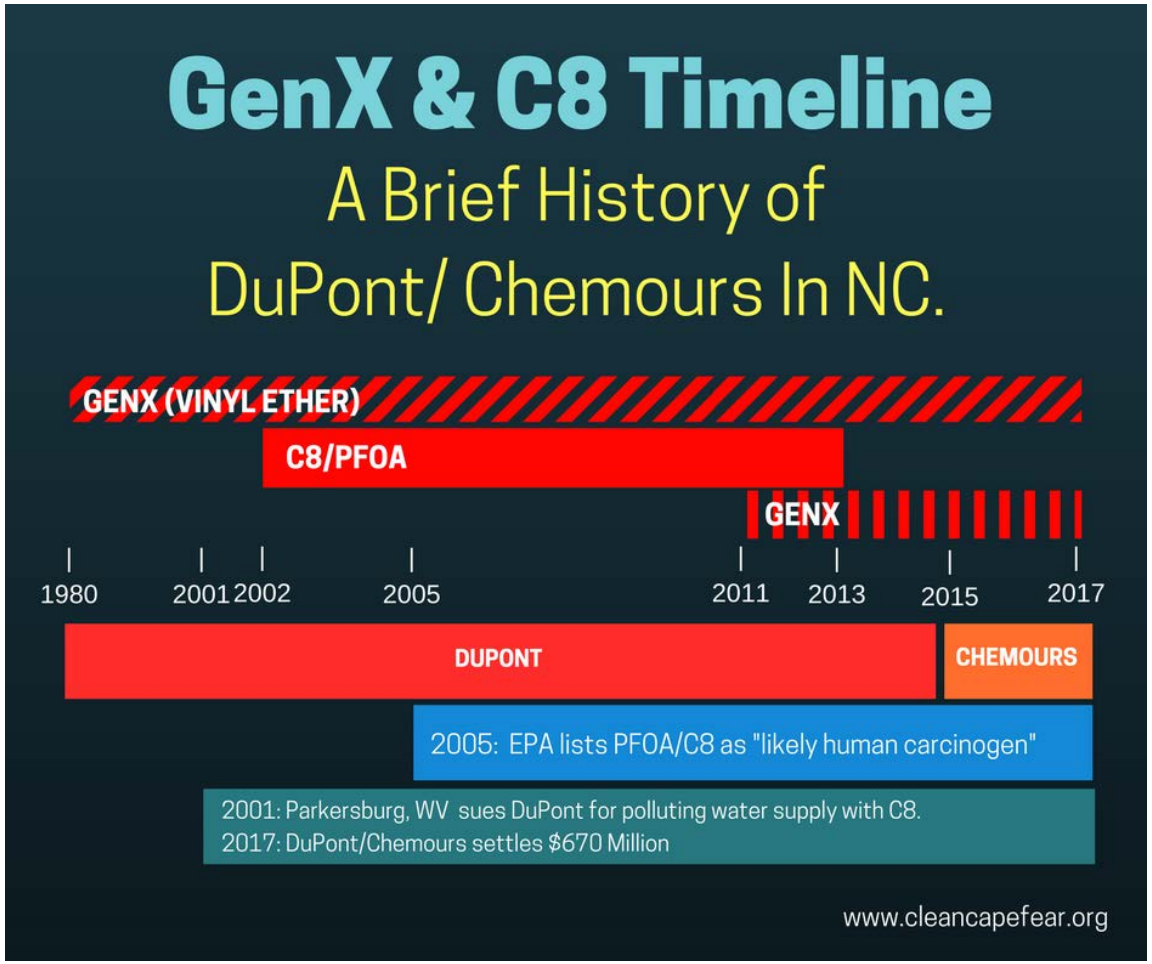
Susanne Brander, a University of North Carolina Wilmington ecotoxicologist, said the testicular cancer finding merits more study -- particular since the illness showed up in an earlier study in which rats were given high doses of GenX.

