EPA National Biosolids Meeting Summary

December 8-10, 2020

Photo courtesy of Ashley Mihle, LOOP Garden

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Day 1: Tuesday, December 8, 12:30-4:30 PM Eastern

Welcome and Opening Remarks

Elizabeth Resek, EPA Biosolids Lead, welcomed participants to the virtual EPA National Biosolids Meeting 2020 and introduced Elizabeth Behl, Director of the Health and Ecological Criteria Division who provided a few opening remarks. The Health and Ecological Criteria Division, within EPA's Office of Water, Office of Science and Technology, is responsible for work under both the Safe Drinking Water Act (SDWA) and the Clean Water Act (CWA). The Biosolids Program is located in HECD.

Deborah Nagle, Director of the Office of Science and Technology (OST) set the stage for the meeting. She highlighted that the National Biosolids Meeting was a chance to bring together EPA, state and tribal co-regulators, utilities, academia and biosolids stakeholders for the first time in almost 10 years to discuss technical and programmatic challenges and needs with the goal of hearing how EPA can best support biosolids management efforts. OST reinvested in the Biosolids Program with two full-time staff (Elizabeth Resek and Elyssa Arnold), two ORISE Fellows (Tess Richman and Lauren Questell), and a dedicated portion of time given to the Biosolids Team from HECD scientists with human health, ecological and nutrient expertise.

The Clean Water Act requires EPA to review sewage sludge regulations every two years to identify any additional pollutants that may occur in biosolids and then set regulations for those pollutants if sufficient scientific evidence shows they may harm human health or the environment. Ms. Nagle stated that assessing pollutants in biosolids is the Biosolids Team's top priority and significant progress has been made. She noted that the Biosolids Team collaborates across the agency for a holistic approach and provided various examples. The Biosolids Team:

- Coordinates with EPA's Office of Research and Development on research efforts, including the recently announced National Priorities: Assessment of Pollutants in Biosolids funding opportunity that totals almost $6 Million.
- Participates on the Agency-wide perfluoroalkyl and polyfluoroalkyl substances (PFAS) workgroup.
- Participated on the Agency-wide workgroup to develop the National Defense Authorization Act interim guidance on the destruction and disposal of PFAS and PFAS-containing materials.
- Coordinates with OST's Engineering and Analysis Division on biosolids methods.
- Coordinates with Office of Wastewater Management on technology, pre-treatment and permitting efforts.
- Works with EPA's Office of General Counsel on resource recovery and regulatory issues.
- Coordinates with EPA's Office of Chemical Safety and Pollution Prevention on Biosolids Program risk assessment efforts.
- Coordinates with EPA's Office of Land and Emergency Management on issues related to risk assessment modeling.
- Collaborates with the EPA Regions who are instrumental in assisting state and tribal biosolids programs.

EPA Biosolids Program Efforts

Ms. Resek gave an overview of EPA's Biosolids Program, which works to meet requirements under Section 405(d) of the Clean Water Act. She reiterated that the program's top priority is to assess pollutants found in biosolids for potential risk to human health and the environment. As part of that

work, every two years EPA conducts biennial reviews by collecting and reviewing publicly available data on the occurrence, fate and transport in the environment, human health and ecological effects, and other relevant information for toxic pollutants that may occur in U.S. biosolids. Data from the biennial reviews may be used to conduct risk assessment screens and refined risk assessments for pollutants found in biosolids. The anticipated release of the next Biosolids Biennial Report (reporting period 2018-2019) is early 2021.

Information was presented also on the Biosolids List in EPA's publicly available CompTox Chemicals Dashboard. The Biosolids List was curated from past biennial reviews and sewage sludge surveys and represents the Agency's understanding of chemicals found in biosolids. A link to the CompTox Chemicals Dashboard primer videos can be found here. Over 500 pollutants have been found to occur in biosolids (in at least one instance) since EPA began tracking their occurrence in 1993 when 40 CFR Part 503 was promulgated. Not all of the approximate 500 pollutants that have been found in biosolids will be present in every wastewater treatment facility. Pollutants found in biosolids will vary depending upon inputs to individual facilities over time. The presence of a pollutant in biosolids alone does not mean that the biosolids pose harm to human health and the environment.

Information was provided on the Biosolids Program's stakeholder engagement efforts that were initiated in 2019, including a webinar series and an overhaul of the biosolids website. Additional activities carried out by the Biosolids Team were discussed and include participation on the Agency-wide workgroup, led by EPA's Office of Land and Emergency Management, that developed interim guidance on the destruction and disposal of PFAS and PFAS-containing materials as part of the National Defense Authorization Act (NDAA). Materials containing PFAS listed in the NDAA include biosolids and soils; aqueous film-forming foam; textiles, other than consumer goods, treated with PFAS; spent filters, membranes, resins, granular carbon, and other waste from water treatment; landfill leachate containing PFAS; and solid, liquid, or gas waste streams containing PFAS from facilities manufacturing or using PFAS. There were early discussions by the workgroup that the land application of biosolids is not considered disposal and therefore it did not fall within the scope of the guidance. The final report was completed in December 2020 and can be found here.

The Biosolids Team is working also to develop a consistent process for evaluating products derived from sewage sludge that are intended for land application. 40 CFR Part 503 does not consider current or anticipate future innovative resource recovery technologies and products. Lastly, Ms. Resek shared an EPA statement from spring 2020 relating to COVID-19, which advises that land application can be continued if all requirements under 40 CFR part 503 are met.

EPA Biosolids Website

Tess Richman, Biosolids Team ORISE Fellow, walked participants through the EPA Biosolids Website that was overhauled in July 2020 to better show how Biosolids Program efforts are inter-related and work to meet statutory requirements under the CWA. Examples of new information found on the website include risk assessment of pollutants found in biosolids, research and a new resource library.

The website is organized into banners (what's new) and sections (long standing topics). The banners include:

- **Biosolids Research,** which contains links to the EPA Science Inventory and the most recent biosolids-specific funding opportunity National Priorities: Evaluation of Pollutants in Biosolids;

- **PFAS**, which includes links to EPA's Risk Assessment for PFOA and PFOS in Biosolids and EPA's Per- and Polyfluoroalkyl Substances (PFAS) Action Plan;
- **EPA Biosolids Webinar Series,** which has hosted eight webinars since 2019 and allows signups for future webinars; and,
- **Biosolids Annual Reporting,** which includes a link to Biosolids compliance and annual reporting.

Ms. Richman noted that the section **Basic Information about Biosolids** is intended for the general public but links to more detailed information. Content in this section is based on the most recent and frequent inquiries received by EPA (e.g., a breakdown of how biosolids are used and disposed based on 2019 annual biosolids reporting).

The subsection on Assessing Pollutants Found in Biosolids includes links to the following: **Process for Regulating Pollutants in Biosolids, EPA's CompTox Chemicals Dashboard, and Regulatory Determinations for Pollutants in Biosolids.**

The **Biosolids Laws and Regulations Biosolids** section contains information on How Biosolids are Regulated and links to **biosolids biennial reports, sewage sludge surveys, risk assessment, compliance**, and how the Biosolids Program relates to the **National Pollutant Discharge Elimination System (NPDES).**

The section on **Technical Resources for Biosolids Managers** is geared toward biosolids managers. This section contains Pathogen Equivalency Committee information, a page on Biosolids Analytical Methods and Sampling Procedures that provides methods for meeting chemical and microbial requirements under Part 503, as well as information on Wastewater Treatment Train Technologies and Use and Disposal Management Practices. Ms. Richman noted that in the technical resources section, the content of the pages has not changed, but is organized to be more user friendly. The new Biosolids Library contains all EPA biosolids documents in a searchable format.

Lastly, Ms. Richman shared that the website contains a list of EPA Regional and State Contacts for Biosolids. The Biosolids Team strives to keep this list updated and asked participants to please notify the team of any changes that should be made.

Research Snapshots

Rob Willis (facilitator, Ross Associates) introduced the research snapshots, which consisted of four fast-paced 10-minute presentations from the following organizations:

- EPA Office of Research and Development (Christopher Impellitteri)
- Water Research Foundation (Ashwin Dhanasekar and Lola Olabode)
- North East Biosolids and Residuals Association (Janine Burke-Wells)
- W4170 (Maria Lucia Silveira, University of Florida and Nicholas Basta, Ohio State University)

Christopher Impellitteri, EPA Office of Research and Development (ORD)

Dr. Impellitteri highlighted the biosolids research projects underway in ORD which include:

- Providing technical support for pathogens and vector attraction reduction. ORD is working to update to the *Environmental Regulations and Technology: Control of Pathogens and Vector Attraction in Sewage Sludge* report, which was last updated in 2003.

- Evaluating types and prevalence of antibiotic resistant bacteria (ARB) and antibiotic resistance genes (ARGs) in biosolids to inform management strategies. ORD hopes to build on ongoing COVID sewage surveillance work.
- Looking at application of non-targeted analysis to municipal wastewater and residuals, including method development and evaluation of Contaminants of Emerging Concern (CECs) in wastewater and biosolids.
- Developing analytical methods for PFAS. This has been a collaborative effort between the Department of Defense and EPA. A method is being validated that includes biosolids as one of the matrices. This method will be validated under Clean Water Act protocols and includes 40 PFAS (https://www.epa.gov/cwa-methods/cwa-analytical-methods-and-polyfluorinated-alkyl-substances-pfas). Single laboratory validation data collection is complete and under review. A multi-laboratory validation will take place in 2021.
- Researching the occurrence, fate, and transport of PFAS in wastewater treatment plants and biosolids. The goal is to identify sources and evaluate pretreatment strategies.
- Researching treatment strategies for biosolids, including incineration and pyrolysis.
- Providing research results to assist the Biosolids Program in development of chemical risk assessments. This includes evaluating chemicals in biosolids to prioritize different CECs and PFAS.
- Characterizing contaminants in land-applied biosolids and application of newer leaching test methods.
- Characterizing soils by evaluating contaminants (PFAS, polycyclic aromatic hydrocarbon, metals) as a function of loading and soil depth.

Dr. Impellitteri also shared information about biosolids-related research grants, including:

- National Priorities: Evaluation of Pollutants in Biosolids, which assists states, municipalities, and utilities in determining potential risks from pollutants found in biosolids and optimize management of biosolids.
- Awarded Grants: Practical Methods to Analyze and Treat Emerging Contaminants (PFAS) in Solid Waste, Landfills, Wastewater/Leachates, Soils, and Groundwater to Protect Human Health and the Environment. This Science to Achieve Results (STAR) Grant includes research on minimizing release of PFAS from land applied biosolids and destruction of PFAS in sewage sludges using electron beam technology.
- Awarded National Priorities Grants: Research on PFAS Impacts in Rural Communities and Agricultural Operations. This National Priorities Grant includes research on small wastewater treatment systems and management of PFAS in effluents and biosolids.

Lastly, Dr. Impellitteri highlighted the following gaps in biosolids research:

- Based on future occurrence evaluations, assess the fate and transport of emerging contaminants (including PFAS) in land-applied biosolids.
- Examine the destruction of emerging contaminants in alternative biosolids management processes (e.g., thermal treatment).
- Develop frameworks for emerging contaminant risk management in agriculture (e.g., reducing plant uptake).
- Characterize biochar derived from the pyrolysis of biosolids and develop frameworks for beneficial use.

- Compare/contrast pyrolysis and alternative technologies (e.g., E-Beam) with existing management strategies using lifecycle assessment approaches.
- Assess microbial contamination of surface and groundwater after land application of biosolids.

Ashwin Dhanasekar, Water Research Foundation (WRF)

Mr. Dhanasekar began his presentation with an overview of the Water Research Foundation (WRF), a non-profit research organization to advance the science of all things water. WRF's One Water organization conducts research in all areas of the water sector including drinking water, wastewater, stormwater and water reuse. Current priorities include PFAS, lead, copper, nutrients, and harmful algal blooms (HABs). This organization also acts as a pass-through entity for federal and state grants.

Mr. Dhanasekar shared a table with a breakdown of how funds are distributed across WEF's research programs. Sixty percent of the annual research budget is dedicated to the Research Priority Program, a strategic research program broadly relevant to the water sector chaired by a Research Advisory Council to prioritize based on priority research needs in the industry. Twenty percent of the budget is dedicated to the Tailored Collaboration Program, a matching program designed to support utility-specific/regional issues. Ten percent is allocated to the Emerging Opportunities Program, a program to address emerging and time-critical issues. The remaining budget is dedicated to the Unsolicited Research Program, a program focused on novel/transformative research which opens every alternate year (next in 2022). Mr. Dhanasekar noted that since the WRF 2003 Biosolids Research Summit there have many new advances in the world of biosolids. While WRF continued to support limited biosolids research, it held another biosolids research summit in 2020. The goals of the summit were to:

- Develop a long term 5-year research plan,
- Prioritize research needs and develop project concepts,
- Identify research partners to provide in-kind support and/or funding,
- Identify volunteers to serve on the WRF Research Advisory Committee, and
- Conclude with clear next steps.

The summit had 45 attendees that encompassed a wide variety of backgrounds and resulted in eleven project concepts: one for microplastics and ten projects that will be funded over time. Key takeaways from the summit included sharing knowledge, localizing research, and addressing CECs.

Janine Burke-Wells, North East Biosolids and Residuals Association (NEBRA)

Ms. Burke-Wells shared an overview of the North East Biosolids and Residuals Association (NEBRA), a small nonprofit created in 1997 with the mission to cooperatively promote the environmentally sound recycling or beneficial use of water, wastewater, and other residuals in the northeastern United States and eastern Canada. She highlighted that NEBRA collaborates with other regional associations/organizations, including the Northwest Biosolids Association, Mid-Atlantic Biosolids Association (MABA), Virginia Biosolids Council, and the California Association of Sanitation Agencies (CASA). She also noted that the Northwest Biosolids Association has one of the best research committees. Ms. Burke-Wells shared that NEBRA is a small association, which gives it the advantage of being nimble and the ability to get things done quickly.

The National Biosolids Data Project, an update to the 2007 *National Biosolids Regulation, Quality, End Use and Disposal Survey,* was highlighted. The project will help inform future research, the quantity of biosolids generated and how they are managed. The team for the data project includes NEBRA, CASA,

Northwest Biosolids, BioCycle, and MABA. The project was initiated through EPA Region 4 funding and the literature review and methods have been completed. The survey work is currently underway with funding from diverse organizations nationwide. There are two surveys: one for State Coordinators and one for water resource recovery facilities (WRRF). The final report is expected in March 2021 with a peer-reviewed publication to follow. Please contact NEBRA or other members of the project team if you have questions.

In addition to the data project, NEBRA reported on the Cost Analysis of the Impacts on Municipal Utilities and Biosolids Management to Address PFAS Contamination. The research found that the average biosolids management costs increased by approximately 37% in response to PFAS concerns, and that beneficial reuse programs experience the most significant cost impacts due to PFAS. Ms. Burke-Wells noted that the sample size was small (29 entities surveyed), and that more funding is needed for further research. The report also includes a chapter on emerging technology for the removal of biosolids contaminants.

Maria Lucia Silveira, W1470

Ms. Silveira spoke about the W4170 "Beneficial Use of Residuals to Improve Soil Health and Protect Public, and Ecosystem Health", a multi-state research group focused on beneficial use of treated wastewater effluent and residuals (such as biosolids) to improve soil health and protect public and ecosystem health. This multi-state research project traditionally focused on agriculture, but land-grant institutions now address many academic fields (aquatic, urban, space, and sustainable energy research). Research focuses on specific and important problems of concern to more than one state. There is a collaborative team effort in which the scientists from multiple disciplines are mutually responsible for designing and conducting the research and accomplishing the objectives. Ms. Silveira shared a timeline for W4170's regional contribution to biosolids research.

- Early 1970's: a biosolids project started in the North Central Region (NC-118 "Utilization and disposal of municipal, industrial and agricultural processing wastes) to evaluate the agronomic impacts of land applying biosolids.
- 1972: Western Region Project W-124 "Soil as a waste treatment system" focused on similar objectives.
- 1977: the NC-118 and W-124 projects reorganized as W-124 "Optimum utilization of sewage sludge on land."
- 1985: the project was renewed as W-170 "Chemistry and bioavailability of waste constituents in soils."
- W170 provided research data and risk assessment support to develop risk-based guidelines for EPA's Part 503 biosolids regulation.
- 1985-1999: W-170 "Chemistry and bioavailability of waste constituents in soils"; Renamed in 2004 (W-1170 "Chemistry, bioavailability, and toxicity of constituents in residuals and residual-treated soils."
- 2009: W-2170 "Soil-based use of residuals, wastewater and reclaimed water."
- 2014: W-3170 "Beneficial reuse of residuals and reclaimed water: Impact on soil ecosystem and human health."
- 2019: W-4170 "Beneficial Use of Residuals to Improve Soil Health and Protect Public, and Ecosystem Health."

Today, the W4170 consists of 50+ scientists from 30 states and is internationally recognized for its research contributions. Research and extension activities are provided to the scientific community; federal, state, regional, and local agencies; communities; and stakeholders. The W4170's research focus has the following objectives:

- Evaluate the short- and long-term chemistry and bioavailability of emerging contaminants (PFAS, microplastics, etc.), pharmaceuticals and personal care products (PPCPs), persistent organic contaminants, and pathogens in residuals, reclaimed water, and amended soils in order to assess the environmental and human health risk-based effects of their application at a watershed scale.
- Evaluate the uses and associated environmental benefits for residuals and wastewaters in various ecosystems (e.g., agricultural, urban, recreational, forest, rangeland, mine-impacted, disturbed, degraded) with respect to changes in soil physical, chemical, biological, nutrient, and trace/heavy metals with respect to soil quality and health.

Most recently, the W4170 provided a science-based response to the EPA Office of Inspector General (OIG) 2018 biosolids report focusing on the unregulated chemicals highlighted in the report.

EPA's Polyfluoroalkyl Substances (PFAS) in Biosolids Risk Assessment

Elyssa Arnold, EPA Biosolids Team Risk Assessment Lead, provided a risk assessment overview and a summary of EPA's perfluorooctanoic acid (PFOA) and perflurorooctanesulfonic acid (PFOS) biosolids risk assessment.

Risk Assessment Overview

Ms. Arnold began her presentation by defining Risk Assessment. EPA's definition of **risk** is the chance of harmful effects to human health or to ecological systems resulting from exposure to an environmental stressor. A **stressor** is any physical, chemical, or biological entity that can induce an adverse response. Stressors may adversely affect specific natural resources or entire ecosystems, including plants and animals, as well as the environment with which they interact. Risk assessment is a scientific process used to characterize the nature and magnitude of health risks to humans and ecological receptors from chemical contaminants and other stressors that may be present in the environment. At EPA, risk assessment typically falls into one of two areas: human health risk assessment and ecological risk assessment. The CWA is a risk-based statute and Part 503 covers both human health and ecological risk. Risk depends on three primary factors:

- How much of a chemical is present in an environmental medium (e.g., biosolids, soil, water, air).
- How much contact a person or ecological receptor (e.g., fish, bird) has with the contaminated environmental medium.
- The inherent toxicity of the chemical (hazard).

Ms. Arnold stressed that hazard (i.e., toxicity) of a stressor does not equate to risk. For risk to be present, there must be exposure to the hazard at a sufficient level to cause a problem. This is a basic tenet of toxicology: the dose makes the poison (Paracelsus). Variability and uncertainty both play important roles in the effort to define hazard and exposure. She defined deterministic and probabilistic risk assessment. **Deterministic** risk assessment is a technique that uses point values and simple models to produce a point estimate of exposure (either high-end or typical exposure). Deterministic

assessments are simple to carry out, often use readily available data, and produce results that are straightforward to interpret. **Probabilistic** risk assessment is a technique that utilizes the entire range of input data to develop a probability distribution of exposure or risk rather than a single point value. The input data can be measured values and/or estimated distributions. The risk assessment process follows a framework with the following steps:

- *Problem formulation/scoping*: gather information and plan how to do the assessment.
- *Exposure*: calculate expected exposure in different environmental media to your receptor(s).
- *Effects/toxicity*: calculate toxicity endpoints of concern.
- *Risk characterization*: compare expected exposure to toxicity and consider other information available to help characterize the possible risk.
- *Risk management and communication*: critical step that asks what the numbers mean and how the scientific assessment translates to the management of the risk.

The CWA Section 405 requires EPA to establish numeric limits and management practices that protect public health and the environment from the effects of chemical and microbial pollutants during the use or disposal of sewage sludge. It also requires EPA to review the biosolids regulations every two years to identify additional toxic pollutants that occur in biosolids and set regulations for those pollutants if sufficient scientific evidence shows that they may harm human health or the environment. The biosolids rule (40 CFR Part 503) was published in 1993 to protect human health and the environment from reasonably anticipated adverse effects of pollutants that may be present in biosolids that are used or disposed. Pollutant concentration limits in the rule were based on the results of risk assessments that were conducted to identify risks associated with the use or disposal of biosolids (land application, surface disposal or incineration). These risk assessments analyzed risks to human, animals, plants, and soil organisms from exposure to pollutants in biosolids through 14 different exposure pathways.

EPA's PFOA and PFOS Biosolids Risk Assessment

The scoping, or problem formulation, stage of EPA's PFOA and PFOS biosolids risk assessment is included in EPA's PFAS Action Plan.

The scoping, or problem formulation, stage of EPA's PFOA and PFOS biosolids risk assessment is included in EPA's PFAS Action Plan. Problem formulation is the part of risk assessment that articulates the purpose for the assessment, defines the problem, determines the conceptual models (sources and routes of exposure), and describes the analysis plan, including the models and tools that will be used in the analysis. Problem formulation also includes engagement with states and tribes, risk managers, scientists, and members of the biosolids community to discuss foreseeable science and implementation issues. Meetings for this purpose were held in November 2020.

PFOA and PFOS are part of a larger group of chemicals called per- and polyfluoroalkyl substances (PFAS). PFAS are highly fluorinated aliphatic molecules that have been released to the environment through industrial manufacturing and through use and disposal of PFAS-containing products. While many PFAS chemicals have been found in biosolids, PFOA and PFOS are among the most abundant and have the largest datasets to support risk assessment. PFOA and PFOS do not readily degrade via aerobic or anaerobic processes. The only dissipation mechanisms in water are dispersion, advection, and sorption to particulate matter such as biosolids in the wastewater stream. While PFOA and PFOS have largely been phased out of production in the United States, their resistance to environmental degradation causes a lingering concern for exposure. They can also be formed from precursors in the environment.

PFOA and PFOS are both highly persistent in the environment and highly mobile. Both chemicals tend to bioaccumulate in humans, terrestrial organisms, and aquatic organisms, although PFOS has shown to have higher bioaccumulation potential than PFOA.

Ms. Arnold shared a chart with measured concentrations of PFOA and PFOS in biosolids from published literature. PFOA and PFOS were not measured by EPA in their national sewage sludge surveys. Sampling for the most recent survey was completed in 2006 and at that time there were not sufficient analytical methods for biosolids to include them in the survey. EPA will use the measurements from published studies such as these (including one that measures PFOA and PFOS in stored samples from the 2006 targeted national sewage sludge survey) to determine the biosolids concentration for the risk assessment. Toxicity endpoints for the risk assessment will be consistent with those determined for human health and ecological receptors by other parts of EPA's Office of Water.

Biosolids use and disposal pathways include land application, surface disposal, and incineration. These are mapped out in conceptual models based on expected major pathways and modeling capabilities. The conceptual models apply to any chemical in biosolids (not specific to PFOA/PFOS), so there is a consistent approach to chemical risk assessment. Ms. Arnold reviewed the conceptual model for agricultural land application on human exposure. There were 14 exposure pathways in 1993 and there have been many advances and changes since, and the dashed lines show what has been added since 1993. The exposure scenario is based on the reasonable maximum exposure, which is defined as a farm family (adult and child) who lives on a farm and consumes farm-raised foods where land-applied biosolids are used. This family would be more highly exposed to biosolids than the general population because the goal is to be protective. This is consistent with recommendations in the 2002 National Research Council report on land-applied biosolids. There are five conceptual models in total:

- Agricultural Land Application Scenario: Human Exposures
- Agricultural Land Application Scenario: Ecological Exposures
- Biosolids Surface Disposal: Human Exposures
- Biosolids Incineration: Human Exposures
- Biosolids Incineration: Ecological Exposures

EPA's modeling approach is currently under development for presentation to the EPA Science Advisory Board in 2021. Modeling for biosolids will be based on publicly available, previously peer-reviewed models for leaching, runoff, erosion, air dispersal, and plant uptake to the greatest extent possible. The approach for PFAS will be consistent, to the extent appropriate, with all other chemical risk assessment for biosolids.

Ms. Arnold gave a summary of the PFOA and PFOS Problem Formulation meetings that took place in November 2020. Two meetings were held (same presentation and discussion questions were used), one with states and tribes and one with other stakeholders in the biosolids community. The meetings were designed to engage and gather input from stakeholders. Major themes of the discussions included cost and availability of analytical methods for PFOA and PFOS in biosolids, explanation of the conceptual models, the need to consider occupational exposure, and the complications presented by precursors. Stakeholders stressed the importance of keeping in mind the impacts of the risk assessment results on biosolids management, the role of pretreatment/source reduction, and the magnitude of risks from biosolids relative to other exposure sources.

The problem formulation meetings are complete, and a draft document is expected to be available in 2021. The Science Advisory Board will review the modeling approach in 2021. The estimated completion of the risk assessment for internal review is in 2022, followed by a public comment period. Ms. Arnold noted that there are a lot of pieces still coming together as EPA builds their risk assessment model, validates the approach, and gathers toxicity data for PFOA and PFOS. If EPA determines that PFOA or PFOS in biosolids may adversely affect public health or the environment, risk managers will consider options for numerical limitations and best management practices for these compounds. If regulatory limits are advised, they will go through a standard regulatory process including inter-Agency and Office of Management and Budget review, as well as public comment.

State Biosolids Program Experience Spotlights

Michigan PFAS and Biosolids Update: State Perspective (Mike Person, Michigan Biosolids Program)

Mr. Person shared an update on PFAS and biosolids in the State of Michigan, noting that Michigan is recognized for its leadership in addressing contamination from PFAS. Mr. Person highlighted that this success is due in part to the Michigan PFAS Action Response Team (MPART), which is a unique multi-agency team that leads coordination and cooperation among all levels of government. MPART organizes and directs PFAS activities of key state departments responsible for environmental and natural resources protection, agriculture, public health, military installations, airports, and fire departments.

The MPART structure includes multiple technical workgroups that address a wide variety of PFAS issues. The Water Resource Division (WRD) within the Department of Environment Great Lakes and Energy (EGLE) is the lead agency for the Biosolids Workgroup. Mr. Person noted that states are feeling pressured to take action to address PFAS and guidance from EPA is needed regarding land application of biosolids in the context of PFAS. This is a very complicated issue involving variabilities in wastewater treatment plant (WWTP) processes, soil types, application rates, fate and transport to surface water and groundwater, as well as crop uptake and food safety concerns. Through its PFAS efforts Michigan is working to better understand the issue to ensure that land application is protective of public health and the environment. The intent of the state's aggressive source reduction effort is so that biosolids land application can continue in the future.

In February 2018, EGLE initiated the Industrial Pretreatment Program (IPP) PFAS Initiative which required Publicly Operated Treatment Works (POTWs) with IPP programs to look for sources of PFAS in their systems. Ninety-five wastewater treatment plants (WWTPs) have IPP programs and initially participated in the program. If potential sources were identified, effluent/influent samples were collected, and the results were compared to WRD's Surface Water Quality Standard for PFOS. If elevated sources were found POTWS were required to go through a process of elimination and reporting. Overall, the IPP PFAS Initiative has been a success with significant reductions in PFOS noted for discharge from WWTPs.

