NORTH CAROLINA PER- AND POLYFLUOROALKYL SUBSTANCES TESTING (PFAST) NETWORK

Quarterly Progress Report (#6) submitted to the North Carolina General Assembly Environmental Review Commission, the NC Department of Environmental Quality, the NC Department of Health and Human Services, and the Environmental Protection Agency (Region 4)

January 1, 2020

NC Policy Collaboratory

1.0 INTRODUCTION

The North Carolina General Assembly (NCGA), in the passing of Session Law (SL) 2018-5, Sections 13.1.(g), directed the North Carolina Policy Collaboratory (Collaboratory) to *"identify faculty expertise, technology, and instrumentation, including mass spectrometers, located within institutions of higher education in the State, including the Universities of North Carolina at Chapel Hill and Wilmington, North Carolina State University, North Carolina A&T University, Duke University, and other public and private institutions, and coordinate these faculty and resources to conduct nontargeted analysis for PFAS, including GenX, at all public water supply surface water intakes and one public water supply well selected by each municipal water system that operates groundwater wells for public drinking water supplies as identified by the Department of Environmental Quality, to establish a water quality baseline for all sampling sites. The Collaboratory, in consultation with the participating institutions of higher education, shall establish a protocol for the baseline testing required by this subsection, as well as a protocol for periodic retesting of the municipal intakes and additional public water supply wells."* The term 'PFAS', listed above, refers to Per- and Polyfluoroalkyl Substances and the study is referred to herein as the NC PFAS Testing Network or PFAST Network.

The PFAST Network was funded by an appropriation from the NCGA. Section 13.1.(i) of SL 2018-5 states, *"Five million thirteen thousand dollars ($5,013,000) of the funds appropriated in this act for the 2018-2019 fiscal year to the Board of Governors of The University of North Carolina shall be allocated to the Collaboratory to manage and implement the requirements of this section, which shall include distribution to the Collaboratory and participating institutions of higher education (i) to cover costs incurred as a result of activities conducted pursuant to this section, (ii) for acquisition or modification of essential scientific instruments, or (iii) for payments of costs for sample collection and analysis, training or hiring of research staff and other personnel, method development activities, and data management, including dissemination of relevant data to stakeholders. No overhead shall be taken from these funds from the participating institutions that receive any portion of these funds. Funds appropriated by this section shall not revert but shall remain available for nonrecurring expenses."*

In addition to the water sampling identified above, additional study parameters are mandated in Section 13.1.(l), which states, *"The Collaboratory shall identify faculty expertise within institutions of higher education in the State, including the Universities of North Carolina at Chapel Hill and Wilmington, North Carolina State University, North Carolina A&T State University, Duke University, and other public and private institutions, and use technology and instrumentation existing throughout the institutions to conduct the following research (i) develop quantitative models to predict which private wells are most at risk of contamination from the discharge of PFAS, including GenX; (ii) test the performance of relevant technologies in removing such compounds; and (iii) study the air emissions and atmospheric deposition of PFAS, including GenX. In addition, Collaboratory may, using relevant faculty expertise, technology, and instrumentation existing throughout institutions identified, evaluate other research opportunities and conduct such research for improved water quality sampling and analyses techniques, data interpretation, and potential mitigation measures that may be necessary, with respect to the discharge of PFAS, including GenX."*

Research activities to carry out these legislative mandates and progress made to date are summarized in this this document which represents the sixth [quarterly] report. For reference, all provisions passed by the NCGA in Section 13 of Session Law 2018-5 [related to this project] are included in Appendix I of this report.

2.0 REPORTING REQUIREMENTS

Section 13.1.(h) of SL 2018-5 states, *"Beginning October 1, 2018, the Collaboratory shall report no less than quarterly to the Environmental Review Commission, the Department of Environmental Quality, and the Department of Health and Human Services on all activities conducted pursuant to this section, including any findings and recommendations for any steps the Department of Environmental Quality, the Department of Health and Human Services, the General Assembly, or any other unit of government should take in order to address the impacts of PFAS, including GenX, on surface water and groundwater quality, as well as air quality in the State."* In addition, Section 13.1(g) states*, "No later than December 1, 2019, Collaboratory shall report the results of such sampling by identifying chemical families detected at each intake to the Environmental Review Commission, the Department of Environmental Quality, the Department of Health and Human Services, and the United States Environmental Protection Agency.*

The April 1, 2019 Quarterly Report noted submission of a letter by PFAST Network scientists to the NC Policy Collaboratory on March 13, 2019 (Appendix II of the April report) requesting a 1-year extension of the study. The reasoning for the request was twofold: 1) to ensure sufficient time for comprehensive analysis and interpretation of non-targeted data and 2) to enable additional sampling of drinking water supply intakes during different seasons. The Collaboratory transmitted this request to the NC General Assembly on March 25, 2019. An approved extension for the study was included in the compromise budget (H966) passed by the NCGA and sent to the Governor on June 27, 2019, which he subsequently vetoed on June 28th.

Since the future of bill H966 remains unclear, the NC General Assembly included an extension for the PFAST Network study in another bill (S433) which the governor signed. Session Law 2019-241 was adopted on November 6, 2019 and Section 7.1.(d) includes revision of the original language from Section 13.1(g) of S.L. 2018-5, now extending the deadline for submission of the final PFAST Network report from the Collaboratory to October 15, 2020. The legislative language in Section 7.1 of SL 2019-241 is provided for reference in Appendix II.

This report fulfills the initial NCGA requirement for the submission of quarterly progress reports and summarizes the work conducted since the October 1, 2019 report. Quarterly progress will continue to be reported with due dates of January 1, April 1, and July 1, 2020, and per Section 7.1.(d) of SL 2019-241, a final report summarizing findings and recommendations will be submitted no later than October 15, 2020.