StarNews article, June 29, 2017
"NC Study: No Cancer Spikes In Lower Cape Fear"

Testicular, Thyroid, Childhood Kidney Cancers Are Already On The Rise In Wilmington, NC.

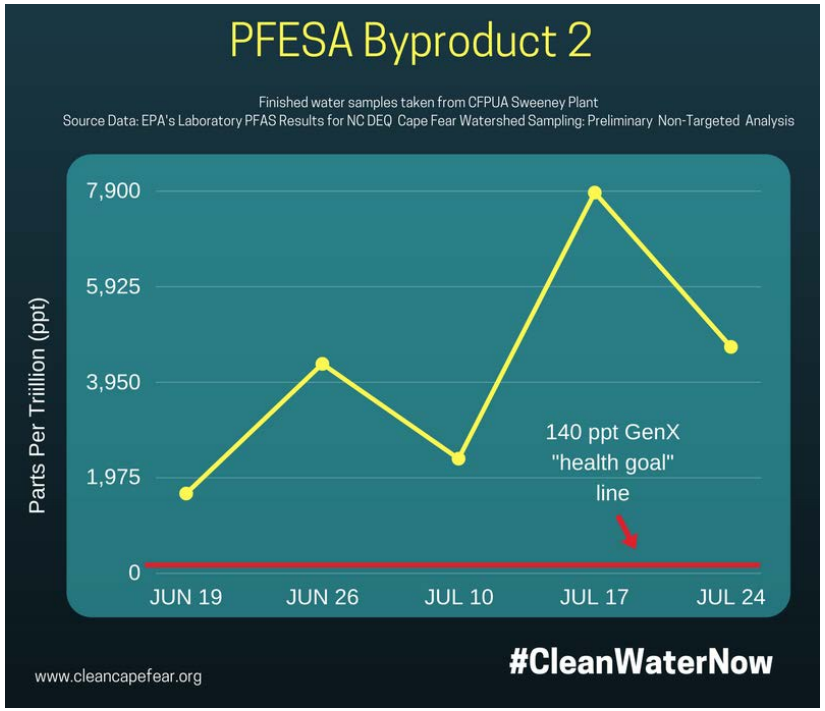
We need a NATIONWIDE PFAS Human Exposure Study.

