PFAS

Impacting Water and Wastewater Utilities

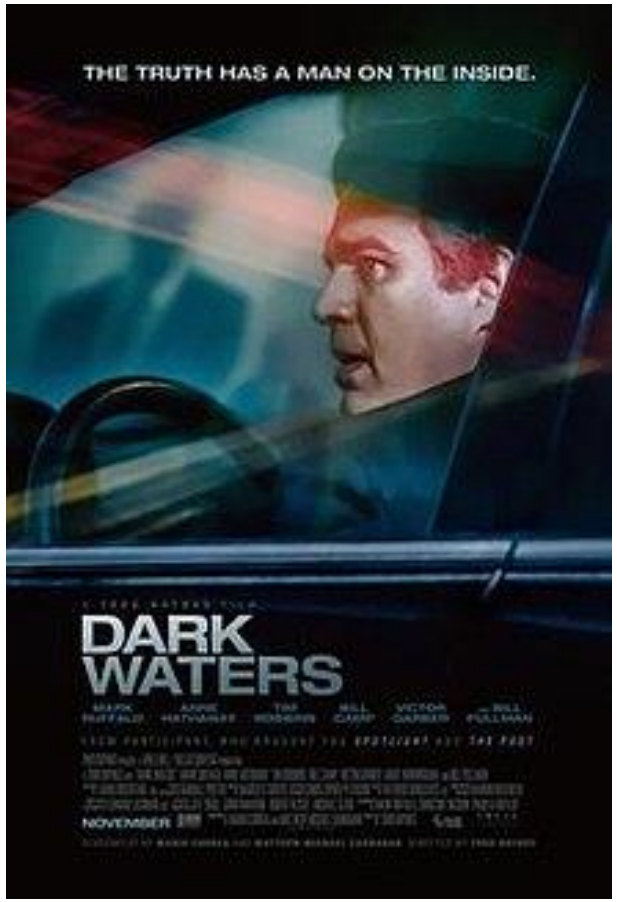
SSR

TAUD Business Conference – August 2024

PFAS IN THE ENVIRONMENT

- We have had many Health Crises in the U.S.
  - Milwaukee, WI: Cryptosporidium
  - Flint, MI: Lead

- PFAS: Billed as the Next Great Public Health Crisis



PFAS IN THE NEWS...

CSWAB
Citizens for Safe Water Around Badger

News & Action CEASE FIRE

Action Alert: U.S. Military is Open Burning PFAS!

Dec 26, 2020

EVERY YEAR, Tennessee's Holston Army Ammunition Plant is permitted to open burn **1,250,000 pounds** of munitions wastes that may contain as much as **15% PFAS** by weight. The open air burning has been ongoing for decades.

NATIONAL

Report: Up to 20 million acres of farmland in US tainted by PFAS

by: Matt Jaworowski
Posted: Apr 17, 2022 / 05:00 AM EDT
Updated: Apr 17, 2022 / 12:03 PM EDT

SHARE

GRAND RAPIDS, Mich. (WOOD) — A new report from the nonprofit **Environmental Working Group** estimates between 2 and 20 million acres of cropland across the United States are contaminated with PFAS — a "forever chemical" that has been used by manufacturers for decades but only recently has been discovered to cause severe health issues.

According to Scott Faber, the vice president of government affairs for the EWG, most of the farmland is contaminated through **sewage sludge** — essentially the leftovers once wastewater and stormwater are processed at a treatment facility. Solid material is sifted out of the water and digested by bacteria. However, even after that process, sewage sludge can still hold elements from the waste, including medical, chemical and industrial waste.

TOP STORIES ON WOODTV.COM

PFAS IN THE NEWS...

SIERRA CLUB

About Us | Explore Issues | Take Action | Get Outside

Many home gardeners buy compost or commercial soil amendments to enhance soil nutrition. But new tests reveal concerning levels of toxic chemicals known as PFAS in fertilizer products which are commonly made from sewage sludge.

Our testing found PFAS or "forever chemicals" in all of the nine fertilizer products tested by the Ecology Center of Michigan and Sierra Club and marketed as "eco" or "natural." Eight of the nine exceeded screening guidelines set by the State of Maine, the state with the strictest safeguards for PFAS contamination of agricultural lands. PFAS in fertilizers could cause garden crops to be a source of exposure for home gardeners.

wpln News Schedule Support Shows + Podcasts Events

Investigation: Dangerous And Persistent Chemicals Discovered At A Middle Tennessee Military Base

SHALINA CHATLANI MAY 14, 2019

Rainwater and other runoff at Arnold Air Force Base collecting in a retention reservoir tested positive for PFAS.
Credit: Shalina ChatlaniWPLN

Become a sponsor

PFAS IN THE NEWS...

Texas Farmers Battle Against PFAS-Contaminated Sludge

March 1, 2024 by ECWQ

Report: 'Forever chemicals' in northeast TN pose longterm risk to region's drinking water

BY: **ANITA WADHWANI** - JANUARY 8, 2024 5:01 AM

PFAS CONCERNS

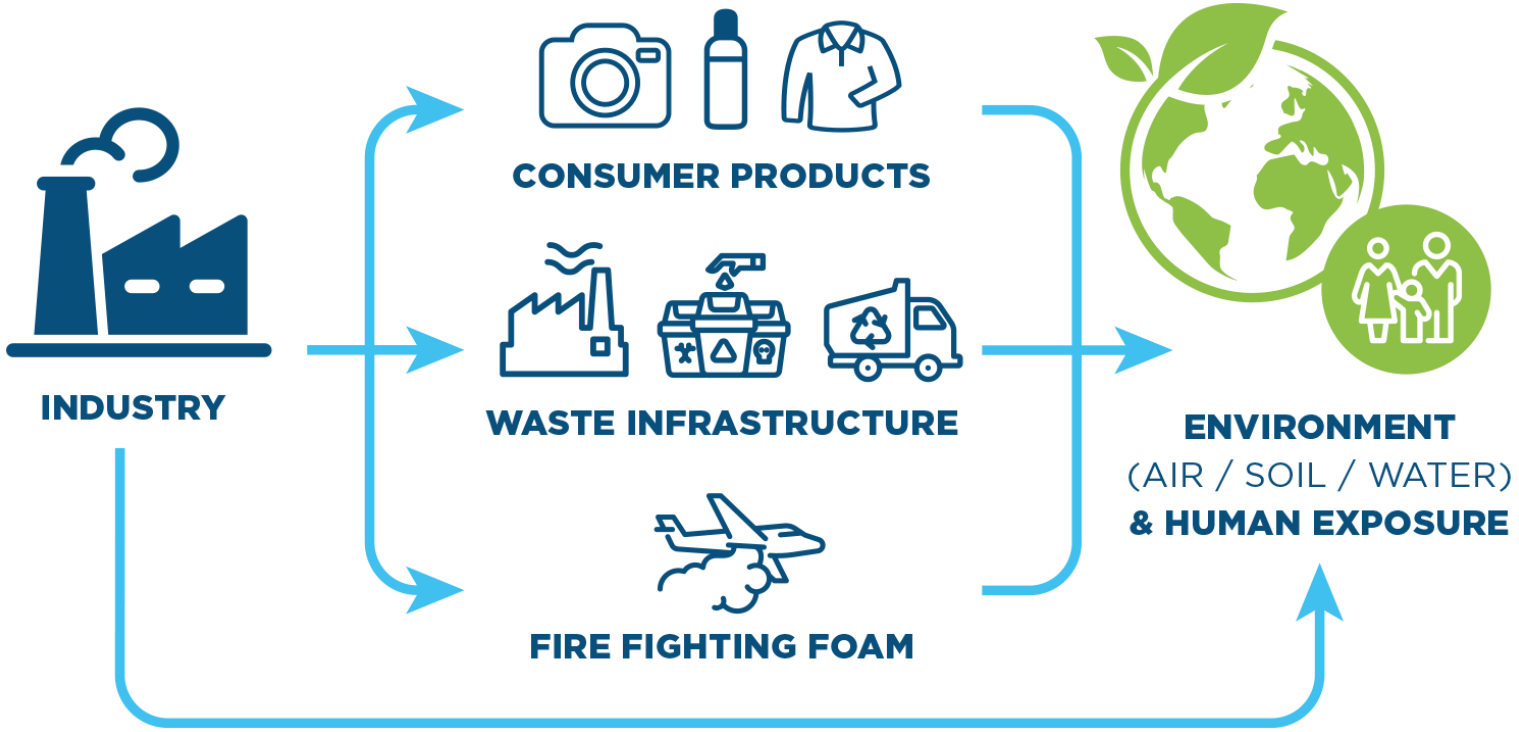
PFAS

- Effects: Potential Carcinogen
- Forever Chemicals
- Bio-Persistent and Bio-Accumulative
- Found worldwide in soil, sediments, and water
- Nearly all U.S. Citizens have PFAS in their blood at detectable levels