QUARTERLY PROGRESS UPDATE

NC PFAST Network scientists have now completed 18 months of research determining baseline levels of targeted PFAS in all public drinking water supplies, some private wells, wastewater, landfill leachates, rainwater and ambient air (gas and particles). Furthermore, Network researchers have been conducting experiments to investigate: the presence and impacts of PFAS in ecologically relevant animal species such as American alligators and different species of fish; effects of soil composition on uptake and distribution of PFAS in crop plants; and effects of PFAS exposure on the immune response, pregnancy, and development. They are processing data and analyzing results, preparing manuscripts, and meeting with public stakeholders to exchange information. For reference, the PFAST Network organizational structure and team leaders were provided in Appendix II of the January 1, 2019 quarterly report, and the specific aims of the research projects were described in Appendix III of that same report. Copies of prior reports can be accessed on the NC PFAST Network website under "Resources" https://ncpfastnetwork.com/resources/. Progress made during the past quarter from October 1 through December 15, 2019 is summarized in the following bullet points:

Overall Program Activities
- Since its launch in April 2019 through December 15, 2019, the PFAST Network website (https://ncpfastnetwork.com) has had 2,618 unique users and 4,009 visits. This website created and maintained by the Network's Risk Communications Team is an important source of information providing background on the study objectives and researchers, details on events and public presentations, as well as other resources such as Frequently Asked Questions. Following completion of the study, results will be made available by the Data Science and Management Team via links on this website. Questions about the Network's PFAS testing or related research can be sent to the general e-mail: ncpfastnetwork@unc.edu, and the Program Management Team will either respond directly or forward specific requests for information to the appropriate team leaders.
- The PFAST Network's synthetic organic chemist continues to develop, test, and optimize chemical reactions for the production of PFAS chemical standards which are not yet commercially available. Validated standards are required for calculating the levels (concentrations) of newly discovered, emerging PFAS contaminants in test samples. In addition, larger quantities of pure substances are needed for animal dosing in toxicology studies and for remediation testing. In many cases, it is more cost effective to produce these bulk testing materials in-house.
- PFAST Network members have participated in national conferences, local workshops, and public meetings to raise awareness of the NC PFAST Network study and to share goals of the various research projects, workflow strategies, and updates with legislative and regulatory committees and community stakeholders. A list of presentations, manuscripts, and new grants from the past quarter can be found in Appendix III of this report.

PFAS Water Sampling and Analysis
- The Water Sampling and Analysis Team led by Dr. Detlef Knappe (NC State University) and Dr. Lee Ferguson (Duke University) completed the first round of sampling from public drinking water sources throughout the state and have started the second round of collection. Untreated (raw) water samples from 190 surface water intakes, 158 municipal

groundwater wells, and 57 county or regional water supplies were collected and analyzed by targeted mass spectrometry to determine levels of 47 or more individual PFAS. As new standards become available, the team adds compounds and re-optimizes the method. A total of 147 samples have been collected so far in round 2, and the team is gearing up to resume trips in January.

- Automated reports of targeted PFAS levels have been generated from the processed data for the first round samples. Approximately half of the reports have been e-mailed to each municipality and to representatives from NC DEQ, NC DHHS, and local legislators in accordance with the PFAST Network notification policy. The Program Management team expects to clear the backlog of reports to be sent out in early January 2020. It should be noted that none of the reports in this batch contained detectable PFAS at levels which would trigger an additional alert to the corresponding county health department director. As a reminder, since there are no established regulatory limits yet for PFAS, Network investigators and Executive Advisory Committee members decided to set their notification level consistent with the US EPA Health Advisory Limit (HAL) of 70 nanogram per liter (ng/L) or parts-per-trillion (ppt) for the observed sum of PFOA + PFOS. Furthermore out of an abundance of caution, results are also flagged if one or more individual PFAS are observed above 70 ppt. To date, only 6 municipalities have been notified of PFAS levels meeting the aforementioned criteria.

- Non-target analyses are ongoing in Dr. Knappe's (NC State) and Dr. Ferguson's (Duke) labs. A higher-throughput method using on-line solid phase extraction (SPE) with high-resolution LC-MS/MS analysis has been established on the Orbitrap mass spectrometers and is still undergoing final validation in both labs. This type of analysis will reveal the presence of additional PFAS not quantified in the targeted analysis. It requires intensive data analysis and interpretation and relies on the creation of comprehensive PFAS spectral libraries and the availability of certified chemical standards for confirmation of proposed chemical structures.

- Dr. Mei Sun's lab at UNC Charlotte selected a type of activated carbon (derived from bituminous coal) as the sorbent for Adsorbable Organic Fluorine (AOF) measurements. The new AOF method was validated and applied to approximately 100 water samples collected in round 1. Additional sample analyses are ongoing as well as comparisons of the total organic fluorine values to the summed PFAS from targeted analysis to estimate the percentage of fluorinated substances accounted for in the analysis (mass balance).

- The Water Sampling and Analysis team is currently working with the Network's Data Science and Management team to finalize the data uploading process and to complete development of visualization tools for public access to the validated results.

Private Well Risk Modeling
- The overall goal of this team led by Dr. David Genereux at NC State and Dr. Jackie MacDonald-Gibson at UNC-CH is to uncover factors influencing the risk of GenX and other PFAS contamination in water supply wells near the Chemours plant by collecting and interpreting new data on the fate and transport of PFAS contaminants in the surficial groundwater system near Chemours and by building and validating machine-learned Bayesian Network (BN) models for risk prediction.

- During this reporting period, the team obtained an additional report on GenX air emissions from DEQ as well as 4 spreadsheets of 2017 PFAS analyses in groundwater and

soils from the Chemours site, originally published as .pdf format in the Geosyntec report. The team also met with Beau Hodges (Principal Geologist) and Rohit Warrier (Geologist) from the Geosyntec office in Raleigh to learn more about their current and future work in the Fayetteville Works area.

- The team conducted field reconnaissance to identify suitable locations for groundwater sampling in Willis Creek and met with people from an impacted community north of Chemours around Marshwood Lake. One resident expressed an interest in hosting a well nest on his property. Four drilling companies were contacted to get quotes for the installation of a well nest in the study area.

- Determination of PFAS concentrations in groundwater samples collected from Georgia Branch have been completed in the Knappe lab at NC State University. The data allowed calculation of (1) PFAS flux through the streambeds, from groundwater to surface water, and (2) stream export of PFAS from the watersheds. Additional water samples have since been collected from the Old Outfall Channel and delivered to Dr. Knappe's lab at NC State for analysis.

- Groundwater samples collected in February 2019 from the Georgia Branch watershed were analyzed at the University of Utah for noble gas and tritium concentrations (for groundwater age-dating). This data and additional measures from streambed sand and underlying clay were used to prepare hydrogeological cross-sections through the stream valley at several different locations, as an aid to understanding the groundwater flow and available chemical data. The team is currently analyzing the results for insights regarding subsurface water and PFAS movement at the site.

- The Bayesian Network (BN) model has been updated with new data, and two predictive models have been developed using different variables. Interactive web-based versions of both models have been developed as well as a GIS mapping application. The models have been tested and cross-validated for accuracy in predicting risk of GenX contamination using new data from Chemours' sampling of homes (all below 140 ng/L GenX) not previously included in the BN training model. Results show that both models can accurately predict and classify these wells on a lower risk of GenX. New samples have also been collected from 18 residences and are currently being analyzed at UNC Chapel Hill for targeted PFAS levels. In addition the team has gathered data for biosolids sites located approximately 12 miles from the Chemours plant and will incorporate this information into the BN model.