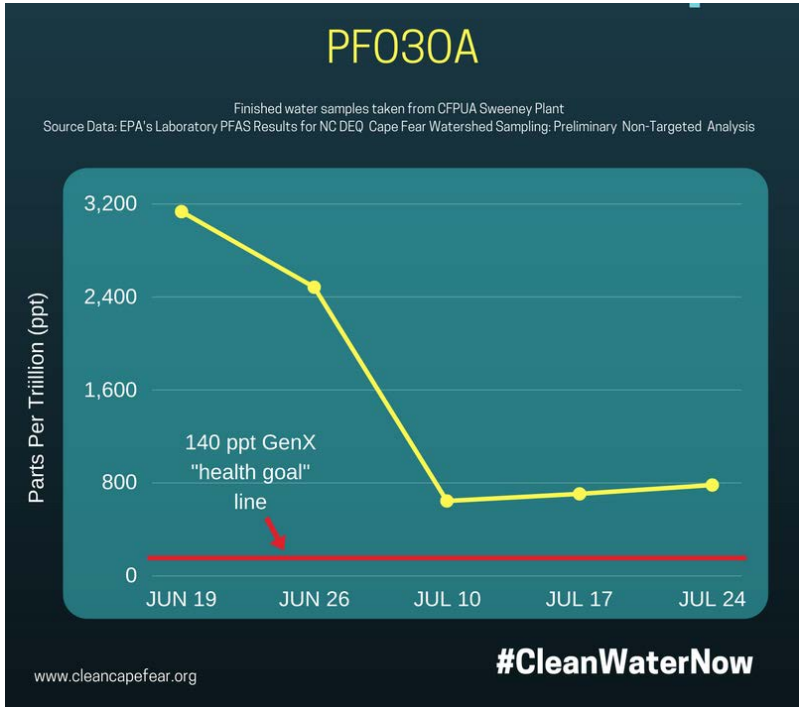
Banning 1 – 2 PFAS Is Not Enough

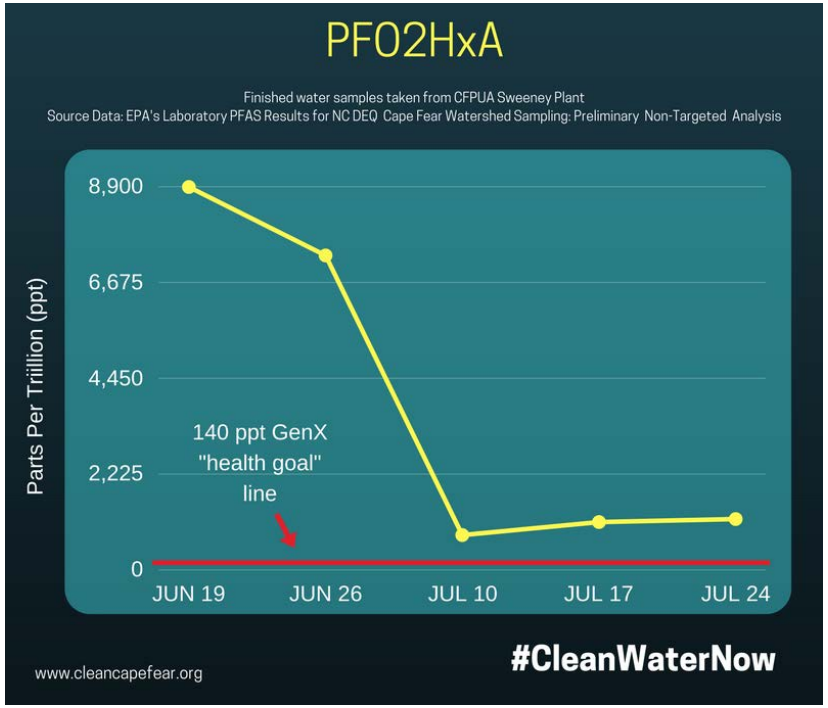


Regulate PFAS, and their byproducts, as a class of highly toxic chemicals.

PFAS Makers Must Provide Standards For All PFAS—Including Byproducts







Tap water is still deemed safe to drink—not based on sound science—but on lack of information.

Rodent Toxicology On All Known PFAS

Currently, the EPA offers health advisories for ONLY two PFAS: PFOA & PFOS.

The Cape Fear River basin finds itself in the unique dilemma of regulating and advising the public on emerging PFAS. These PFAS are so new scientists can't even:

- **Name them.**
- **Access test standards to accurately weigh and quantify them (targeted analysis).**
- **Begin to address toxicological health effects using basic animal studies.**
- **Confidently declare the water is safe to drink for ALL populations.**

Mandatory Comprehensive PFAS Testing

September 6, 2017:
Chemours poisons private wells with PFAS air pollution. Clean Cape Fear attends Fayetteville DEQ meeting. Begins sending postcards advising residents to request testing using the full EPA 537 method + 6 PFECA + Nafion byproducts.