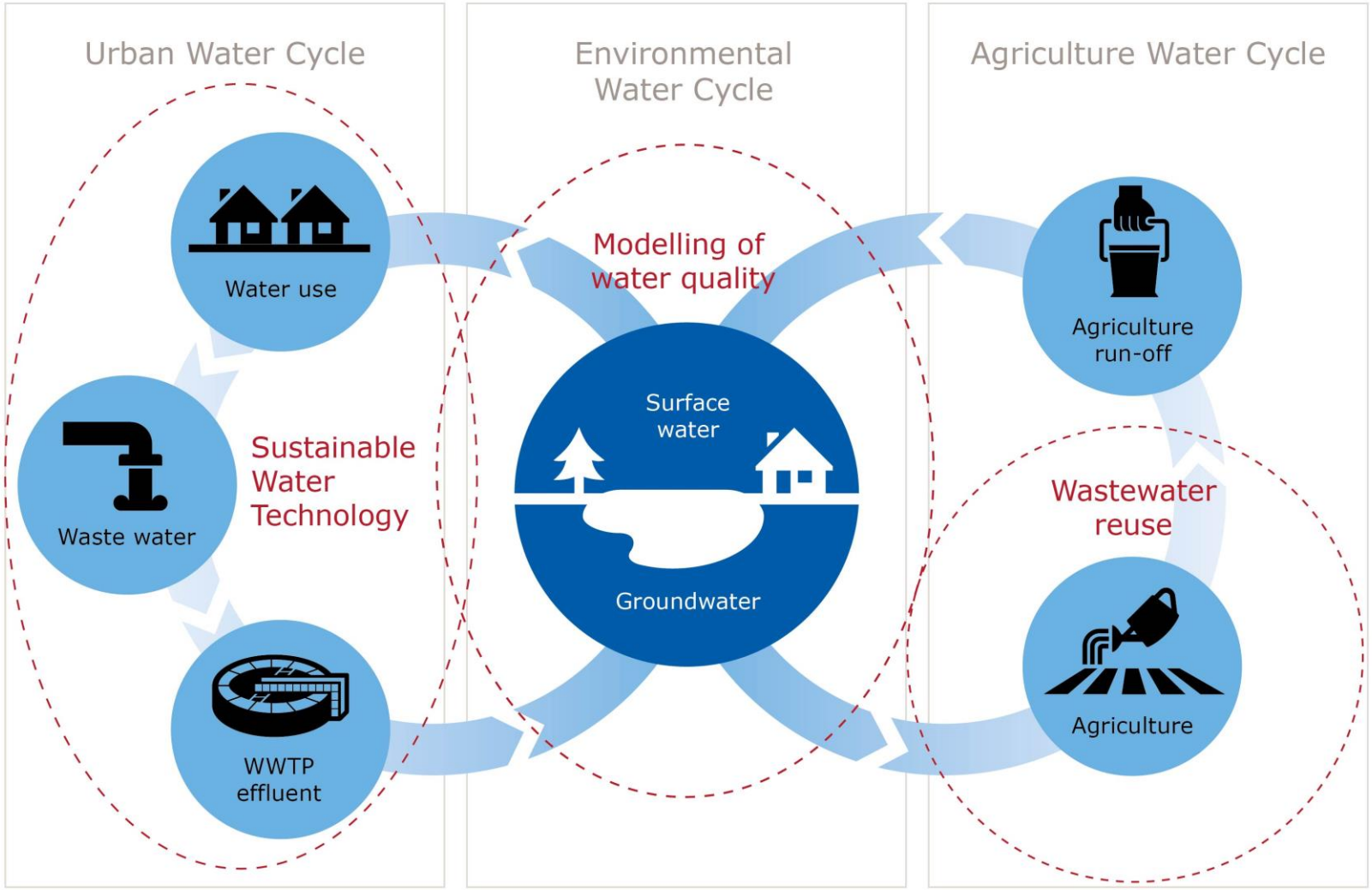
Biopersistent/Bioaccumulative characteristics effect dosages

PFAS AFFECTS MANY STAKEHOLDERS

- The Public
- Water Utilities
- Industrial Waste Producers
- Waste Outlets
- Biosolid Outlets
- Environmental Regulators
- Environmental Activists



PFAS AND THE CIRCULAR NATURE OF WATER



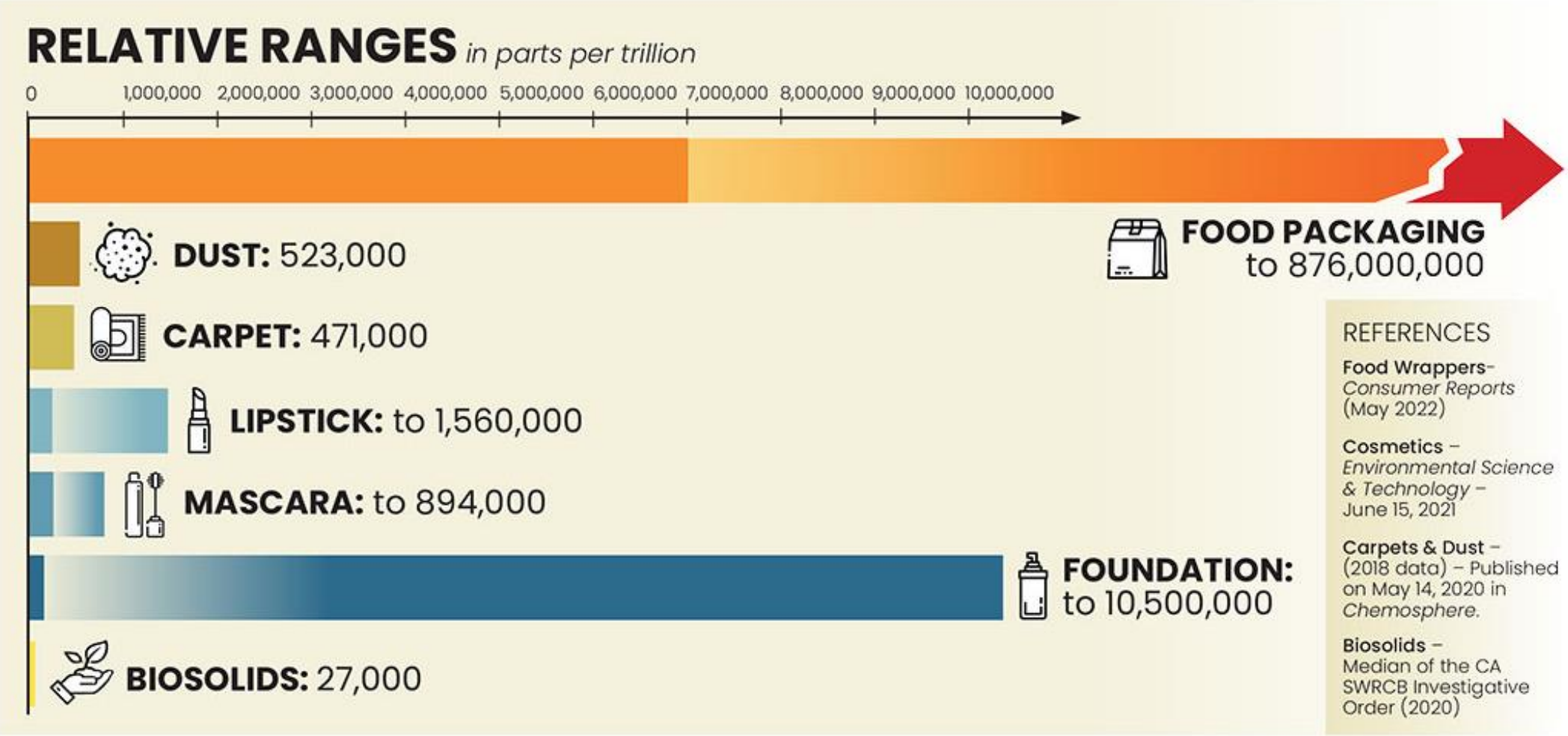
PLACING PFAS IN CONTEXT

Distinguishing Highly Contaminated Sites from Background Levels

- PFAS Manufacturing Sites: 100,000 to 500,000 ppt
- Firefighting Training Sites and Military Installations: > 1,000,000 ppt
- Compared to USEPA MCL - 4ppt

Units are important: Water (ppt); Solids (ppb)

PFAS By The Numbers



Source: BioCycle CONNECT, VOL. 3, NO. 14 | July 27, 2022

PFAS IN THE ENVIRONMENT

DRINKING WATER

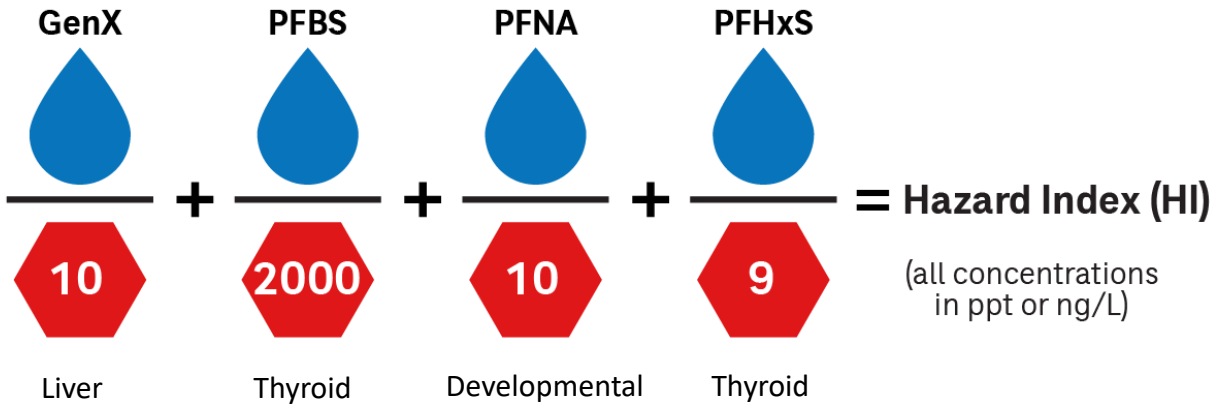
UCMR5 REQUIREMENTS

Unregulated Contaminant Monitoring Rule 5 (UCMR5)

- Initial Monitoring
  - Quarterly samples within 12 month period
  - Smaller communities: semi-annual
- Community Water Systems required to report within 12 months
  - PFAS Levels
  - Potential Health Effects
- Trigger Levels
  - Below – reduced monitoring
  - Above – Continue Monitoring

HOW ARE PFAS REGULATED?

Compound	Health-Based MCL Goals (non-enforceable)	MCL (enforceable)
PFOA	0 ppt	4.0 ppt
PFOS	0 ppt	4.0ppt



= **Hazard Index (HI)** 1.0

(all concentrations in ppt or ng/L)

EPA Final Rule for Drinking Water Announced - April 2024.

PFAS TRIGGER LEVELS

Compound	Trigger levels
PFOA	1.3 ppt
PFOS	1.3 ppt
Hazard Index	0.3

EPA Final Rule for Drinking Water Announced - April 2024.

PFAS REGULATORY SCHEDULE

- Within three years of rule promulgation (2024 – 2027):
  - INITIAL MONITORING must be complete
- Starting three years following rule promulgation (2027 – 2029):
  - Results of INITIAL monitoring must be included in Consumer Confidence Reports (CCRs…i.e., Annual Water Quality Reports)
  - CONTINUED monitoring results must be included in CCRs
  - Public notification for monitoring and testing violations
- Starting five years following rule promulgation (starting 2029)
  - COMPLY with all MCLs
  - Public notification for MCL violation

EPA Final Rule for Drinking Water Announced - April 2024.