PFAS Removal Performance Testing
- The overall goal of this team led by Dr. Orlando Coronell at UNC Chapel Hill and Dr. Mei Sun at UNC Charlotte is to identify optimum technologies for removing both legacy and emerging PFAS from contaminated surface and ground waters in NC as well as from finished drinking water. This research involves multiple collaborating laboratories (Coronell, Sun, Knappe, Stapleton, Leibfarth) each focused on a particular technology.

- Five types of ion exchange (IX) resins were selected based on screening test results for further regeneration and kinetic tests. The team evaluated the effects of cations, anions, salt concentrations, and pH on resin regeneration and also examined the sorption kinetics within 120 minutes.

- PFAS removal experiments with high-pressure membranes have been performed and the feed and permeate samples are awaiting analysis for PFAS concentrations to assess

rejection by the membranes. The lab is also evaluating membrane modification for potential enhancement of PFAS rejection using additional polyamide formation to reduce contaminant permeation and passage. Performance testing of these membranes with salt solutions is in progress.

- Sample analysis has been completed to characterize PFAS removal from finished drinking water by in-home filters in NC households. A manuscript summarizing findings from Dr. Heather Stapleton's lab at Duke University is currently under review.

- Evaluation of electrochemical degradation for PFAS removal from waste streams generated during challenge tests and analysis of the resulting degradation products is ongoing in Dr. Mei Sun's lab. They redesigned the electrochemical reactor for a better seal and studied the efficiency of Ebonex Plus electrodes to degrade PFOA in the new reactor setup. Since no PFOA degradation was observed, they tested new boron-doped diamond (BDD) anodes and achieved a PFOA reduction of 93%.

- Synthesis and characterization of the next generation of Ionic Fluorogels is underway. The materials are being optimized for PFAS removal to overcome the limitations of commercial activated carbon and ion-exchange technologies. Among other developments, these materials feature more rigid crosslinking groups which will impact mechanical properties. Preliminary sorption studies indicate that many of these materials are on par with or better than the 1st generation Ionic Fluorogels. Degradation experiments are currently being designed to assess chemical stability of the Fluorogels in different aqueous environments relevant to water treatment.

Air Emissions and Atmospheric Deposition
- The overall goal of this team led by Dr. Barbara Turpin at UNC Chapel Hill and Dr. Ralph Mead at UNC Wilmington is to enhance our understanding of the airborne composition, distribution and concentrations of PFAS. There is limited data available regarding the atmospheric gas-particle partitioning, reactions, and deposition of legacy and emergent PFAS, and it has been recognized that airborne PFAS have been found far from point sources due to limited environmental degradation (persistence) and ubiquitous release from consumer products and waste streams.

- The Turpin lab collected gas- and particle-phase samples at 5 sites across the state (Fayetteville, Wilmington, Greenville, Research Triangle Park, and Charlotte) using quartz fiber filters for particles and polyurethane foam (PUF) for gases. Seasonally-composited filter samples (and blanks) were extracted and analyzed by targeted mass spectrometry to determine levels of 34 PFAS.

- The team also conducted intensive air sampling from October to December 2019 using two high volume samplers placed south-southwest and north-northeast of the Chemours facility, in line with the main wind directions. High volume sampling will allow for better time resolution (as opposed to seasonal composites) when sampling close to the Chemours facility. These samples have not yet been analyzed, but the results will help determine whether it is possible to make real-time measurements with a chemical ionization mass spectrometer (CIMS) close to a point source. The CIMS detection limits for PFAS are being determined and the team also plans to examine atmospheric chemistry involving PFAS compounds in controlled laboratory experiments.

- Through the end of November 2019, the Mead lab has collected and analyzed wet deposition samples from their main station in Wilmington for a total 81 rain events. In

addition, winter and summer samplings were carried out at 5 other sites across the state (Bald Head Island, UNC-C, UNC-CH, ECU, and App. State), and 23 dry deposition samples were collected over 2-week intervals in Wilmington. Sample processing and targeted mass spec analysis for 22 PFAS are in progress.

- The team is also examining the influence of air-mass back trajectory on PFAS concentration and distribution. They performed 72 hour air-mass back trajectory analysis on all 81 samples from UNCW so far. Based on tentative classifications of these samples, they have collected a variety of events including 7 terrestrial, 13 marine and 61 mixed events. As more data are generated the list will be updated.

Other Applied Research Opportunities:

Novel PFAS Inputs into the environment: landfill leachates and wastewater treatment:
- The Barlaz lab at NC State University has sampled 15 municipal solid waste landfills across North Carolina from February through October 2019. Each site has been sampled twice. The team has preliminary PFAS data for the first round of leachate samples. A preliminary report for first round of sampling was sent to each landfill operator before the second event took place. All samples from rounds 1 and 2 are being reanalyzed in December.
- A total of 31 wastewater treatment plants have been sampled including 2 that were sampled every week for 4 weeks to assess temporal variability. All sampled plants primarily treat domestic wastewater, while 20 also treat some type of industrial wastewater. All wastewater treatment plants were sampled twice. The team has obtained preliminary concentration data for 26 PFAS compounds at 24 tested plants and reports were sent to the plant operators. All samples from rounds and 1 and 2 are being reanalyzed.
- The team has sampled 1 lined Construction and Demolition (C&D) waste landfill in North Carolina two times. They identified one other landfill they wanted to sample, but were denied access (only 2 of NC's 36 open C&D landfills have leachate collection and control systems). The team has also collected one-time water samples from runoff emanating from 4 out-of-state C&D landfills. Data analysis for these samples is ongoing.

PFAS bioaccumulation in aquatic environments: alligator and fish studies:
- The Belcher lab at NC State University has completed sampling of alligator and striped bass serum samples for the season. Currently the team has sampled 100+ striped bass across the state, including but not limited to the Cape Fear River. 2018 sample analysis has been completed and the findings will soon be published. The 2019 Striped bass samples are awaiting analysis. These include fish from the Pamlico and Roanoke rivers to compare exposures across NC Rivers.
- Samples have also been collected from ~90 North Carolina alligators. Analysis of serum PFAS concentrations and biomarker analysis has been completed for most of these samples and results will be shared soon. Preliminary findings of PFAS exposure and adverse health impacts associated with elevated PFAS exposure found in alligators living in the Cape Fear watershed were presented to North Carolina Wildlife Resource Commission staff in December 2019.
- The team has also collected tissue samples from 2 species of sun fish, 2 species of catfish, American shad, and striped bass that have been collected from the lower and North East

Cape Fear, the Deep and the Haw Rivers. Full analysis of these samples from fish consumed by NC fishers is ongoing. In October 2019, Dr. Belcher shared sampling and analysis guidelines and preliminary data with NC DEQ and DHHS staff.

