UNIVERSITY OF WISCONSIN SEA GRANT

2021 PFAS Workshop: Setting a Research Agenda for PFAS in Wisconsin

SUMMARY

The 2021 PFAS workshop "Setting a research agenda for PFAS in Wisconsin," held online July 29 and 30, 2021, brought together a pool of academics and governmental staff interested in PFAS research. The goals of the workshop were to 1.) identify completed and in-progress research on PFAS, 2.) determine the knowledge gaps in PFAS research, 3.) develop and foster working collaborations between academic staff and governmental agencies and 4.) create a research agenda for Wisconsin. Specifically, the workshop explored current studies and projects from four different PFAS categories: 1.) environmental contamination, 2.) exposure pathways, 3.) wastes, biososlids and remediation and 4.) toxicology and epidemiology. These interdisciplinary goals and topics required the assembly of traditional scientists, social scientists, outreach specialists and governmental staff. Participants were selected from their disciplines to spark dialogue that would lead to the development of an actionable PFAS research agenda.

ORGANIZATION OF THE WORKSHOP

The format of the workshop was designed to enhance creative and effective discussions between academics and governmental staff. Prior to the event, the organizers distributed the four topics and overall structure to all participants to promote active participation in the workshop. Keynote speakers from each topic were given seed questions to guide conceptualization of the topic issues and required to prepare a presentation including their individual research projects, knowledge gaps and future research directions. Additionally, panelists from each topic were given similar seed questions.

Agency and university perspectives kicked off the meeting with broad overviews from the Wisconsin departments of Natural Resources and Health Services, as well as the University of Wisconsin-Madison. These perspectives set the direction of the workshop and clearly laid out the specific agenda of each organization.

The rest of the workshop was divided into four two-hour sections, one section per topic. Each topic was further broken down into a 5-minute keynote, followed by a 30-minute panel of three speakers, then 25 minutes of breakout sessions, with the remaining time used for sharing a brief summary of each breakout group with the larger group. The breakout sessions became a useful way to incorporate a diverse group of thoughts into the larger session and generated significant conversations about knowledge gaps and future research projects.

After completing all four sections, the workshop concluded with future goals and next steps. With the input of participants, the organizers developed a plan to keep conversations and collaborations moving forward.

MAIN OUTCOMES

Evaluation of Current Status

The workshop was motivated by the current explosion of interest in the impacts of PFAS on human and environmental health. As Wisconsin moves forward on PFAS research, understanding the large gaps in PFAS knowledge will help develop an agenda to determine which issues require research, the order in which to address these issues and how questions can be formulated to lead to actionable science.

During the workshop, it became apparent that there are more gaps in the research than what is known about PFAS. In fact, there is still speculation about the number of PFAS in the entire family, a number that is somewhere between 4,000 to more than 9,000 compounds. The knowledge gaps in PFAS research were compared to the knowledge gaps regarding PCBs in the early 2000s. In addition to all the gaps in traditional PFAS research, it became clear there were even more gaps in social science PFAS research. A large portion of what PFAS research has already discovered is focused on a particular set of PFAS (i.e., PFOA, PFOS, etc.). This family of chemicals has varying chemical structures that lead them to act differently from other forms. The workshop was divided into four main topics; however, many participants often overlapped their ideas and potential future work between two or more of the topics. While it can be easier to separate future research into simple singular topics, many participants stated all these topics are heavily interconnected, and intermixing disciplines will not only help answer more questions but can also produce actionable science that goes beyond a typical research project.

Environmental Contamination

The fate and transport of PFAS are not fully understood. Because PFAS are man-made chemicals used in many different industrial and consumer products (e.g., aqueous film-forming foams (AFFFs), textiles, metal plating, food packaging, etc.), they can enter the environment through multiple routes (e.g., leaching from landfills, biosolids, firefighting foams, etc.). One of the first and largest gaps in environmental contamination is understanding where PFAS are in the environment, specifically, where in Wisconsin. Some PFAS-contaminated sites around Wisconsin and the United States are known, but the number of contaminated sites is increasing as sites are continuing to be discovered and polluted. Specifically, PFAS are being found in the leachate of an increasing number of landfills. However, it is poorly understood how effective these sites are at containing the chemicals and what happens to the PFAS once they are in the disposal site. Moreover, for PFAS already in the environment, it is critical to understand how they both move through an ecosystem and break down. Research has shown that PFAS can transport via animals, air, water or soil; however, it is less understood how specific PFAS compounds or PFAS mixtures transport and break down in animals (i.e., trophic transfer), soil, surface or groundwater and air.