PREVENTING CONTAMINATION

Field Clothing and PPE

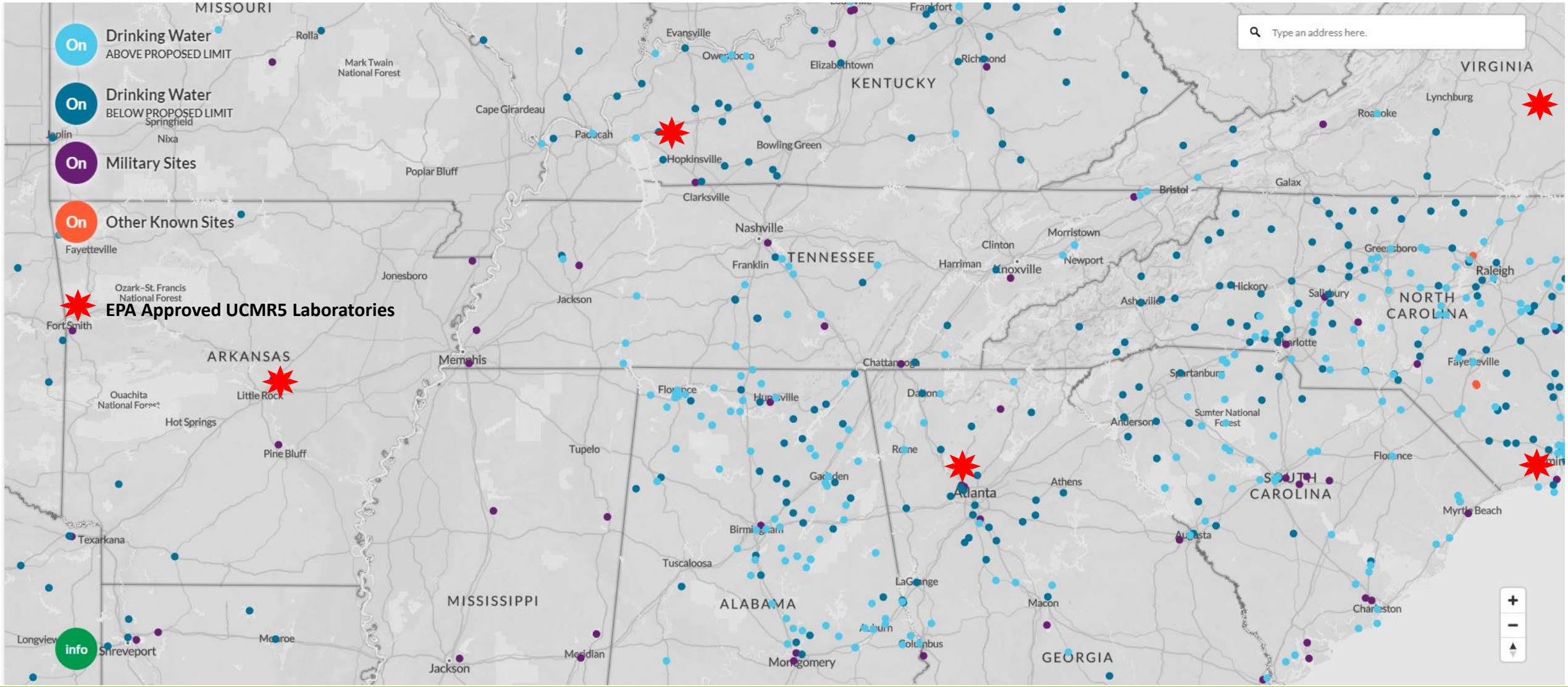
Prohibited Items	Acceptable Items
• New clothing that is waterproof, water resistant, or stain-treated • Clothing or footwear containing Gore-Tex™, Scotch Gard™, RUCO®, etc. • Clothing laundered with fabric softener • Latex gloves • Cosmetics, moisturizers, or other personal hygiene/care products on the morning of sampling that are not PFAS free • Plastic water bottles and food wrappers	• Boots made with polyurethane and PVC for wet conditions, or rubber overboots (“chicken boots”) • Reflective safety vests, Tyvek®, Cotton clothing, synthetic under clothing, medical braces • Banana Boat Sport performance Coolzone Broad Spectrum SPF 30 Sunscreen • PFAS-free deionized (DI) water

PREVENTING CONTAMINATION

Sampling Equipment

Prohibited Items	Acceptable Items
• Teflon® containing materials (tubing, aluminum foil) • Low density polyethylene (LDPE) • Waterproof field books/plastic clipboards or binders. • Water resistant sample bottle labels. • Tyvek® material • Sample containers made of LDPE materials • Post-It Notes • Chemical (blue) ice packs • Excel Purity Paste, TFW Multipurpose Thread Sealant, Vibra-Tite Thread Sealant • Equipment with Viton Components (need to be evaluated on a case by case basis)	• Stainless steel • High density polyethylene (HDPE) • Polyvinyl chloride (PVC) • Silicone • Acetate • Polyurethane and Polypropylene • Loose paper (non-waterproof). Clear packing tape, or lab-applied labels. • Aluminum or Masonite field clipboards • Sharpies®, pens • Regular ice • Gasoils NT Non-PTFE Thread Sealant Bentonite

PFAS CONTAMINATION IN TENNESSEE (2024)



Reference: Environmental Working Group (February 2024) Interactive Map: PFAS Contamination (ewg.org)

PFAS MESSAGING

Talking to our Communities about PFAS

- This is not our first time
- We have established our representation among the Community
- Speak to Our Legacy:

Water Utility Professionals are Public Health and Environmental Stewards

PFAS MESSAGING

1	BE FIRST	The first source of communication often becomes the source against which all others are measured.
2	BE RIGHT	Accuracy is critical to credibility.
3	BE CREDIBLE	Honesty is fundamental to building trust.
4	EXPRESS EMPATHY	People must know that their leaders care.
5	PROMOTE ACTION	Provide a call to action.
6	SHOW RESPECT	Lack of respect undermines trust.

Reference:
US CDC Crisis and Emergency Communication Principles

PFAS MESSAGING

Talking to our Communities about PFAS: Unique Considerations

- Passive Receivers
- Real Exposure Pathways
- Paying for PFAS
- Speak Up Now

Reference: Chris Peot, Talking to Our Communities About PFAS, WE&T May 2023

Drinking Water Treatment for PFOS

Ineffective Treatments

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

PAC Dose to Achieve

50% Removal	16 mg/l
90% Removal	>50 mg/L

Dudley et al., 2015

Effective Treatments

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

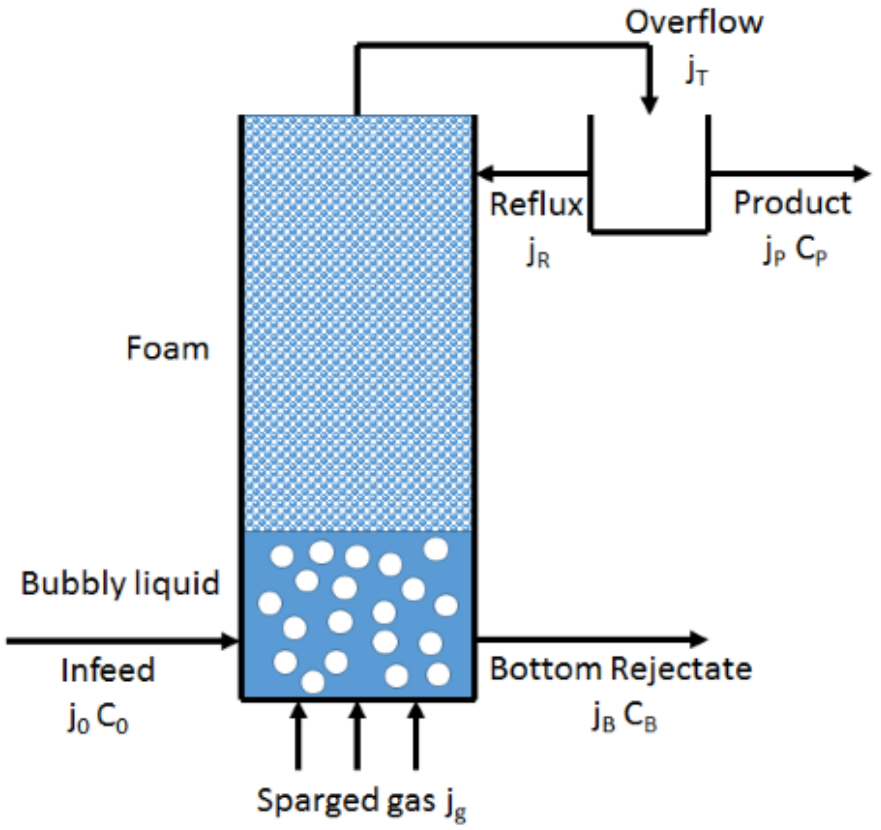
Reference: EPA PFAS Treatment in Drinking Water and Wastewater –State of the Science, Speth (2020)

PFAS Treatment for Drinking Water and Wastewater

- Concentrated Media Problem:
- 1. Spent IX sorbents regeneration waste
- 2. Membrane Reject
- 3. SAFF Foam
- 4. GAC Reactivation may be OK

PFAS Treatment for Drinking Water and Wastewater

- FOAM FRACTIONATION



AIR In – PFAS Out

- PFAS preferentially adsorb to the surface of the bubbles as they rise upwards, accumulate at the top of the column as a concentrated foamate then removed for further treatment or disposal.
- Effective for long-chain PFOS,PFOA
- Implemented at Pilot and Field Scale