Health effects following exposure: mouse model of immunotoxicity:
- The DeWitt lab at East Carolina University has completed four experiments dosing animals with PFMOAA, PFMOPrA, PFMOBA, and Nafion BP2 (which are four of the PFAS found in high concentrations in the Cape Fear River in 2016). Data analysis for all four studies is ongoing, and the team is drafting manuscripts to share findings of these experiments.
- Repeat experiments with Nafion BP2 and higher administered doses of PFMOAA will be conducted starting in January 2020, as well as a dosing study with a mixture (likely Nafion BP2 and PFMOAA). The team plans to end this second round of experiments with a dosing study of PFHxA. As in the first set of experiments, mice will be orally exposed to PFAS in water, and daily body weights and in-life observations will be recorded in addition to the assessment of immune response modulation.
- In November, Dr. Jamie DeWitt was appointed to the NC Secretaries Science Advisory Board to the Department of Environmental Quality and Department of Health and Human Services.

PFAS bioaccumulation and distribution in crop plants: greenhouse studies:
- The Duckworth lab at NC State University has been conducting greenhouse experiments with compost-amended and PFAS-spiked soils and have harvested lettuce plants for analysis. They developed methods for extractions from plant tissues and soil for PFAS concentration analysis by targeted mass spectrometry. The team has determined concentrations of Gen X in soil, pore-water, roots, and shoots of lettuce. They have also calculated translocation factors. Further analysis for other PFAS found through the experiments is ongoing.

Health effects following exposure: placental inflammation and immune cell signaling:
- The Fry lab at UNC Chapel Hill completed experiments to address the question: "do PFAS in drinking water pose a risk to pregnant women and could they affect the health and function of her placenta?" They have measured levels of PFAS in drinking water, placenta, cord blood, and maternal serum samples from pregnant women in NC and conducted laboratory experiments using placental cells to investigate the effects of PFAS on placental health and function. Their results will provide information about the PFAS exposure profile for NC women during pregnancy and help determine whether their exposures are coming from drinking water.
- They have analyzed 122 placental samples collected at delivery for a suite of 22 targeted PFAS including GenX. These samples were derived from the UNC Preterm Biobank (PTB) study. They have also analyzed 68 water samples to date from pregnant women recruited through the high-risk perinatal clinics at UNC Hospital for the Environment, Perinatal Outcomes, and Children's Health (EPOCH) study. Women were given 3 water sampling kits with instructions to take home, collect water samples at 3 times spaced out during her pregnancy, and mail back in to UNC. Analysis of additional water and biological samples is proceeding.

- The team has also exposed placental cells to different PFAS and looked for changes in genes expression (production of functional proteins or RNA) related to cellular pathways involved in normal placental function. Following 24-hour treatment of cells with PFOA, PFOS, or GenX, they measured a panel of 91 inflammatory genes that are expressed in human placenta and evaluated the data for associations of PFAS exposure with preeclampsia (pregnancy complication characterized by high blood pressure, swelling, and protein in urine).

Risk Communications:
- A key activity and accomplishment of the Risk Communications team this quarter was their second of three planned symposia. The team collaborated with the Research Triangle Environmental Health Collaborative (http://environmentalhealthcollaborative.org/) to co-sponsor and organize a 1.5-day research symposium on October 23-24, 2019. The PFAS Summit was held at the NC Biotech Center in RTP and brought together 154 researchers, elected officials, regulatory agencies, environmental nonprofits, and residents of communities impacted by PFAS contamination to discuss how to limit exposure to PFAS in North Carolina, with a focus on the research occurring in the NC PFAST Network. The symposium included interactive working groups focused on identifying important data gaps and potential solutions to PFAS contamination in three categories: (1) missing links in understanding PFAS fate and transport, (2) alternative options for PFAS treatment and disposal, and (3) how to factor emerging knowledge about PFAS into risk assessment. A copy of the agenda is included in Appendix IV, and symposium presentations are available online https://ncpfastnetwork.com/resources/. A final report from the symposium for publication will be available soon.
- The team organized a 1.5 hour webinar on Oct. 3, 2019 to introduce the topic of PFAS to educators. The webinar was entitled: *Per- and Polyfluoroalkyl Substances (PFAS)- What are they and how are NC scientists investigating their prevalence in the environment and their potential impacts to humans and wildlife?* Network presenters Wanda Bodnar, Jamie DeWitt, and Scott Belcher joined Dana Haine of the UNC Institute for the Environment to provide background about PFAS and to explain how scientists are studying potential health effects of PFAS, impacts of PFAS on ecosystems & wildlife (e.g., bioaccumulation) and what can be done to minimize exposure. The full webinar and accompanying teacher resources are available online: https://ncpfastnetwork.com/resources/
- To increase PFAS awareness among the public, the Team also presented about the PFAST Network at the NC School of Science and Math to about 40 students as part of Science Day on October 5, 2019. Resources were also shared with the School Dean of Sciences to share with environmental sciences teachers. The team also held an event called Beer-Reviewed Science, which is a form of science café, at the Transfer Food Hall in Raleigh, NC on July 23, 2019 featuring Network scientists Detlef Knappe and Scott Belcher. There were approximately 30 people in attendance (this event was not included in a prior report).
- The team also worked with Team 5 co-leader Rebecca Fry's public health master's student to finalize PFAS graphics in consultation with other Network researchers. These graphics are available to download and for widespread use by Network researchers and the members of the public https://ncpfastnetwork.com/printed-materials/. The Risk Communications team is currently working on text for crediting use of the graphics.

Data Science and Management

- The PFAST Network's Data Science and Management continues working with research teams to develop tools and provide support for field data collection and geo-referencing of sampling sites across North Carolina. Team members developed tools for routing/mapping and extracting other contributing high-resolution stream data. The team is currently working on prototype, interactive PFAS visualizations.

- The team is also testing and refining the prototype for uploading PFAS results and Metadata into the PFAS Data Hub which will soon be accessible through the PFAS Network website. Updates include options to display aggregated metadata, visualize calculation of reported PFAS concentrations and view additional basemaps. The Data Hub has recently been populated with water sampling location data received from NCSU's Center for Geospatial Analytics. Lack of unique identifiers for each drinking water source (except for the EPA source ID) and uncertainty of which groundwater well will be selected for sampling by each municipality have been limiting factors. A procedure has to be developed to match the sampling points with DEQ records using GPS coordinates.