To expand upon the IPP initiative, EGLE conducted a statewide Biosolids Study that selected and sampled effluent, influent and biosolids from 42 WWTPs, conducted site investigations of biosolids land application sites, and evaluated various fate and transport modeling techniques. Mr. Person presented graphs of PFOS concentrations in biosolids at WWTPs. He noted that in Michigan, most biosolids are land applied as a slurry which is about 3-6% solids, so researchers tried to focus on that type of sludge if it was stored in the plant. Researchers sampled what was available and collected samples from different locations within some plants. The data collected so far will likely lead to conducting a more intensive

study at some WWTPs in their attempt to understand PFOS in biosolids. The threshold level of 150 ppb is being used at the point at which biosolids is considered industrially impacted. Mr. Person noted how the industrially impacted number was developed and stressed that this is not a risk-based number. A detailed summary report is expected to be released in late 2020. The current study results and strategy will be presented at the next stakeholders meeting and will then need to go through MPART review.

WRD has begun working with non-IPP WWTPs that accept landfill leachate, septage, or other types of high strength waste to conduct a short-term waste characterization study and analyze the WWTP effluent and waste stream for PFAS, metals, and compatible pollutants. WRD developed a compliance strategy to handle industrial direct discharges and industrial stormwater discharges that exceed the water quality standards for PFOS. WRD is starting the process to develop a permitting strategy for municipal groundwater discharges similar to what is done for municipal NPDES facilities.

Mr. Person noted that EGLE is currently in the process of developing a biosolids strategy. The focus of the strategy is to continue using surface water quality standards to drive the implementation of PFAS source controls at POTWs with IPP requirements in their NPDES permits. Through this approach, wastewater treatment plants have experienced significant reduction in PFOS concentrations in both effluent and biosolids. Further improvements are anticipated as control programs continue to be implemented and refined. EGLE is also committed to ensuring that industrially impacted biosolids are not land applied and to evaluate historical land application scenarios that may present unacceptable risks to public health. Until a fully vetted risk-based evaluation is completed for PFOS (PFAS) in biosolids, EGLE is implementing the strategy to guide WWTPs and inform landowners/farmers regarding biosolids land application with detectable concentrations of PFAS.

Impact of Past Biosolids Land Application on One Maine Farming Community (Carla Hopkins, Maine Department of Environmental Protection)

Ms. Hopkins began her presentation by discussing a farm in southern Maine who saw elevated PFOS levels in milk in December 2016. Class B biosolids and paper mill residuals were applied to the farmland from the 1980s to the early 2000s. PFOS in the soil leached to groundwater affecting the dairy cows. In 2018, Maine adopted screening concentrations for residuals, including biosolids, for three PFAS compounds: PFBS: 1,900 ng/g, PFOA: 2.5 ng/g, and PFOS: 5.2 ng/g. This was based on leaching to groundwater modeling with 200 ng/L as an endpoint. In March 2019, the state began requiring facilities that land-apply biosolids and biosolids-derived products to test for PFBS, PFOA and PFOS in Class B programs, Class A pellet programs, and Class A composters (this includes WWTP sludge and dewatered septage). Ongoing testing was required beginning in February 2020.

In March 2019, the governor of Maine formed the Maine PFAS Task Force to study the threats of PFAS contamination to public health and the environment. The task force consisted of public health experts, Department of Health and Human Services, Department of Environmental Protection, Department of Agriculture Conservation and Forestry (DACF), and Maine Emergency Management Agency, industry experts, drinking water sector, environmental groups, and the final report was issued January 2020. The report laid out two key recommendations relating to biosolids:

- Prioritize locations for sampling where biosolids were spread on fields that produce crops for human consumption or feed, and
- Greatly expand testing of agricultural produce and products grown and/or raised in soils where biosolids have been agronomically utilized.

The DACF started conducting an off-the-shelf milk testing program in 2019 and 2020. Samples over the detection limit prompted further testing at contributing farms. Results from a farm in central Maine were very high (>10,000 ppt in milk). The farm had accepted Class B biosolids in approximately 1980-2003 (WWTP with significant contribution from industry) and Class A sludge-derived liming product in approximately 2006-2015 and spread the farm's manure. Samples were taken from all media from the farm and homes adjacent to the farm site. Ms. Hopkins showed a series of graphs with the concentrations found in milk (all >10,000 ng/L; milk tank = 32,200 ng/L), beef (20.9 ng/g), beef manure (113 ng/g), dairy manure (35.1 ng/g), and barn water from public water supply (4.52 ng/L). Feed sources had the highest levels in grass samples from fields. Corn results are still being reviewed, but it appears corn uptake is lower than grass. Samples of purchased grain from offsite are non-detectable. The soil and associated grass saw some significant levels.

Next steps following this study will be to coordinate treatment systems for those impacted above the EPA Health Advisory; continue expanding private drinking water well testing based on results; if necessary, review information from other sites that received Class B biosolids from the same generator that provided biosolids to the sites discussed earlier and sample as appropriate; and expand testing to sites that received other Class B biosolids.

Day 2: Wednesday, December 9, 1:00-4:00 PM Eastern

The second day of the meeting consisted of breakout sessions. The purpose of these breakout sessions was to brainstorm specific areas and actions for EPA to work alongside the biosolids community. It was important to help EPA understand what successes and challenges are being experienced by the biosolids community. There were seven concurrent breakout sessions, and each was run three times.

Breakout 1: Chemical and Microbial Methods for Meeting Part 503 Requirements

40 CFR Part 503 identifies allowable methods to be used for pathogens and vectors, inorganic pollutants, and some physical and aggregate biosolids properties. This session explored the use of existing methods and the potential need for new methods. PFAS methods were not a focus of this breakout session. The following questions were used to focus the discussions:

- *What methods are you currently using?*
- *What methods work well and what methods are difficult to use or present problems?*
- *What method would you like to be made available that isn't currently available or allowed under Part 503?*

Breakout 2: Considerations for Resource Recovery

EPA is aware of new approaches and products that are derived from sewage sludge. Part 503 may create regulatory hurdles to the development of these products, something that EPA did not envision when it promulgated the regulation in 1993. The following questions were used to focus the discussions:

- *What resource recovery efforts are you pursuing?*
- *What hurdles or obstacles are you facing?*
- *What would you like to be doing?*

Breakout 3: Experiences in Risk Communications

Communicating risk uncertainties from pollutants in biosolids is challenging. Concerns over biosolids containing high levels of PFAS chemicals are presenting challenges for land application. This session explored biosolids risk communication strategies, tools and messaging. The following questions were used to focus the discussions:

- *What risk communication strategies, tools and/or messaging have you used? What worked well and what did not?*
- *What obstacles are you facing?*
- *What strategies, tools, and messaging are needed?*

Breakout 4: Thermal Technologies: Incineration, Pyrolysis and Gasification

This session explored the use of incineration, pyrolysis and gasification as options for biosolids management. While EPA continues to support the land application of biosolids, additional management options are needed, particularly for biosolids that are highly contaminated with PFAS. The following questions were used to focus the discussions:

- *Are you currently employing incineration, pyrolysis or gasification? Why did you choose a particular thermal technology?*
- *What is working well? What challenges are you experiencing?*
- *What obstacles exist for implementing thermal technologies? How can obstacles be addressed?*

Breakout 5: Surface Disposal and Storage Approaches, Planning and Challenges

This session explored surface disposal and storage approaches, planning, and challenges. The following questions were used to focus the discussion:

- *What surface disposal and storage planning have you done?*
- *What issues are you facing when developing a plan?*
- *What is working well and what challenges are you experiencing?*

Breakout 6: Continuity and Institutional Knowledge Transfer within Biosolids Programs

Biosolids co-regulators and management professionals experience turnover in personnel. This session explored ways to create and maintain continuity and institutional knowledge transfer within and across the biosolids community. The following questions were used to focus the discussions:

- *How is knowledge and information transferred currently?*
- *What works and doesn't work well?*
- *What obstacles exist for successful knowledge transfer? How could these obstacles be addressed?*

Breakout 7: (Non-PFAS) Current Challenges for State and Tribal Biosolids Programs

While PFAS is a major issue for biosolids programs today, this session explores non-PFAS challenges that state and tribal programs currently face and what possible solutions exist. The following questions were used to focus the discussions:

- *What are some of the challenges your program currently faces?*
- *What is working well and what isn't?*
- *What obstacles are you experiencing to address biosolids issues? How could these obstacles be addressed?*

Day 3: Thursday, December 10, 12:30-4:30 PM Eastern

Reflections and Insights from Experienced Biosolids Practitioners

The purpose of this session was to provide meeting participants with reflections and insights from biosolid practitioners with many years of experience. The seven speakers each shared how their work in the biosolids community has evolved over the years, including what they've learned and can pass on to newer biosolids managers.

Speakers:

- Kyle Dorsey, Washington Department of Ecology
- Lauren Fondahl, EPA Region 9
- Greg Kester, California Association of Sanitation Agencies
- Cynthia Sans, EPA Region 7
- Frederick J. Hegeman, Wisconsin Department of Natural Resources
- John Dunn, EPA Region 7
- Bob Bastian, Retired Senior Environmental Scientist, EPA's Office of Wastewater Management

In their ten-minute presentations, speakers were asked to answer the following questions:

- *What advice would you give your younger self?*
- *In biosolids, what has been the most impactful development or achievement you have witnessed or have been a part of and why was it so impactful?*

Kyle Dorsey, Washington Department of Ecology

Mr. Dorsey focused on the importance of networking and the value of knowing what others are doing and thinking. He offered the advice, "Do something you like, and do it with heart. Pay attention to good, better, best – it drives a lot of what happens in the industry." Mr. Dorsey noted that social media presents challenges to biosolids messaging and suggested that the biosolids community better understand and improve how the industry is represented on social media. Mr. Dorsey believes that biosolids managers need to go on the offensive to protect the quality of biosolids and to keep contaminants out of treatment plants. Lastly, Mr. Dorsey stressed that the quality of biosolids should be used as an indicator of success for protecting the environment.

Lauren Fondahl, EPA Region 9

Ms. Fondahl shared that she is often called to be the expert on things when she isn't an expert. The advice she would give to her younger self would be to take a class on agronomic rate. She shared that

she was successful in helping to develop a form for third-party contractors who take biosolids for storage and use. Ms. Fondahl stressed the need to better understand what is occurring nationwide.

Greg Kester, California Association of Sanitation Agencies

Mr. Kester shared how he successfully evolved his career over the years. Each of the major career accomplishments he highlighted had the same thread: listen to everyone in the room, even the opposition. He stressed that together we can make better regulations and regulations must be based on science.

Cynthia Sans, EPA Region 7

Ms. Sans advised participants that on days when you feel frustrated and you are not making progress, take a step back and look at a longer period of time – look at your progress as a whole. Ms. Sans shared that she wished she had realized how critical it is to take advantage of the experience of others in your field; they have insights. She highlighted that fiscal year 2013 saw the creation of the Biosolids Center of Excellence, located in EPA Region 7, which is responsible for Part 503 compliance and enforcement. Biosolids e-reporting began in 2016 and in 2019, the Biosolids Center of Excellence developed expedited settlement for sludge, which allows for faster enforcement and frees up resources for larger cases. When asked Ms. Sans stated that overapplication or application that did not meet certain requirements (e.g., pollutant ceiling limit exceeded, or vector attraction reduction was not sufficient); and the need to test before application are two of the most common Part 503 violations.

Frederick J. Hegeman, Wisconsin Department of Natural Resources (DNR)

Mr. Hegeman noted that these meetings are important, and networking is critical in this field - and in life in general - stressing that teamwork is key. He advised participants to make sure to take time to relax and enjoy life. Mr. Hegeman noted that he has seen a lot of evolution in the program, the work and what is emphasized in the 12 years that he has been at WI DNR. Some current issues include maintaining compliance, especially with Class B biosolids, and finding places to distribute final Class A product.

John Dunn, EPA Region 7

Mr. Dunn shared that regulators need to be an umpire, not an advocate. They should help people comply in the easiest way possible – protect the environment and help people do the right thing. He advised regulators to look at their specific role and adapt to changes that occur over time. Sometimes your role is to sit back and observe, other times you act. As a regulator, you need to understand the activities you regulate (e.g., how sewage treatment plants work). The source of a problem is usually upstream, so you need to understand process and how to help WWTP workers. Mr. Dunn shared that his major accomplishment was getting the use of agronomic rates into Part 503.

Bob Bastian, Retired Senior Environmental Scientist, EPA Office of Wastewater Management

Mr. Bastian shared that support for technology and resource recovery is needed. Water supply and the recycling of water has become the focus, and we need mechanisms to track and ensure performance. When he started his career, sludge was viewed as hazardous waste because of what could be in it, but by dealing with pathogens and chemical contaminants, biosolids can be managed as a resource. Mr. Bastian noted that this evolution from hazardous waste to resource is one of the most important changes that he has seen. Mr. Bastian's advice to lesser experienced biosolids managers is to, "Keep the big picture in front of you. If you can't see where you are trying to get to, you need to take a step back."

Areas and Actions for EPA Support: Report Outs from Breakout Sessions

There was a significant amount of energy and participation around the breakout session topics. Detailed notes were taken during all Day 2 breakout sessions and they will be helpful to EPA in its efforts. Key takeaways and themes are captured in this report (see the following bullets under each breakout session).

Breakout 1: Chemical and Microbial Methods for Meeting Part 503 Requirements

- Clarification is needed on what methods are acceptable under Part 503.
- Several participants noted that it is difficult to meet holding times for fecal coliform and salmonella when using existing methods. They requested guidance on how to address the issues they are experiencing.
- Odors remain an obstacle to biosolids acceptance (e.g., nuisance and/or perception that odor indicates health risk). Additional methods for vector attraction reduction and stability are needed.
- A request was made for EPA to develop nutrient analysis methods for biosolids (wastewater methods are currently being used and it varies by state). However, it was noted also that test labs are calibrated with localized agronomic recommendations from land grant universities. If EPA standardized nutrient test methods, the localized agronomic recommendations would have to be considered.
- Education is needed on methods selection and sampling. Contextual information and references would be helpful in understanding the most desirable or appropriate approach needed under certain circumstances.

Breakout 2: Considerations for Resource Recovery

There is a Part 503 regulatory hurdle to allowing innovative resource recovery products and technologies.

- An EPA determination on the land application of struvite under Part 503 is needed.
- Cost considerations:
    - Understanding lifecycle costs and benefits of the products/options is needed so a utility can select the best option to meet the community's needs.
    - It can be difficult to account for the reliability of a program in lifecycle costs.
    - Sometimes market demand is not sufficient to cover costs of resource recovery (e.g., struvite).
- Some facilities are looking for sludge incinerator ash reuse opportunities while others have success stories that were shared.
- Composting was discussed:
    - In the pacific north west facilities who want to do composting are encountering issues with air quality regulations.
    - Regulation of compost varies across states.
    - The American Carbon Registry, Water Environment Federation and others are examining carbon credits for composting.
- A coordinated effort that includes EPA is needed to obtain acceptance of biosolids use on organic crops (e.g., EPA/US Department of Agriculture dialogue).
- EPA needs to play a role in promoting Class A EQ biosolids use.

- Phosphorus accumulation in soils is jeopardizing land application of biosolids.
- Messaging and emphasis are needed on the beneficial use of biosolids to counter the view that biosolids land application is simply a disposal option.
- Biosolids land application can be part of the climate change solution.
- US Geological Survey/US Department of Agriculture/EPA coordination on soil conservation and soil health efforts is needed.
- US Forest Service/EPA coordination on reclamation of fire ravaged lands as a remediation tool is needed.
- EPA's promotion of the concept of circular economy relative to biosolids beneficial use is needed. Note that EPA's Sustainable Materials Management Program can be leveraged for this purpose.
- More discussion on biochar relative to biosolids is needed.
- There was discussion around interstate regulations and the need for standardization across the nation.

Breakout 3: Experiences in Risk Communications

- Examples of ongoing risk communication efforts were discussed:
    - Public Interest Center that is trained to speak to the public.
    - Interstate Technology & Regulatory Council and the Association of Clean Water Administrators risk communication materials.
- Potential Strategies:
    - Farmers, health professionals and local conservation districts can help develop messaging and act as messengers.
    - Identify best news outlets to get messaging to the public.
    - Identify experts and a mechanism to readily access them so that a response to the public is timely.
    - Ensure websites are current and user-friendly.
    - Keep farmers updated regularly (e.g., newsletter).
- Biosolids community should work together for consistent messaging and have communication materials readily available.
- Hold webinars on crisis communication (e.g., spills).
- EPA should play a role in messaging, sometimes jointly with states and stakeholders.
- Develop a template for a Memorandum of Understanding (MOU) that can be used between utilities and communities.
- Document case studies that can be shared with the public.
- Messaging:
    - Needs to be concise, clear, timely, easy to understand and honest.
    - Should show understanding and empathy.
- Anticipate and eliminate triggers:
    - Give people notice that you are land applying.
    - Ensure haulers drive safely and are considerate of the community.
    - Require signage at Class B and Class A (where appropriate) land application sites that are visible from the road. Include pertinent information (e.g., permit #, operator #).

- Challenges:
    - Public trust and misinformation.
    - Lack of science.

Breakout 4: Thermal Technologies: Incineration, Pyrolysis and Gasification

- Participants discussed advantages to incineration (e.g., limits on land application, location constraints prevent adding digestors, efficiencies in operating system without added fuel and fluctuations in sludge makeup).
- Significant challenges exist when trying to meet water, air and waste regulations.
    - Coordination between EPA programs is needed.
- It is difficult for existing incineration units to comply with new Clean Air Act requirements which leads to pressure on capacity of units, some units shutting down, some utilities moving away from incineration, and concern around communities being able to meet requirements.
- It can be difficult to get new thermal units permitted.
- Moving to gasification can be a challenge because location of existing pipelines cannot always be moved to accommodate the gasification unit.
- Facilities are interested in pyrolysis and gasification but are very wary due to the lack of existing full-scale operating facilities that prove that the technology is a safe investment.
- It is difficult to find a market (e.g., sludge biochar) or beneficial use (e.g., ash).
- Some successful examples of ash beneficial use were shared by participants.
- Facilities are moving away from incineration as upgrades become more expensive.
    - There is often public opposition to incineration.
    - Knowledge transfer for running systems can be a challenge for facilities.

Breakout 5: Surface Disposal and Storage Approaches, Planning and Challenges

Surface disposal sites include landfills or monofills used only for sewage sludge, sewage sludge surface impoundments, and some lagoons (excluding treatment and storage lagoons). Beneficial use of biosolids via land application is distinct from surface disposal.

- There was a lot of interest in the topic of surface disposal and participants in the breakout sessions had robust discussions where they exchanged ongoing practices and challenges.
- Based on the discussions, there is significant confusion on the differences between and requirements for staging, storage and disposal.
    - A request for guidance and training on the topic was made.
    - Small communities in particular struggle due to limited financial resources and limited expertise.
- Knowledgeable and experienced participants stressed the need for early planning to ensure that facilities are ready at the time the lagoon reaches capacity.
    - Lack of planning is resulting in stockpiles.

Breakout 6: Continuity and Institutional Knowledge Transfer within Biosolids Programs

- Participants shared knowledge transfer practices that work well such as: factsheets, regular coordination meetings and calls, compliance plans, sampling plans, standard operating

procedures, accessible historical files, electronic materials, and certain EPA documents (e.g., pathogen and vector attraction guidance).
- Regular training and conferences are integral to knowledge transfer.
- Publicly available technical assistance information is needed.
- EPA needs to update guidance and technical documents. There is often a reluctance to rely on existing EPA materials that were developed in the 1990's and early 2000's.
- Field/site tours for both biosolids managers and regulators can be extremely beneficial.
- Biosolids issues are often complex and nuanced (solutions are not "one size fits all"). There is a need to ensure that the nuances of biosolids management are transferred.
- There are often differences between state biosolids regulations which can create issues when biosolids cross state lines.

Breakout 7: (Non-PFAS) Current Challenges for State and Tribal Biosolids Programs

- EPA's re-engagement is welcomed (e.g., helpful new website, responsive to questions, and improved communications).
- Examples of successful collaboration were highlighted (e.g., partnerships with farmers; coordination with Canada and USDA/extension services; and coordination between states and tribes).
- Gaps exist in current science and understanding (e.g., new technologies, chemicals of emerging concern, phosphorus, microplastics).
- More research is needed on the beneficial use of biosolids, as well as better communication of research currently underway.
- There are challenges with tracking interstate transfers of biosolids.
- Working in and communicating with remote areas can present challenges.
- Changing climate is influencing land application opportunities, timing, storage needs, etc.
- There is a lack of clarity around regulatory jurisdiction (e.g., movement of biosolids across tribal lands, states and federal facilities).
- Navigating the beneficial use of biosolids with the potential risk of contaminants found in biosolids.
- Challenges exist with phosphorous and algae management associated with biosolids applications.
- There is a lack of funding and staff to administer biosolids programs.
- Staff turnover is a constant challenge.
- States receiving biosolids from outside their state can have difficulty tracking the treatment processes used for those biosolids in order to ensure Part 503 and state compliance.
- Better reporting is needed for sludge that is stored or going to landfills in EPA's annual biosolids reporting.

Conclusions

Elizabeth Behl, Director of the Health and Ecological Criteria Division, shared some final remarks to close out the meeting. She reflected on the robust discussions and networking that occurred. She expressed her appreciation to the biosolids community for "stepping up" when EPA could not engage in biosolids issues to the extent necessary in past years, and for continuing to meet the needs of communities across

the country. Ms. Behl stated that the Biosolids Team will reflect on the lessons learned from the meeting to inform program efforts and she committed to continuing communication and collaboration with co-regulators and stakeholders.

The entire Biosolids Team would like to thank those in the biosolids community for providing input on the meeting agenda, the presenters and the participants who made the EPA National Biosolids Meeting 2020 a success.

Appendix A: Meeting Registrants

Location	First Name	Last Name	Company
Alexandria, VA (AlexRenew)	Allison	Deines	Alexandria Renew Enterprises
Association of Clean Water Administrators (ACWA)	Jake	Adler	ACWA
	Sean	Rolland	ACWA
California Association of Sanitation Agencies (CASA)	Sarah	Deslauriers	CASA
	Greg	Kester	CASA
City of Tacoma	Dan	Thompson	City of Tacoma
City of Vancouver	Frank	Dick	City of Vancouver
Cleveland, OH (NEORSD)	Kathryn	Crestani	NEORSD
Green Bay, WI (NEW Water)	Bruce	Bartel	NEW Water Green Bay Metropolitan Sewerage District
Kansas City, MO (KC Water)	Matt	Bond	KC Water
Kissimmee, FL (Toho Water Authority)	Todd	Swingle	Toho Water Authority
Littleton, CO (Roxborough Water & Sanitation District)	Barbara	Biggs	Roxborough Water & Sanitation
Metropolitan St. Louis Sewer District (MSD)	Jay	Hoskins	MSD
Metropolitan Water Reclamation District of Greater Chicago	Albert	Cox	Metropolitan Water Reclamation District of Greater Chicago
Mid-Atlantic Biosolids Association (MABA)	William	Toffey	MABA
Mission, KS (Johnson County Wastewater)	Jeanette	Klamm	Johnson County Wastewater
National Association of Clean Water Agencies (NACWA)	Chris	Hornback	NACWA
New England Interstate Water Pollution Control Commission (NEIWPCC)	Jen	Lichtensteiger	NEIWPCC
	Christina	Stringer	NEIWPCC
North East Biosolids & Residuals Association (NEBRA)	Janine	Burke-Wells	NEBRA
Northwest Biosolids (NW Biosolids)	Erika	Kinno	NW Biosolids
	Maile	Lono-Batura	King County
Synagro	Layne	Baroldi	Synagro Technologies
Virginia Beach (HRSD)	Jamie	Heisig-Mitchell	HRSD
Virginia Biosolids Council	Robert	Crockett	Advantus Strategies
W4170	Nick	Basta	University of Florida
	Maria	Silveira	Ohio State University
Washington, DC (DC Water)	Chris	Peot	DC Water

Water Environment Federation (WEF)	Patrick	Dube	WEF
	Steve	Dye	WEF
	Claudio	Ternieden	WEF
Water Research Foundation (WRF)	Ashwin	Dhanasekar	WRF
	Lola	Oladobe	WRF
Alabama	Wayne	Crockett	Alabama Department of Environmental Management-Land Division
	Cody	Ennis	Alabama Department of Environmental Management-Land Division
	Rick	Kelsey	Alabama Department of Environmental Management-Land Division
Alaska	Lori	Aldrich	Alaska Department of Environmental Conservation
Arizona	Sondra	Francis	Arizona Department of Environmental Quality
California	Scott	Hatton	Central Valley Regional Water Quality Control Board – Fresno
	Laleh	Rastegarzadeh	State Water Resources Control Board
	Brianna	St Pierre	California State Water Board
	Heather	Williams	CalRecycle
Colorado	Tim	Larson	Colorado Department of Public Health & Environment
	Nathan	Moore	Colorado Department of Public Health & Environment
Connecticut	Craig	Motasky	Connecticut Department of Energy and Environmental Protection
Delaware	Brian	Churchill	Delaware Department of Natural Resources and Environmental Control
Florida	Maurice	Barker	Florida Department of Environmental Protection
Idaho	Tressa	Nicholas	Idaho Department of Environmental Quality
Illinois	Wei	Han	Illinois Environmental Protection Agency
	Jaime	Rabins	Illinois Environmental Protection Agency

Indiana	Kate	Garvey	Indiana Department of Environmental Management
	Thomas	Kreke	Indiana Department of Environmental Management
	Brenda	Stephanoff	Indiana Department of Environmental Management
Iowa	Tom	Atkinson	Iowa Department of Natural Resources
	Emy	Liu	Iowa Department of Natural Resources
Kansas	Shelly	Shores-Miller	Kansas Department of Health & Environment
Louisiana	Ronda	Burtch	Louisiana Department of Environmental Quality
	Todd	Franklin	Louisiana Department of Environmental Quality
Maine	Carla	Hopkins	State of Maine Department of Environmental Protection
	Paul	Secord	State of Maine Department of Environmental Protection
Massachusetts	Jennifer	Wood	Massachusetts Department of Environmental Protection
Michigan	Stephen	Mahoney	Michigan Department of Agriculture and Rural Development
	Michael	Person	Michigan Department of Environment, Great Lakes and Energy
	Cindy	Sneller	Michigan Department of Environment, Great Lakes and Energy
Minnesota	Lauren	Bammert	Minnesota Pollution Control Agency
	Sherry	Bock	Minnesota Pollution Control Agency
	Cole	Huggins	Minnesota Pollution Control Agency
Missouri	Greg	Caldwell	Missouri Department of Natural Resources
Montana	Fred	Collins	Montana Department of Environmental Quality
	Andrew	Ulven	Montana Department of Environmental Quality

Nebraska	Reuel	Anderson	Nebraska Department of Environment and Energy
New Hampshire	Anthony	Drouin	New Hampshire Department of Environmental Services
	Wade	Pelham	New Hampshire Department of Environmental Services
New Jersey	Anthony	Pilawski	New Jersey Department of Environmental Protection
	Patrick	Brown	New Jersey Department of Environmental Protection
New Mexico	Sarah	Holcomb	New Mexico Environment Department
	Susan	Lucas Kamat	New Mexico Environment Department
New York	Molly	Trembley	New York State Department of Environmental Conservation
	Sally	Rowland	New York State Department of Environmental Conservation
North Carolina	Todd	Crawford	North Carolina Department of Environmental Quality
	Poonam	Giri	North Carolina Department of Environmental Quality
	Erick	Saunders	North Carolina Department of Environmental Quality
	Vivien	Zhong	North Carolina Department of Environmental Quality
North Dakota	Sarah	Waldron Feld	North Dakota Department of Environmental Quality
Ohio	Kennedy	Gardner	Ohio Environmental Protection Agency
	Dana	Martin-Hayden	Ohio Environmental Protection Agency
	Betsy	Sheerin	Ohio Environmental Protection Agency
	Erin	Sherer	Ohio Environmental Protection Agency
Oklahoma	Gregory	Carr	Oklahoma Department of Environmental Quality
	Toby	Harden	Oklahoma Department of Environmental Quality
	Myles	Mungle	Oklahoma Department of Environmental Quality