Reference: OPEC SAFF; ECT2 FOAM-X

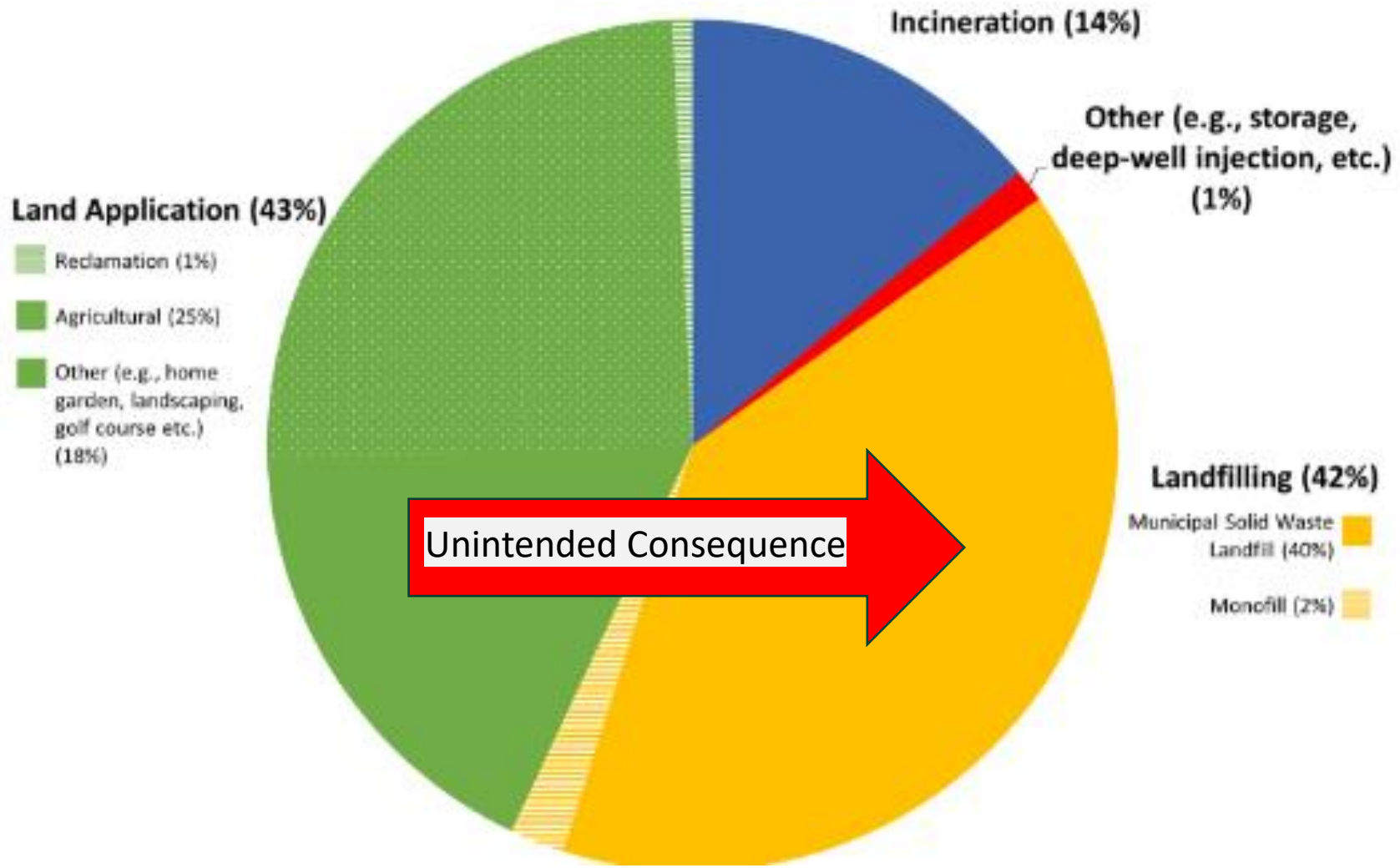
PFAS IN THE ENVIRONMENT

BIOSOIDS

LAND APPLICATION IN THE U.S.

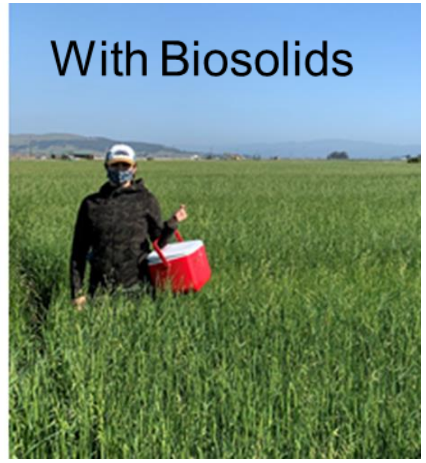
- Regulated via 40 CFR Part 503 Federal Regs (1993)
- Biosolids designated as Class A or Class B
- 7 million dry metric tons produced annually
- Land application accounts for 60% of the biosolids
  - 28% Class A
  - 29% Class B

LAND APPLICATION IN THE U.S.

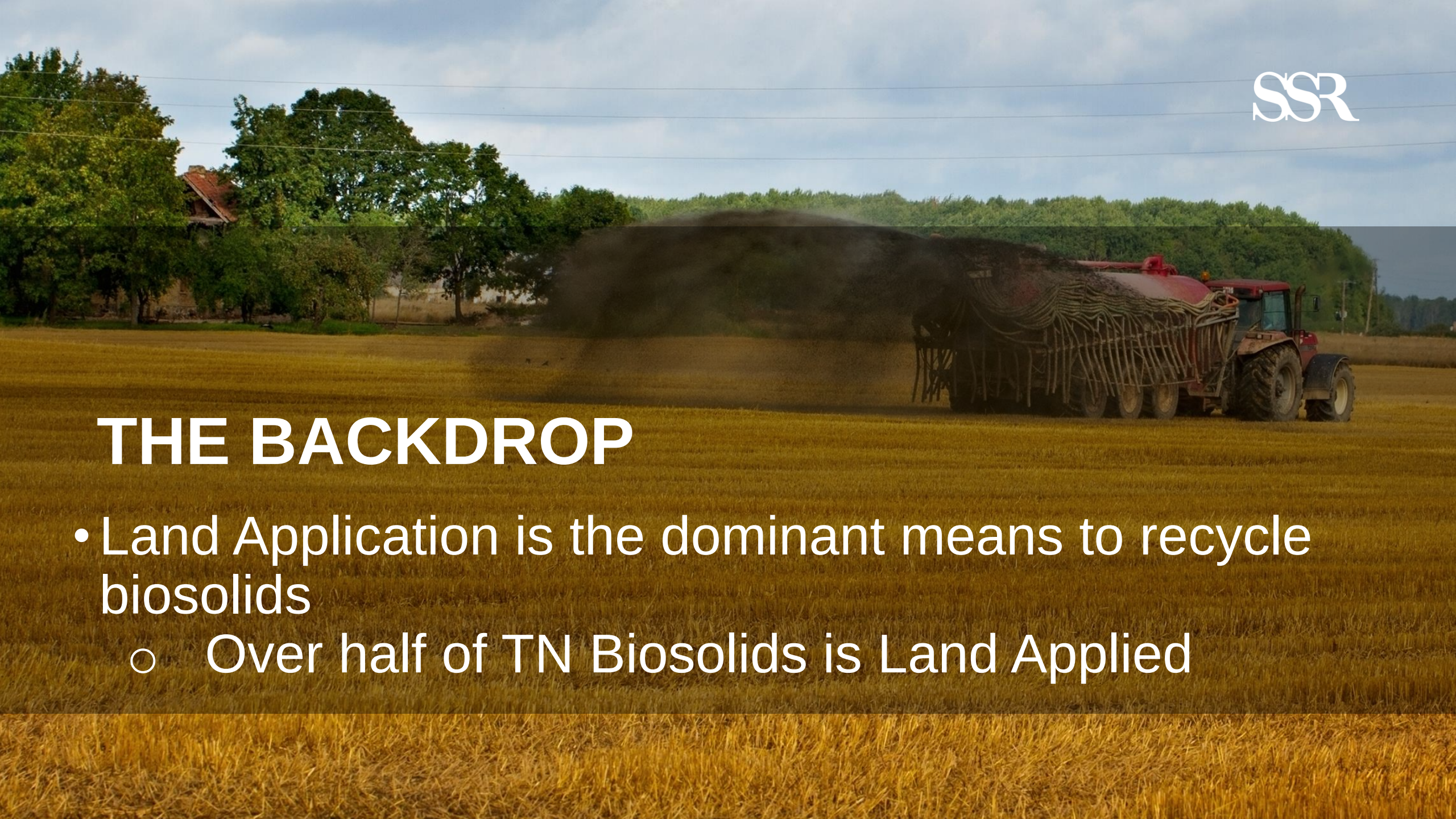


LAND APPLICATION BENEFITS

- Biosolids are a Resource!
- Returns Valuable Nutrients and Carbon to Soil
- Avoid Unnecessary Production of Commercial Fertilizers
- Provide Economic Benefits to Farmers
- Boost Production of Agricultural Products
- Help Lower Ratepayers Cost and Utilities Carbon Footprint



THESE BENEFITS ARE AT RISK DUE TO PFAS



THE BACKDROP

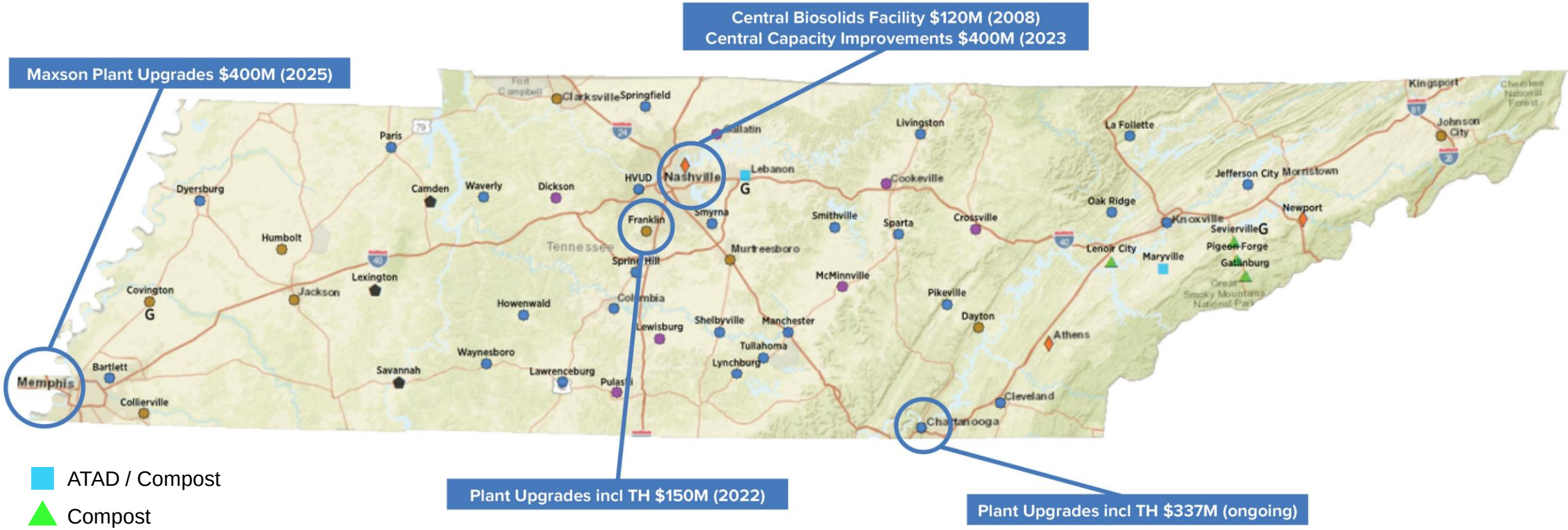
- Land Application is the dominant means to recycle biosolids
  - Over half of TN Biosolids is Land Applied