APPENDIX I

LEGISLATIVE LANGUAGE PASSED BY THE NORTH CAROLINA GENERAL ASSEMBLY
(Session Law 2018-5, Sections (f) through (l), effective June 12, 2018)

FUNDING TO ADDRESS PER- AND POLY-FLUOROALKYL SUBSTANCES, INCLUDING GENX/USE OF EXPERTISE AND TECHNOLOGY AVAILABLE IN INSTITUTIONS OF HIGHER EDUCATION LOCATED WITHIN THE STATE

SECTION 13.1.(f) The General Assembly finds that (i) per- and poly-fluoroalkyl substances (PFAS), including the chemical known as "GenX" (CAS registry number 62037-80-3 or 13252-13-6), are present in multiple watersheds in the State, and impair drinking water and (ii) these contaminants have been discovered largely through academic research not through systematic water quality monitoring programs operated by the Department of Environmental Quality or other State or federal agencies. The General Assembly finds that the profound, extensive, and nationally recognized faculty expertise, technology, and instrumentation existing within the Universities of North Carolina at Chapel Hill and Wilmington, North Carolina State University, North Carolina A&T State University, Duke University, and other public and private institutions of higher education located throughout the State should be maximally utilized to address the occurrence of PFAS, including GenX, in drinking water resources.

SECTION 13.1.(g) The North Carolina Policy Collaboratory at the University of North Carolina at Chapel Hill (Collaboratory) shall identify faculty expertise, technology, and instrumentation, including mass spectrometers, located within institutions of higher education in the State, including the Universities of North Carolina at Chapel Hill and Wilmington, North Carolina State University, North Carolina A&T State University, Duke University, and other public and private institutions, and coordinate these faculty and resources to conduct nontargeted analysis for PFAS, including GenX, at all public water supply surface water intakes and one public water supply well selected by each municipal water system that operates groundwater wells for public drinking water supplies as identified by the Department of Environmental Quality, to establish a water quality baseline for all sampling sites. The Collaboratory, in consultation with the participating institutions of higher education, shall establish a protocol for the baseline testing required by this subsection, as well as a protocol for periodic retesting of the municipal intakes and additional public water supply wells. No later than December 1, 2019, Collaboratory shall report the results of such sampling by identifying chemical families detected at each intake to the Environmental Review Commission, the Department of Environmental Quality, the Department of Health and Human Services, and the United States Environmental Protection Agency.

SECTION 13.1.(h) Beginning October 1, 2018, the Collaboratory shall report no less than quarterly to the Environmental Review Commission, the Department of Environmental Quality, and the Department of Health and Human Services on all activities conducted pursuant to this section, including any findings and recommendations for any steps the Department of Environmental Quality, the Department of Health and Human Services, the General Assembly, or any other unit of government should take in order to address the impacts of PFAS, including GenX, on surface water and groundwater quality, as well as air quality in the State.

SECTION 13.1.(i) Five million thirteen thousand dollars ($5,013,000) of the funds appropriated in this act for the 2018-2019 fiscal year to the Board of Governors of The University of North Carolina shall be allocated to the Collaboratory to manage and implement the requirements of this section, which shall include distribution to the Collaboratory and participating institutions of higher education (i) to cover costs incurred as a result of activities conducted pursuant to this section, (ii) for acquisition or modification of essential scientific instruments, or (iii) for payments of costs for sample collection and analysis, training or hiring of research staff and other personnel, method development activities, and data management, including dissemination of relevant data to stakeholders. No overhead shall be taken from these funds from the participating institutions that receive any portion of these funds. Funds appropriated by this section shall not revert but shall remain available for nonrecurring expenses.

SECTION 13.1.(j) The Collaboratory should pursue relevant public and private funding opportunities that may be available to address the impacts of PFAS, including GenX, on surface water and groundwater quality, as well as air quality, in order to leverage funds appropriated by this section, or any other funds provided to the Collaboratory, including the Challenge Grant authorized in Section 27.5 of S.L. 2016-94, as amended by Section 10.4(a) of S.L. 2017-57.

SECTION 13.1.(k) In the event that the United States Environmental Protection Agency no longer provides access to its analytical instrumentation at no cost to the State for water quality sampling analysis related to per- and poly-fluoroalkyl substances (PFAS), including the chemical known as "GenX" (CAS registry number 62037-80-3 or 13252-13-6), or if the Department of Environmental Quality determines that such analysis is not being performed in a sufficiently timely manner, the Collaboratory shall coordinate such analysis in the most cost-effective manner using relevant faculty expertise, technology, and instrumentation, including mass spectrometers, existing throughout institutions of higher education located throughout the State, until such time as the Department of Environmental Quality is able to perform such analysis with instrumentation acquired pursuant to subsection (q) of this section. The Collaboratory, in consultation with the Department and relevant experts across institutions of higher education in the State, including the Universities of North Carolina at Chapel Hill and Wilmington, North Carolina State University, North Carolina A&T State University, Duke University, and other public and private institutions, shall establish a protocol for delivery of such samples taken by the Department to the entity designated to perform analysis of the samples, chain of custody protocols, and other matters to ensure proper handling and processing of the samples, which protocols shall be subject to approval by the United States Environmental Protection Agency, if such approval is required pursuant to authority delegated from the United States Environmental Protection Agency to the Department to administer federal environmental law.

SECTION 13.1.(l) The Collaboratory shall identify faculty expertise within institutions of higher education in the State, including the Universities of North Carolina at Chapel Hill and Wilmington, North Carolina State University, North Carolina A&T State University, Duke University, and other public and private institutions, and use technology and instrumentation existing throughout the institutions to conduct the following research (i) develop quantitative models to predict which private wells are most at risk of contamination from the discharge of PFAS, including GenX; (ii) test the performance of relevant technologies in removing such compounds; and (iii) study the air emissions and atmospheric deposition of PFAS, including GenX. In addition, Collaboratory may, using relevant faculty expertise, technology, and instrumentation existing throughout institutions identified, evaluate other research opportunities and conduct such research for improved water quality sampling and analyses techniques, data interpretation, and potential mitigation measures that may be necessary, with respect to the discharge of PFAS, including GenX.