Oregon	Pat	Heins	Oregon Department of Environmental Quality
Pennsylvania	Kevin	McLeary	Pennsylvania Department of Environmental Protection
Rhode Island	Alex	Pinto	Rhode Island Department of Environmental Management
South Carolina	Byron	Amick	South Carolina Department of Health and Environmental Control
	Tyra	Foulks	South Carolina Department of Health and Environmental Control
	Brenda	Green	South Carolina Department of Health and Environmental Control
Texas	Kellie	Crouch	Texas Commission on Environmental Quality
	Brian	Sierant	Texas Commission on Environmental Quality
	Shelby	Williams	Texas Commission on Environmental Quality
Utah	Daniel	Griffin	Utah Division of Water Quality
Vermont	Joshua	Burns	Vermont Department of Environmental Conservation
	Eamon	Twohig	Vermont Department of Environmental Conservation
Virgin Islands	Austin	Callwood	Department of Planning and Natural Resources
Virginia	Bryan	Cauthorn	Virginia Department of Environmental Quality
	Christina	Wood	Virginia Department of Environmental Quality
	Neil	Zahradka	Virginia Department of Environmental Quality
Washington	Amber	Corfman	Washington State Department of Ecology
	Kyle	Dorsey	Washington State Department of Ecology
	Shawnte	Greenway	Washington State Department of Ecology
Wisconsin	Frederick	Hegeman	Wisconsin Department of Natural Resources
	Wade	Strickland	Wisconsin Department of Natural Resources
	Stephen	Warrner	Wisconsin Department of Natural Resources

National Tribal Water Council	Shaun	Livermore	Poarch Creek Indians Utilities Authority
EPA Biosolids Program	Janice	Alers-Garcia	U.S. EPA
	Elyssa	Arnold	U.S. EPA
	Elizabeth	Behl	U.S. EPA
	Christine	Bergeron	U.S. EPA
	Cassandra	Kirk	U.S. EPA
	Cara	Lalley	U.S. EPA
	Deborah	Nagle	U.S. EPA
	Lauren	Questell	U.S. EPA
	Elizabeth	Resek	U.S. EPA
	Tess	Richman	U.S. EPA
	Barbara	Soares	U.S. EPA
EPA Office of General Counsel	Peter	Ford	U.S. EPA
EPA Office of Enforcement and Compliance Assurance	Carey	Johnston	U.S. EPA
	Courtney	Tuxbury	U.S. EPA
EPA Office of Research and Development	Carolyn	Acheson	U.S. EPA
	Laura	Boczek	U.S. EPA
	Ron	Herrmann	U.S. EPA
	Christopher	Impellitteri	U.S. EPA
	Marc	Mills	U.S. EPA
	Jorge	Santo Domingo	U.S. EPA
EPA Office of Science and Technology - Engineering and Analysis Division	Adrian	Hanley	U.S EPA
	Lemuel	Walker	U.S EPA
EPA Office of Wastewater Management	Rebecca	Christopher	U.S. EPA
	Smiti	Nepal	U.S EPA
	Jan	Pickrel	U.S. EPA
EPA Region 2	Alia	Roufaeal	U.S. EPA
EPA Region 3	Diana	Saintignon	U.S. EPA
EPA Region 4	Becky	Allenbach	U.S. EPA
	Ramanathan	Sampath	U.S. EPA
	Donnell	Ward	U.S. EPA
EPA Region 5	John	Colletti	U.S. EPA
	Kenneth	Gunter	U.S. EPA
EPA Region 6	William	Cooper	U.S. EPA
EPA Region 7	Seth	Draper	U.S. EPA
	John	Dunn	U.S. EPA
	Alex	Owutaka	U.S. EPA
	Cynthia	Sans	U.S. EPA

EPA Region 8	Paul	Garrison	U.S. EPA
	Kristin	Ratajczak	U.S. EPA
EPA Region 9	Lauren	Fondahl	U.S. EPA
EPA Region 10	Michael	Le	U.S. EPA

Appendix B: Presentations

U.S. Environmental Protection Agency Biosolids Program

Elizabeth Resek, Biosolids Lead

Office of Water, Office of Science and Technology

Health and Ecological Criteria Division

resek.elizabeth@epa.gov

Meeting CWA Requirements

Section 405(d) of the Clean Water Act (CWA) requires EPA to:

Establish numeric limits and management practices that protect public health and the environment from the reasonably anticipated adverse effects of chemical and microbial pollutants during the use or disposal of sewage sludge.

Review biosolids (sewage sludge) regulations every two years to identify additional toxic pollutants that occur in biosolids (i.e., biennial reviews) and set regulations for those pollutants if sufficient scientific evidence shows they may harm human health or the environment.

Meeting CWA Requirements

Biennial Reviews

- Review publicly available information on occurrence, fate and transport in the environment, human health and ecological effects, and other relevant information for pollutants found in biosolids.

- Data may be used to conduct risk screens and refined risk assessments for pollutants found in biosolids.

- Biosolids Biennial Report No.8 (reporting period 2018-2019) anticipated release end of 2020. https://www.epa.gov/biosolids/biennial-reviews-sewage-sludge-standards

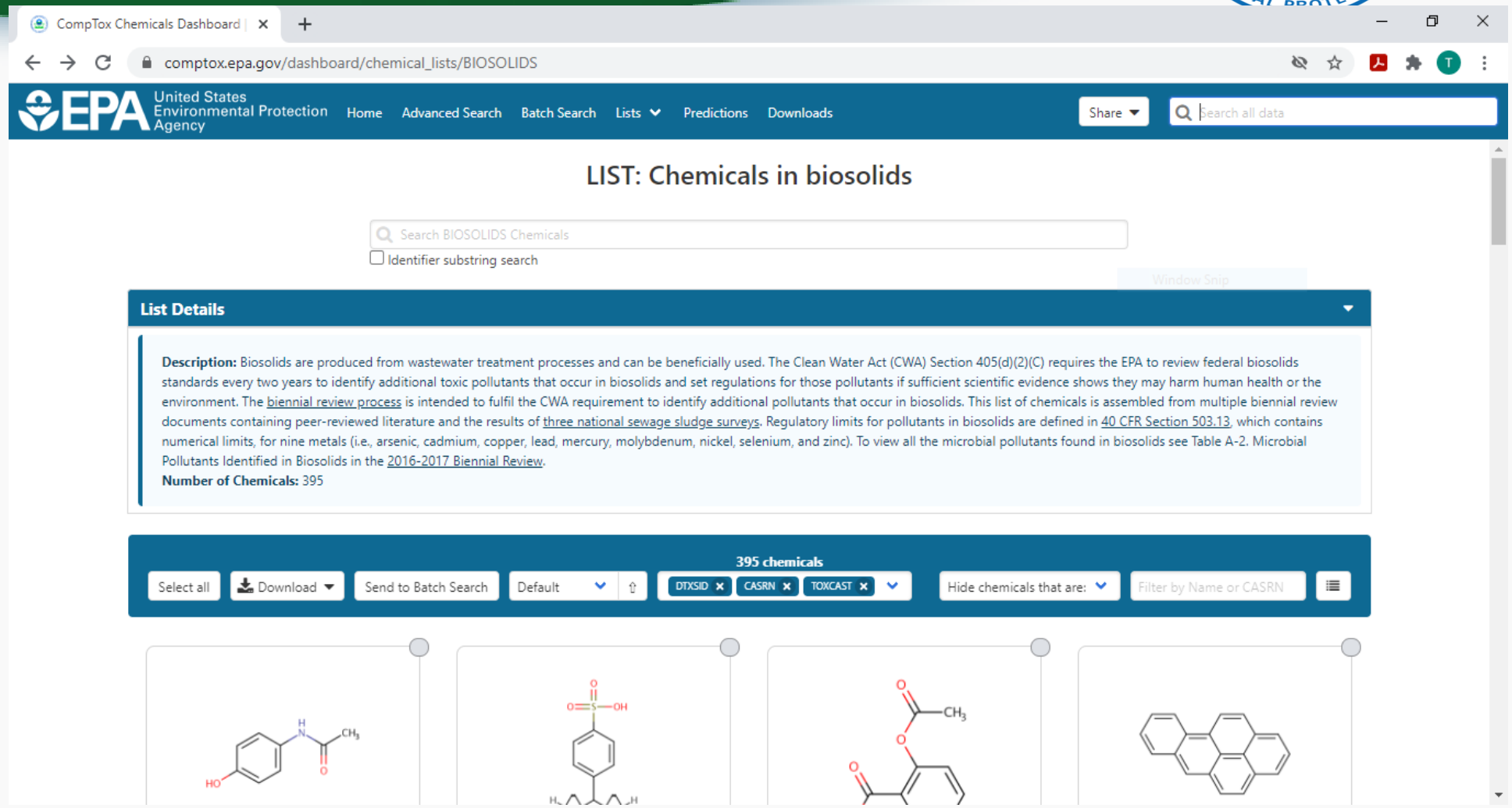
Meeting CWA Requirements

Biosolids List in EPA's CompTox Chemicals Dashboard

- Biosolids List in EPA's publicly available **CompTox Chemicals Dashboard** was curated from past biennial reviews and sewage sludge surveys representing the Agency's understanding of chemicals found in biosolids. https://comptox.epa.gov/dashboard/chemical_lists/BIOSOLIDS

- CompTox Chemicals Dashboard primer videos: https://www.epa.gov/chemical-research/comptox-chemicals-dashboard-primer-videos

Meeting CWA Requirements



Stakeholder Engagement

Biosolids Webinar Series

- Kicked-off in Fall 2019.
- Register for future webinars on EPA's biosolids website: https://www.epa.gov/biosolids

EPA Biosolids Website

- Completely overhauled and launched in July 2020.

EPA Commitment to Continued Engagement

- Participation in stakeholder-led meetings and calls.
- Follow-up to December 2020 meeting.

Additional Activities

National Defense Authorization Act Interim Guidance on Destruction and Disposal of PFAS and PFAS-Containing Materials

- EPA Biosolids Team participated on Agency-wide workgroup.
- Effort led by EPA Office of Land and Emergency Management.
- Due January 2021.

Resource Recovery

- A consistent process for evaluating products derived from sewage sludge that are intended for land application is needed.
- 40 CFR Part 503 does not consider or anticipate current and future innovative resource recovery technologies and products.
- Work in this area is ongoing.

COVID

EPA Statement on Biosolids Land Application (Spring 2020)

Existing requirements and guidance help ensure that biosolids are processed, handled, and land-applied in a manner than minimizes the risk of exposure to pathogens, including viruses. We have no evidence that biosolids contain infectious SARS-CoV-2 virus when requirements under 40 CFR part 503 are met for Class A biosolids. Generally, pathogens may exist when requirements are met under 40 CFR part 503 for Class B biosolids, which is why EPA's site restrictions that allow time for pathogen degredation should be followed for harvesting crops and turf, for grazing of animals, and public contact. All requirements under 40 CFR part 503 should continue to be met. Additionally, per CDC's Guidance for Controlling Potential Risks to Workers Exposed to Class B Biosolids, employers should prevent work-related illness by providing proper personal protective equipment (PPE) and supporting other health and safety practices for persons hauling and land applying biosolids. While no additional COVID-19–specific protections are recommended for the land application of biosolids, consider checking for advisories from your local health department.

Thank You!

Biosolids Team

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EPA

Office of Research and Development

EPA-OST Virtual
Biosolids Workshop
December 8, 2020

SAFE AND SUSTAINABLE WATER RESOURCES RESEARCH PROGRAM

Biosolids Research Overview

Christopher A. Impellitteri, EPA-ORD

Biosolids Research Projects

Pathogen and Vector Attraction Reduction	Inform the update to the *"Environmental Regulations and Technology: Control of Pathogens and Vector Attraction in Sewage Sludge"* report (EPA/625/R-92/013).
ARBs and ARGs	Evaluate types and prevalence of antibiotic resistant bacteria (ARB) and antibiotic resistance genes (ARGs) in biosolids to inform management strategies.
Emerging Contaminants (CECs)	Application of non-targeted analysis to municipal wastewater and residuals and method development and evaluation of CECs in wastewater and biosolids.

Biosolids Research Projects

PFAS Analytical Methods	**Development and validation of a PFAS isotope dilution method for biosolids.** • Collaboration with DoD • 40 different PFAS • Single validation data collection is complete
PFAS Prevalence and Pretreatment	**Research on the occurrence, fate, and transport of PFAS in wastewater treatment plants and biosolids. Identify sources and evaluate pretreatment strategies.**
Treatment Strategies	**Treatment strategies for biosolids, including incineration and pyrolysis.**

Biosolids Research Projects

Risk Assessments

Provide OW-OST with information to support the development of chemical risk assessments.

- Computational toxicology
- Evaluate chemicals in biosolids for risk assessment prioritization

Contaminants and Land Application

Characterize contaminants in land applied biosolids.

- Liquid and solid forms
- Metals and coliforms
- Emerging contaminants (alkylphenol ethoxylates, PFAS)
- Leaching test methods

Contaminants and Soils

Characterization of soils by evaluating contaminants (PFAS, PAH, metals) as a function of loading and soil depth.

Biosolids-Related Research Grants

- **Open National Priorities RFA (Closes January 5, 2021):** Evaluation of Pollutants in Biosolids
- **Awarded Grants:** Practical Methods to Analyze and Treat Emerging Contaminants (PFAS) in Solid Waste, Landfills, Wastewater/Leachates, Soils, and Groundwater to Protect Human Health and the Environment
- **Awarded National Priorities Grants:** Research on PFAS Impacts in Rural Communities and Agricultural Operations

Research Gaps

- Based on future occurrence evaluations, assess the fate and transport of emerging contaminants (including PFAS) in land-applied biosolids.
- Examine the destruction of emerging contaminants in alternative biosolids management processes (e.g., thermal treatment).
- Develop frameworks for emerging contaminant risk management in agriculture (e.g., reducing plant uptake).
- Characterize biochar derived from the pyrolysis of biosolids and develop frameworks for beneficial use.
- Compare/contrast pyrolysis and alternative technologies (e.g., E-Beam) with existing management strategies using lifecycle assessment approaches.
- Assess microbial contamination of surface and groundwater after land application of biosolids.

Contact

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The views expressed in this presentation are those of the individual author and do not necessarily reflect the views and policies of the US EPA.

THE Water Research FOUNDATION

Biosolids: Upcoming Research Snapshot

Ashwin Dhanasekar

ABOUT

MISSION

Advancing the science of water to improve the quality of life

VISION

To create the definitive research organization to advance the science of all things water to better meet the evolving needs of subscribers and the water sector

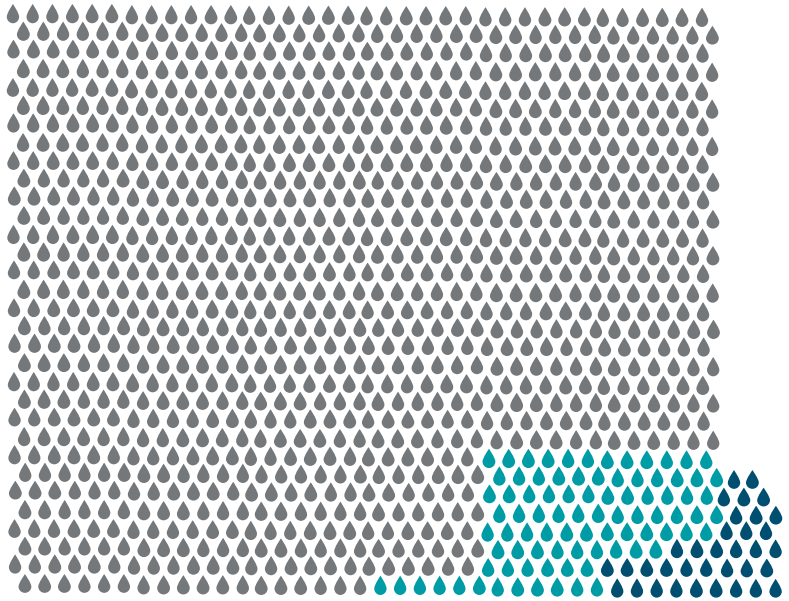
VALUES

Integrity • Leadership • Respect
Innovation • Collaboration

One Water

WRFs research benefits all areas of the water sector, as well as agriculture, energy, watershed management, and other commercial industries.

WRF AT A GLANCE



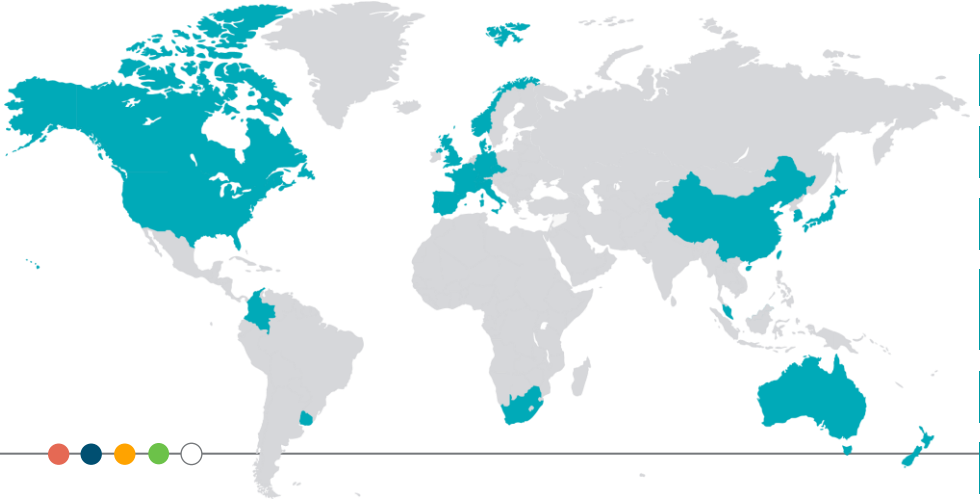
SUBSCRIBERS

1034 UTILITIES

39 MANUFACTURERS

89 CONSULTANTS

The Water Research Foundation operates and affects change on **6 continents**



PROGRAMS

- Research Priority
- Tailored Collaboration
- Emerging Opportunities
- Unsolicited Research
- Grants/Awards
- Facilitated Research
- Paul L. Busch Award

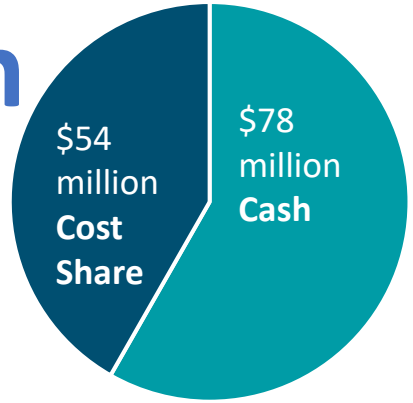
RESEARCH PRIORITIES

- PFAS & Constituents of Emerging Concern
- Lead & Copper
- Harmful Algal Blooms (HABs)
- Resiliency
- Infrastructure
- Integrated Water Management
- Energy Efficiency
- Nutrients

FUNDED RESEARCH

$132 Million

Contractually Funded Research



RESEARCH PORTFOLIO

1 Federal Contracts

4 Federal/ State Grants

323 Active Projects

172 Co-funders IN **291** Co-funded projects

THE Water Research FOUNDATION®

WRF Research Programs

At-a-Glance: Distinguishing Features of WRF Research Programs

Research Program & Description	% Annual Research Budget	Project Approval	Anticipated Schedule
Research Priority A strategic research program broadly relevant to the water sector	60	WRF Board-appointed Research Advisory Council (RAC)	April/March
Tailored Collaboration A matching program designed to support utility-specific/regional issues	20	WRF Board-appointed Tailored Collaboration Review Committee	Pre-proposal & proposal period starts 2 QTR project selection 3 QTR
Emerging Opportunities A program to address emerging and time critical issues; additionally, supports partnering opportunities and add-ons to current projects	10	WRF Board Executive Committee	Rolling
Unsolicited Research A program that focuses on novel, transformative research	10†	WRF Board-appointed RAC	Opening in 2020
Facilitated Research A program that is fully funded by the project team	0	WRF CEO and leadership team	Rolling

†While research budget is allocated to this program annually, research-project funds are released every other year, starting in 2020.

Background

- The last Biosolids Research Summit was in 2003.
- There are tons of new advances in the world of Biosolids since then.
- EPA submitted a report in 2019 claiming a need for risk assessment on 352 constituents.
- This is/was impacting utilities and how they can use their biosolids.
- WRF has had bits and pieces of research covering Biosolids.
- WRF stepped up to hold a focused research summit to identify key research needs.

Goals of the Summit

- Develop a long term 5-year research plan
- Prioritize research needs and develop project concepts
- Identify research partners to provide in-kind support and/or funding
- Identify volunteers to serve on the WRF Research Advisory Committee
- Conclude with clear next steps

WRF Biosolids Research Summit

- 45 Attendees
- Academics, Utility Representatives, Social Scientists, Non-Profits, Consultants
- Co-Sponsored by WEF & NYCDEP
- Support from SFPUC & DC Water
- 11 Project Concepts

Research Needs

Contaminants	Benefits	Utility Needs
Presence	Crop yield	Product Development
Fate and Transport	Water holding capacity	Communication
Risk Assessments	Fire ravaged lands	
Pathways	Brown fields	
Relative concentrations	Mine reclamation	
Plant uptake	Soil remediation	
Nutrient run-off	Carbon sequestration	
Microplastics		

Key Takeaways from Research Summit

Share the Knowledge

Better pooling of research to combat misinformation

Share, condense and disseminate

Keep the conversation going

Localize Research

Local research, outreach and support local gatekeepers

Buy-in and encourage staff pride for Biosolids products

Address CECs as a whole

Develop protocols/tools to address emerging contaminants as a whole

Objectives

To improve the economic value and sustainability of products that represent 95% of our mass and a third of our cost for our community's water and wastewater services.

Summarize known benefits and long-term successful reuse enterprises as case studies.

Quantify factors of interest that are currently lacking data (soil health, risk assessment of contaminants, customer demands/expectations).

Next Steps

- The AC will keep prepping the Research Area for a 2021 launch.
- The project concepts will get ranked and prioritized based on current developments.
- Till the RAC approves the AC, staff will be pursuing other opportunities, if any, to continue research.

Advisory Committee

- John Willis *Brown & Caldwell* (RAC Liaison)
- Karri Ving *SFPUC*
- Nick Basta *OSU*
- Patrick Dube *WEF*
- Matt Seib *MMSD*
- Joshua Cheng *CUNY*
- Greg Kester *CASA*
- Erica McKenzie *Temple U*
- Maile Lono-Batura *NW Biosolids*

WRF Staff

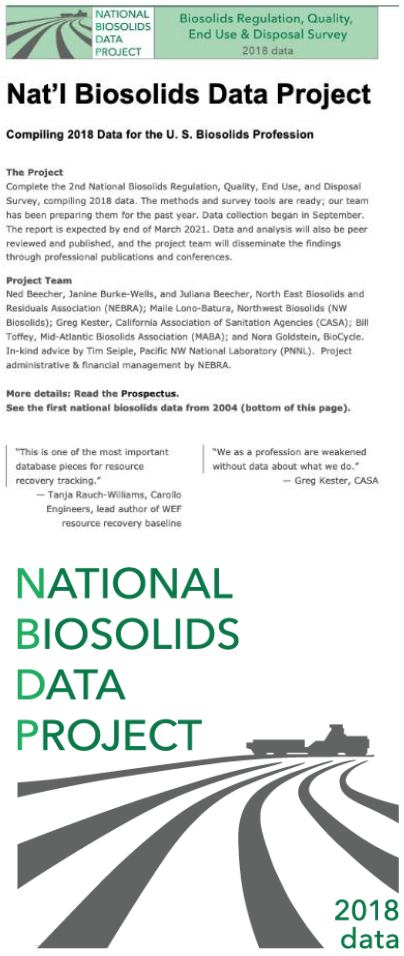
- Stephanie Fevig, Research Program Manager
- Ashwin Dhanasekar, Research Program Manager

Research Snapshots

North East Biosolids & Residuals Association

- Small non-profit created in 1997 with mission to cooperatively promote the environmentally sound recycling or beneficial use of water, wastewater, and other residuals in the Northeast, New England and eastern Canada
- Other regional associations/collaborators include Northwest Biosolids Association, Mid-Atlantic Biosolids Association, Virginia Biosolids Council and the newest South East Biosolids Association; California Association of Sanitation Agencies
- Research Committees – NWBA's is the best! https://nwbiosolids.org/whats-happening/resource-library
- NEBRA can be nimble! https://www.nebiosolids.org/why-biosolids-organizations-are-needed

The National Biosolids Data Project 2018 data



- The 2nd compilation of biosolids nationwide & by states; first compilation published in 2007 reporting 2004 data
- Team includes NEBRA, CASA, NW Biosolids, BioCycle, MABA
- Literature review & methods completed in spring, thanks to a cooperative agreement with EPA Region 4
- Funding for current project from diverse organizations nationwide
- Final report planned for end of March 2021; peer-review publication to follow
- 2 separate surveys: State Coordinators & WRRFs
- The State Survey is here: https://www.surveymonkey.com/r/NBDPStateSurvey7Oct2020

The NBDP Webpage: https://www.nebiosolids.org/national-biosolids-survey-2018-data

The National Biosolids Data Project 2018 data

We need state coordinators help to provide whatever info you have!

PROGRESS:

- 14 state coordinators have started survey… Well done!
- DE, IN, MO, NJ, OR, and TX have completed their spreadsheet & survey and had phone interviews with us. Superb! Thank you.
  "It was kind of fun,…" we heard one say.
- The separate survey of WRRFs ("WWTP Survey") is going out very soon. We are hoping for thousands of responses. Please spread the word - and the email invitation.
- Please start your state's survey ASAP.
- We are here to help with questions, filling in the survey, talking through it on the phone – whatever you need!
- We know this is a big request; thank you for your time and effort.

NATIONAL BIOSOLIDS DATA PROJECT 2018 data

Support from biosolids leaders nationwide

NACWA

CASA carollo loop

Water Environment Federation
the water quality people

Virginia Biosolids Council SYNAGRO

Denali Water Solutions Hazen

RENDA Environmental CDM Smith WM

NATIONAL BIOSOLIDS DATA PROJECT

2018 data

dc water is life CHARLOTTE WATER Mid-Atlantic Biosolids Association

San Francisco Water Power Sewer

SLOW-RELEASE Milorganite NITROGEN FERTILIZER

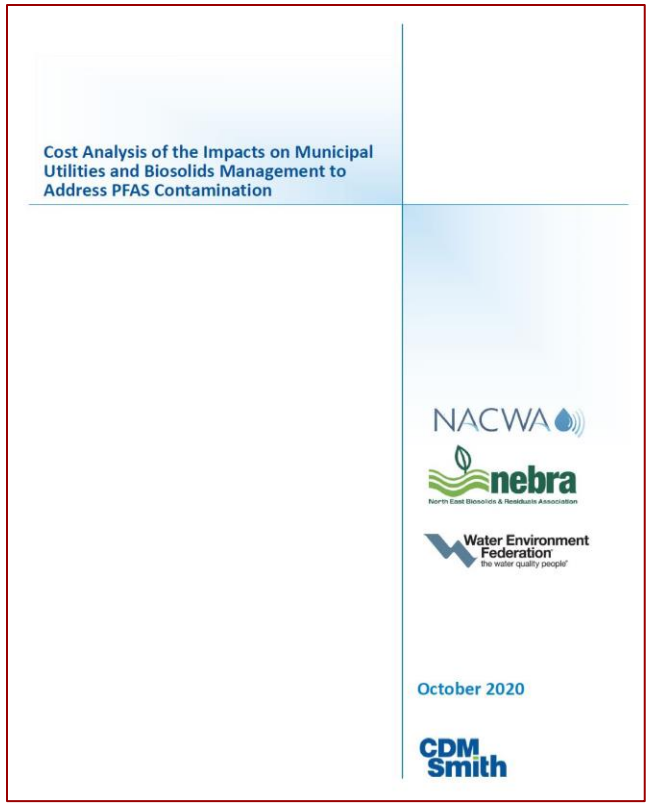
Jacobs Illinois Association of Wastewater Agencies NEFCO

MERRELL BROS.