PRESSURES ON EXISTING TENNESSEE BIOSOLIDS APPROACH

THE BACKDROP

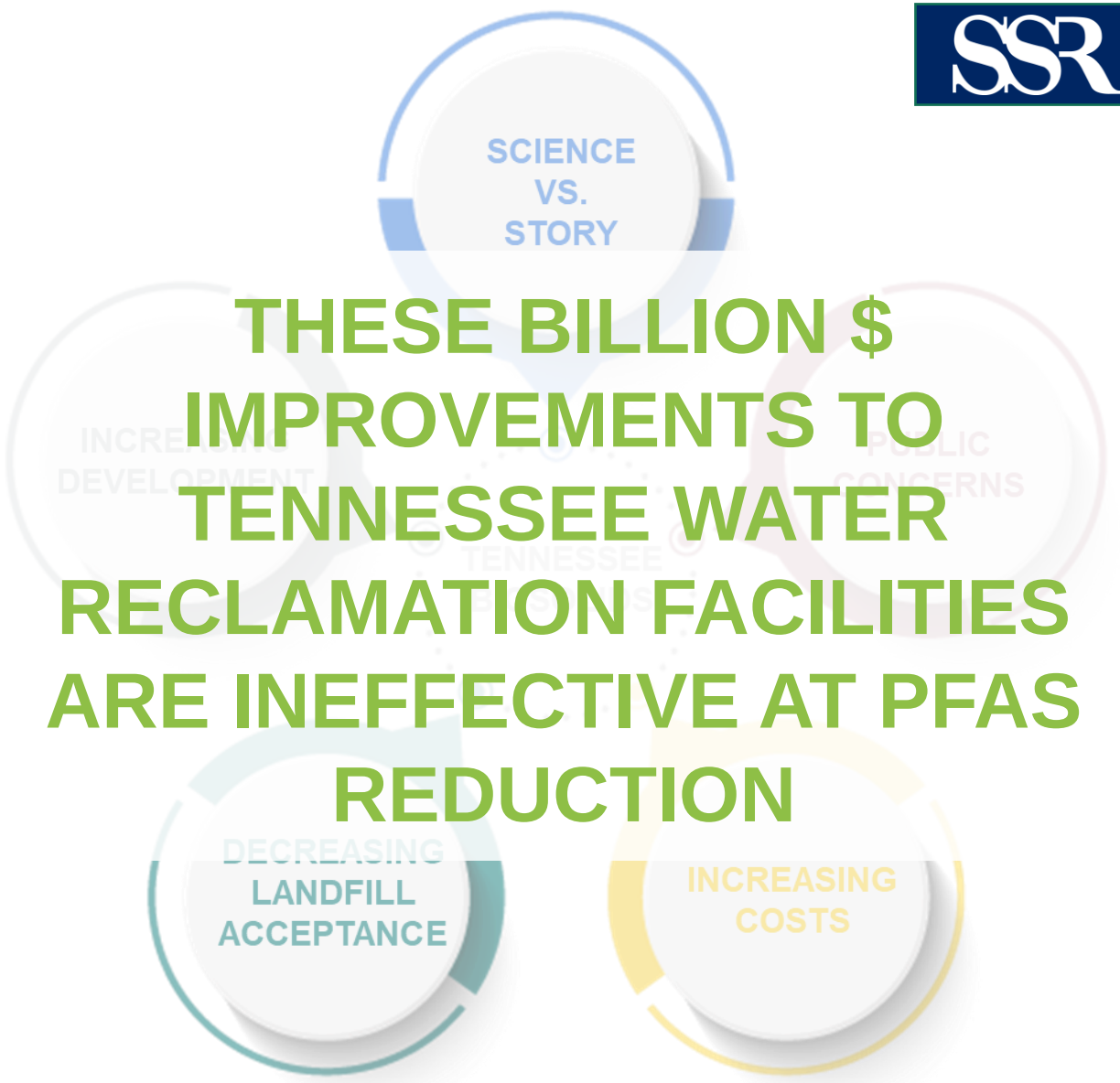
- Recent Unprecedented Capital Investment to Improve Biosolids Product
  - Class B (Screening, Grit Removal, Product Odor Control)
  - Class A (TPAD, ATAD, Incineration, Thermal Drying, Pyrolysis, Gasification, Thermal Hydrolysis (Digestion Intensification)

BIOSOLIDS PROCESSING IN TENNESSEE



Tennessee Water Utilities Investing $1 Billion in Improvements in the Next Several Years

PRESSURES ON EXISTING TENNESSEE BIOSOLIDS APPROACH



THESE BILLION $ IMPROVEMENTS TO TENNESSEE WATER RECLAMATION FACILITIES ARE INEFFECTIVE AT PFAS REDUCTION

PFAS CONTAMINATION IN TENNESSEE (2022)

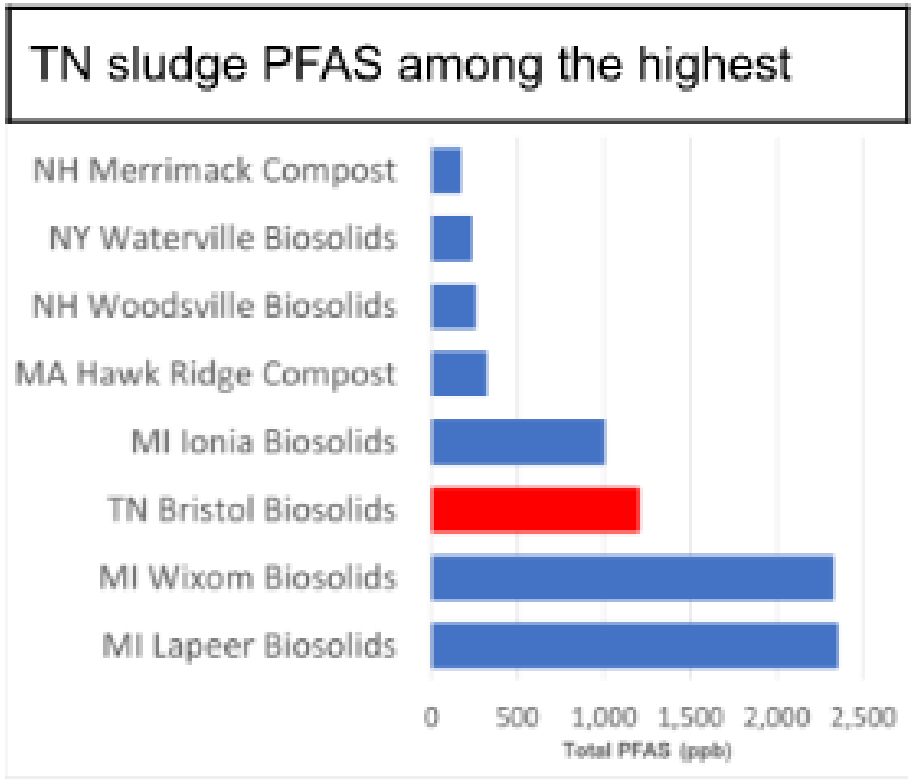
Lawsuit: Biosolids transport company wants to take Chattanooga's sludge to Polk County again

Sierra Club Reporting

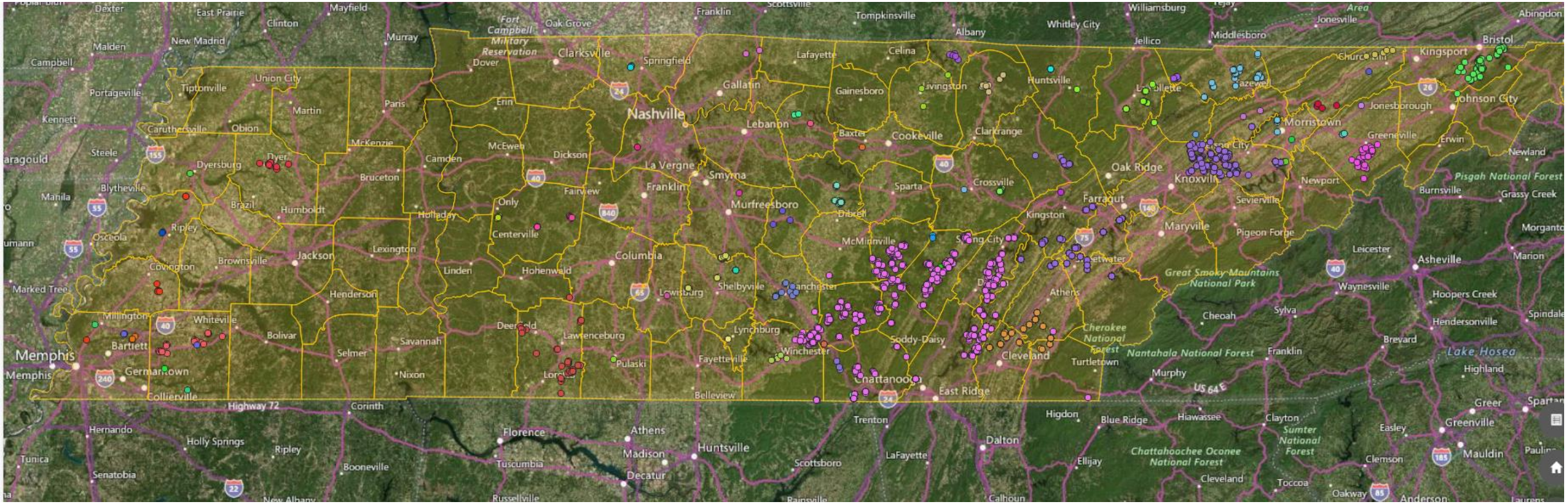
Tennessee Has a PFAS Problem

Discharges of PFAS are contaminating Tennessee's lakes, rivers and lands

- Extremely high levels of PFAS have been measured in Tennessee Wastewater Treatment Plant sludge applied to land
- High levels of PFAS are contaminating Tennessean's drinking water
- Tennessee does not understand the scope of the pollution
- Farms across in other states have been shut down
- TN Attorney General knows PFAS are a problem and is suing manufacturers over PFAS contamination