FUTURE RESEARCH GOALS

- Developing a PFAS chemical fingerprint framework
  - Where are inputs of PFAS specifically coming from?
  - What amount of PFAS comes from specific systems (e.g., septic systems or wastewater treatment plants)?
  - Do landfills effectively contain PFAS? Can they contain PFAS indefinitely?
  - How can fingerprinting of PFAS be used to understand fate and transport in different media?
- Measuring the transport of PFAS from known contamination sites

  - How do PFAS move throughout the environment? What are the main controlling drivers of transport? Will specific variables in an environment change the driving factors?
  - What are the impacts of bio-spreading? How should PFAS from specific spreading events be tracked?
  - How are different PFAS incorporated into plants for human consumption? Do the rates of transport change upon availability?
  - How do different PFAS infiltrate groundwater/surface water? Can they be put into classes?
  - How do mixtures play a role in transport? Again, can they be put into classes?
- Following the fate and breakdown of PFAS from known contamination sites
  - How do specific groups within the family of PFAS behave?
  - How do PFAS move through tropic levels?
  - How do specific animals break down/store PFAS?
  - Can mixtures impact fate and breakdown?
- Large-scale bio-monitoring of PFAS in the environment over time
  - What are background levels of PFAS and how are they changing?
  - What PFAS are most common and could be of highest concern?
  - What are the main sources of PFAS in an area?
  - What are the legacy impacts of PFAS that have been taken off the market in the U.S.?
  - How do PFAS inputs from other countries impact U.S. exposure?

EXPOSURE PATHWAYS

Humans can be exposed to PFAS through ingestion, inhalation and dermal exposure; however, scientists have different levels of understanding for each exposure pathway. For instance, ingestion of PFAS is the most commonly studied exposure pathway. There is sparse research on dermal or inhalation exposure pathways. Currently, state and federal agencies test for legacy PFAS and initial replacement PFAS from major source identification (e.g., industrial discharge or AFFF use). These exposure pathways assessments are from non-targeted analysis. In Wisconsin, most of the assessment on exposure pathways is through water consumption and fish consumption. One of the largest knowledge gaps in exposure pathways is understanding PFAS concentrations in the sources of contribution and how background levels of PFAS play a role. By understanding the amount of PFAS in the source, models can be created to help understand the relative source contribution. Another large gap in exposure pathways knowledge is understanding the inequities in PFAS exposure (e.g., fish consumption from contaminated lakes near low-income houses may disproportionally increase PFAS exposures). Moreover, most of the research has been completed on PFOS and PFOA exposure pathways, and there is little knowledge on other PFAS or mixtures of PFAS that may alter accumulation, availability, transfer, etc.

FUTURE RESEARCH GOALS

- Mixtures in exposure pathways
  - How do specific mixtures impact accumulation rates?

  - How can cocktail studies of PFAS inform exposure rates?
  - Which mixtures should be the focus? Can the PFAS be classified into groups?
  - How do mixtures of PFAS impact absorption rates in different exposure pathways?
- PFAS exposure through food
  - Are there animals or crops that can accumulate PFAS to levels of concern for human consumption?
  - How do biosolids play a role in PFAS uptake in plants?
  - Are there specific foods that accumulate more PFAS or more mixtures of PFAS, or house more PFAS breakdown products?
- PFAS in drinking water
  - How do PFAS transfer between groundwater and surface water?
  - How do mixtures of PFAS in water impact sensitive populations such as fetuses and infants?
- Inequities of PFAS exposure
  - Are certain populations more at risk from PFAS exposure?
  - What activities can increase these disparities?
  - How can programs limit these disparities?