METRO WASTEWATER RECLAMATION DISTRICT

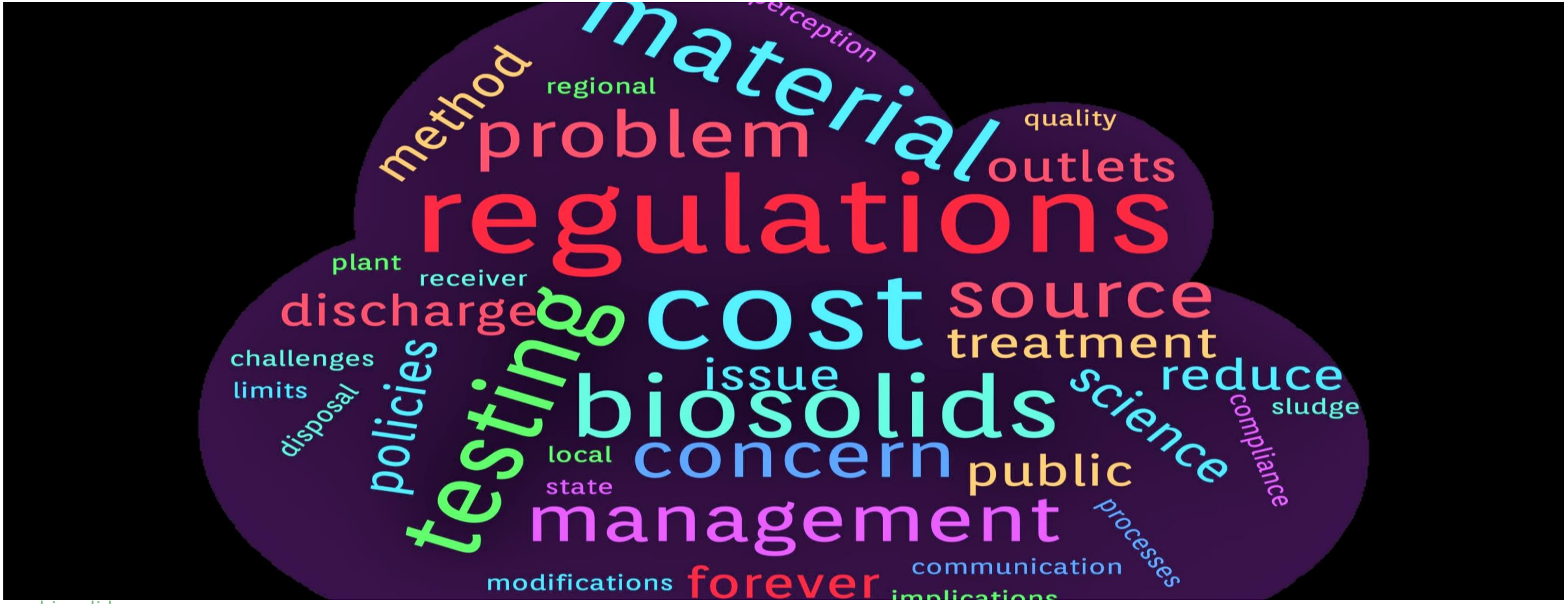
Brown AND Caldwell

PFAS Cost Impacts on Utilities and Biosolids Management



- Average biosolids management cost increased by 37%
- Beneficial reuse programs experience the most significant cost impacts due to PFAS
- 29 entities surveyed; 9 detailed case studies
- Chapter on emerging technologies
- Available on WEF, NACWA, and NEBRA websites https://www.nebiosolids.org/pfas-biosolids

Cost Study
Qualitative Results on PFAS Challenges

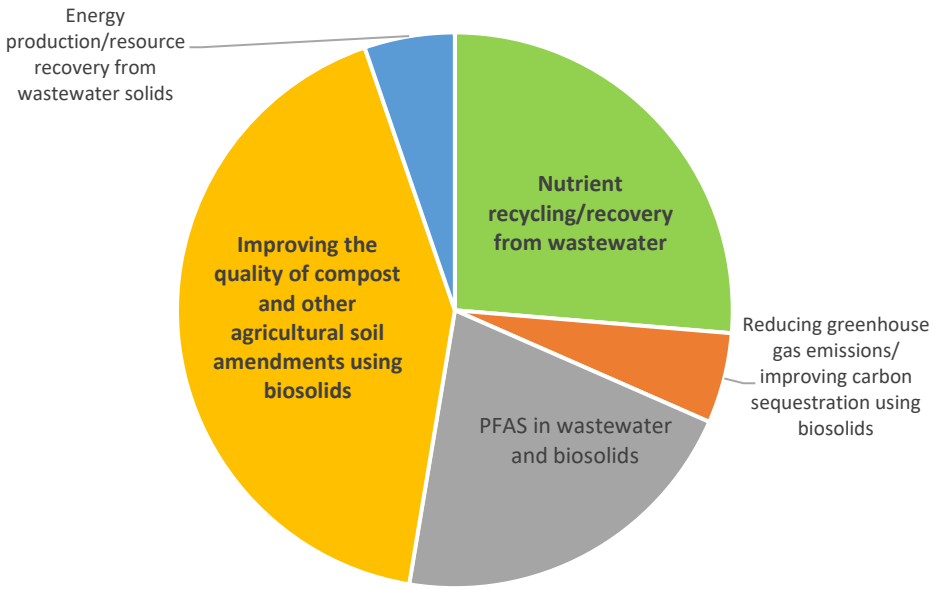


Member Research Interests and Other Initiatives

- PFAS fate & transport modeling for Maine soils (Stone Environmental)
- Webinars on innovative solids handling solutions for PFAS
- NW Biosolids: GHG Calculator https://bggc.nwbiosolids.org/
- CASA: restoring fire-ravaged land with biosolids https://casaweb.org/renewable-resources/biosolids/
- Carbon sequestration in soils with biosolids

Research Topic of Most Interest to NEBRA Members

10/29/20 survey



Thank You for your Attention!

Questions?

Contact:
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(603) 323-7654
http://www.nebiosolids.org

USDA NIFA Multistate Research Project
W4170- Beneficial Use of Residuals to Improve Soil Health and Protect Public, and Ecosystem Health

EPA Virtual Biosolids Meeting
December 8, 2020

Maria Silveira –Professor of Soil and Water Science, Univ. of Florida
Nicholas Basta – Professor of Soil and Environmental Science, Ohio State Univ.

Multistate Research Project

The Land-Grant universities were established with passage of the Morrill Act in 1862

Research focus on agricultural and mechanical research but land-grant institutions now address many academic fields (aquatic, urban, space, and sustainable energy research)

The Hatch Act of 1887 – Multistate Research Fund - provided the framework for funding agricultural research at land-grant institutions. Led to establishment of State Agricultural Experiment Stations (SAES) associated with 1862 Institutions

- Research focuses on a specific and important problem of concern to **more than one state**
- Collaborative **team effort** in which the scientists are mutually responsible for designing and conducting the research, and accomplishing the objectives
- **Multiple disciplines** participate in the research

W170 Regional Project Contribution to Biosolids Research

Timeline:

- **Early 1970's**: a biosolids project started in the North Central Region (NC-118 "Utilization and disposal of municipal, industrial and agricultural processing wastes) to evaluate the agronomic impacts of land applying biosolids

- **1972**: Western Region Project W-124 "Soil as a waste treatment system" focused on similar objectives

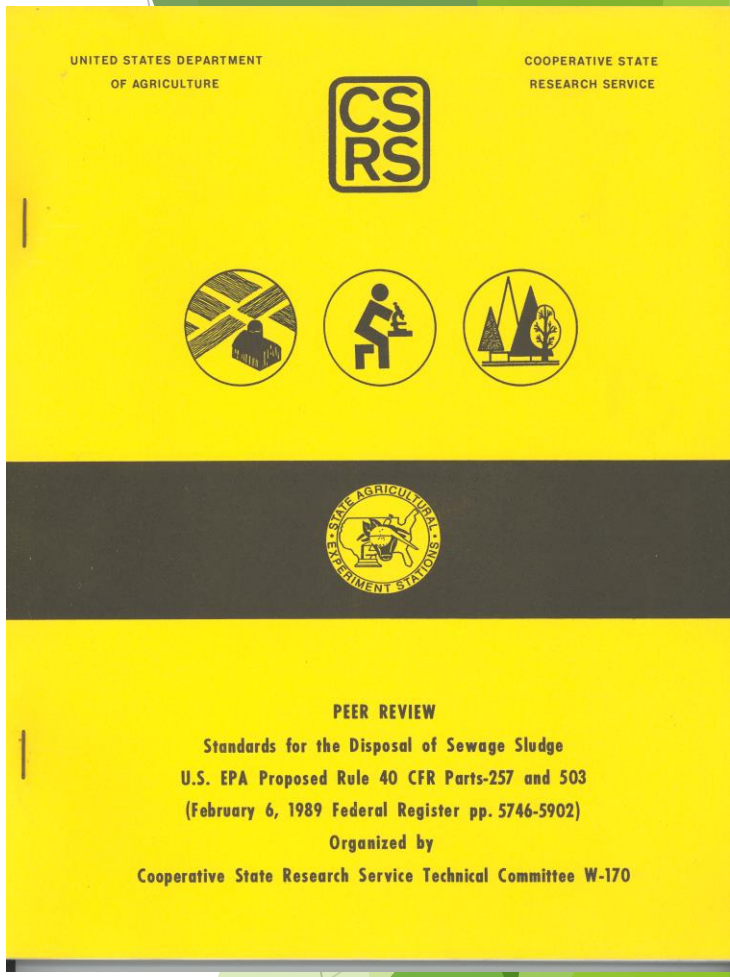
- **1977**: the NC-118 and W-124 projects reorganized as W-124 "Optimum utilization of sewage sludge on land"

- **1985**: the project it was renewed as W-170 "Chemistry and bioavailability of waste constituents in soils"

  - A key study by this group was the regional experiment with Chicago biosolids that was replicated at several locations in the U.S.
  - **W170 provided research data and risk assessment support to develop risk based guidelines (Tables 2, 3, 4) in Part 503 1993 rule**

W-170 Peer Review of the 503 Risk Assessment and Draft Rules

- A group of EPA, W-170 scientists, and other specialists engaged in revision of the technical basis for the 503 rule
- The focus of the review was the data sets and mathematical models used to evaluate exposure pathways, most exposed individuals, and health and environmental effects
- The revised numbers were then submitted to the rule writers for their consideration
- The final rule was published on February 19, 1993



W170 Regional Project Contribution to Biosolids Research

Timeline:

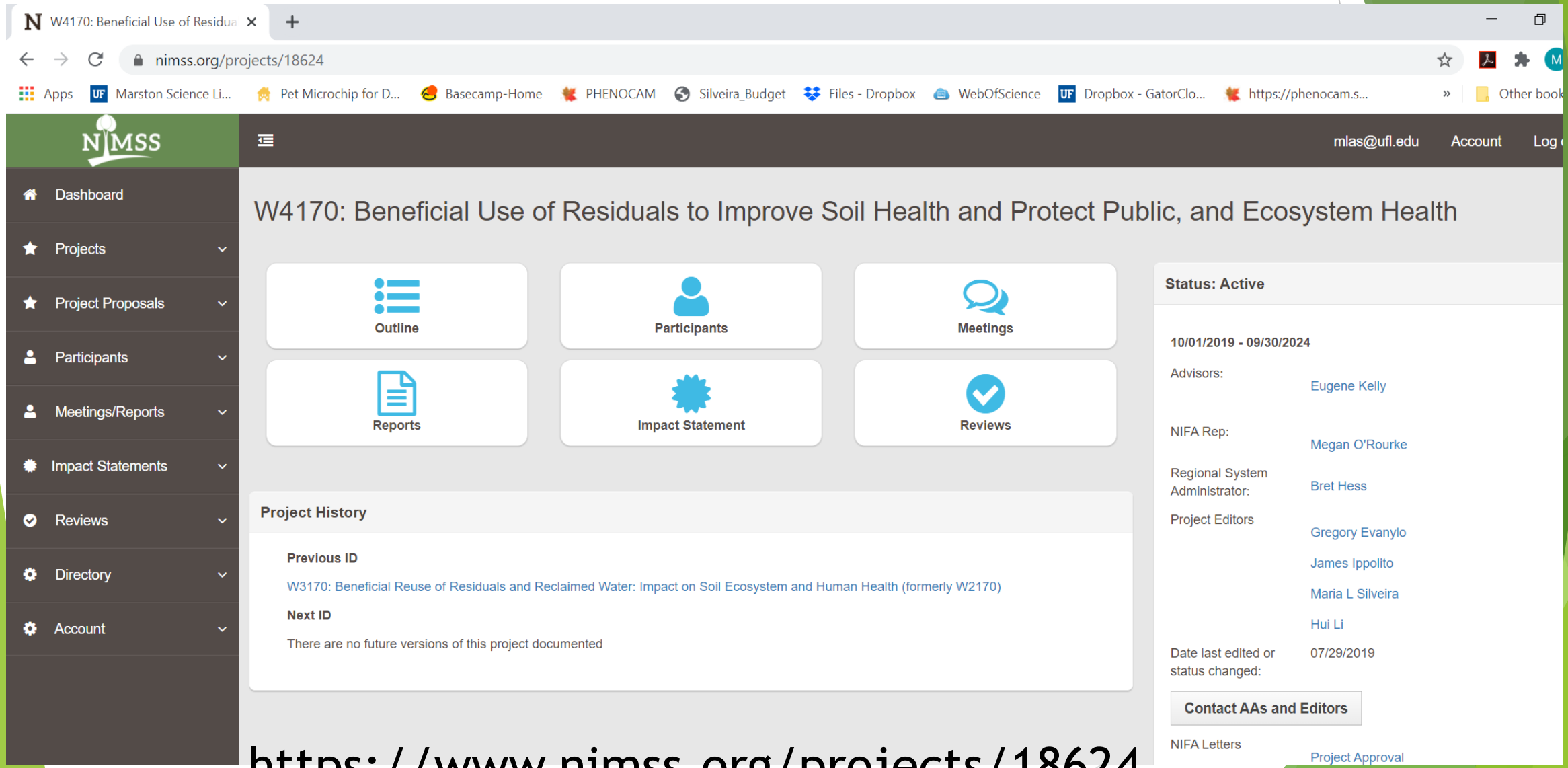
- **1985-1999**: W-170 “Chemistry and bioavailability of waste constituents in soils”. Renamed in 2004 (W-1170 “Chemistry, bioavailability, and toxicity of constituents in residuals and residual-treated soils”
- **2009**: W-2170 “Soil-based use of residuals, wastewater and reclaimed water”
- **2014**: W-3170 “Beneficial reuse of residuals and reclaimed water: Impact on soil ecosystem and human health”
- **2019**: **W-4170 “Beneficial Use of Residuals to Improve Soil Health and Protect Public, and Ecosystem Health”**

W4170 Beneficial Use of Residuals to Improve Soil Health and Protect Public, and Ecosystem Health

- 50+ scientists from 30 states with extensive history on biosolids research
- USEPA Office of Water, Office of Research and Development
- USDA, ARS
- Biosolids Regional Groups (NW, NEBRA, CASA, MWRD, Mid Atlantic)
- Other biosolids stakeholders, industry representatives
- Research and extension activities to scientific community, **federal, state, regional, and local agencies, community and stakeholders**

Diverse expertise with national and international recognition

W4170 Beneficial Use of Residuals to Improve Soil Health and Protect Public, and Ecosystem Health



https://www.nimss.org/projects/18624

Participant	Instituition	Participant	Instituition
Badgley, Brian D	Virginia Tech Univ.	Kumar, Kuldip	MWRD-Chicago
Basta, Nicholas T.	Ohio State Univ	Kuo-Dahab, Camilla	University of Massachusetts
Batjiiaka, Ryan	San Francisco Public Utilities Commission	Lee, Linda	Indiana - Purdue University
Borch, Thomas	Colorado State University	Li, Hui	Michigan State University
Brose, Dominic	Metropolitan Water Reclamation District of Greater Chicago	McLain, Jean	Univ. of Arizona
Brown, Sally	University of Washington	McPhillips, Lauren	Pennsylvania State Univ.
D'Angelo, Elisa M	University of Kentucky	Meregillano, Tom	Orange County Sanitation District
Daniels, W. Lee	Virginia Tech Univ.	Moss, Lynne	Black & Veatch Inc.
Dunbar, James	Lystek International Limited USA Operations	Murphy, Cheryl	Michigan State University
Elliottt, Herschel	Pennsylvania State Univ.	Norton, Urszula	University of Wyoming
Evanylo, Gregory	Virginia Tech Univ.	Pepper, Ian	University of Arizona
Gan, Jay	University of California, Riverside	Preisendanz, Heather	Pennsylvania State Univ.
Gentry, Terry	Texas AgriLife Research	Raj, Cibin	Pennsylvania State Univ.
Gerba, Chuck	Arizona - University of Arizona	Rock, Channah	University of Arizona
Gray, Andrew	California -Riverside : University of California, Riverside	Roseberg, Richard	Oregon State University
Hawkins, Shawn	University of Tennessee	Rosen, Carl	University of Minnesota
Hettiarachchi, Gang	Kansas State University	Seyfferth, Angelia L	University of Delaware
Huang, Qingguo	University of Georgia	Shannon, Robert	Pennsylvania State Univ.
Hue, N.V.	University of Hawaii	Silveira, Maria L	Univ. of Florida
Ippolito, James	Colorado State University	Watson, John E	Pennsylvania State Univ.
Iqbal, Javed	Univ. of Nebraska	Xia, Kang	Virginia Tech Univ.
Judy, Jonathan	Univ. of Florida	Xing, baoshan	University of Massachusetts
Kaiser, Michael	Univ. of Nebraska	Ying, Samantha C	University of California, Riverside
Kester, Greg	California Association of Sanitation Agencies	Zhang, Hailin	Oklahoma State University

W4170 Research Focus

Objective 1. Evaluate the short- and long-term chemistry and bioavailability of **emerging contaminants** (PFAS, microplastics, etc), pharmaceuticals and personal care products (PPCPs), persistent organic contaminants, and pathogens in residuals, reclaimed water, and amended soils in order to assess the environmental and human health risk-based effects of their application at a watershed scale.

- Chemistry, bioavailability, fate, and transport of CECs/PPCPs: carbamazepine, estrogens, sulfamethoxazole, trimethoprim, ofloxacin, ciprofloxacin and azithromycin, caffeine, etc
- Antibiotic resistant microorganisms
- Perfluorochemicals (PFAS)
- Engineered nano-particles (ENP)

Research for this objective was conducted by members from PA, WA, IN, MA, FL, VA, GA, MI, and KY

W4170 Research Focus

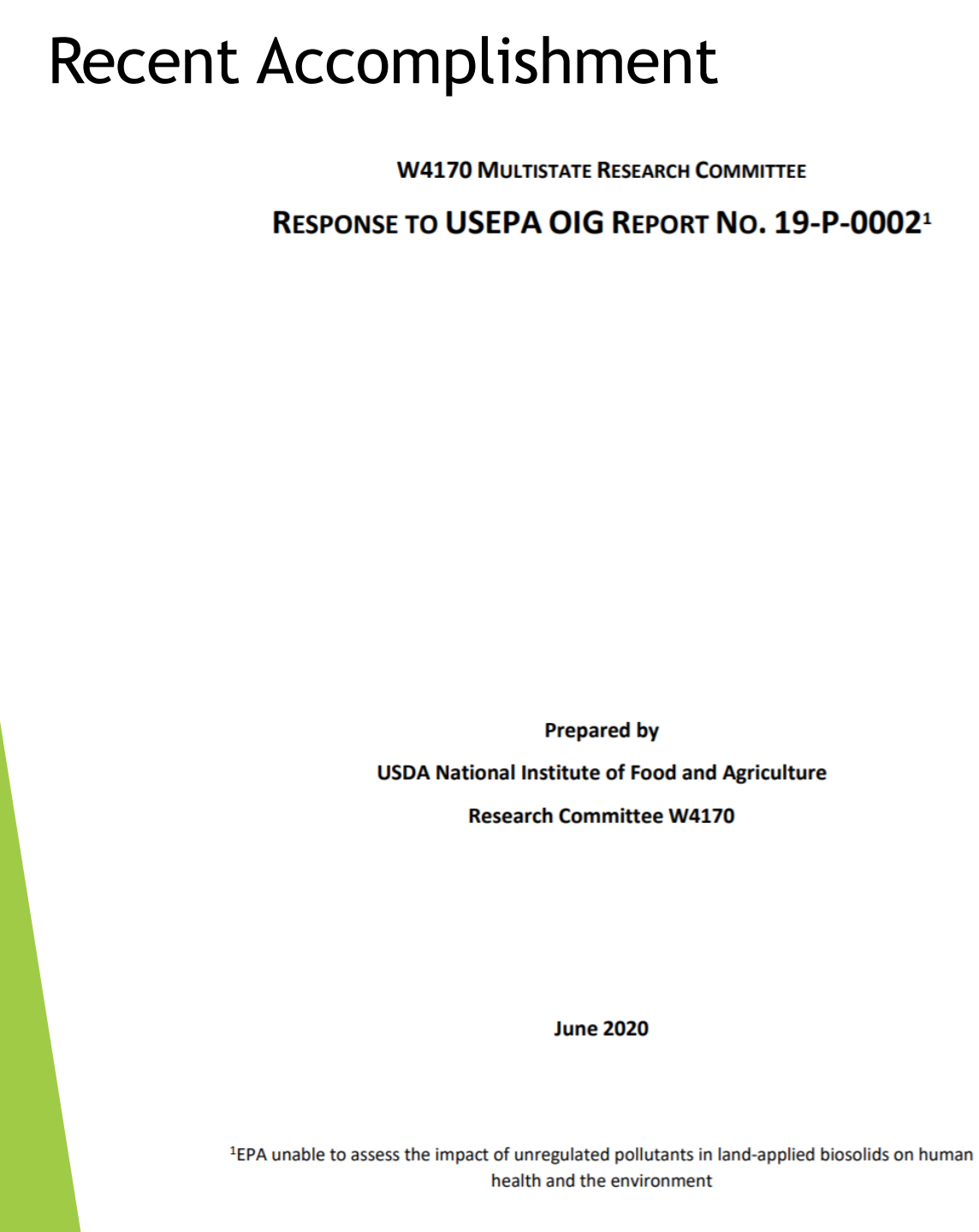
Objective 2. Evaluate the uses and associated **environmental benefits** for residuals and wastewaters in various ecosystems (e.g., agricultural, urban, recreational, forest, rangeland, mine-impacted, disturbed, degraded) with respect to changes in soil physical, chemical, biological, nutrient, and trace/heavy metals with respect to soil quality/soil health

- Assessment of benefits in agriculture and urban: food production, soil health, etc
- Greenhouse gas balance, soil carbon
- Impacts on water quality
- Mined and disturbed lands mitigation

Research on this topic was conducted by members from PA, HA, CO, OH, WA, FL, MN, VA, GA, NE and KS

Recent Accomplishment

On November 15, 2018 the USEPA Office of Inspector General (OIG) published "EPA Unable to Assess the Impact of Hundreds of Unregulated Pollutants in Land-Applied Biosolids on Human Health and the Environment," Report No. 19-P-0002 (USEPA, 2018). The OIG report alleged that "…[EPA] lacked the data or risk assessment tools needed to make a determination on the safety of 352 pollutants found in biosolids…[including] 61 designated as acutely hazardous, hazardous or priority pollutants in other programs."



W4170 MULTISTATE RESEARCH COMMITTEE

RESPONSE TO USEPA OIG REPORT NO. 19-P-0002[1]

Prepared by

USDA National Institute of Food and Agriculture

Research Committee W4170

June 2020

[1]EPA unable to assess the impact of unregulated pollutants in land-applied biosolids on human health and the environment

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Alyssa Zearley, Research Associate
School of Environment and Natural Resources, Ohio State University, Columbus, OH

https://www.nimss.org/system/ProjectAttachment/files/000/000/502/original/W4170%20Response%20to%20OIG%20Report%20July%2023%202020%20final.pdf

Response to OIG Report

The response from USEPA Office of Water, which has regulatory oversight of the national biosolids program, in Appendix D stated "We are concerned about how the science is presented in the OIG report. It is biased and raises alarm...and is taken out of context"

Concern from USEPA Office of Water and widespread concern from practitioners led to the creation of this review and response

The objective was to provide a science-based review of chemicals of concern highlighted in the OIG report

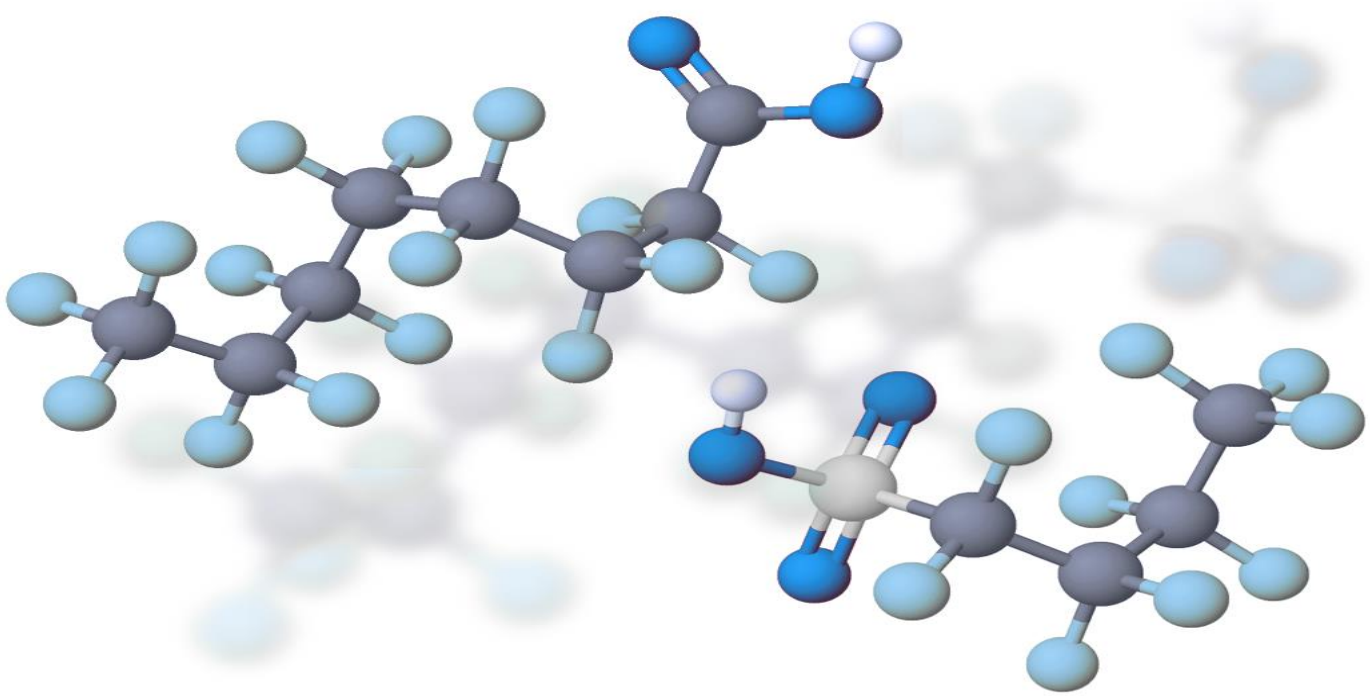
- Document shows that the OIG report did not consider the concentration of chemicals found in the biosolids. Often, the bulk of human exposure to these chemicals is from domestic use of consumer goods and **only trace amounts are found in biosolids**

- **"Sufficient data and research are available to conclude that current biosolids regulations are protective of human health and the environment**. Of course, as with any regulation intended to protect public health and the environment, they must always be dynamic and evolve with updated science. That fact does not imply that they are not protective while research is ongoing."