Deny Federal Contracts To Chronic PFAS Polluters

Chemours joins Fortune 500 list of largest U.S. companies

Fluoropolymers Business

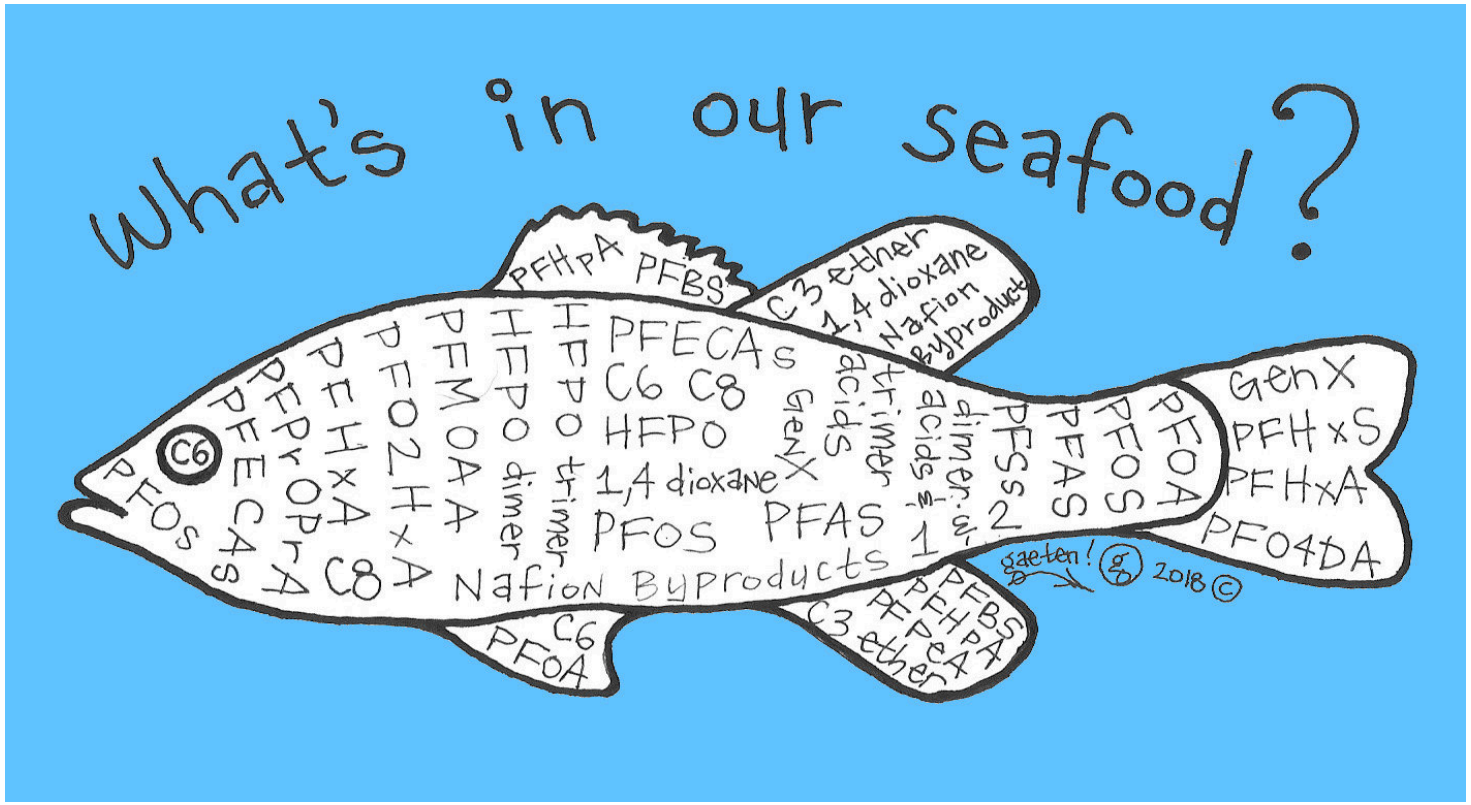
Chemours Fluoropolymers Are Used in a Broad Portfolio of Applications