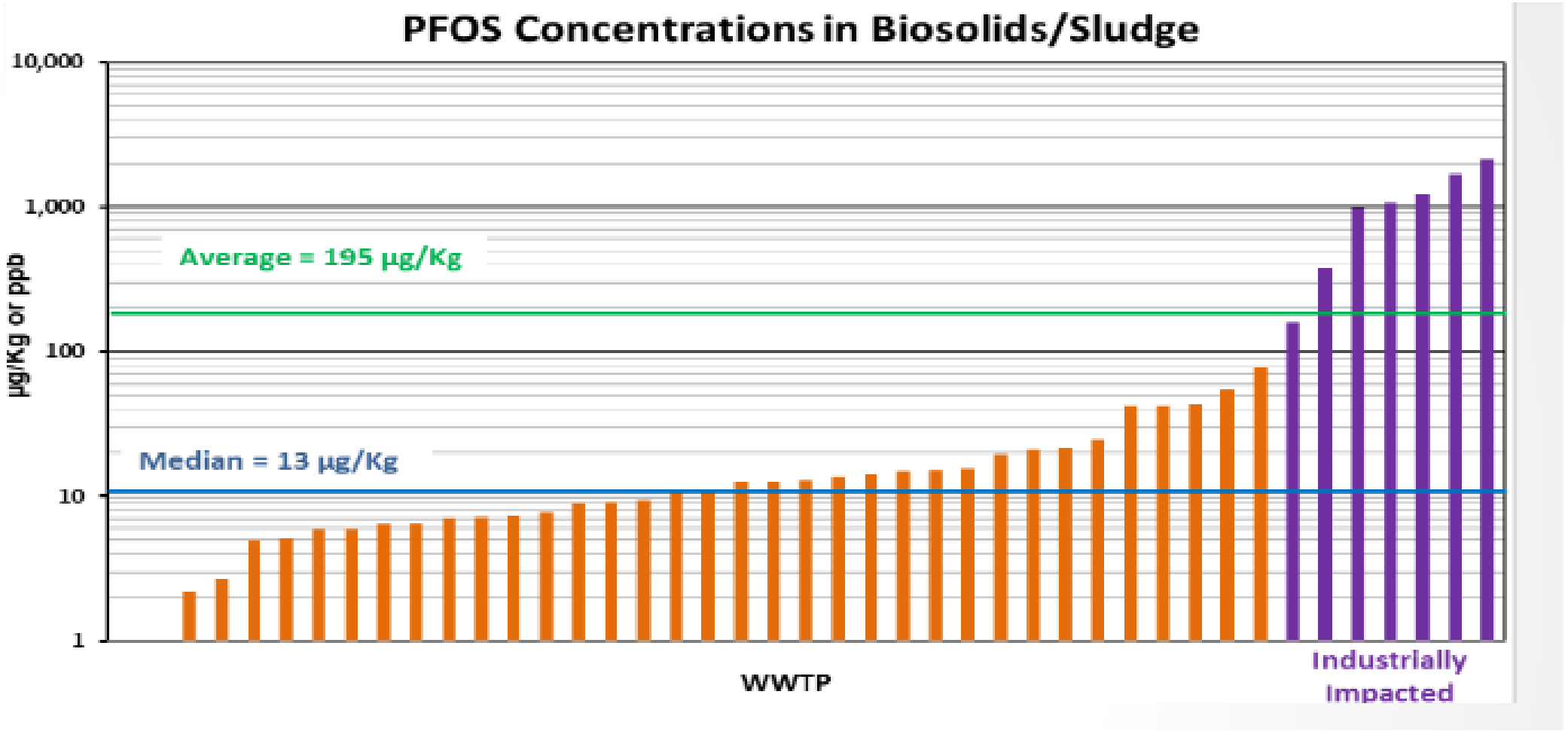


Tennessee Active Biosolids Land Application Sites



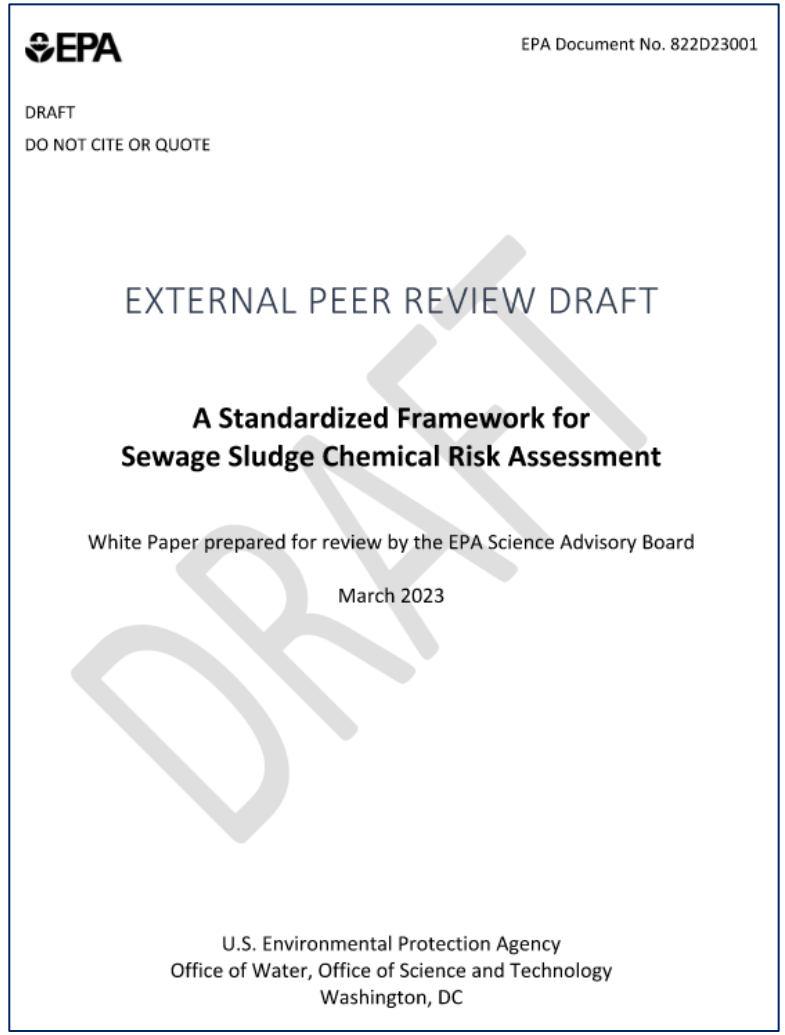
BIOSOLIDS PROCESS AT THE BREAKING POINT?

RESULTS FROM SURVEY OF MICHIGAN WWTPS



PFAS IN BIOSOLIDS

- EPA RISK ASSESSMENT FRAMEWORK
  - EPA's Prioritization Process
  - Biosolids Screening Tool (BST)
  - Refined Risk Assessment
  - Estimated Completion Dec 2024



EPA

EPA Document No. 822D23001

DRAFT

DO NOT CITE OR QUOTE

EXTERNAL PEER REVIEW DRAFT

A Standardized Framework for Sewage Sludge Chemical Risk Assessment

White Paper prepared for review by the EPA Science Advisory Board

March 2023

DRAFT

U.S. Environmental Protection Agency
Office of Water, Office of Science and Technology
Washington, DC

PFAS IN BIOSOLIDS

- RESPONSES TO EPA RISK ASSESSMENT FRAMEWORK
  - SAB Review
  - NACWA Review
  - WEF Review

NACWA

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June 28, 2023

Dr. Shaunta Hill-Hammond
Designated Federal Officer (DFO)
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue NW
Washington, DC

Submitted via electronic mail to: hill-hammond.shaunta@epa.gov

Re: NACWA Considerations for the Science Advisory Board Biosolids Panel's Review of the Standardized Framework for Sewage Sludge Chemical Risk Assessment and Biosolids Screening Tool

Dear Dr. Hill-Hammond:

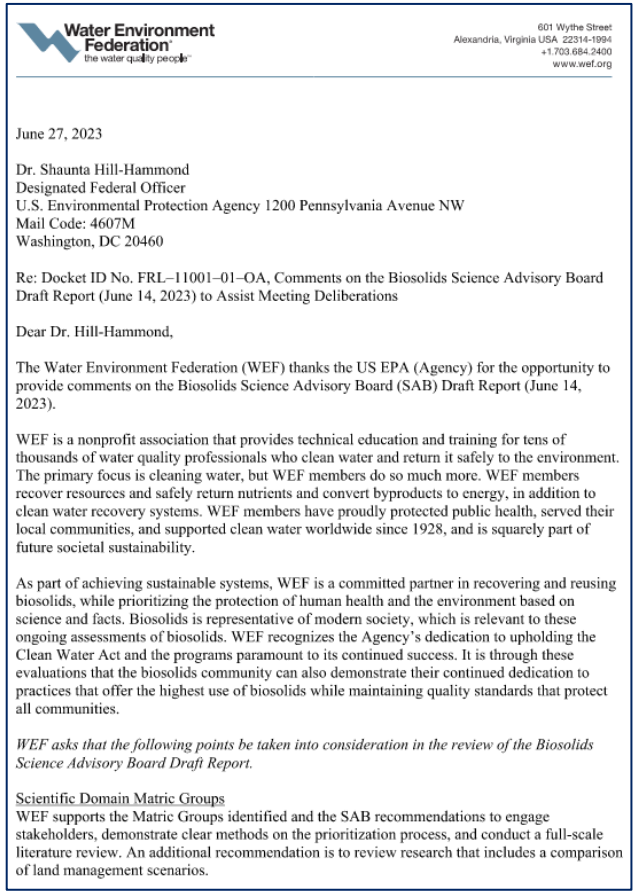
The National Association of Clean Water Agencies (NACWA) appreciates the opportunity to provide written feedback on the U.S. Environmental Protection Agency's (EPA) *Approach to Biosolids Chemical Risk Assessment and Biosolids Screening Tool* review before the Science Advisory Board (SAB) Biosolids Panel.