THANK YOU!

Maria Silveira
Email: mlas@ufl.edu

EPA's PFOA & PFOS Biosolids Risk Assessment



EPA National Biosolids Meeting 2020

Elyssa Arnold
Biosolids Program
U.S. EPA Office of Water

Outline

- What is Risk Assessment?
- Why do we do Risk Assessment for Biosolids?
- EPA's PFOA & PFOS Biosolids Risk Assessment
    - Summary of the November Problem Formulation Meetings
    - Next Steps

WHAT IS RISK ASSESSMENT?

What is Risk?

- EPA Definition: **Risk** is the chance of harmful effects to human health or to ecological systems resulting from exposure to an environmental stressor.

- A **stressor** is any physical, chemical, or biological entity that can induce an adverse response. Stressors may adversely affect specific natural resources or entire ecosystems, including plants and animals, as well as the environment with which they interact.

What is Risk Assessment?

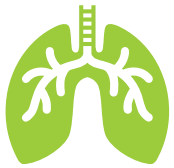
- Risk Assessment is a scientific process.
- EPA uses risk assessment to characterize the nature and magnitude of health risks to humans and ecological receptors from chemical contaminants and other stressors that may be present in the environment.
- At EPA, risk assessment typically falls into one of two areas:
    - Human health risk assessment
    - Ecological risk assessment

What is Risk Assessment?

- Risk depends on the following 3 primary factors:
  - How much of a chemical is present in an environmental medium (*e.g.*, biosolids, soil, water, air).
  - How much contact a person or ecological receptor (*e.g.*, fish, bird) has with the contaminated environmental medium.
  - The inherent toxicity of the chemical (hazard).

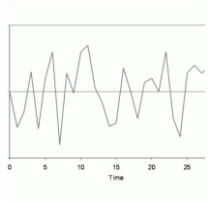
Risk = Exposure * Toxicity

Risk Assessment Terminology



Risk

The chance of harmful effects to human health or to ecological systems.



Variability

The range of toxic response or exposure.

Uncertainty

Our inability to know for sure, often due to incomplete data.

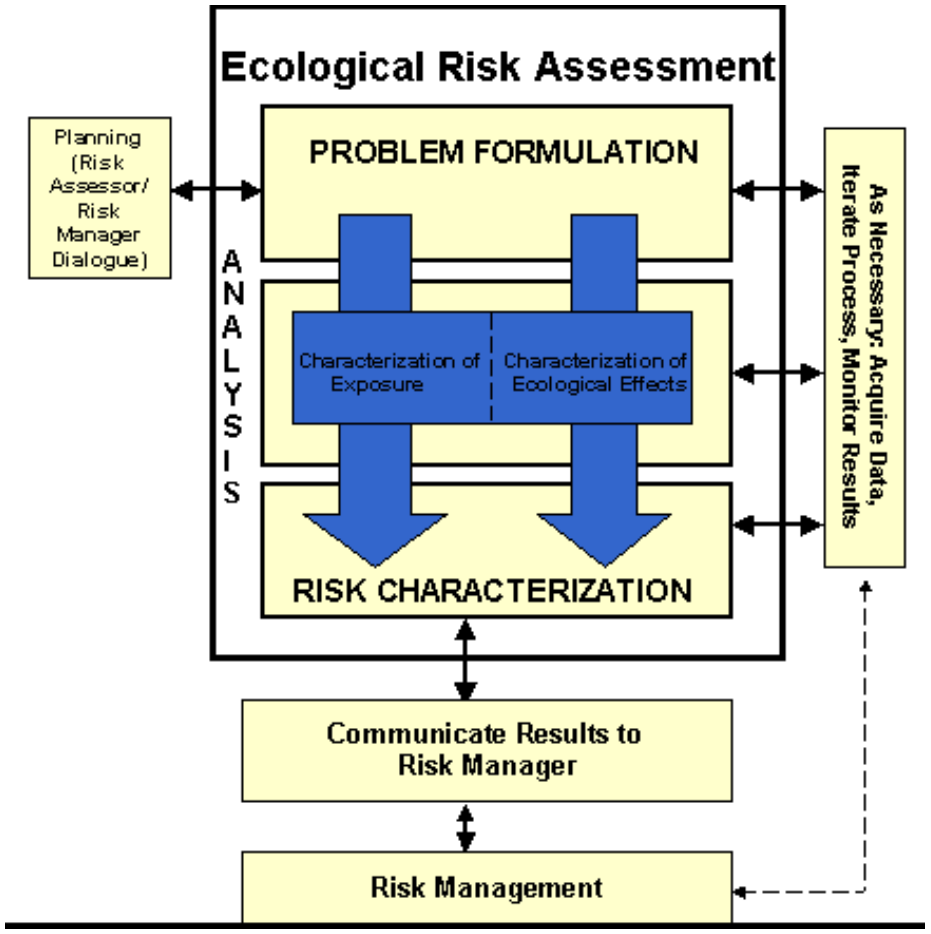
Types of Risk Assessment

- **Deterministic** risk assessment
  - A technique that uses point values and simple models to produce a point estimate of exposure (either high-end or typical exposure). Deterministic assessments are simple to carry out, often use readily available data, and produce results that are straightforward to interpret.
- **Probabilistic** risk assessment
  - A technique that utilizes the entire range of input data to develop a probability distribution of exposure or risk rather than a single point value. The input data can be measured values and/or estimated distributions.

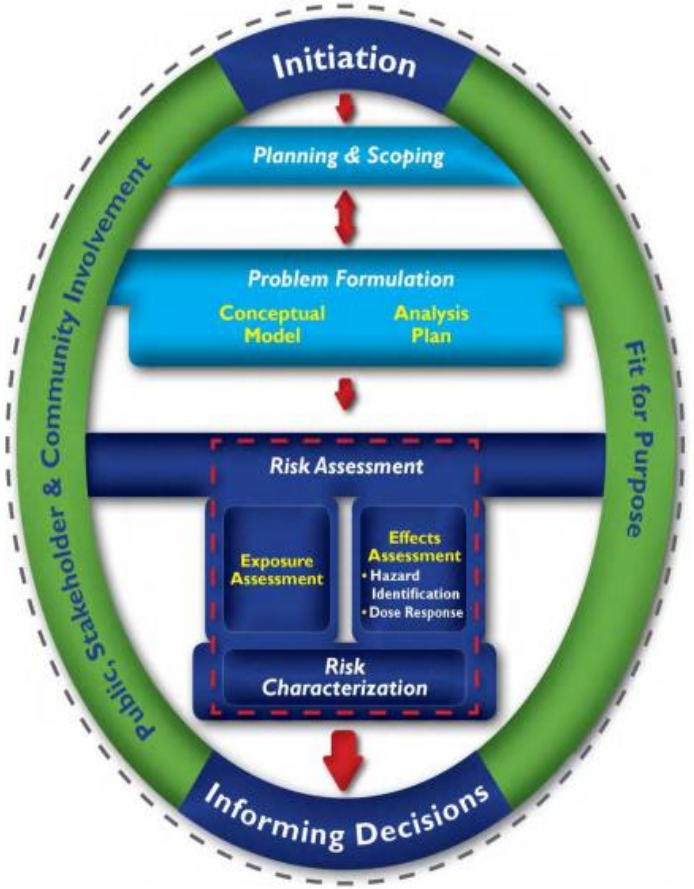
Risk Assessment Framework

- Problem Formulation / Scoping
- Exposure
- Effects / Toxicity
- Risk Characterization
- Risk Management and Communication

Risk Assessment Framework



Human Health Risk Assessment



WHY WE DO RISK ASSESSMENT FOR BIOSOLIDS

Why do Risk Assessment for Biosolids?

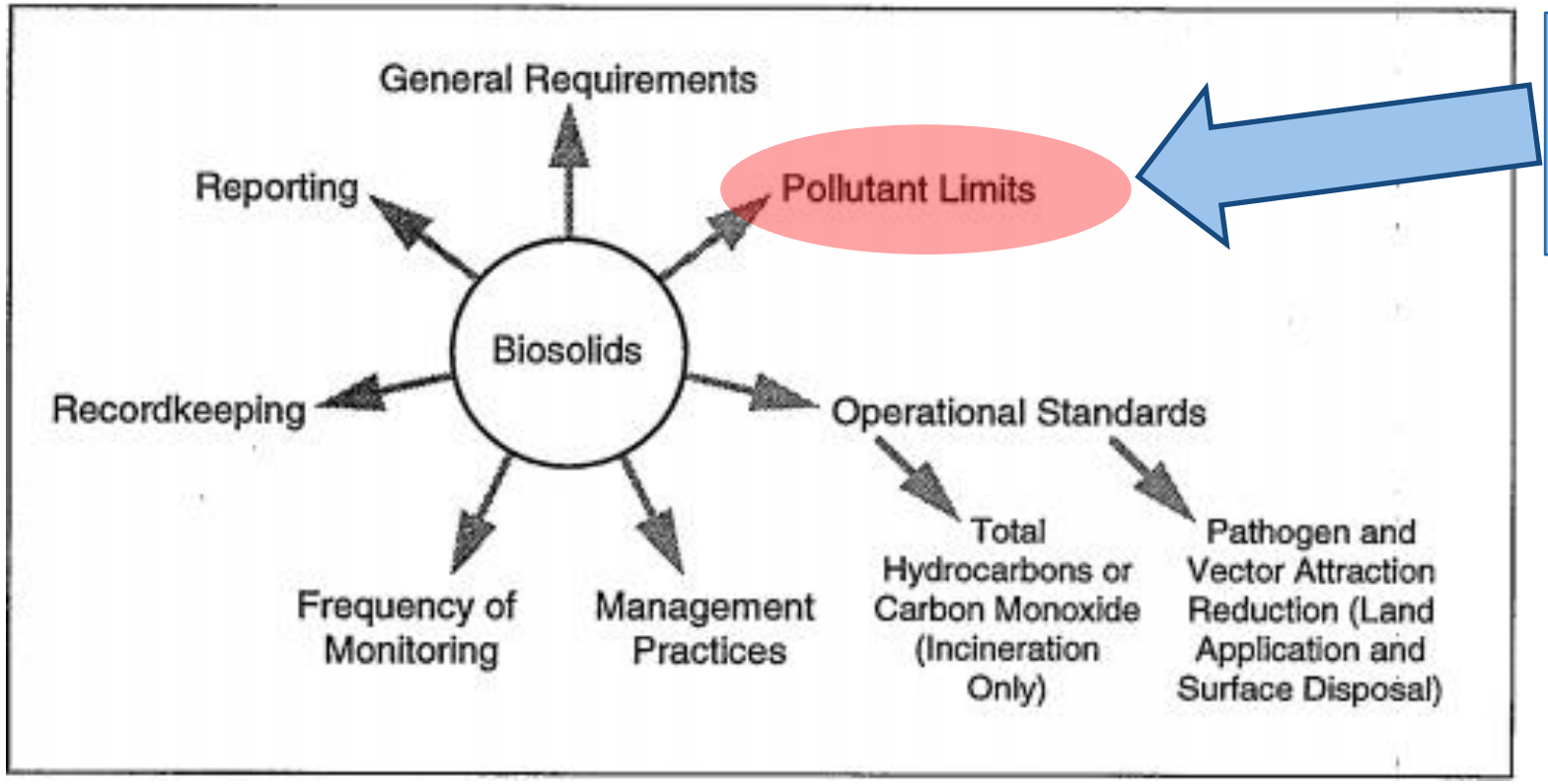
Clean Water Act, Section 405 requires EPA:

- To establish numeric limits and management practices that protect public health and the environment from the effects of chemical and microbial pollutants during the use or disposal of sewage sludge.
- To review biosolids (sewage sludge) regulations every two years to identify additional toxic pollutants that occur in sewage sludge and set regulations for those pollutants if sufficient scientific evidence shows that they may harm human health or the environment.

The Biosolids Rule: 40 CFR Part 503

- Rule published in 1993 to protect human health and the environment from reasonably anticipated adverse effects of pollutants that may be present in biosolids that are used or disposed.
- Based on the results of risk assessments that were conducted to identify risks associated with the use or disposal of biosolids (land application, surface disposal or incineration).
- Informed by National Academy of Sciences 1983 procedures for risk assessment in the federal government.
- Analyzed risks to human, animals, plants, and soil organisms from exposure to pollutants in biosolids through 14 different exposure pathways.

40 CFR Part 503



Pollutant limits in 40 CFR part 503 are supported by risk assessment

EPA'S PFOA & PFOS BIOSOLIDS RISK ASSESSMENT

Biosolids Risk Assessment in the PFAS Action Plan

- Activity: Scoping biosolids risk assessment for PFOA/PFOS
- Purpose: EPA is in the early scoping stages of risk assessment for PFOA and PFOS in biosolids to better understand the implications of PFOA and PFOS in biosolids to determine if there are any potential risks.
- Timeframe: 2020

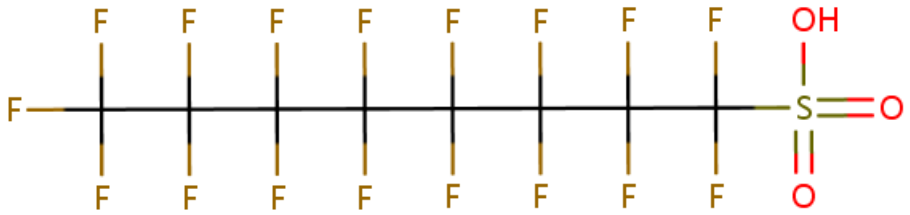
https://www.epa.gov/pfas/epas-pfas-action-plan

Problem Formulation

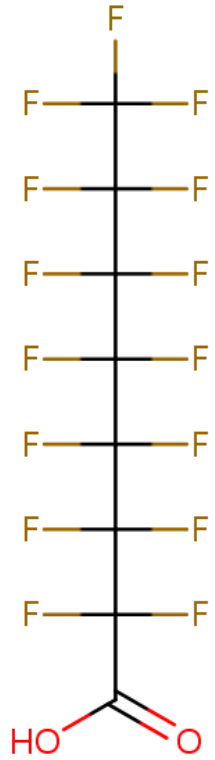
Problem Formulation is the part of the risk assessment that:

- Articulates the purpose for the assessment
- Defines the problem
    - Chemical sources and occurrence
    - Fate and transport in the environment
    - Toxicity endpoints
- Determines the conceptual models (sources and routes of exposure) for assessing adverse effects to human health and ecological receptors (*e.g.*, birds, fish)
- Describes the analysis plan, documenting the approach for acquiring reliable data and the models and tools to be used in the analysis
- **Includes engagement with states and tribes, risk managers, scientists, and members of the biosolids community to discuss foreseeable science and implementation issues.**

PFOS and PFOA



Perfluorooctanesulfonic Acid (PFOS)
$C_8HF_{17}O_3S$
CASRN: 1763-23-1



Perfluorooctanoic Acid (PFOA)
$C_8HF_{15}O_2$
CASRN: 335-67-1

PFOS and PFOA Sources and Environmental Fate

- PFOS and PFOA are part of a larger group of chemicals called per- and polyfluoroalkyl substances (PFAS).
- PFAS are highly fluorinated aliphatic molecules that have been released to the environment through industrial manufacturing and through use and disposal of PFAS-containing products.
- While many PFASs have been found in biosolids, PFOS and PFOA are among the most abundant and have the largest data sets to support risk assessment.
- PFOS and PFOA do not readily degrade via aerobic or anaerobic processes.
- While PFOS and PFOA have largely been phased out of production in the United States, their resistance to environmental degradation causes a lingering concern for exposure. They can also be formed from precursors in the environment.

Concentrations of PFOA and PFOS in Biosolids

Year Sampled	PFOA (ng/g dry wt)	PFOS (ng/g dry wt)	Reference
2001	12 - 70	308 - 618	Venkatesan, 2013
2004-2007	8 - 68	80 - 219	Sepulvado, 2011
2005	8.3 - 219	8.2 - 110	Loganathan 2007
2005	18 - 241	<10 - 65	Sinclair, 2006
2006	--	81 - 160	Schultz, 2006
2006-2007	18 - 69	31 - 702	Yu, 2009
2007	20 -128	32 - 418	Yoo, 2009
2011	1 - 14	4 - 84	Navarro, 2016
2014	10 - 60	30 - 102	Mills, Dasu (in prep)
2018	1-11	2 – 1,100	EGLE, 2020

Toxicity Endpoints

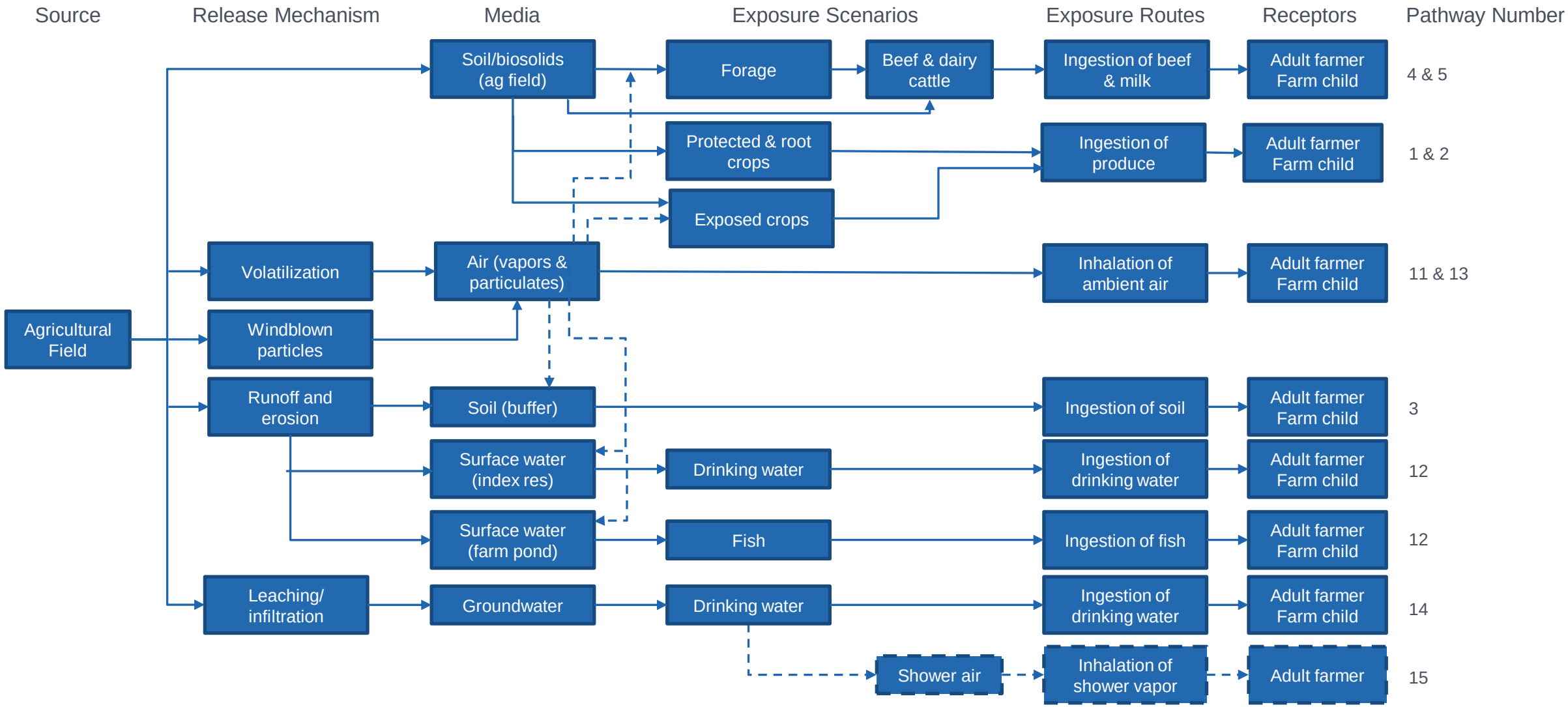
- Human Health - Reference Dose (RfD) and Cancer Slope Factor (CSF)
  - Human health effects data support both ambient water criteria for human health and Safe Drinking Water Act regulatory determinations.
  - Health Effects Support Documents (HESDs) for PFOA and PFOS Health Advisories were published in 2016.
  - Ongoing work to evaluate newer published literature.
- Ecological – survival, growth, and reproduction
  - Relevant toxicity studies from peer-reviewed literature were identified through ECOTOX searches (https://cfpub.epa.gov/ecotox/) and reviewed for data quality.
  - Aquatic life and aquatic-dependent wildlife effects data support ambient water criteria for aquatic life and aquatic-dependent wildlife
  - Toxicity endpoints for non-aquatic dependent birds, mammals, terrestrial invertebrates, and terrestrial plants are currently being evaluated by the Biosolids Program

Biosolids Use and Disposal Pathways

1. Land Application
2. Surface Disposal
3. Incineration

40 CFR Part 503.1: *"(a) Purpose. (1) This part establishes standards, which consist of general requirements, pollutant limits, management practices, and operational standards, for the final use or disposal of sewage sludge generated during the treatment of domestic sewage in a treatment works. Standards are included in this part for sewage sludge applied to the land, placed on a surface disposal site, or fired in a sewage sludge incinerator."*

Conceptual Model for the Agricultural Land Application Scenario: Human Exposures



Dashed arrows and box outlines indicate a pathway or route that has been added since 1993.

Modeling Approach

- Currently under development for presentation to the Science Advisory Board in 2021
    - Biosolids Screening Tool for deterministic, screening-level assessment
    - Probabilistic Risk Assessment framework for chemicals that fail at the screening level
- Modeling for biosolids will be based on publicly available, previously peer-reviewed models for leaching, runoff, erosion, air dispersal, and plant uptake to the greatest extent possible
- Approach for PFAS will be consistent, to the extent appropriate, with all other chemical risk assessment for biosolids

November PF Meeting Input

- Data sharing – thank you!
- Methods – cost and availability
- Conceptual models
- Occupational exposure
- Precursors
- Big picture:
    - Impacts on biosolids management
    - Pre-treatment/source reduction
    - Risks from biosolids relative to other exposure sources (*e.g.*, household)

Next Steps

- Problem Formulation
    - Meetings completed December 2020
    - Draft document Spring 2021
- Science Advisory Board review of modeling approach – Spring 2021
- Risk Assessment – estimated completion in 2022 for internal review, followed by public comment
- If EPA determines that PFOA or PFOS in biosolids may adversely affect public health or the environment, risk managers will consider options for numerical limitations and best management practices for these compounds (as there are with current Part 503 pollutant limits).
- If regulatory limits are advised, they will go through a standard regulatory process including inter-Agency and OMB review as well as public comment.

Thank you

Elyssa Arnold

Risk Assessment Lead, EPA Biosolids Program

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202-566-1189

MICHIGAN DEPARTMENT OF
ENVIRONMENT, GREAT LAKES, AND ENERGY

Michigan PFAS & Biosolids Update
State Perspectives

Mike Person
Michigan Biosolids Program
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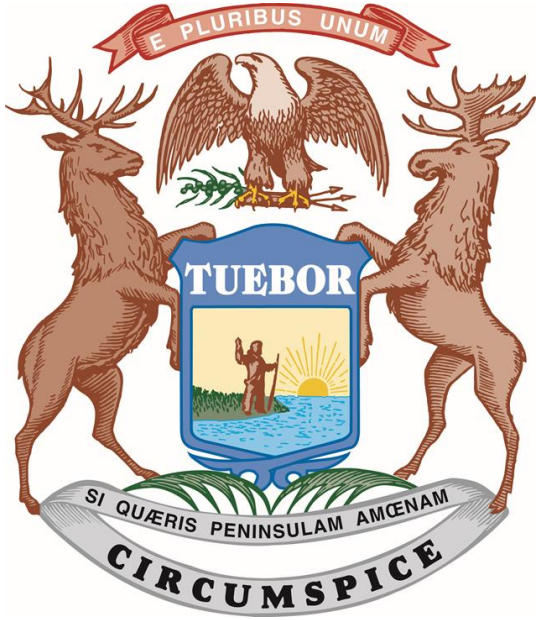
Michigan PFAS Action Response Team (MPART)



- Unique multi-agency approach
- Leads coordination and cooperation among all levels of government
- Directs implementation of state's action strategy
- WRD -Member of Great Lakes PFAS Task Force

Biosolids

Plans to amend the biosolids workgroup to include other beneficial use programs

MPART Biosolids Workgroup

EGLE WRD, RRD, MDARD, DHHS

- **Mission:**
  - *Expand knowledge of PFAS and biosolids within wastewater collection and treatment systems to develop guidance to municipal Wastewater Treatment Plants (WWTPs), land application contractors, and farmers/landowners regarding land application of biosolids containing PFAS.*
  - *Establish a durable process to evaluate biosolids land application sites.*
  - *In conjunction with Industrial Pretreatment Program (IPP) Initiative efforts, reach equilibrium in program status that allows the majority of WWTPs to maintain the option to safely land apply biosolids. This is contingent on identifying and controlling sources within wastewater collection systems and on ability to develop guidance above.*

IPP PFAS Initiative

- February 2018 – 95 WWTPs required to screen Industrial Users
  - Evaluate Industrial Users as potential sources of PFAS
  - Sample effluent if sources above screening criteria (12 ppt PFOS)
  - Sample biosolids if PFOS > 50 ppt in effluent
  - Source control/elimination of PFOS from sources
  - Ongoing monitoring of sources & POTW effluent
  - Status reports submitted to EGLE

Additional information on IPP PFAS Initiative:
https://www.michigan.gov/pfasresponse/0,9038,7-365-86510---,00.html