APPENDIX II

LEGISLATIVE LANGUAGE PASSED BY THE NORTH CAROLINA GENERAL ASSEMBLY
(Session Law 2019-241, Sections 7.(a) through 7.(d),
effective Nov. 6, 2019)

GENERAL ASSEMBLY OF NORTH CAROLINA
SESSION 2019

SESSION LAW 2019-241
SENATE BILL 433

AN ACT TO MAKE VARIOUS CHANGES TO THE STATUTES GOVERNING THE DEPARTMENT OF NATURAL AND CULTURAL RESOURCES AND TO REMOVE CERTAIN LANDS FROM THE STATE NATURE AND HISTORIC PRESERVE, AS RECOMMENDED BY THE DEPARTMENT; TO AMEND CERTAIN REPORTS OF THE NORTH CAROLINA POLICY COLLABORATORY TO THE GENERAL ASSEMBLY; TO CLARIFY CERTAIN APPROPRIATIONS IN THE 2018 HURRICANE FLORENCE DISASTER RECOVERY ACT; TO CORRECT AN EFFECTIVE DATE; TO REPEAL AND REPLACE AN ACT PROVIDING FOR EMERGENCY OPERATING FUNDS FOR UTILITIES; TO ADJUST FOR INFLATION THE THRESHOLD FOR DEPARTMENT OF ADMINISTRATION APPROVAL OF STATE LEASES; AND TO CLARIFY AND AMEND THE SEPTIC TANK SITE SUITABILITY DETERMINATION PROCESS.

The General Assembly of North Carolina enacts:

COLLABORATORY/FIREFIGHTING FOAM
      SECTION 7.(a) The North Carolina Policy Collaboratory at the University of North Carolina at Chapel Hill (Collaboratory) shall create an inventory of aqueous film-forming foam (AFFF) used or stored by fire departments in North Carolina operated, managed, or overseen by units of local government, including those located at or serving airports. This inventory shall include, at a minimum, the following:
      (1)   The name and address of each fire department that owns or otherwise has on the premises of a fire station a firefighting vehicle that carries AFFF or a storage tank or other vessel for AFFF.
      (2)   The volume, trade name, and CAS number of AFFF used by each department in 2018 for fighting fires or firefighter training.
      (3)   The number of firefighting vehicles carrying AFFF and the volume of AFFF carried by each vehicle.
      (4)   Each fire department's annual cost of acquiring AFFF and last known purchases of AFFF.

(5) The volume, trade name, and CAS number of AFFF stored by each fire department or unit of local government for firefighting use and the portion of these AFFFs that are no longer utilized and could be removed from inventory for disposal.

(6) Other data deemed relevant by the Collaboratory to establish a statewide inventory of AFFF used for fighting fires or firefighter training.

The Office of the State Fire Marshal of the Department of Insurance and all units of local government shall provide any assistance requested by the Collaboratory to acquire and compile the data required by this section.

SECTION 7.(b) The North Carolina Policy Collaboratory at the University of North Carolina at Chapel Hill (Collaboratory) shall develop a proposal for identifying and collecting AFFF that is expired or no longer needed or wanted by each fire department in North Carolina operated, managed, or overseen by units of local government, including those located at or serving airports. This proposal should include recommendations on which State agency or agencies could oversee such a collection effort and cost estimates on this collection, stockpiling, and disposal. The Department of Insurance Office of the State Fire Marshal, the Department of Environmental Quality, the Department of Health and Human Services, and the Department of Public Safety shall provide any assistance requested by the Collaboratory to acquire and compile the data required by this section.

SECTION 7.(c) The Collaboratory shall submit an interim report with the results of the studies required by subsections (a) and (b) of this section no later than April 1, 2020, and a final report no later than October 15, 2020, to the Joint Legislative Oversight Committee on Agriculture and Natural and Economic Resources and the Environmental Review Commission.

SECTION 7.(d) Section 13.1(g) of S.L. 2018-5 reads as rewritten:

"**SECTION 13.1.(g)** The North Carolina Policy Collaboratory at the University of North Carolina at Chapel Hill (Collaboratory) shall identify faculty expertise, technology, and instrumentation, including mass spectrometers, located within institutions of higher education in the State, including the Universities of North Carolina at Chapel Hill and Wilmington, North Carolina State University, North Carolina A&T State University, Duke University, and other public and private institutions, and coordinate these faculty and resources to conduct nontargeted analysis for PFAS, including GenX, at all public water supply surface water intakes and one public water supply well selected by each municipal water system that operates groundwater wells for public drinking water supplies as identified by the Department of Environmental Quality, to establish a water quality baseline for all sampling sites. The Collaboratory, in consultation with the participating institutions of higher education, shall establish a protocol for the baseline testing required by this subsection, as well as a protocol for periodic retesting of the municipal intakes and additional public water supply wells. No later than ~~December 1, 2019,~~ October 15, 2020, the Collaboratory shall report the results of such sampling by identifying chemical families detected at each intake to the Joint Legislative Oversight Committee on Agriculture and Natural and Economic Resources, the Environmental Review Commission, the Department of Environmental Quality, the Department of Health and Human Services, and the United States Environmental Protection Agency."

APPENDIX III

LIST OF MEETINGS, CONFERENCES, WEBINARS, MANUSCRIPTS AND GRANTS FROM THE NC PFAST NETWORK SCIENTISTS DURING THE OCT. 1 – DEC. 31, 2019 REPORTING PERIOD

The Research Triangle Environmental Health Collaborative 12th Annual Summit: "PFAS: Integrating Science and Solutions in North Carolina," October 23-24, 2019, Research Triangle Park, NC.
Presentations:
- Jason Surratt, "NC PFAS Testing Network: Overview of the Study"
- Lee Ferguson, "NC PFAS Testing Network Results: Water Sampling and Analysis"
- Barbara J. Turpin, "Air Emissions and Atmospheric Deposition"
- Scott Belcher, "Bioaccumulation & Impacts of Novel & Legacy PFAS in Wildlife of Coastal North Carolina"
- Dave Genereux, "Discharge of PFAS from groundwater to surface water near the Fayetteville Works, North Carolina"
- Orlando Coronell, "Removal of PFAS from drinking water by reverse osmosis membranes, residential filters, and a novel resin"
- Mei Sun, "Removal of PFAS from drinking water by activated carbon, ion exchange resin, and electrochemical oxidation"
- Jamie Dewitt, "Descriptive toxicological approaches to understand health risks of understudied PFAS"
- Rebecca Fry, "PFAS and Placental Toxicity"

Society of Environmental Toxicology and Chemistry (SETAC) North America 40th Annual Meeting, Nov. 3-7, 2019, Toronto, ON, CA
Presentations:
- Abigail S. Joyce, "Mapping the Extent of PFAS Contamination in North Carolina's Drinking Water Sources: The NC PFAST monitoring Network".
- Jean-Rene Thelusmond, "Per- and Polyfluoroalkyl Substances (PFAS) in Landfill Leachate, Municipal Wastewater and Occurrence in Drinking Water Sources"
- Theresa C. Guillette, "Ecological Impacts of PFAS in Coastal North Carolina"
Posters:
- "Analytical Challenges in Quantifying PFAS in North Carolina Drinking Water Sources," Noelle J. DeStefano; Zachary R. Hopkins; Abigail S. Joyce; Gordon J. Getzinger; P. Lee Ferguson; Detlef R.U. Knappe
- "Air Concentrations of Per- and Polyfluoroalkyl Substances (PFAS) in North Carolina," Jiaqi Zhou, Karsten Baumann, Jason D. Surratt, Ralph Mead, Steve Skrabal, Robert J. Kieber, G. Brooks Avery, Joan D. Willey, Megumi Shimizu, Jamie C. DeWitt, Mei Sun, Wanda Bodnar, Zhenfa Zhang, Leonard B. Collins, Barbara J. Turpin