Chemours | Investor Day 2017 7

Chemours Makes Fortune 500 List a Second Consecutive Year

Representing the Latest Proof Point of the Company's Growth Strategy

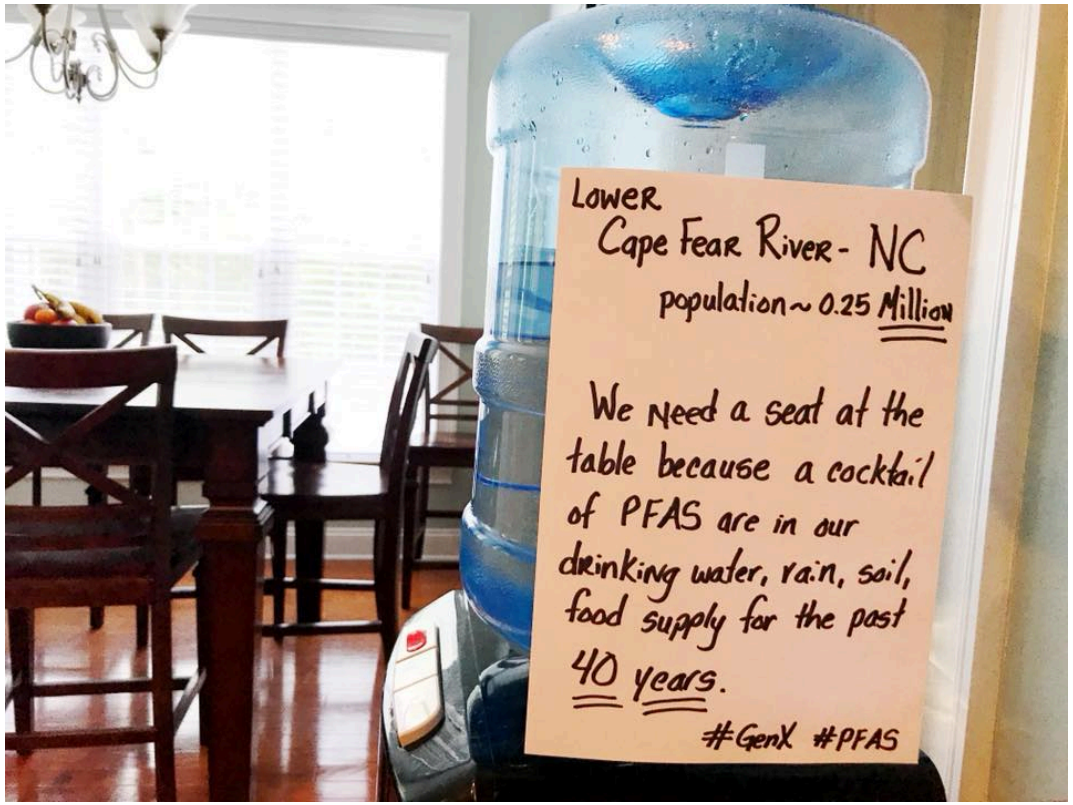
PFAS Polluters Must Pay For Clean Up



Widespread air and water pollution from DuPont/Chemours means chronic exposure to toxic PFAS. PFAS live forever. Infecting our food and water. Polluters must pay for remediation of our environment.

Maximum Contaminate Level (MCL):

1 ppt For ALL PFAS



A quarter of a MILLION people in Southeastern NC are living with PFAS contamination.

In their:

- **Drinking water**
- **Soil**
- **Rain**
- **Food Supply**

Make Public Health More Important Than Political/Industry Pressures

EPA's Pruitt and staff to attend chemical industry meeting at luxury resort next week

Washington Post, November 2, 2017

E.P.A. Chief's Calendar: A Stream of Industry Meetings and Trips Home

New York Times, October 3, 2017

In just the first 15 days of May, Mr. Pruitt met with the chief executive of the Chemours Company, a leading chemical maker, as well as three chemical lobbying groups; the egg producers lobby; the president of

Suppressed Study: The EPA Underestimated Dangers of Widespread Chemicals

The CDC has quietly published a controversial review of perfluoroalkyl substances, or PFAS, that indicates more people are at risk of drinking contaminated water than previously thought.

by **Abrahm Lustgarten**, **Lisa Song** and **Talia Buford**, June 20, 4:54 p.m. EDT

ProPublica, June 20, 2018

OUR river. OUR air. OUR land. OUR basic human rights.

Thank You!