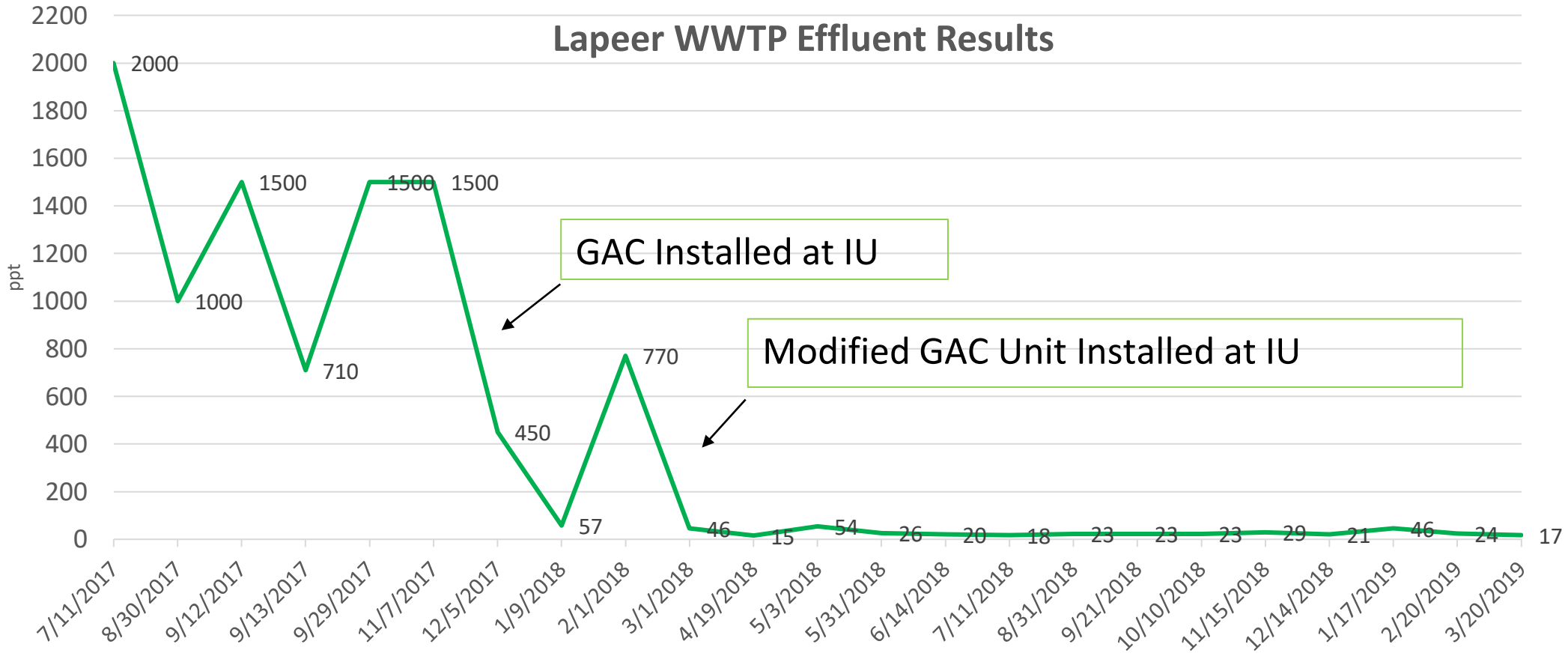
Substantial Reductions in PFOS Concentrations at WWTPs

Municipal WWTP	PFOS, Effluent (ppt, most recent**)	PFOS Reduction in Effluent (highest to most recent)	Actions Taken to Reduce PFOS
Lapeer	17*	99%	Treatment (GAC) at source (1)
Wixom	16*	99%	Treatment (GAC) at source (1)
Ionia	<8.49	98%	Treatment (GAC) at source (1)
Port Huron	18*	99%	Elimination of source PFOS (2)
Howell	5.2	96%	Treatment (GAC/resin) at source (1)
Bronson	10	96%	Treatment (GAC) at source (1)
Kalamazoo	3.09	92%	Treatment (GAC) at sources (2), change water supply
K I Sawyer	9.3	96%	Eliminate leak AFFF, some cleaning
GLWA (Detroit)	9.8	74%	Treatment (GAC) at sources (17)
Belding	9.4	32%	Restricted landfill leachate quantity accepted

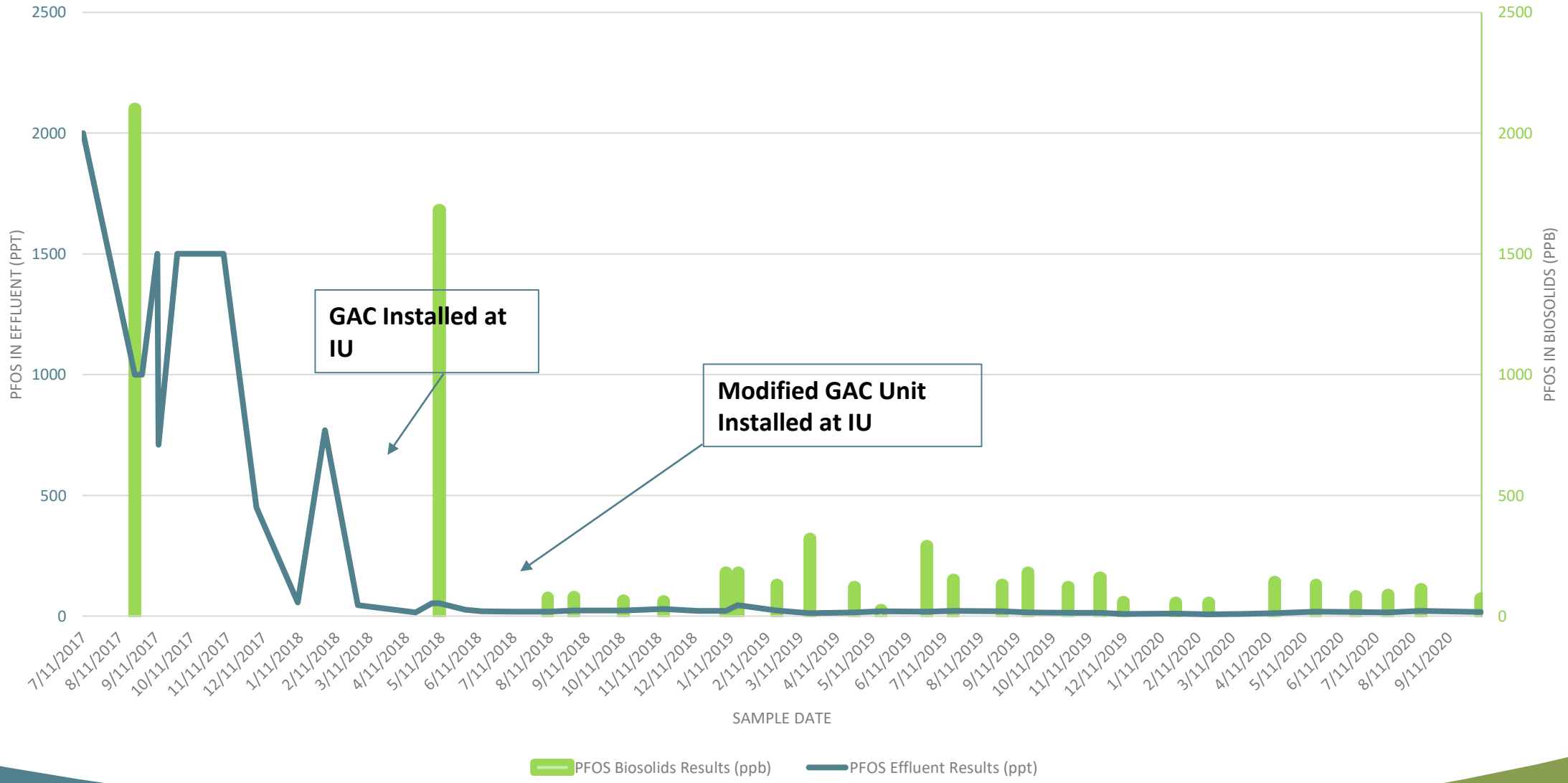
*Greater than Water Quality Standards

**Data received as of November 27, 2020

PFOS Reduction After IU Pretreatment



PFOS Reduction After IU Pretreatment



Source Document

Evaluation and Identification of significant sources of PFOS to WWTPS in Michigan.

www.Michigan.gov/PfasResponse

Expanding upon the IPP initiative

- Non-IPP WWTPs: Landfill Leachate/Septage/ High Strength Waste
- Compliance Strategy Developed:
  - Industrial Direct Discharges
  - Industrial Stormwater Discharges

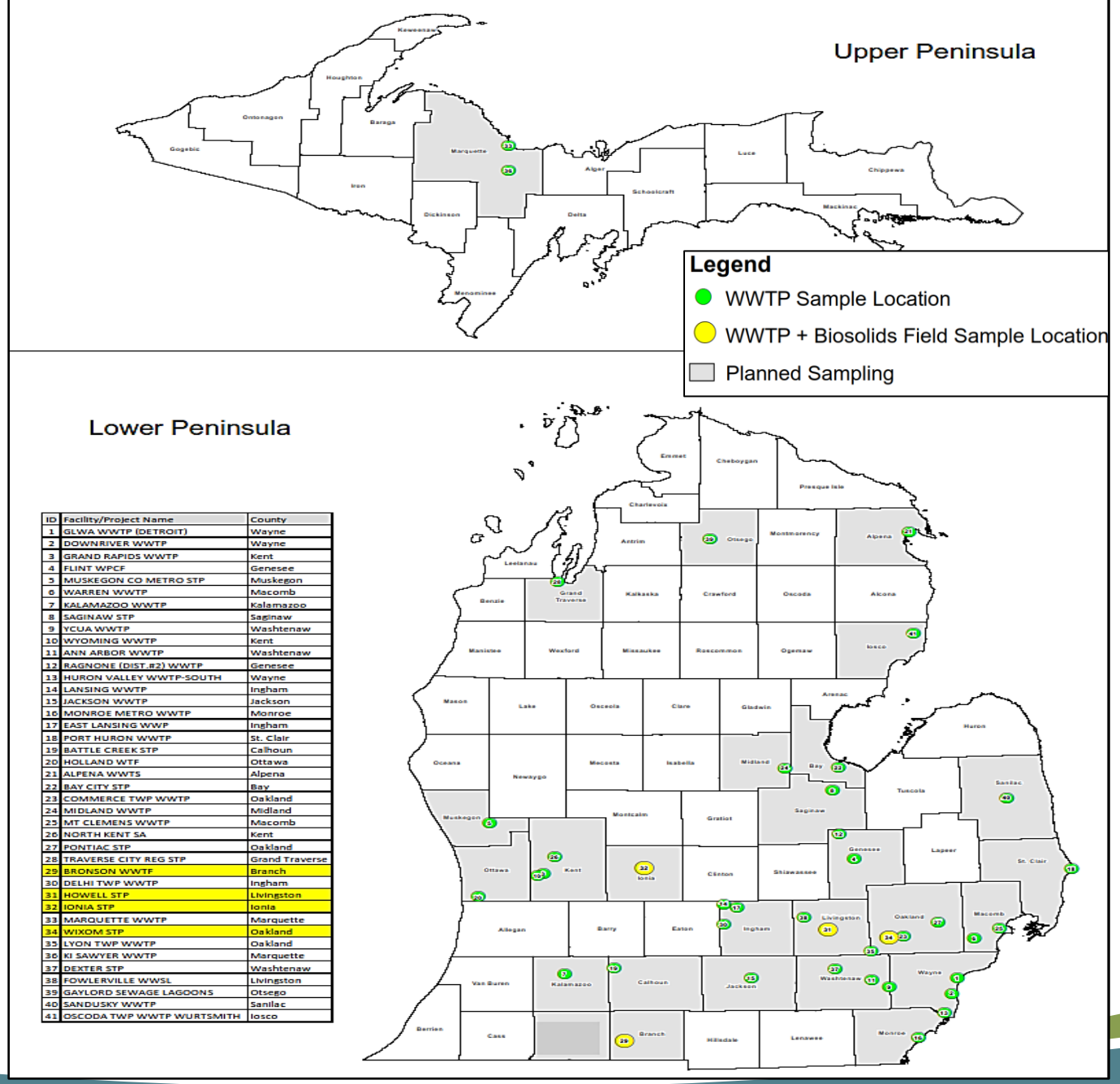
https://www.michigan.gov/documents/pfasresponse/Compliance_Strategy_for_Addressing_PFAS_PFOS-PFOA_from_Industrial_Direct_Discharges_and_Industrial_Storm_Water_Discharges_698878_7.pdf

- Municipal Groundwater Discharges

Statewide Biosolids Study

- Selected /sampled Effluent, Influent, & Biosolids from 42 WWTPs
  - 20 Largest
  - Various treatment processes
  - Some with no industrial users
- Conduct Site Investigations (soil, gw, sw) of Biosolids Land Application Sites
- Evaluate various fate and transport modeling techniques

Statewide Biosolids Study Locations

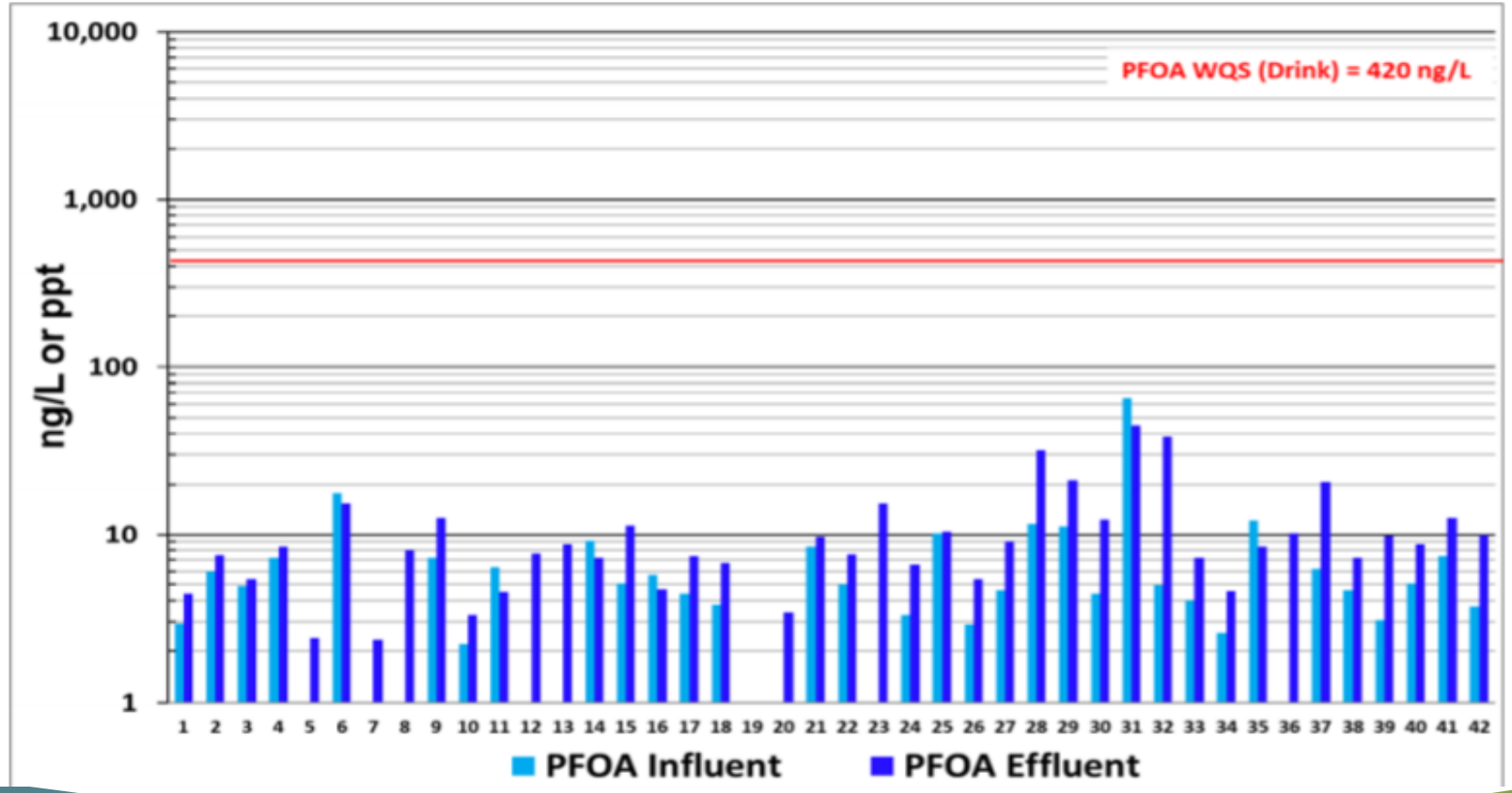


ID	Facility/Project Name	County
1	GLWA WWTP (DETROIT)	Wayne
2	DOWNRIVER WWTP	Wayne
3	GRAND RAPIDS WWTP	Kent
4	FLINT WPCF	Genesee
5	MUSKEGON CO METRO STP	Muskegon
6	WARREN WWTP	Macomb
7	KALAMAZOO WWTP	Kalamazoo
8	SAGINAW STP	Saginaw
9	YCUA WWTP	Washtenaw
10	WYOMING WWTP	Kent
11	ANN ARBOR WWTP	Washtenaw
12	RAGNONE (DIST.#2) WWTP	Genesee
13	HURON VALLEY WWTP-SOUTH	Wayne
14	LANSING WWTP	Ingham
15	JACKSON WWTP	Jackson
16	MONROE METRO WWTP	Monroe
17	EAST LANSING WWP	Ingham
18	PORT HURON WWTP	St. Clair
19	BATTLE CREEK STP	Calhoun
20	HOLLAND WTF	Ottawa
21	ALPENA WWTS	Alpena
22	BAY CITY STP	Bay
23	COMMERCE TWP WWTP	Oakland
24	MIDLAND WWTP	Midland
25	MT CLEMENS WWTP	Macomb
26	NORTH KENT SA	Kent
27	PONTIAC STP	Oakland
28	TRAVERSE CITY REG STP	Grand Traverse
29	BRONSON WWTF	Branch
30	DELHI TWP WWTP	Ingham
31	HOWELL STP	Livingston
32	IONIA STP	Ionia
33	MARQUETTE WWTP	Marquette
34	WIXOM STP	Oakland
35	LYON TWP WWTP	Oakland
36	KI SAWYER WWTP	Marquette
37	DEXTER STP	Washtenaw
38	FOWLERVILLE WWSL	Livingston
39	GAYLORD SEWAGE LAGOONS	Otsego
40	SANDUSKY WWTP	Sanilac
41	OSCODA TWP WWTP WURTSMITH	Iosco

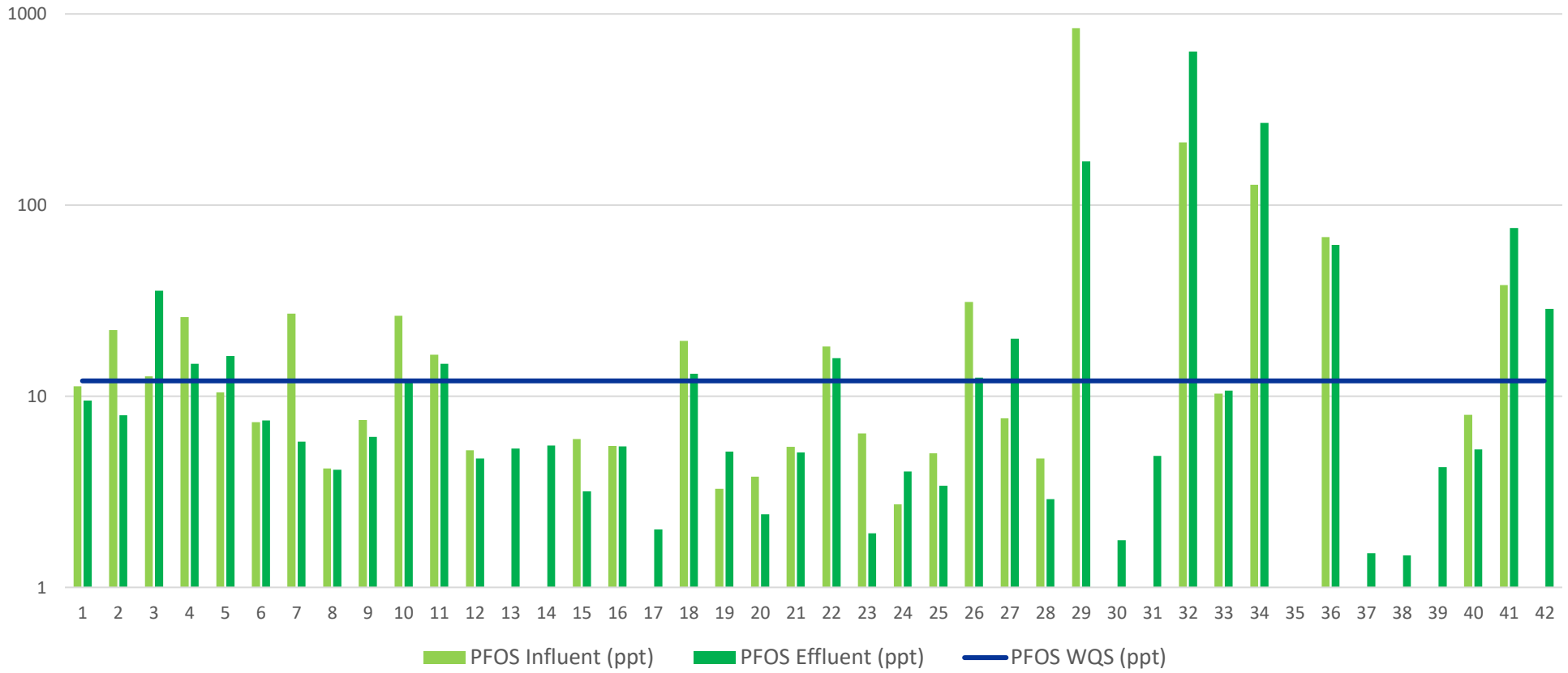
2018 Statewide Study
WWTP PFOA Influent and Effluent Data

Figure 5. PFOA Influent and Effluent Concentrations in WWTPs*

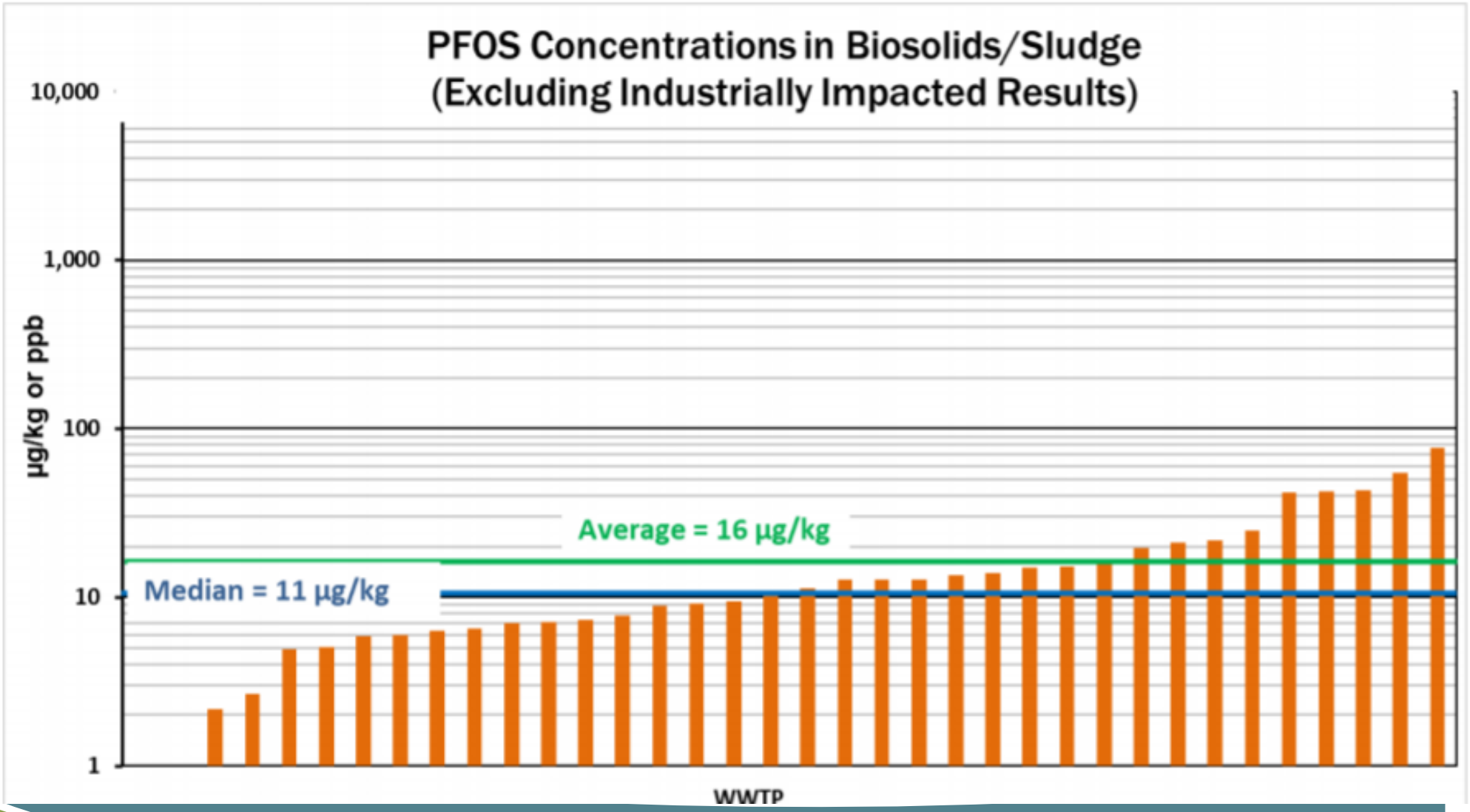
NOTE: The PFOA water quality value depicted in the chart is the most conservative value and only applies to surface waters used as a drinking water source. The PFOA water quality value for surface water not used as a drinking water source is 12,000 ng/L.