NACWA represents the interests of over 350 publicly owned wastewater utilities of all sizes across the country. Our members are anchor institutions in their communities that everyday provide the essential service of treating billions of gallons of our nation's wastewater and managing the millions of tons of biosolids generated as a byproduct of the wastewater treatment process in a manner that ensures the continued protection of public health and the environment.

We offer the following comments for the SAB:

The Biosolids Risk Assessment Framework Needs to Consider the Practical Implications of Implementation

The objective of the draft document *A Standardized Framework for Sewage Sludge Chemical Risk Assessment* (hereinafter referred as "Document") is to "allow EPA to prioritize and efficiently evaluate chemicals for their potential to cause harm" based on their concentrations in biosolids. While the framework presents a straight-forward tiered process, the actual steps require further refinement to ensure that the chemical prioritization and evaluation are appropriate for biosolids, labor and time-effective, and protective of



Water Environment Federation
the water quality people

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www.wef.org

June 27, 2023

Dr. Shaunta Hill-Hammond
Designated Federal Officer
U.S. Environmental Protection Agency 1200 Pennsylvania Avenue NW
Mail Code: 4607M
Washington, DC 20460

Re: Docket ID No. FRL–11001–01–OA, Comments on the Biosolids Science Advisory Board Draft Report (June 14, 2023) to Assist Meeting Deliberations

Dear Dr. Hill-Hammond,

The Water Environment Federation (WEF) thanks the US EPA (Agency) for the opportunity to provide comments on the Biosolids Science Advisory Board (SAB) Draft Report (June 14, 2023).

WEF is a nonprofit association that provides technical education and training for tens of thousands of water quality professionals who clean water and return it safely to the environment. The primary focus is cleaning water, but WEF members do so much more. WEF members recover resources and safely return nutrients and convert byproducts to energy, in addition to clean water recovery systems. WEF members have proudly protected public health, served their local communities, and supported clean water worldwide since 1928, and is squarely part of future societal sustainability.

As part of achieving sustainable systems, WEF is a committed partner in recovering and reusing biosolids, while prioritizing the protection of human health and the environment based on science and facts. Biosolids is representative of modern society, which is relevant to these ongoing assessments of biosolids. WEF recognizes the Agency's dedication to upholding the Clean Water Act and the programs paramount to its continued success. It is through these evaluations that the biosolids community can also demonstrate their continued dedication to practices that offer the highest use of biosolids while maintaining quality standards that protect all communities.

WEF asks that the following points be taken into consideration in the review of the Biosolids Science Advisory Board Draft Report.

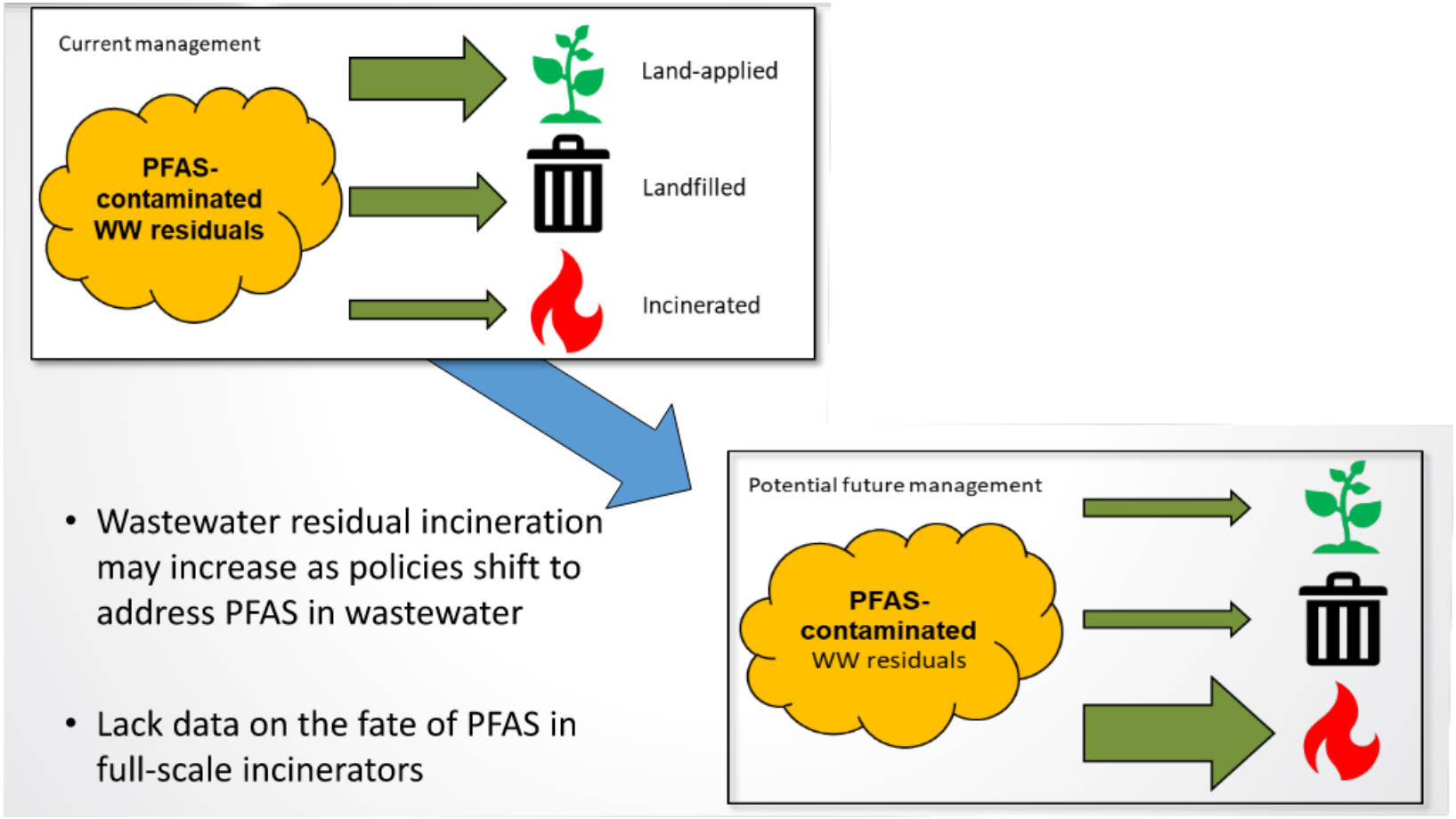
Scientific Domain Matric Groups
WEF supports the Matric Groups identified and the SAB recommendations to engage stakeholders, demonstrate clear methods on the prioritization process, and conduct a full-scale literature review. An additional recommendation is to review research that includes a comparison of land management scenarios.

PFAS IN BIOSOLIDS

- RESPONSES TO EPA RISK ASSESSMENT FRAMEWORK
  - Review Research that Includes Land Management Scenarios
  - Real World Reasonable Maximum Exposure (RME) Scenarios
  - Consider Background Levels & Intentionally Ingested Consumer Products
  - Framework needs an Off-ramp
  - Layers of Conservative Assumptions result in Excessive Risk and Hazard Quantification

SAB APPROVAL EXPECTED - SEPTEMBER 2023

CHANGING FATE OF WASTEWATER RESIDUALS



- Wastewater residual incineration may increase as policies shift to address PFAS in wastewater
- Lack data on the fate of PFAS in full-scale incinerators

Reference: EPA PFAS Treatment in Biosolids – State of Science, September 2020

CHANGING FATE OF WASTEWATER RESIDUALS

- In 2022, EPA water chief stated “EPA is facing a “frontier issue” as it grapples with addressing PFAS in biosolids but is **pledging to work with key groups to preserve the three management methods -- land application, incineration and landfilling** -- that wastewater treatment facilities currently use to dispose of biosolids while also protecting public health.”

Inside EPA, Oct 2022

CHANGING FATE OF WASTEWATER RESIDUALS

- EPA Lists PFOA/PFAS as Hazardous under CERCLA (April 2024)
- Responses from Utility Advocates (NEBRA, NACWA, WEF, CASA)
  - PFAS Producers and Heavy Users Are Not the Same as PFAS Receivers
  - Request for Specific Exemption for Public Water Utilities
  - Beneficial Use is Not Disposal

COMPARING STATE RESPONSES

REVIEW OF STATE RESPONSES: MAINE

- Milk contamination led to moratorium on land application in March 2019.
- In July 2022, state law bans biosolids application to soils/land.
- In February 2023, bulk material import ban to landfills.
- The result:
  - Massive amounts of biosolids disposal at landfills caused unstable conditions;
  - Inability to remove solids from WWTFs resulted in permit compliance issues, odor complaints, rate hikes.
- Maine is now looking Long-Term at Regional Facilities (Time/$$$$)