WASTES, BIOSOLIDS AND REMEDIATION

In recent years, the detection of PFAS at sites around the country and in Wisconsin has continually increased. Management agencies have been tasked with addressing PFAS contamination through regulatory strategies from waste and materials management programs. Specific technologies have been developed to remove PFAS from water treatment plants and have focused on certain sorbents. Specific sorbents are effective for specific PFAS; however, currently used sorbents cannot remove all PFAS in a system and are dependent on initial PFAS concentrations. Additionally, in PFAS removal, sometimes a waste sludge is created that must be disposed of in the remediation process. Currently, the sludge or biosolid can be sent to fields where it can be applied in bio-spreading or sent to landfills. The fate and transport of specific PFAS and mixtures of PFAS in land spreading are not completely understood. Additionally, the effectiveness of landfills to contain these forever chemicals is unknown; landfills may only be a temporary solution to a long-term problem. Moreover, the remediation process is currently an expensive procedure and some PFAS waste must be shipped to specific landfills around the country, which adds to the cost of remediation. Therefore, many sites avoid testing for PFAS. Without an understanding of which PFAS are in a contaminated area in what concentration, the remediation process is relatively useless for PFAS. Currently, one of the biggest barriers to PFAS remediation is the cost of PFAS detection and subsequent removal. It is critical that scientists find new ways or improve current procedures to remediate and dispose of PFAS.

FUTURE RESEARCH GOALS

- PFAS containment
  - What is the effectiveness of current landfills for containment? How long can they last?
  - How do we improve containment devices/areas?

  - How effective are sorbents? Which ones should be the focus?
  - What happens to the PFAS in the containment areas?
  - Which technology should be invested in? Should the focus be on a single technique?
- PFAS remediation
  - What PFAS should be the focus? Can some PFAS be left in the environment?
  - What are the limitations of removing PFAS from contaminated sites?
  - How should PFAS be handled once they are removed?
  - How do removal technologies work with other contaminant removal technologies? Synergistically or antagonistically?
- Wastes
  - How should biosolids and wastes be handled?
  - How can bio-spreading be used without additional harm?
  - What techniques should be utilized to dispose of waste? Incineration?
- Challenges
  - How to build trust in the public for testing. What are the factors limiting testing for PFAS?
  - How to eliminate known hurdles for testing sites for PFAS.

TOXICOLOGY AND EPIDEMIOLOGY

Understanding the toxicological impacts of PFAS is critical to protecting human and environmental health. In recent years, research using animal models has suggested that high levels of PFAS can increase cholesterol, reduce antibody response and decrease women's fertility. PFAS have also been shown to increase the risk of thyroid disease, osteoarthritis, ulcerative colitis and some cancers (kidney and testicular) using animal models. Although researchers have begun to elucidate multiple PFAS health impacts, a majority of the research has been done on PFOS and PFOA. There are only two PFAS standards at the federal level (PFOA and PFOS), and a range of PFAS recommendations and standards of up to 20 PFAS out of the 5,000-plus PFAS. Researchers have started to develop pharmacokinetic modeling for individual PFAS, which allows for better estimates of exposure. However, these models are not available for all PFAS and because PFAS constitute a diverse family of compounds, different PFAS can react differently in the environment and in the human body. Moreover, there has been an increase in epidemiological research to correlate human health with PFAS levels. A vast majority of these studies have only scratched the surface of understanding bio-monitoring and correlations.

FUTURE RESEARCH GOALS

- Health impacts
  - Which PFAS are the most toxic?
  - What end points are the most sensitive? Most important to human health? Most important to environmental health?
  - Do all PFAS follow typical dose responses?

    - How do PFAS impacts in certain species translate to other species?
- Mixtures in health impacts
    - How do mixtures affect health effects?
    - Are certain mixtures more toxic?
    - Do PFAS act synergistically or antagonistically?
    - What cocktails of PFAS should be the focus?
- Pharmacokinetic modeling
    - How can PFAS be grouped together?
    - What are the fate and transport of PFAS in human and animals?
    - How do toxicological impacts of PFAS translate from animal models to humans?
    - Can we create classes for pharmacokinetic modeling?
- Bio-monitoring
    - How much and what PFAS are in specific populations?
    - Which populations are more vulnerable and more at risk?
    - What PFAS should be the focus?
    - Which end points are linked to specific PFAS? Groups of PFAS?
    - How can epidemiology studies be used to support or make regulatory decisions?

CURRENT ROADBLOCKS

- Funding
    - Where will the funding come from?
    - It can be very expensive to measure PFAS, which can consume large portions of grants.
    - Who is responsible for mitigation and remediation of PFAS when they are found in the environment?
- Multilayered questions
    - How can all four topics be answered together?
    - How can we incorporate human and environmental health?
    - How can social science be added to traditional science questions?