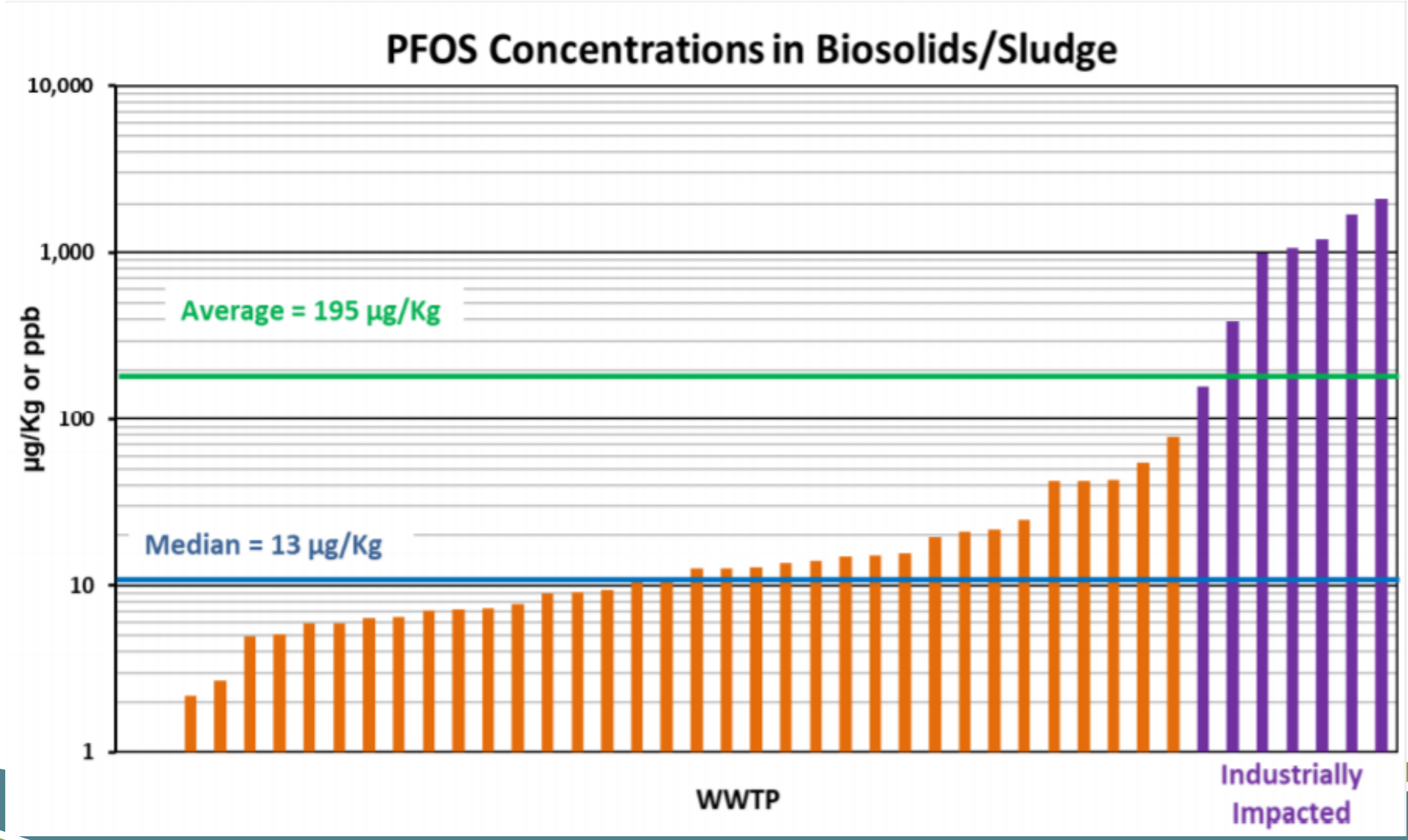
2018 Statewide Study
WWTP PFOS Influent and Effluent Data



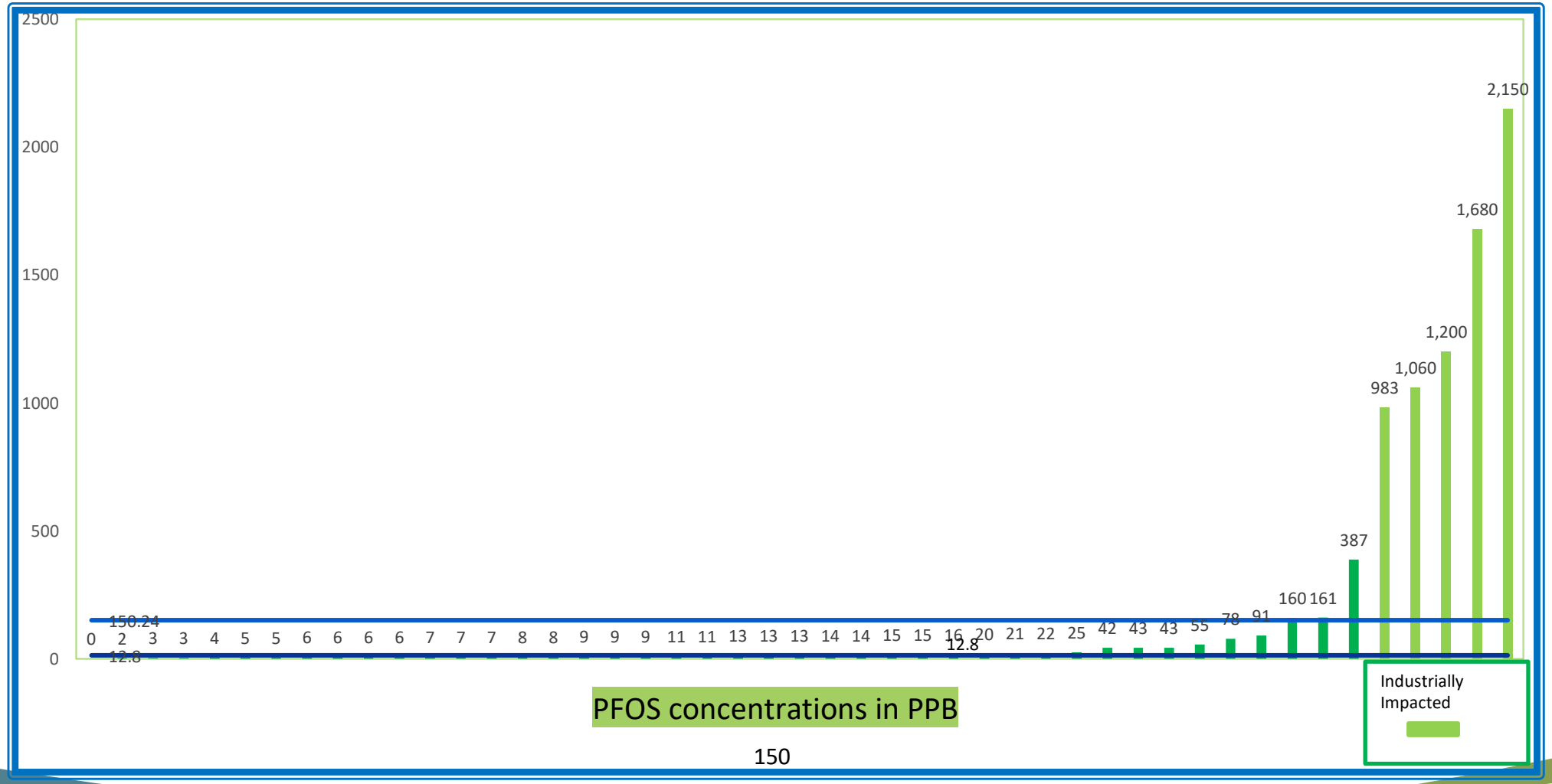
Statewide Study - Sludge/Biosolids PFOS Results



Statewide Study - WWTP Stabilized Sludge/Biosolids PFOS Results



Statewide Study - WWTP Stabilized Sludge/Biosolids PFOS Results



PFAS in Sludge /Biosolids - When is it considered industrially impacted?

No Regulatory Limit - Looking to EPA to lead

- Threshold level of 150 ppb is being used at the point at which biosolids is considered industrially impacted.

- Determination of "industrially impacted" is based on a number of factors including
  - Review of literature and land application studies with high PFAS concentrations (Decatur, Alabama)
  - Results of Statewide Biosolids Study
  - Results of soil /gw sampling of land application sites in Michigan
  - Natural Break Point in results

***This is not a risk-based number. As more information about fate and transport of these chemicals becomes available, including the field study results, this level will be reevaluated as necessary*

EGLE

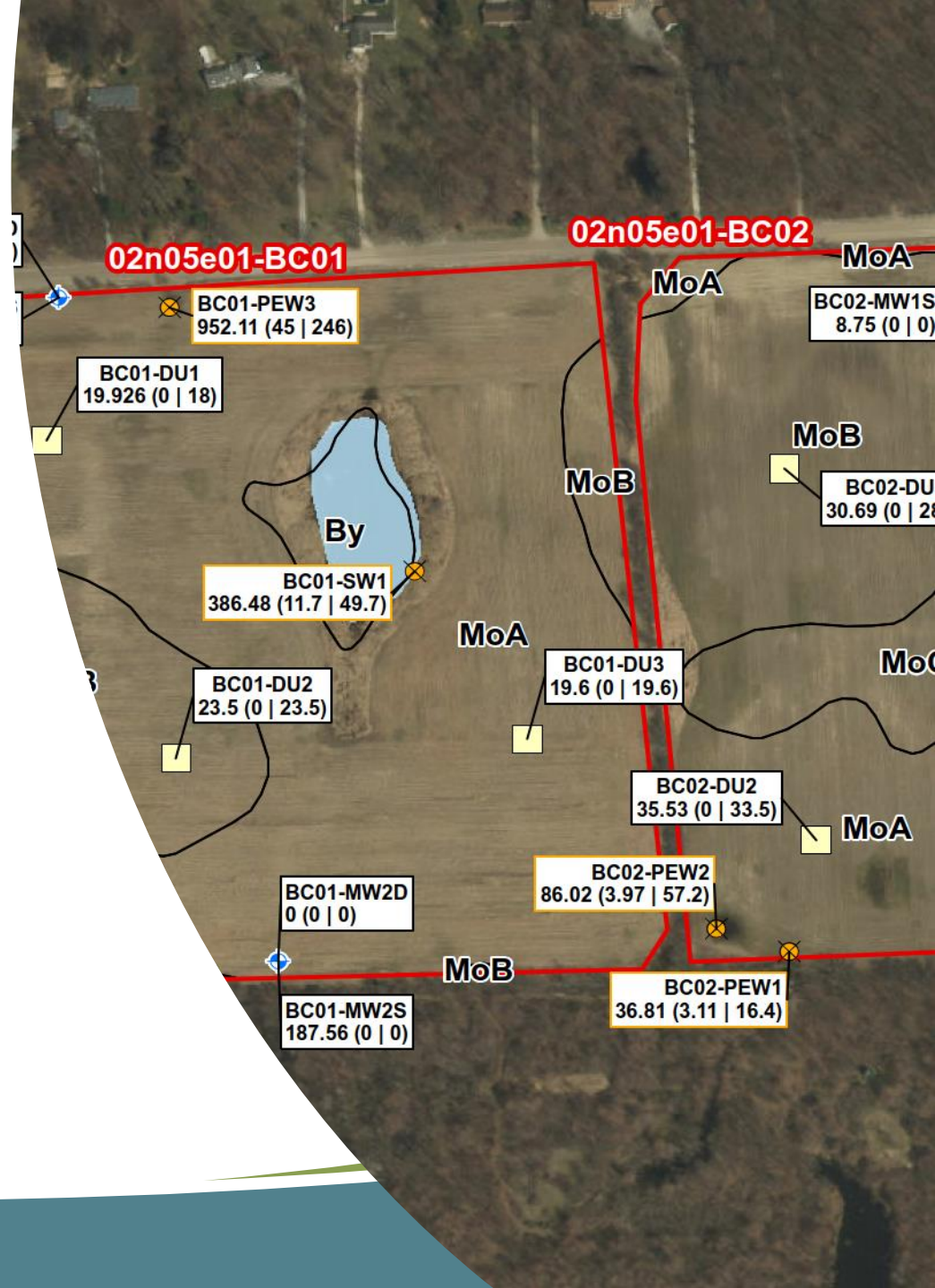
Statewide Biosolids Study

Land Application Field Screening

22 Fields Screened from 8 WWTPS

- 3 WWTPs w/ PFOS > 1000 ppb
- 5 WWTPs w/ PFOS < 100 ppb

- **Sampled: Soils, groundwater, tile drains, swales, ponding/perched waters and surface waters**
- Developed field prioritization process to screen "worst case scenarios" for each facility
- Lapeer reports posted on MPART website
- Reports pending for remaining fields



Summary Report Document

**Detailed Report expected late 2020*

EGLE MICHIGAN DEPARTMENT OF ENVIRONMENT, GREAT LAKES, AND ENERGY

SUMMARY REPORT:

Initiatives to Evaluate the Presence of PFAS in Municipal Wastewater and Associated Residuals (Sludge/Biosolids) in Michigan

June 2020

WATER RESOURCES DIVISION
800-662-9278 | Michigan.gov/EGLE

EGLE

Strategy - Land Application of Biosolids Containing PFAS

- *Strategy to assist with biosolids management decisions*
  - Draft Strategy Document expected January with implement for spring 2021.
  - Present Study results and strategy at the next stakeholders meeting.
  - Strategy will need to go through MPART review
  - Webinar for WWTPs/ Contractors upon implementation

Strategy Components - Land Application of Biosolids Containing PFAS

Source Reduction - Continue aggressively identifying and reducing significant sources of PFAS in wastewater and biosolids.

Research –Continuing efforts with evaluation and study of PFAS in biosolids and land application sites.

- Continue supporting EPAs efforts to develop a biosolids standard for PFAS

Prevention - While continuing to drive PFAS biosolids concentrations lower through aggressive source reduction efforts work to identify /prevent industrially impacted biosolids from being land applied.

Sampling - Additional monitoring for PFAS of land applied biosolids.

EGLE

Strategy Components - Land Application of Biosolids Containing PFAS

Communication / Transparency - Open dialogue between WWTPS / Contractors and landowners /farmers on PFAS in biosolids

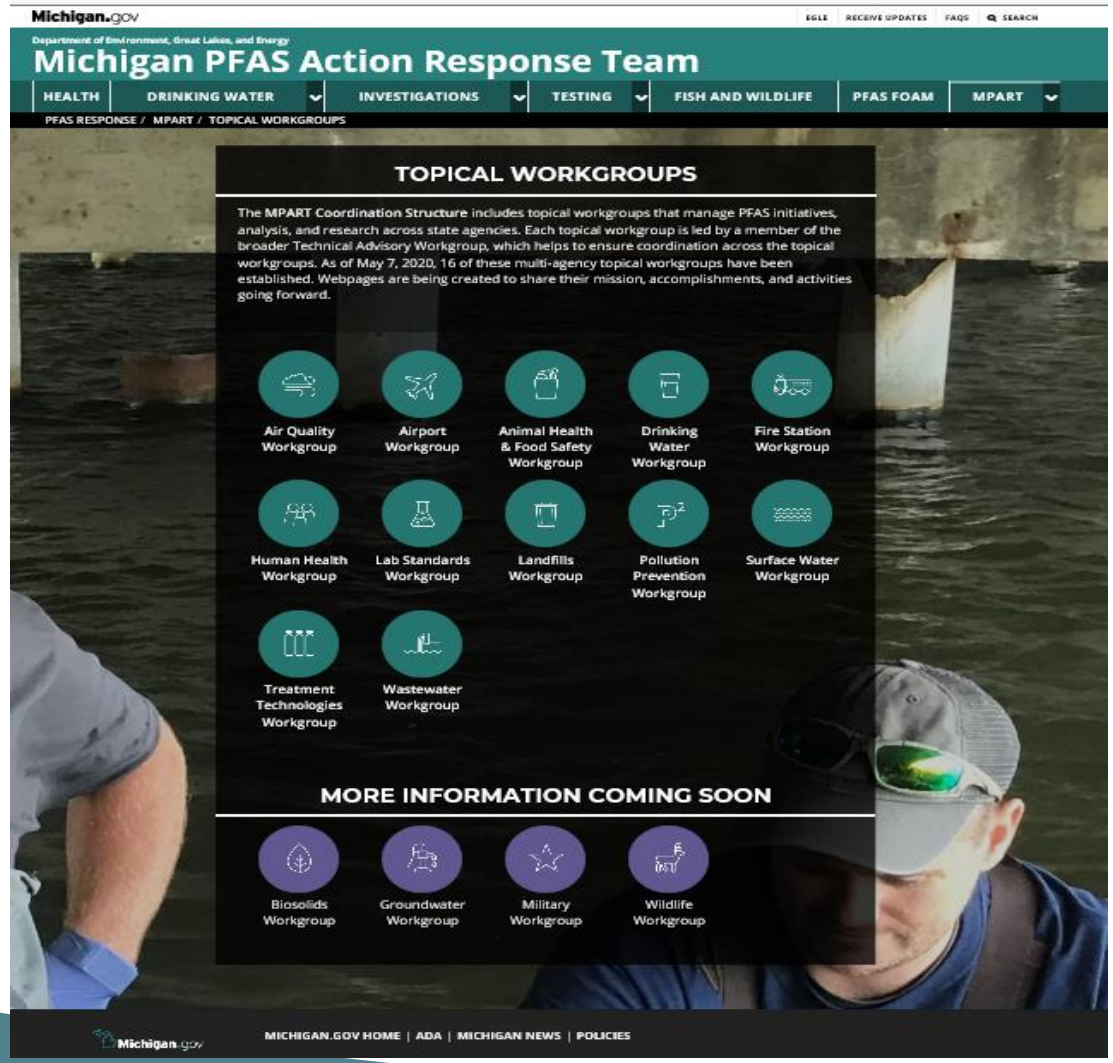
Provide tools for disseminating information /analytical on PFAS in biosolids.

MWEA BS Committee -

- The PFAS and Biosolids Quick Facts for Landowners document

- Best Management Practices Document

Visit the MPART Biosolids Workgroup



www.Michigan.gov/PfasResponse

or search

MPART Biosolids Workgroup

Biosolids Workgroup

MISSION:

- Expand knowledge of PFAS and biosolids within wastewater collection and treatment systems to develop guidance to municipal Wastewater Treatment Plants (WWTPs), land application contractors, and farmers/landowners regarding land application of biosolids containing PFAS.
- Establish a durable process to evaluate biosolids land application sites.
- In conjunction with Industrial Pretreatment Program (IPP) Initiative efforts, reach equilibrium in program status that allows the majority of WWTPs to maintain the option to safely land apply biosolids. This is contingent on identifying and controlling sources within wastewater collection systems and on ability to develop guidance above.

This workgroup is led by the Department of Environment, Great Lakes, and Energy (EGLE) and consists of representatives from Michigan Department of Agriculture and Rural Development (MDARD) and Michigan Department of Health and Human Services (MDHHS).

What are Biosolids?
Recent Accomplishments | Next Steps | Research/Studies and Reports | Timeline of Accomplishments
Contact Information

WHAT ARE BIOSOLIDS?

Biosolids are the nutrient-rich organic materials resulting from the treatment of domestic sewage in a wastewater treatment plant (WWTP) (visit our FAQ). Biosolids contain essential plant nutrient and organic matter. When treated and processed, biosolids can be recycled and applied to crops as fertilizer to improve and maintain productive soils and stimulate plant growth. For more information on biosolids, go to EGLE's Water Resources Division (WRD) Biosolids Program Web Page: Michigan.gov/Biosolids.

For more information on PFAS and biosolids see MPART's Frequently Asked Questions document.

RECENT ACCOMPLISHMENTS:

After the Lapeer WWTP was found to be a significant source of PFAS contamination to the Flint River, tests revealed that Lapeer's sludge contained high levels of PFOS. In response, EGLE prohibited the sludge from being spread on land. MPART hired AECOM Technical Services Inc. to investigate PFAS issues related to Lapeer's Biosolids in late 2017/early 2018.

Reports from the Lapeer Biosolids PFAS Investigation were finalized and posted on the MPART website in late 2018. Following this investigation and the Michigan IPP PFAS Initiative, the Biosolids Workgroup conducted a review of available research to better understand how common PFAS might be in biosolids.

Following are highlights of the Biosolids Workgroup efforts over the past year:

- The Biosolids Workgroup expanded the Lapeer Biosolids PFAS Investigation to a Statewide Biosolids and WWTP PFAS Study to further our knowledge on the prevalence of PFAS in municipal WWTP effluents (the outflow of treated water) in Michigan and to evaluate what happens to PFAS in biosolids that are spread on land (a final report is anticipated in the Summer of 2020).
  - The Statewide Biosolids and WWTP PFAS Study achieved the following:
    - Developed a detailed sampling work plan to identify and prioritize facilities to be investigated, which included surveying each facility on treatment process and selecting sample locations.
    - Collected samples of effluent, influent, and biosolids/sludge from the high priority WWTPs across Michigan and gathered detailed wastewater treatment process information from each WWTP based on the work plan.
    - Developed the EGLE Biosolids Site Selection Procedure to prioritize sites and identify those most in need of further investigation.
    - Collected samples of soil, surface water, tile drain water, and groundwater from agricultural fields that received biosolids from high priority WWTPs, which were WWTPs known to have industrially impacted biosolids with high concentrations of PFAS.
    - Collected soil and surface water samples from agricultural fields that were expected to have a "typical" amount of PFAS in the biosolids. These fields served as a comparison group for the highly impacted biosolids at other fields.
    - Collected crop samples from the Lapeer field that received biosolids impacted by PFAS.
    - Re-sampled permanent monitoring wells installed at the Lapeer field the previous spring.
    - Evaluated and selected a PFAS fate and transport model based on Michigan data and conditions. See Report – Review of Available Software for PFAS Modeling Within the Vadose Zone.
    - Conducted the modeling to evaluate the potential for PFOS/PFOA migration from Michigan biosolids land application sites. Numerical Modeling of PFOS and PFOA Migration Through the Vadose Zone Following Land Application of Municipal Biosolids. Expected release in 2020.
- The Biosolids Workgroup also completed the following activities:
  - Completed the Biosolids FAQ document.
  - Completed the Biosolids and Sludge PFAS Sampling Guidance. The guidance was developed by EGLE based on information gained during the Statewide Biosolids and Municipal WWTP PFAS Study (Summary Report).
  - Refined procedures and processes developed under the Lapeer investigation and included lessons learned from planning the Statewide Biosolids and Municipal WWTP PFAS Study.
  - Developed partnerships between EGLE, MDHHS, MDARD, and the agricultural community that allowed work on this issue to continue in a systematic and scientifically based way. Hosted stakeholder meetings attended by a cross section of the agricultural and wastewater treatment communities involved in biosolids land application.
  - Integrated Biosolids Workgroup efforts with those of the Wastewater, Surface Water, and Treatment Technology Workgroups while continuing involvement with groups such as the Michigan Water Environment Association – Biosolids and PFAS Committees, Michigan Rural Water Association, Michigan Waste and Recycling Association, Farm Bureau, and the North East Biosolids & Residuals Association.
  - Conducted residential well sampling around biosolids land application sites in the Palo area in Ionia County and held public meetings on the situation.
  - Participated in discussions with United States Environmental Protection Agency (USEPA) staff and various State of Michigan Departments and Divisions about investigating non-biosolid sludge applied to land.

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Impact of Past Biosolids Land Application on One Maine Farming Community

Carla Hopkins, ESIV

Residuals Management Unit

Background – Farm in Southern Maine

- December 2016 elevated PFOS in milk from farm in southern Maine
- Farm had accepted Class B biosolids and paper mill residuals from 1980s to early 2000s
- PFOS in soil made its way into groundwater and then dairy cows

Background – Rulemaking

- In 2018, Maine adopted screening concentrations for residuals, including biosolids, for three PFAS compounds:
  - PFBS: 1,900 ng/g
  - PFOA: 2.5 ng/g
  - PFOS: 5.2 ng/g
- Based on leaching to groundwater modeling with 200 ng/L as endpoint

Background – Testing Requirements

- In March 2019, began requiring facilities that land-apply biosolids and biosolids-derived products to test for PFBS, PFOA and PFOS
  - Class B programs
  - Class A pellet programs
  - Class A composters (includes WWTP sludge and dewatered septage)
- Ongoing testing required for these facilities February 2020

Background – PFAS Task Force

- In March 2019, Governor forms PFAS task force to study the threats of PFAS contamination to public health and the environment
- Public health experts, DHHS, DEP, DACF, MEMA, industry experts, drinking water sector, environmental groups
- Final Report issued January 2020
- Two key recommendations relating to biosolids:
  - Prioritize locations for sampling where biosolids were spread on fields that produce crops for human consumption or feed
  - Greatly expand testing of agricultural produce and products grown and/or raised in soils where biosolids have been agronomically utilized

Background – Central Maine Farm

- Maine Department of Agriculture, Conservation and Forestry (DACF) off-the-shelf milk testing program in 2019 and 2020
- Sample over the detection limit prompted further testing
- June 2020 tested milk at contributing farms
- Results of 12,700 ppt, 14,400 ppt, 14,900 ppt and 32,200 ppt PFOS in milk
- Farm had accepted Class B biosolids ~1980-2003 (WWTP with significant contribution from industry) and Class A sludge-derived liming product ~2006-2015 and spread own manure
- DEP initiated an investigation in July 2020

Sampling Activity

- Matrices sampled June 2020 to present:

- Milk
- Dairy Cow Manure
- Beef Cow Manure
- Hog Manure
- Surface Water
- Soil
- Animal Drinking Water Source
- Beef
- Residential Drinking Water Wells
- Spring (used as drinking water)
- Eggs
- Hay
- Haylage
- Corn Silage
- Fish Byproduct (used as feed)
- “Green Chop”
- Grass
- Purchased Feed
- Class A Liming Product
- Produce (grown with farm manure)
- Groundwater

Farm Fields - Overview

Milk and Beef Results

Milk

Sample ID	Sample Date	PFOS (ng/L)	Validation Qual	PFOA (ng/L)	Validation Qual
Milk Tank	6/24/20	12,700		31.9	
Milk Tank (re-test)	6/24/20	14,400		38.5	
Milk Tank (re-test)	6/24/20	14,900		52.9	J
Milk Tank	7/13/2020	32,200		46.5	J

Beef

Sample ID	Sample Date	PFOS (ng/g Dry)	Validation Qual	PFOA (ng/g Dry)	Validation Qual
COW-GROUND BEEF	7/13/2020	20.9		ND	

"J" indicates an estimated value. This is commonly applied to values that are either very low or very high compared to the calibration range of a test.
"ND" indicates that compound not detected in the sample.

Manure Results

Manure					
Sample ID	Sample Date	PFOS (ng/g Dry)	Validation Qual	PFOA (ng/g Dry)	Validation Qual
BEEF MANURE PAD	7/31/2020	113	J	22.1	J
DAIRY MANURE PIT	7/31/2020	35.1	J	4.48	J
HOG MANURE STACK	7/31/2020	39.9	J	5.81	J

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"ND" indicates that compound not detected in the sample.

Water and Other Results

Surface Water and Animal Drinking Water Source

Sample ID	Sample Date	PFOS (ng/L)	Validation Qual	PFOA (ng/L)	Validation Qual
DAIRY BARN TROUGH	7/13/2020	4.52		2.44	
SW-101 (by home fields)	7/28/2020	127.8		266.5	
SW-103 (pond-201 fields)	7/31/2020	6,390		1,920	
SW-104 (pond-201 fields)	7/31/2020	7,330		3,340	

Other

Sample ID	Sample Date	PFOS (ng/g Dry)	Validation Qual	PFOA (ng/g Dry)	Validation Qual
Class A Liming Product	7/9/2020	30.9		54.7	

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"ND" indicates that compound not detected in the sample.

Feed Results

Feed					
Sample ID	Sample Date	PFOS (ng/g Dry)	Validation Qual	PFOA (ng/g Dry)	Validation Qual
GRASS-201-5	7/31/2020	352.90		49.96	
GREEN CHOP	7/8/2020	31.43		1.58	J
HAY SILOED 2019	7/8/2020	0.44	J	ND	
HAY-1 (haybale)	7/8/2020	50.61		7.64	
GRASS-RIDGE-1	7/31/2020	399.10		39.82	
GRASS-RIDGE-3	7/31/2020	396.07		86.06	
SILAGE-2019	7/8/2020	ND		ND	
BYPRODUCT-1	7/13/2020	13.61		2.30	
GRAIN-071320	7/13/2020	ND		ND	

"J" indicates an estimated value. This is commonly applied to values that are either very low or very high compared to the calibration range of a test.
"ND" indicates that compound not detected in the sample.