Society of Toxicology (SOT) Annual Meeting, EPA RTP, NC, Oct. 7, 2019
Poster: *Best Poster Award (3rd Place)*
- "Ecological Impacts of Per- and Polyfluoroalkyl Substances (PFAS) in Aquatic Predators of Cape Fear River, North Carolina"
  <u>Theresa C. Guillette</u>, Madison Polera, Matthew Guillette, Gabe Bendfeldt, Helen Nyugen, Scott M. Belcher

BayesiaLab 2019 Conference, North Carolina Biotechnology Center, RTP, NC, Oct. 10–11, 2019
Presentation:
- Javad Roostaei and Jackie MacDonald-Gibson "Risk Analysis of PFAS Contamination in Private Water Wells: a Bayesian Network Model"

Michigan Regional Chapter of the Society of Toxicology Fall Meeting, PFAS Exposure and Toxicology in Michigan and Beyond, Ann Arbor, MI, Oct. 18, 2019
Presentation:
- Jamie DeWitt gave a talk on PFAS mode of action

2nd Africa Conference on Health Effects of Endocrine Disruptors. Sustainable Approaches towards Healthy African Communities, **Pretoria, South Africa. Nov. 3-7, 2019**
Presentation:
- Scott M. Belcher, "Impacts of Per- and Polyfluoroalkyl Substances on Alligators and Fish".

2019 AWWA Water Quality Technology Conference, Dallas, TX, Nov. 3-7, 2019
Poster:
- "Removing Legacy and Emerging Per- and Polyfluoroalkyl Substances by Anion Exchange Resins," <u>Yen-Ling Liu</u> and Mei Sun

Soil Science Society of America meeting, San Antonio, TX, Nov. 10-13, 2019
Presentation:
- Yuanbo Li, "Effect of soil compost-amendment on mitigation of PFAS uptake into lettuce"
- Li also co-organized a symposium session titled "Emerging Contaminants in Soil, Water and Plant Systems"

2019 North Carolina Water Quality Association Meeting, Greensboro, NC, Nov. 12, 2019
Presentation:
- Abigail S. Joyce and Noelle DeStefano, "PFAS Contamination in North Carolina's Drinking Water Sources: The NC PFAST monitoring Network"

North Carolina Costal Conference, NC Sea Grant, Wilmington, NC, Nov. 19, 2019
Presentation:
- Scott Belcher, "Impacts of Per- and Polyfluoroalkyl Substances on Alligators and Fish from Coastal North Carolina"
Poster:
- "Ecological Impacts of Per- and Polyfluoroalkyl Substances (PFAS) in Aquatic Predators of the Cape Fear River, North Carolina," <u>Madison Polara</u>, Theresa C. Guillette, Cara Kowalchyk, Matthew Guillette, Gabe Bendfeldt, Helen Nyugen, Scott M. Belcher

Beer-Reviewed Science at the Transfer Food Hall in Raleigh, NC, July 23, 2019
- Detlef Knappe and Scott Belcher were the featured speakers at this science café-style event coordinated by NC State members of the Network's Risk Communications team

Endocrine Society State of the Science: PFAS Chemicals Webinar on Oct. 2, 2019
- "Bioaccumulation and Adverse Impacts of PFAS: Insights from Aquatic Vertebrates Living in Contaminated Water. Presented by Scott Belcher. Link to access recorded presentation: https://www.endocrine.org/topics/edc/what-edcs-are/common-edcs/pfas

NC PFAS Testing Network Teachers Education Webinar held Oct. 3, 2019
- "PFAS: What are they and how are NC scientists investigating their prevalence in the Environment and their potential impacts humans and wildlife?"
  - Wanda Bodnar, "Characterizing PFAS Contamination in NC: The PFAS Testing Network"
  - Jamie DeWitt, "Investigating the health effects of PFAS exposure"
  - Scott Belcher, "Investigating the Effects of PFAS Exposure on Ecosystems & Wildlife: Bioaccumulation and Adverse Impacts."

NC School of Science and Math's Science Day, Durham, NC, Oct. 5, 2019
- Dr. Ariana Eily presented information about the PFAST Network to students and teachers

SeparationScience Featured Webinar sponsored by Thermo Scientific on Nov. 13, 2019:
- "Latest mass spectrometry-based trends for identifying and quantifying unknown PFAS compounds. Presented by P. Lee Ferguson, Abigail S. Joyce, and Gordon Getzinger Link to access recoding: https://www.sepscience.com/webinars-and-eseminars/

Manuscripts:
- Guillette T.C. , McCord, J. Guillette, M., Polera, M.E., Rachels, K.T., Morgeson, C., Kotlarz, N, Knappe, D.R.U., Reading, B.J., Strynar, M., Belcher, S.M. (2019) Elevated Levels of Per- and Polyfluoroalkyl Substances in Cape Fear River Striped Bass (Morone saxatilis) are Associated with Biomarkers of Altered Immune and Liver Function. Environment International (In press Accepted Nov. 22, 2019).
- Thelusmond, J., Levis, J.W., Barlaz, M. A. The presence of poly- and perfluoroalkyl substances (PFAS) in landfill leachate and domestic wastewater, in preparation.
- E. Kumarasamy, I. M. Manning, L. B. Collins, O. Coronell, & F. A. Leibfarth. Ionic Fluorogels for Remediation of Per- and Polyfluoroalkyl Substances from Water. ChemRxiv doi: 10.26434/chemrxiv.10046576.v1; submitted to a peer reviewed journal.
- Herkert, N.J., Merrill, J., Peters, C., Bollinger, D., Zhang, S., Hoffman, K., Ferguson, P.L., Knappe, D.R.U., Stapleton, H.M. Assessing the Effectiveness of Point-of-Use Residential Drinking Water Filters for Perfluoroalkyl Substances (PFAS), submitted.
- Brittany Saleeby, Megumi Shimizu, Rachael Mott, Rosa Idalia Sanchez Garcia, G. Brooks Avery, Robert J. Kieber, Ralph N. Mead, Stephen A. Skrabal, Joan D. Willey, Temporal Variability of Emerging Perfluoroalkyl Substances in the Cape Fear River, North Carolina, USA: Impacts to Drinking Water Source," submitted to Water Research.

