



Report from The University of North Carolina at
Wilmington Regarding the Implementation of Section
20.(a)(2) of House Bill 56 (S.L. 2017-209)

Work conducted by UNCW included the following personnel:

Water and Sediments

(Objectives 1-3 and additional products)

Drs. Ralph N. Mead, G. Brooks Avery,
Robert J. Kieber, Megumi Shimizu,
Stephen A. Skrabal

Oysters

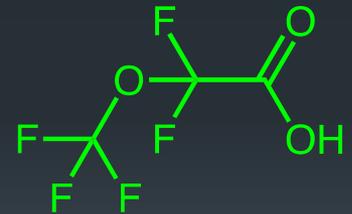
(Objective 4)

Drs. Aswani Volety, Andrea
Bourdelaïs, and Ai Ning Loh

Objective 1: Quantification and identification of perfluorinated alkyl substances (PFAS) in raw and finished drinking water collected at the Sweeney Water Treatment Plant

■ Status:

- Weekly sampling of raw and finished drinking water from Sweeney Water Treatment Facility since November 2017
- To date, characterization and structural elucidation of potentially new PFAS compounds is on-going.
- We positively identified PFMOAA (CAS# 674-13-5) through custom synthesis of an authentic standard. The standard has been shared with EPA.



Objective 2: Develop a method to quantify GenX in sediments collected along the Cape Fear River

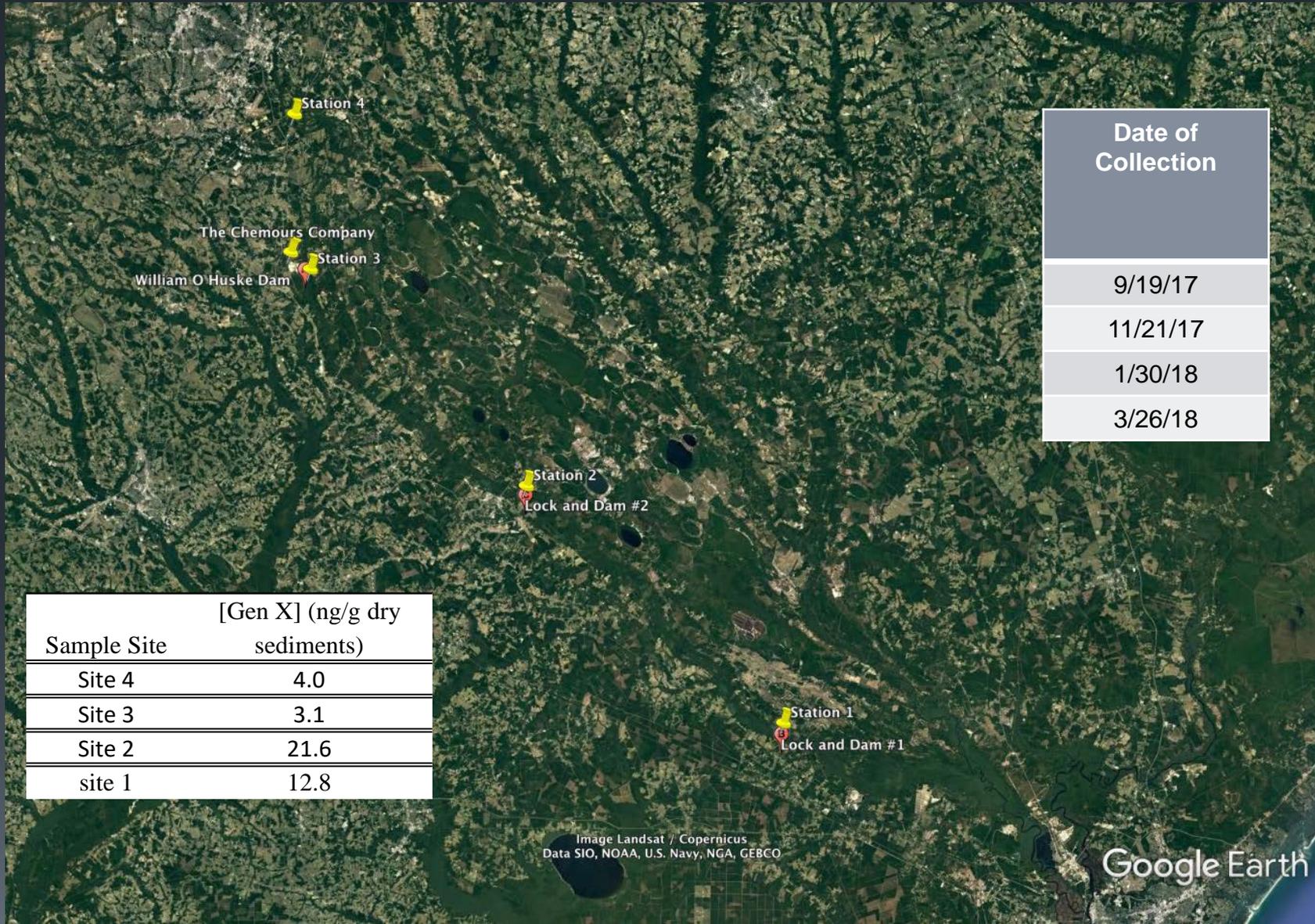
■ Status:

- Method has been developed (surrogate recoveries average 110% n= 18)
- Several sampling trips along upper and lower Cape Fear River have been conducted. Sediment and overlying water has been collected each trip





Middle Cape Fear River



Date of Collection
9/19/17
11/21/17
1/30/18
3/26/18

Sample Site	[Gen X] (ng/g dry sediments)
Site 4	4.0
Site 3	3.1
Site 2	21.6
site 1	12.8

Image Landsat / Copernicus
Data SIO, NOAA, U.S. Navy, NGA, GEBCO

Google Earth



Lower Cape Fear River



Date of Collection
9/11/17
10/23/17
2/06/18

Sample Site	[Gen X] (ng/g dry sediments)
M61	14.1

Data SIO, NOAA, U.S. Navy, NGA, GEBCO



Significance of Preliminary Sediment Results

- GenX (CAS # 1325-13-6) detected in all sediments analyzed to date
- This data along with additional measurements will be used to determine any trends or controlling factors on the distribution of GenX in sediments



Objective 3: Conduct GenX Biodegradation Studies in Sediments

- Status:
 - Long term incubation (1 year) will begin in May 2018
 - Sediment data are being used to select sediments used in biodegradation experiment (creek)



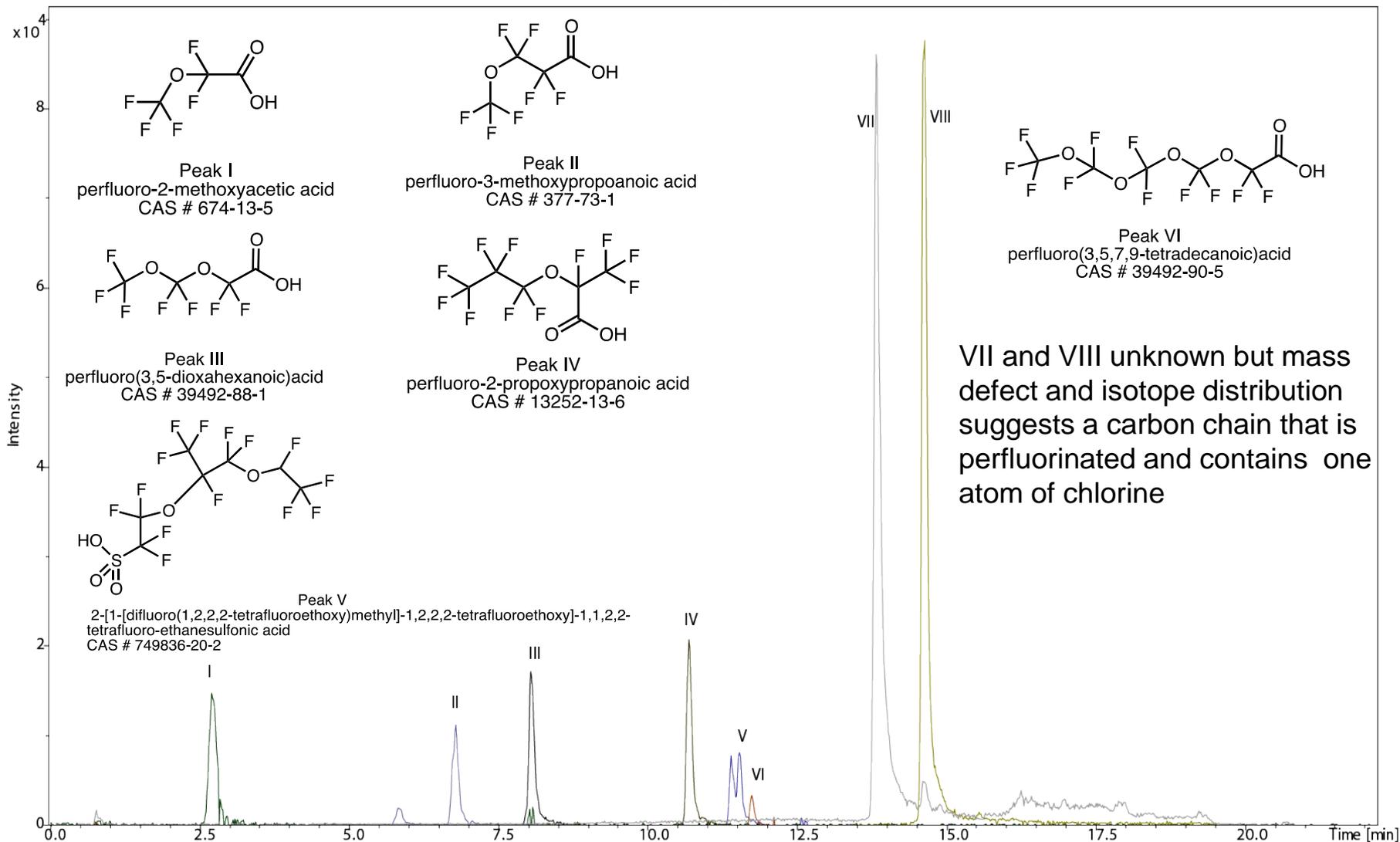
Other Products



Can we identify other perfluorinated substances in sediments in addition to GenX (CAS # 1325-13-6) ?

Sedimentary Occurrence of PFAS

M61 Extracted Ion Chromatogram from LC/QTOF





What non-point sources may supply GenX after the pipe is shut off?

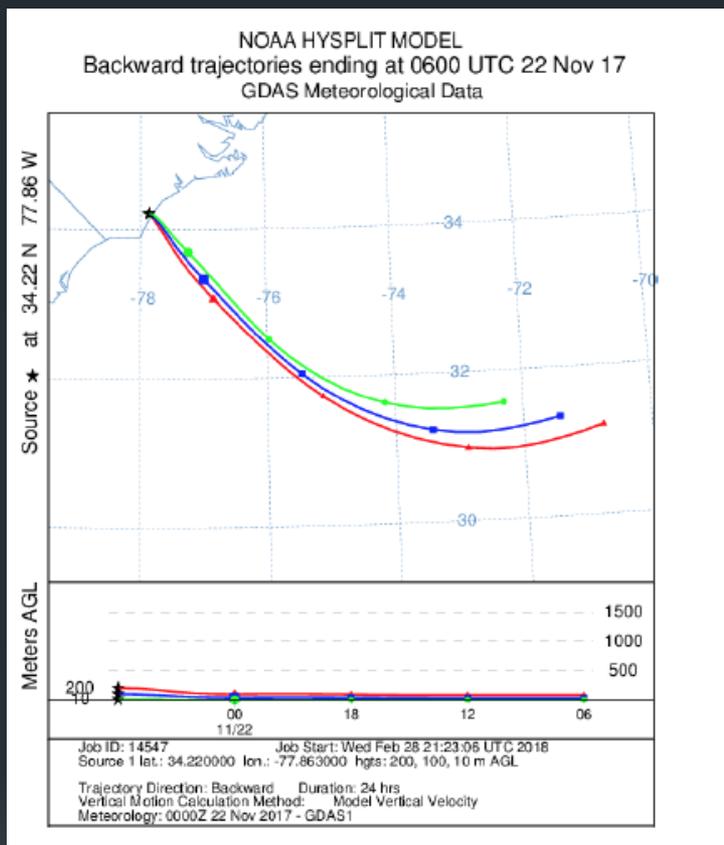


GenX in Rainwater Collected at UNCW Site

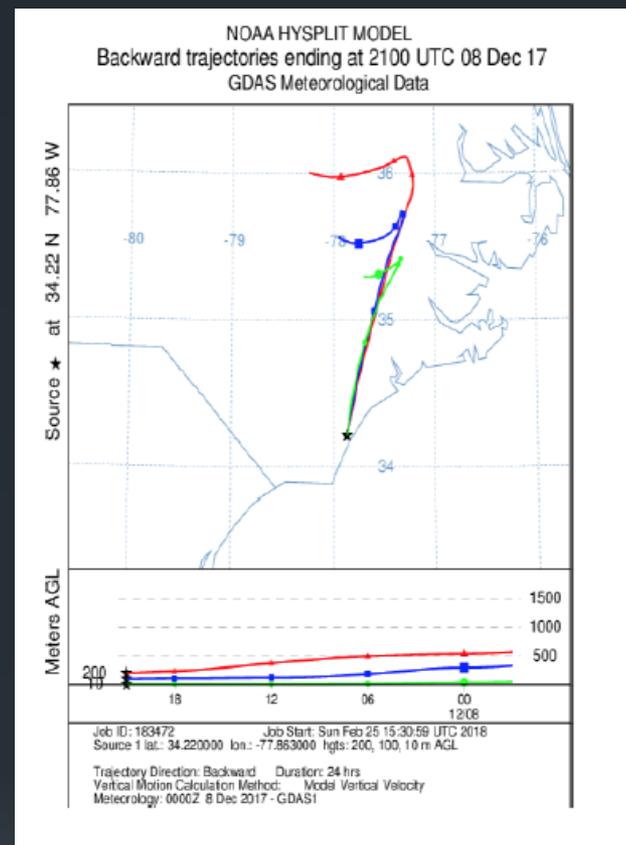
Rainwater:

- Our group has been conducting National Science Foundation-funded rainwater research for over two decades resulting in one of the most comprehensive long-term data sets in the world.
- Using our rain collection facilities we collected and analyzed rain samples for GenX.
- Based on these results we informed NCDAQ that GenX was indeed present in some rain samples leading to their current rainwater study of atmospheric transport of this compound.

How does wind direction impact GenX (CAS # 1325-13-6) concentration?



E 1775
11/21-22/17
GenX <3 ppt (ng/L)
0.26 inches received at UNCW site
pH not analyzed



E 1781
12/8-9/17
GenX >500 ppt (ng/L)
1.8 inches received at UNCW site
pH4.68



So what is the take home message from these two back trajectories?

- Long range atmospheric transport of GenX (other PFAS?) is possible based upon our data.
- For example: GenX is present in locations that are not near Chemours plant
- Concentration of Genx (other PFAS?) at specific locations are impacted by origin of the air mass (Air mass back trajectories)

How does GenX get into rain?

- Evidence suggests the air emission of a precursor is responsible for GenX in rain

Hydrolysis Reaction



hexafluoropropylene dimer acid fluoride
(CAS 2062-98-8)

perfluoro-2-propoxypropanoic acid
(CAS 13252-13-6)

Experiments performed in our laboratory showed the hydration (adding water) to the corresponding carboxylic acid known as GenX (CAS 13252-13-6) occurs in less than 10 minutes. The latter compound is what is detected in drinking water and other matrices.

The take home message from this experiment is that the dimer acid fluoride emitted into the atmosphere can rapidly turn into GenX when it encounters water (i.e. rain) and be transported potentially long distances from where it was emitted



Biosolids

Biosolids: (organic matter recycled from sewage, used in agriculture) After discussions with CFPWA about the biosolid collection from the water treatment process we offered to analyze this material for GenX. Although our sediment methodology was still in the development phase, we were able to conclude that GenX was present in biosolids from CFPWA. This resulted in the current measurements and study of GenX in biosolids being conducted by private laboratories by CFPWA.



Statewide Emerging Contaminant Symposium

Our group organized and hosted a symposium on December 10, 2017 that included all major groups working on GenX studies within the state. This included university researchers (e.g., UNCW, NCSU, Duke, ECU), state agencies (e.g., DEQ and DAQ), water treatment facility representatives from CFPUA and Brunswick County, and non-profits (e.g., NC River Watch, Southern Environmental Law Center, NC Coastal Federation). Presentations updated all parties involved on the state of the GenX issue as well as the research challenges relevant to addressing this state-wide problem. Collaborations were established between the variety of groups and organizations to leverage current resources to answer important questions related to GenX.



Summary of Findings, Objective 4:

An initial study of the effects of exposure to GenX on the growth, survival, and filtration rates of juvenile oysters suggests that very high concentrations may decrease filtration and increase mortality rates, yet there was little bioaccumulation of GenX in oyster tissues.



Effects on Juvenile Oysters of Exposure to GenX

- Juvenile oysters were obtained from UNCW's Shellfish Hatchery
- Three groups were exposed to GenX (1, 10, and 100 ppb), three times per week for four weeks; there also was a control group
- Mortality rates were low (1 to 2 per group) with the exception of the 100 ppb treatment group, where mortality was 25%
- Decreased filtration rates also were documented primarily in the 100 ppb treatment group
- There was limited bioaccumulation of GenX in oyster tissues



Ongoing and Future Oyster Work:

- Bioaccumulation studies using adult oysters and lower maximum exposures to GenX are underway
 - Collection of wild oysters from the Cape Fear River at various locations for tissue concentration analyses
 - Analysis of how quickly oysters rid themselves of GenX
- 



QUESTIONS?

THANK YOU!