FUTURE DIRECTIONS

- The Wisconsin PFAS listserv will be used to pass along funding opportunities, connect collaborators and solicit experts in specific fields. To be added to the PFAS listserv, please email dehnert2@aqua.wisc.edu.
- Wisconsin Sea Grant hopes to put together a PFAS seminar series. This will continue the collaboration between state agencies and academics and hopefully grow the PFAS research community. It will provide an opportunity to share research findings, ongoing work and new problems that arise. More information will be available on the Sea Grant website, seagrant.wisc.edu.
- Wisconsin Sea Grant hopes to put together either an annual or bi-yearly workshop to continue to build the PFAS agenda, share progress and foster collaborations.

PARTICIPANTS

Over the two workshop days, 67 people participated, including members from seven different universities and four state agencies. From this workshop, an email listserv was created. For a full list of participants or to be added to the listserv, contact Wisconsin Sea Grant at info@seagrant.wisc.edu

PFAS WORKSHOP – AGENDA

Dates: July 29-30, 2021

Title: Setting a Research Agenda for PFAS in Wisconsin

DAY 1 – THURSDAY JULY 29

Location: Online

Format: Overviews and 2 technical panels followed by breakout discussions (45 minutes per panel: 10–15-minute keynote + 3 to 4 panelists give 3-5 minutes of comments each + Q&A/Discussion)

Agenda:

8:30 – 8:45 a.m. – Welcome & Agenda Overview – Jamie Schauer, Wisconsin State Laboratory of Hygiene

8:45 – 9:15 a.m. – Agency, University Perspectives – (10 minutes each)

- Mimi Johnson – DNR
- Jon Meiman – DHS
- Jim Hurley – UW/Academia

9:15 – 10:00 a.m. **Technical Panel 1 - Environmental Contamination** - Christy Remucal, UW-Madison, Keynote

Panelists: Martin Shafer (WSLH), Matt Gramse (DATCP), Matt Silver (DNR)

10:00 – 10:35 a.m. Breakout sessions

10:35 – 10:50 a.m. Report out from Breakout discussions (each group, 2-3 bullets)

10:50 – 11:35 a.m. – **Technical Panel 2 - Exposure Pathways** – Curtis Hedman, Wisconsin Department of Health Services, Keynote

Panelists: *Meghan Williams (DNR), Tom Pearson (UW-Stout), Xiaofei He (DHS)*

11:35 - 12:05 p.m. Breakout sessions

12:05 – 12:20 p.m. Report out from Breakout discussions (each group, 2-3 bullets)

Wrap-up:

12:20 -12:45 p.m. Q and A (Anything that has not been addressed),
Summary and Next Steps – Jamie Schauer and Jim Hurley

DAY 2 – FRIDAY, JULY 30

Location: Online

Format: Overviews and 2 technical panels followed by breakout discussions (45 minutes per panel: 10–15-minute keynote + 3 to 4 panelists give 3-5 minutes of comments each + Q&A/ Discussion) and **wrap-up**.

8:30 – 8:45 a.m. Welcome, Agenda Repair, Expectations for day, Questions from yesterday

8:45 – 9:30 a.m. **Technical Panel 3 – Waste, Biosolids, and Remediation** – Adrian Stocks, Wisconsin Department of Natural Resources, Keynote

Panelists: *Shangping Xu (UW-Milwaukee), Jim Tinjum (UW-Madison), Jason Lowery (DNR)*

9:30 – 10:15 a.m. Breakout sessions

10:15 – 10:30 a.m. Report out from Breakout discussions (each group, 2-3 bullets)

10:30 – 11:15 **Technical Panel 4 – Toxicology and Epidemiology** – Sarah Yang, Wisconsin Department of Health Services, Keynote

Panelists: *Sathish Kumar (UW-Madison), Amy Shultz (SHOW – UW-Madison), Sean Strom (DNR)*

11:15 – 11:45 a.m. Breakout sessions

11:45 – 12:15 p.m. Report out from Breakout discussions (each group, 2-3 bullets)

Wrap-up:

12:15 – 12:30 p.m. Wrap-up and Next Steps – Jamie Schauer and Jim Hurley

INSTRUCTIONS GIVEN TO FACILITATORS FOR BREAKOUT ROOMS

BREAKOUT ROOM FACILITATOR ROLE:

The facilitator main role is to assist the breakout group in talking about the topic and answering a few goal questions.