Soil Results

Soil					
Sample ID	Sample Date	PFOS (ng/g Dry)	Validation Qual	PFOA (ng/g Dry)	Validation Qual
CS-BARN-1	7/24/2020	23.29		1.94	J
CS-BARN-2	7/24/2020	4.33		0.44	J
FIELD 1	7/28/2020	15.58		3.86	
FIELD 2	7/28/2020	45.62		48.75	
NO SPREAD 1	7/28/2020	27.22		3.18	
P2	7/28/2020	150.3		22.85	
201-1	7/31/2020	294	J	11.7	
201-2	7/31/2020	479		31.3	
201-3	7/31/2020	283		18.4	
201-4	7/31/2020	544		16.8	
201-5	7/31/2020	422		16.4	
201-6	7/31/2020	571		20.2	
RIDGE-1	7/31/2020	579		21.4	
RIDGE-2	7/31/2020	792		30.3	
RIDGE-3	7/31/2020	981		38.7	
RIDGE-4	7/31/2020	1,080		49.6	
RIDGE-5	7/31/2020	1,010	J	42.5	
RIDGE-6	7/31/2020	553		30.6	

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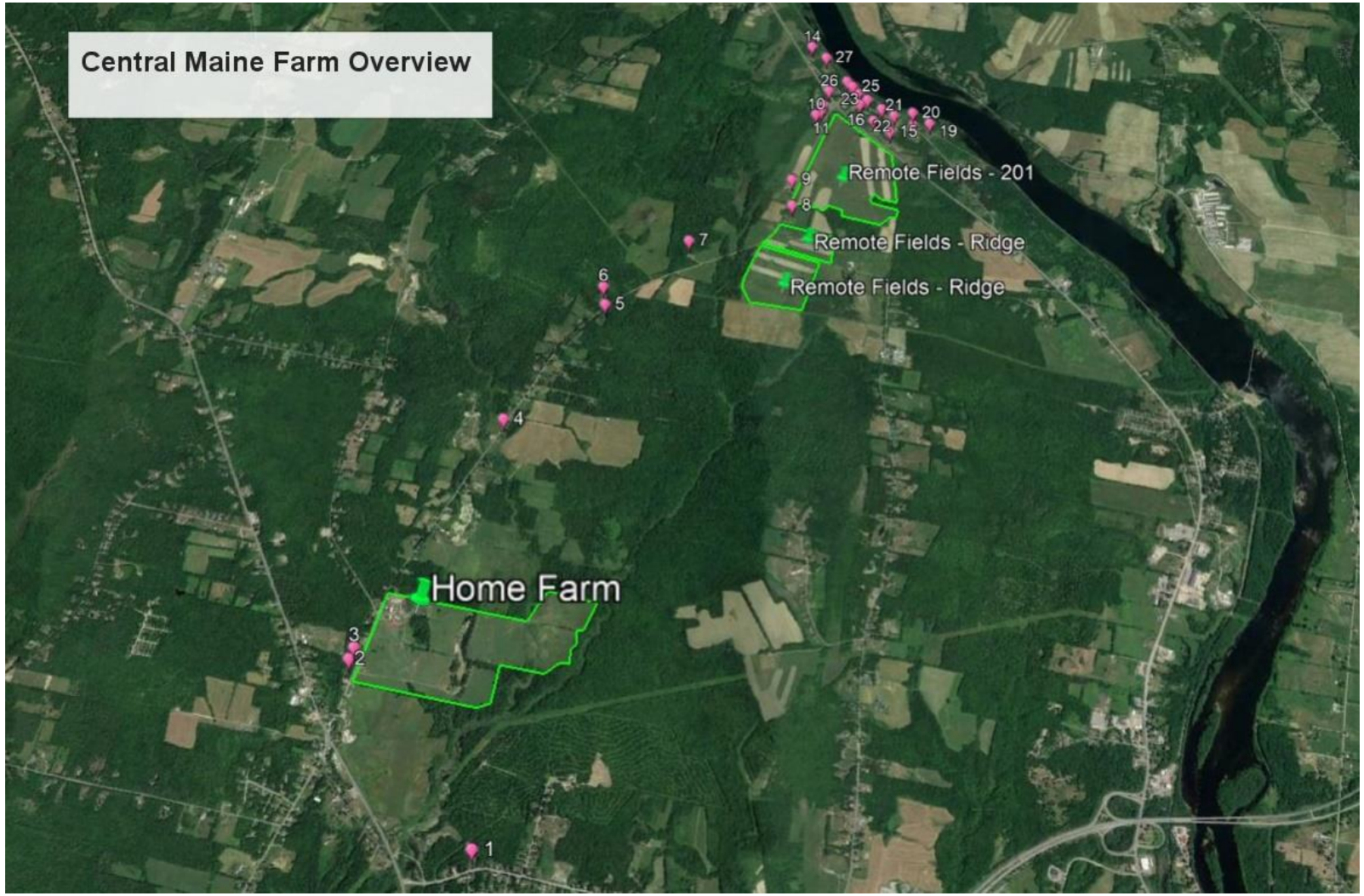
"ND" indicates that compound not detected in the sample.

Soil and Associated Grass Results

Soil and Associated Grass					
Sample ID	Sample Date	PFOS (ng/g Dry)	Validation Qual	PFOA (ng/g Dry)	Validation Qual
201-5 Soil	7/31/2020	422		16.4	
201-5 Grass	7/31/2020	352.90		49.96	
RIDGE-1 Soil	7/31/2020	579		21.4	
RIDGE-1 Grass	7/31/2020	399.10		39.82	
RIDGE-3 Soil	7/31/2020	981		38.7	
RIDGE-3 Grass	7/31/2020	396.07		86.06	

"J" indicates an estimated value. This is commonly applied to values that are either very low or very high compared to the calibration range of a test.
"ND" indicates that compound not detected in the sample.

Sample Locations - Overview



Residential Drinking Water Results

Residential Drinking Water					
Sample ID	Sample Date	PFOS (ng/L)	Validation Qual	PFOA (ng/L)	Validation Qual
1	11/03/2020	ND		ND	
2	11/03/2020	ND		0.49	J
3	11/03/2020	0.734	J	0.222	J
4	11/03/2020	ND		11.4	
5	11/03/2020	ND		0.818	J
6	10/29/2020	ND		5.25	
7	8/28/2020	1.12	J	23.92	
8	8/28/2020	60.36		50.02	
9	9/18/2020	ND		1.08	

"J" indicates an estimated value. This is commonly applied to values that are either very low or very high compared to the calibration range of a test.
"ND" indicates that compound not detected in the sample.

Residential Drinking Water Results

Residential Drinking Water

Sample ID	Sample Date	PFOS (ng/L)	Validation Qual	PFOA (ng/L)	Validation Qual
10	9/18/2020	2,680		898	
11	9/18/2020	2,150		784	
12	9/18/2020	170		394	
13	11/03/2020	641		278	
14	10/22/2020	ND		0.25	
15	10/22/2020	58.4		1,910	
16	9/18/2020	12,000		3,800	
17	10/22/2020	189		424	
18	10/22/2020	ND		ND	

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"ND" indicates that compound not detected in the sample.

Residential Drinking Water Results

Residential Drinking Water					
Sample ID	Sample Date	PFOS (ng/L)	Validation Qual	PFOA (ng/L)	Validation Qual
19	10/22/2020	ND		216	
20	11/03/2020	26		96.1	
21	10/22/2020	59.7		288	
22	10/22/2020	3,170		3,520	
23	10/22/2020	243		220	
24	10/22/2020	511		1,400	
24-1	10/22/2020	2,920		3,070	
25	11/03/2020	3,190		3,140	
26	11/04/2020	414	J	1,130	J
27	10/22/2020	25.4		108	

"J" indicates an estimated value. This is commonly applied to values that are either very low or very high compared to the calibration range of a test.
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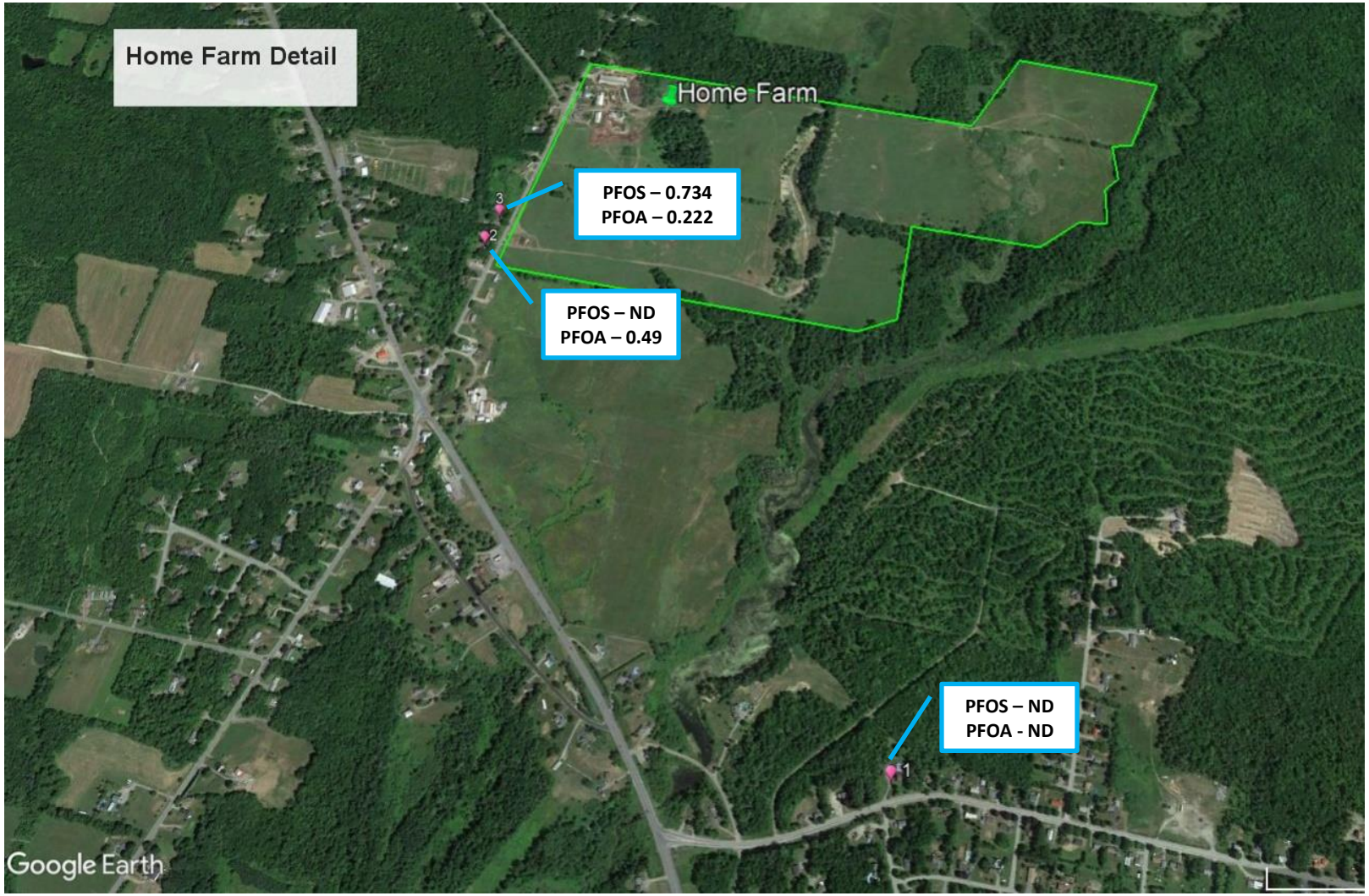
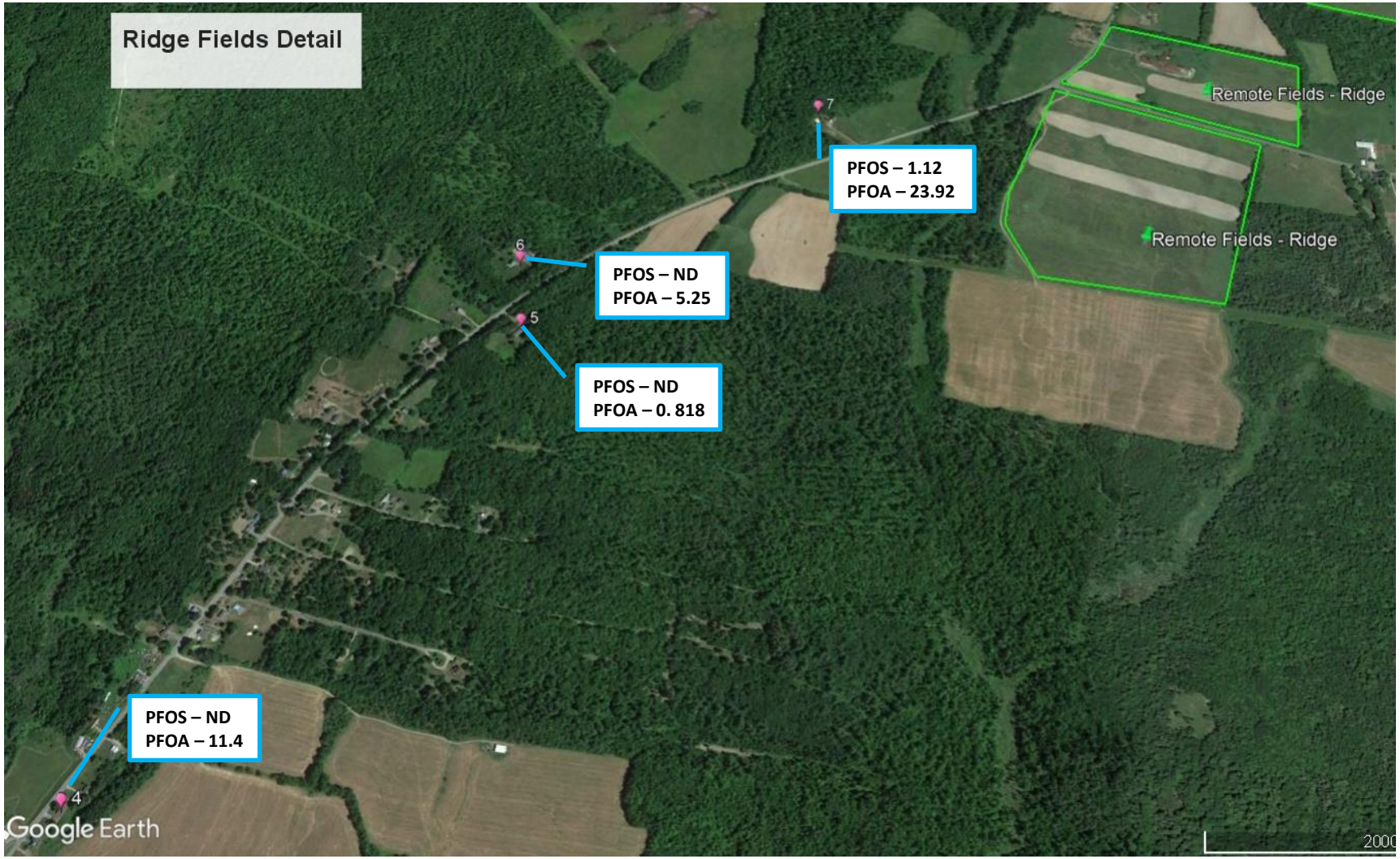
Sample Locations – Home Farm Detail



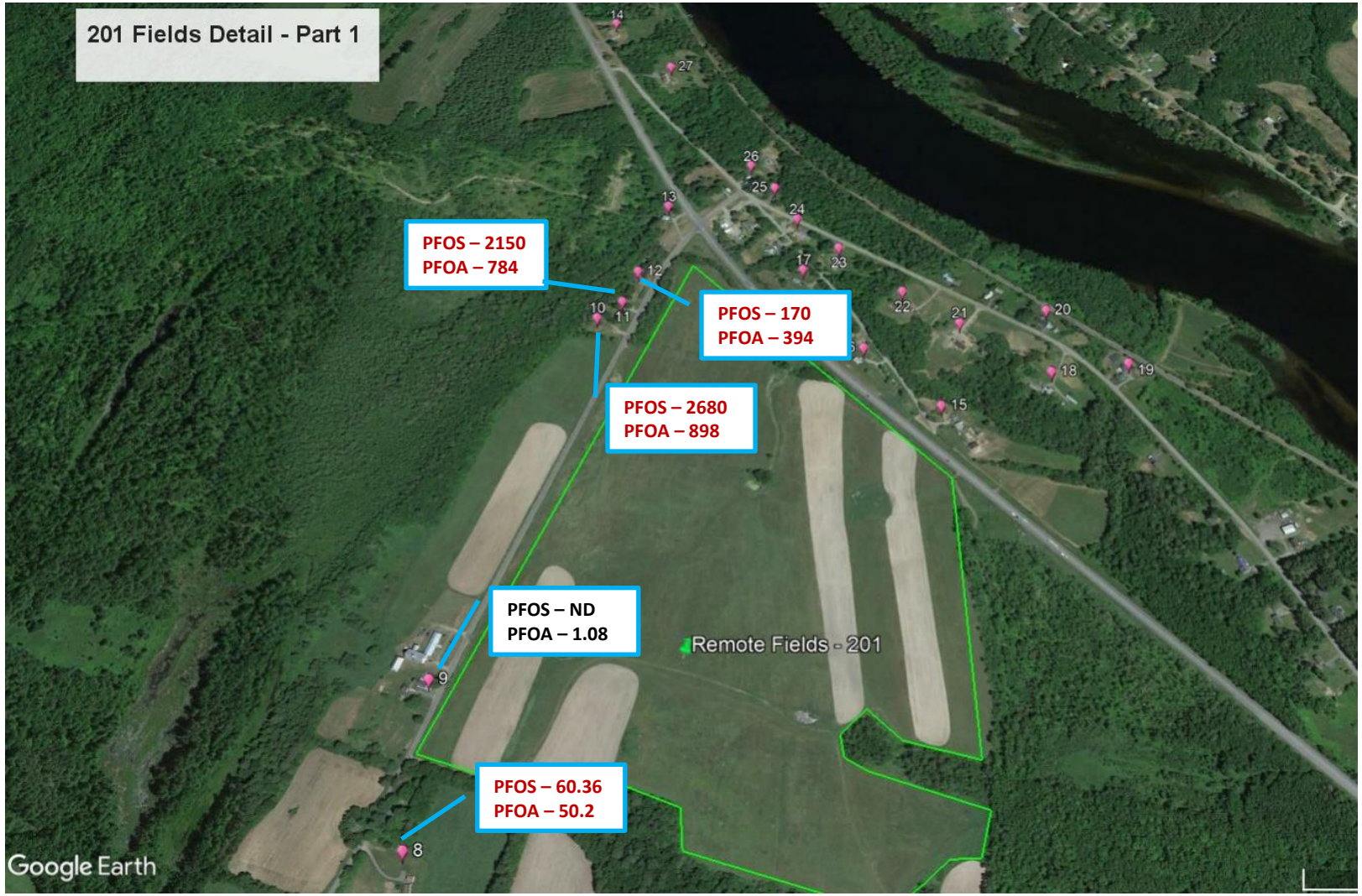
*All Results in ng/L (parts per trillion)

Sample Locations – Ridge Fields Detail



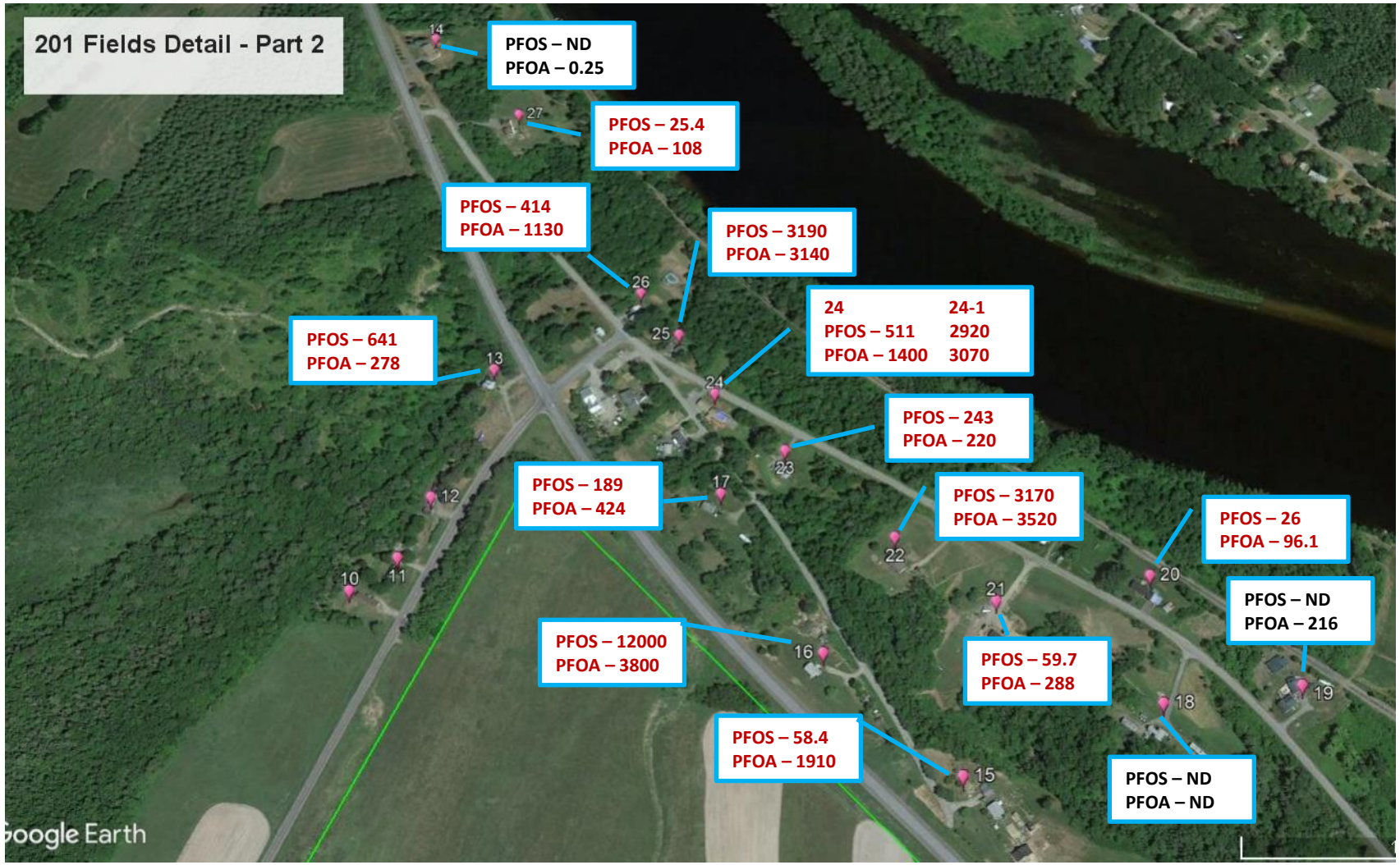
*All Results in ng/L (parts per trillion)

Sample Locations – 201 Fields Detail



*All Results in ng/L (parts per trillion)

Sample Locations – 201 Fields Detail

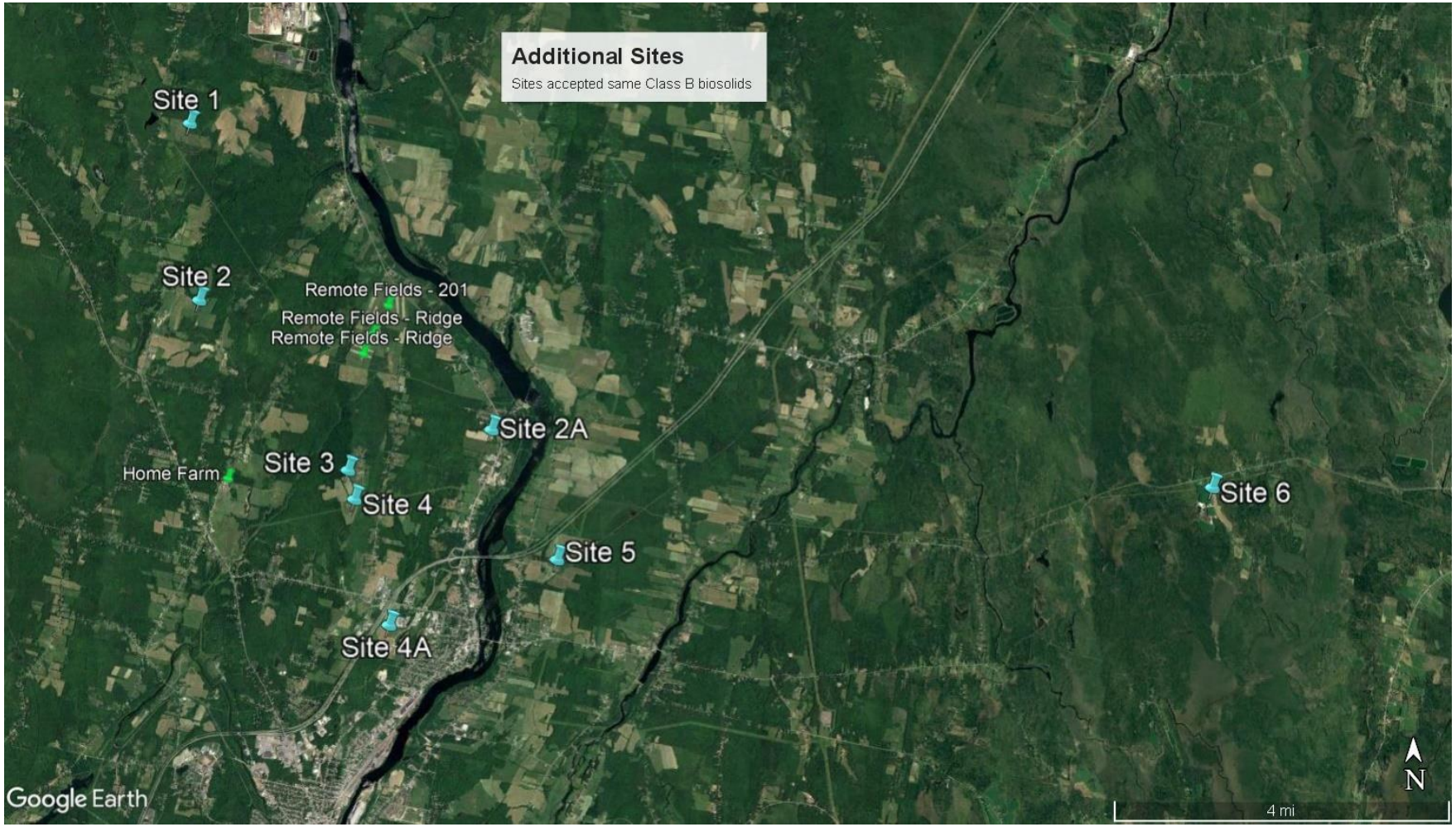


*All Results in ng/L (parts per trillion)

Current Work

- Expanding private drinking water well testing based on results
- Reviewing data for soils that received only manure from farm – no Class A or Class B biosolids
- Reviewing data for soils that received only Class A sludge-derived liming product – no Class B biosolids
- Reviewing data from other sites that received the same Class B biosolids during the same timeframe as this farm

Additional Sites



Additional Sites – Soil Results

Soil					
Sample ID	Sample Date	PFOS (ng/g Dry)	Validation Qual	PFOA (ng/g Dry)	Validation Qual
Site 1 (3)	10/29/2020	328		31	
Site 1 (F2-1)	10/29/2020	60		58.4	
Site 2 (P-1)	10/29/2020	83.9		7.21	
Site 2 (5-1/5-2)	10/29/2020	220		12.3	
Site 2A	No Data	No Data		No Data	
Site 3 (A1)	10/29/2020	157		6.27	
Site 3 (B1)	10/29/2020	239		9.07	
Site 4 (2A)	10/29/2020	298		13.3	
Site 4 (2C)	10/29/2020	409		11.4	
Site 4A	No Data	No Data		No Data	
Site 5	No Data	No Data		No Data	
Site 6 (G4)	10/29/2020	403		26.1	
Site 6 (G5)	10/29/2020	208		34.1	

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"ND" indicates that compound not detected in the sample.

Additional Sites – Water Results

Water					
Sample ID	Sample Date	PFOS (ng/L)	Validation Qual	PFOA (ng/L)	Validation Qual
Site 1 – 1	10/29/2020	4.99		1.6	J
Site 1 – 2	10/29/2020	4.54		16.8	
Site 1 – 3	10/29/2020	0.573	J	1.32	J
Site 2 – 1	10/29/2020	25.7		22.1	
Site 2 – 2	10/29/2020	3.26		15.4	
Site 2A	No Data	No Data		No Data	
Site 3	10/29/2020	No Data		No Data	
Site 4 – 1	10/29/2020	9,360		2,720	
Site 4A	No Data	No Data		No Data	
Site 5	10/29/2020	No Data		No Data	
Site 6 – 1	10/29/2020	37,400		18,200	
Site 6 – 2	10/29/2020	552		1,740	
Site 6 – 3	10/29/2020	60,700		19,200	

"J" indicates an estimated value. This is commonly applied to values that are either very low or very high compared to the calibration range of a test.
"ND" indicates that compound not detected in the sample.

Additional Sites – Milk Results

Milk					
Sample ID	Sample Date	PFOS (ng/L)	Validation Qual	PFOA (ng/L)	Validation Qual
Site 2 (Milk Tank)	10/26/2020	863		-	
Site 2 (Milk Tank)	11/17/2020	620		4.07	

"J" indicates an estimated value. This is commonly applied to values that are either very low or very high compared to the calibration range of a test.
"ND" indicates that compound not detected in the sample.

Next Steps

- Coordinating treatment systems for those impacted above the EPA Health Advisory
- Continue expanding private drinking water well testing based on results, if necessary
- Review information for other sites that received Class B biosolids from same generator as sites discussed earlier and sample as appropriate
- Expand testing to sites that received other Class B biosolids

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