New grants received:

- Barlaz, M. A., Field, J. A. and Simonich, S. "Characterization and Quantification of per- and polyfluoroalkyl substances in landfill gas and estimate of emissions from US Landfills" US EPA: $900,000, 9/19 – 8/22 ($419,992 to NCSU).
- Belcher, S.M., "Exploring fish consumption as a route of PFAS exposure" NIEHS sponsored NCSU CHHE Pilot Grant Program: $38,875.

APPENDIX IV

AGENDA FROM THE 12TH ANNUAL SUMMIT OF THE RESEARCH TRIANGLE ENVIRONMENTAL HEALTH COLLABORATIVE CO-SPONSORED WITH THE NC PFAST NETWORK

**NORTH CAROLINA BIOTECHNOLOGY CENTER
RESEARCH TRIANGLE PARK, NC
OCTOBER 23-24, 2019**

"PFAS: INTEGRATING SCIENCE AND SOLUTIONS IN NC"

PFAS: Integrating Science and Solutions in North Carolina
October 23-24, 2019 | NC Biotech Center, RTP, NC

Summit Goals
To highlight recent research from the NC PFAS Testing Network and facilitate conversation about strategies to limit human and environmental exposure to PFAS.

October 23

8:00　**Registration**

8:30　**Welcome and Summit Overview**
David Brown, Administrator, Research Triangle Environmental Health Collaborative
Wanda Bodnar, Scientific Program Analyst, NC PFAST Network, Assistant Professor, Environmental Sciences and Engineering, UNC Chapel Hill

8:45　**CDC/ATSDR's Involvement in PFAS and Health**
Patrick Breysse, Director, National Center for Environmental Health, Agency for Toxic Substances and Disease Registry, Centers for Disease Control and Prevention

9:15　**NC PFAS Testing Network: Initial Findings Related to Water and Air Quality**
Overview of the Study and Moderator: Jason Surratt, Program Director, NC PFAS Testing Network, Professor, Environmental Sciences and Engineering, UNC Chapel Hill
Water Sampling and Analysis: Lee Ferguson, Associate Professor, Civil and Environmental Engineering, Duke University
Air Emissions and Atmospheric Deposition: Barbara Turpin, Professor and Chair, Environmental Sciences and Engineering, UNC Chapel Hill

10:15　***Break***

10:30　**Perspectives from the Field: How Agencies and Communities are Responding to PFAS Contamination in NC**
Moderator: Katy May, Co-Director, Community Engagement Core, Center for Human Health and Environment, NC State
Schumata Brown, Town Manager, Town of Maysville, NC
Linda Culpepper, Director, Division of Water Resources, NC Department of Environmental Quality
Emily Donovan, Co-founder, Clean Cape Fear
Zack Moore, Section Chief, Epidemiology, Division of Public Health, NC Department of Health and Human Services
Emily Sutton, Haw Riverkeeper, Haw River Assembly

11:30　**Perspectives from Jones Street: Legislative Action to Address PFAS Contamination in NC**
Moderator: Jeff Warren, Research Director, NC Policy Collaboratory
**All legislators present will be invited to speak during the scheduled panel
Senator Rick Gunn, District 24
Representative Pricey Harrison, District 61
Representative John Szoka, District 45
Senator Mike Woodard, District 22

12:25　**Charge to the Working Groups**
Kathleen Gray, Director, Community Engagement Core, UNC Center for Environmental Health and Susceptibility

12:30　***Lunch***

1:15 **Engaging in Dialogue to Identify Solutions: Working Group Discussions of Key Questions Associated with PFAS Exposure**
Session 1: Initial scoping and identification of information gaps / research needs

Group A: What are the missing links in our understanding of fate and transport of PFAS?
Scott Belcher, Research Professor, Toxicology, NC State
Dave Genereux, Professor, Marine, Earth and Atmospheric Sciences, NC State
Jennifer Redmon, Senior Environmental Health Scientist and Chemical Risk Assessment Specialist, RTI International
Facilitators: Bryan Luukinen, Duke Superfund Research Center, and Sarah Yelton, UNC Institute for the Environment

Group B: Which alternative treatment and disposal options offer most promise?
Michael Borchers, Assistant Director, Water Resources Department, City of Greensboro
Orlando Coronell, Associate Professor, Environmental Sciences and Engineering, UNC Chapel Hill
Mei Sun, Assistant Professor, Civil and Environmental Engineering, UNC Charlotte
Facilitators: Neasha Graves, UNC Center for Environmental Health and Susceptibility, and Andrew George, UNC Institute for the Environment

Group C: How can emerging knowledge about PFAS be factored into risk assessment?
Jamie DeWitt, Associate Professor, Pharmacology and Toxicology, East Carolina University
Sue Fenton, Group Leader, Reproductive Endocrinology Group, National Institute of Environmental Health Sciences
Rebecca Fry, Carol Remmer Angle Distinguished Professor and Associate Chair, Environmental Sciences and Engineering, UNC Chapel Hill
Facilitators: Kathleen Gray, UNC Center for Environmental Health and Susceptibility, and Ariana Eily, Duke Science and Society Initiative

4:15 **Working Group Reports**

5:00 **Adjourn**

October 24
8:30 **Controlling PFAS at the Source: Legal Obligations and Liability**
Geoff Gisler, Senior Attorney and Leader, Clean Water Program, Southern Environmental Law Center

8:50 **Potential Solutions for PFAS: NIEHS Superfund Research Program Remediation Research**
Heather Henry, Health Scientist Administrator, Superfund Research Program, National Institute of Environmental Health Sciences

9:10 **Industry Perspective on Understanding and Abating Organic Fluorinated Compounds**
Sean Uhl, Manufacturing Technology Director, Chemours Fluoroproducts
Amber Wellman, Sustainability Program Manager, Chemours Fluoroproducts

9:30 **Charge to the Working Groups**
Kathleen Gray, Director, Community Engagement Core, UNC Center for Environmental Health and Susceptibility

Co-sponsored by: Research Triangle Environmental Health Collaborative (RTEHC) & NC PFAS Testing (PFAST) Network

9:35   *Break*

9:45   **Engaging in Dialogue to Identify Solutions continued**
Session 2: Potential solutions that address information gaps/research needs
         A: Understanding fate and transport of PFAS in the environment
         B: Alternative treatment and disposal options
         C: Factoring emerging knowledge about PFAS into risk assessment

11:45   **Working Group Reports**

12:25   **Closing Remarks and Adjourn**
David Brown, Administrator, Research Triangle Environmental Health Collaborative