1. When the breakout group starts, the facilitator will direct everyone to introduce themselves and give a 15-20 second elevator speech: name, role and PFAS affiliation.
2. The rest of the time should be spent talking about and answering the three initial questions of the technical panel (see below).

3. Try to engage everyone in the breakout group, by directly asking questions, prompting follow-up questions, etc. However, feel free to run the breakout group how you see best fit!
4. If you are running out of discussion, feel free to use some of the secondary questions provided for that technical panel (see below).
5. You will have a recorder in your group so, no need to take any notes.
6. You will oversee 1 breakout group per technical panel (total of 4 breakout groups).

BREAKOUT ROOM RECORDER ROLE:

The recorders' main role is to take big picture notes from the breakout session and report the main 2-3 points back to the whole group.

1. During the breakout group, take big picture notes about what was talk about (e.g., group prioritized learning about PFAS bioaccumulation rates to better understand fish consumption limits).
2. You can also assist the facilitator in any way they might need.
3. Summarize the breakout group in 2-3 points.
4. Present/summarize the breakout groups to the larger group.
5. You will oversee 1 breakout group per technical panel (total of 4 breakout groups).

TECHNICAL PANEL 1 BREAKOUT GROUPS – JULY 29 10-10:35 AM.

INITIAL QUESTIONS:

1. What are the biggest gaps for PFAS contamination in the environment?
2. What research needs to be done to fill the gaps? And are there specific questions from you or your agency that if answered would be useful to the department?
3. What research question is top priority? Or what is the priority of the research questions we talked about today?

SECONDARY QUESTIONS:

1. What factors lead to higher environmental contaminations and what can be done to mitigate this?
2. How can environmental contamination research questions include aspects or secondary questions that could provide information for human health?
3. Open up to any questions/thoughts.
4. Feel free to add any questions you would like! Facilitator's choice.

TECHNICAL PANEL 2 BREAKOUT GROUPS – JULY 29 11:35-12:05 PM.

INITIAL QUESTIONS:

1. What are the biggest gaps in PFAS exposure pathways research?
2. What research needs to be done to fill the gaps? And are there specific questions from you or your agency that if answered would be useful to the department?
3. What research question is top priority? Or what is the priority of the research questions we talked about today?

SECONDARY QUESTIONS:

1. What are the inequitable effects of PFAS exposure on families of low income, people of diverse backgrounds?
2. Are certain exposure pathways more important to human exposure? Which ones and why?
3. For exposure from hunting and gathering, is there a radius/zone that can be predicted?
4. What aspects to environmental toxicology research can be added to improve our understanding of exposure pathways?
5. Open up to any questions/thoughts.
6. Feel free to add any questions you would like! Facilitator's choice.

TECHNICAL PANEL 3 BREAKOUT GROUPS – JULY 30 9:30-10:05 AM.

INITIAL QUESTIONS:

1. What are the biggest gaps in wastes, biosolid and remediation research for PFAS?
2. What research needs to be done to fill the gaps? And are there specific questions from you or your agency that if answered would be useful to the department?
3. What research question is top priority? Or what is the priority of the research questions we talked about today?

SECONDARY QUESTIONS:

1. Are there remediation techniques that should receive more time and funding and why?
2. Are there techniques that should get more funding and attention to help monitor and contain waste and biosolids and why?
3. How can we bridge the gap between prevention, containment and remediation of PFAS?
4. Open up to any questions/thoughts.
5. Feel free to add any questions you would like! Facilitator's choice.

TECHNICAL PANEL 4 BREAKOUT GROUPS – JULY 30 11:15-11:45 AM.

INITIAL QUESTIONS:

1. What are the biggest gaps in PFAS toxicology and PFAS epidemiology research?
2. What research needs to be done to fill the gaps? And are there specific questions from you or your agency that if answered would be useful to the department?
3. What research question is top priority? Or what is the priority of the research questions we talked about today?

SECONDARY QUESTIONS:

1. What information is needed to treat PFAS as a class of chemicals? What are the pros and cons of treating them as a class for both environmental and human health?
2. How can environmental toxicology research be improved to help with both human health and the way humans utilize environmental resources?
3. Open to any questions/thoughts.
4. °Feel free to add any questions you would like! Facilitator's choice.