REVIEW OF STATE RESPONSES: MICHIGAN

Guidance Recommendations on Land Application

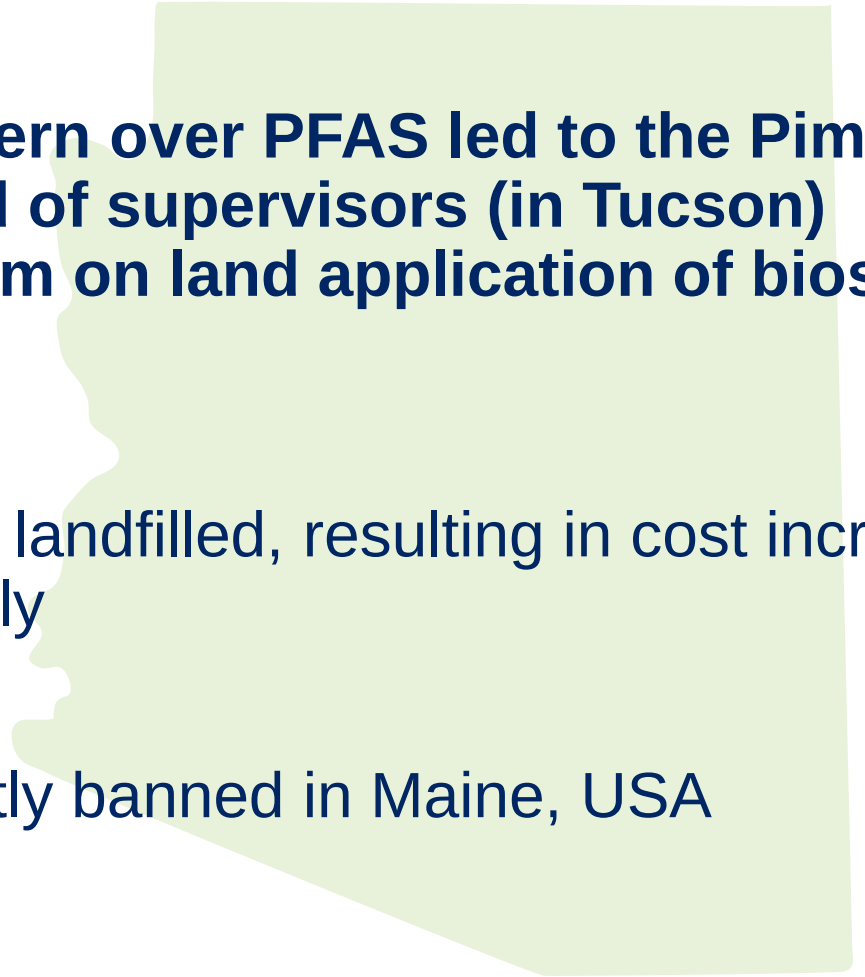
PFOS concentration > 150 ppb
- Land application not allowed!
- Alternative disposal (landfilling) required.
- Investigate source reduction of PFAS

PFOS concentration > 50 and <150 ppb
- Land application allowed at no more than 1.5 DT/acre
- Investigate source reduction of PFAS

PFOS concentration < 50 ppb
- Land application is allowed
- If PFOS > 20 ppb, consider investigating sources

Source: Michigan EGLE Land Application of Biosolids Containing PFAS; Interim Strategy, March 2021

REVIEW OF STATE RESPONSES: ARIZONA



- **In January 2020 concern over PFAS led to the Pima County Arizona board of supervisors (in Tucson) imposing a moratorium on land application of biosolids in Pima County**

- Biosolids subsequently landfilled, resulting in cost increase of $1.3m to $3.3m annually

- Land application recently banned in Maine, USA

REVIEW OF STATE RESPONSES: ARIZONA

Collaborative study between University of Arizona and Pima County Wastewater to answer: IS LAND APPLICATION A MAJOR SOURCE OF PFAS?

Field study implemented in Pima County in March 2020

- Surface and depth soil samples collected from agricultural plots that had received **known loadings of biosolids since 1984**
- Analyzed for PFAS
- Biosolids and groundwater samples also assayed
- Appropriate controls also utilized

PROJECT SAMPLE PLAN CRITERIA

Field Type	Agriculture	Irrigated with groundwater	Cumulative biosolids applied	Duration of application (years)
Undisturbed	No	No	None	--
Agricultural	Yes	Yes	None	--
Group 1	Yes	Yes	≤20 (tons/acre)	4-9
Group 2	Yes	Yes	21-30 (tons/acre)	12-20
Group 3	Yes	Yes	>30 (tons/acre)	6-9

ARIZONA RESPONSE HIGHLIGHTS

- Low incidence of PFAS analytes in soils with long-term land application of biosolids
- PFAS soil concentrations in irrigated agricultural plots were fairly similar with or without land application of biosolids
- Biosolids and irrigation water were both sources of PFAS
- 72% attenuation of PFAS occurred within the surface 6 feet of soil

MORATORIUM ON LAND APPLICATION RESCINDED IN NOVEMBER 2020

PIMA COUNTY RESEARCH: LOCAL PROBLEM SOLVED BY LOCAL STUDY

- Peer-review publication:
- *Science of the Total Environment*: 793 (2021) 148449

FOR A NATIONAL PROBLEM WE NEED A NATIONAL STUDY

National Collaborative Project Overall Objective

To evaluate whether or not land application of biosolids is a significant public health route of exposure to PFAS in Multiple Geographic Regions in the U.S.

ALREADY ESTABLISHED PARTNERS

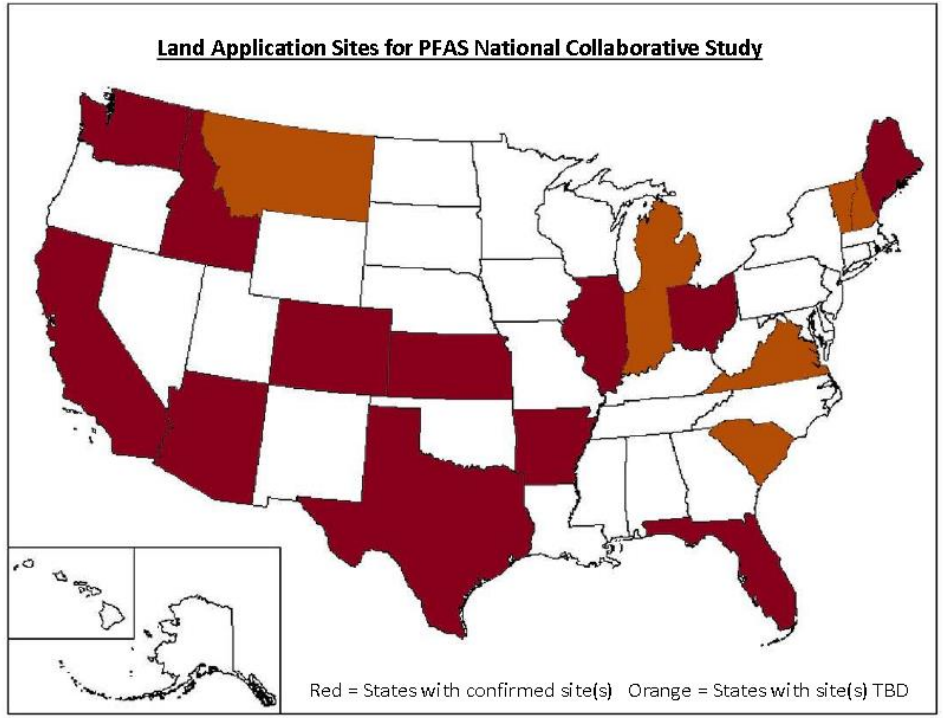
1. **Utilities:** major wastewater treatment plant that recycles its biosolids via land application

2. **Non-Profit Associations:** Groups such as CASA, NACWA, NEBRA, MABA, NW Biosolids, Arizona Business Council are all on board. These groups in turn are well connected with utilities.

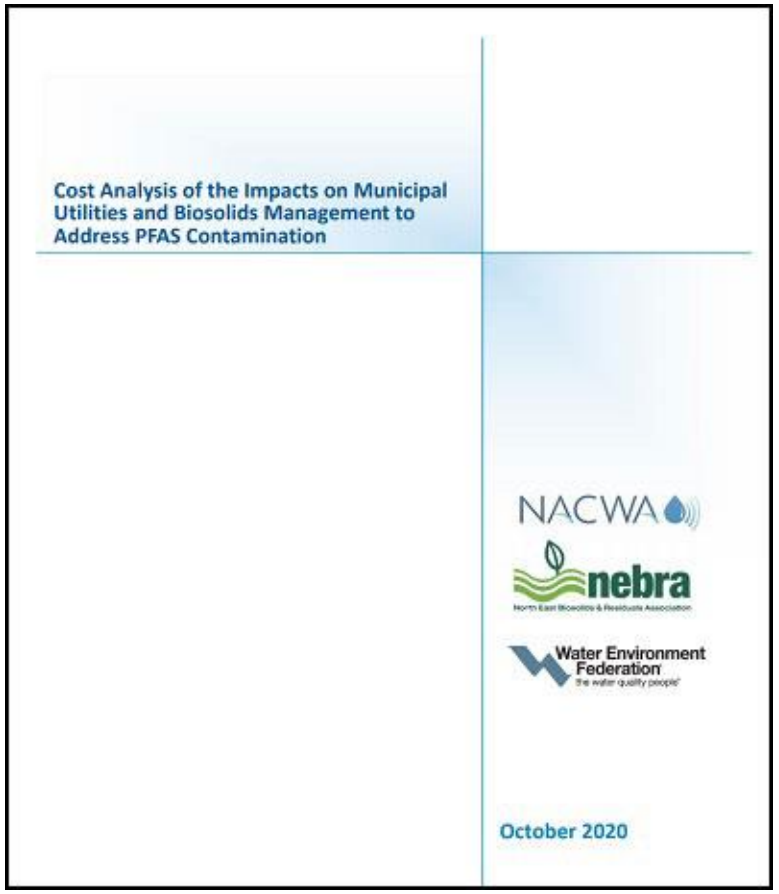
3. **Private Sector:** Companies that manage biosolids for public agencies will be contacted. These include companies like Synagro, Denali Water.

POTENTIAL SITES TO BE SAMPLED (to date)

- Sampling began in fall 2022 and has continued throughout 2023. As of November 2023, 20 sites from states around the country had completed sampling with an additional three (3) sites in progress (see map). Soil characterization and PFAS analyses are ongoing..
- Necessary criteria to be eligible for the project
  - Long-term (>10 years) land application
  - Known loading rate of biosolids
  - If possible, multiple loading rates (2 or 3 different rates) plus control (no biosolids)
  - Any soil PFAS data from prior years
  - Rainfall or irrigation data, if possible
  - Soil characterization data, if possible
  - Depth to groundwater
  - PFAS analytical data from biosolids, if available

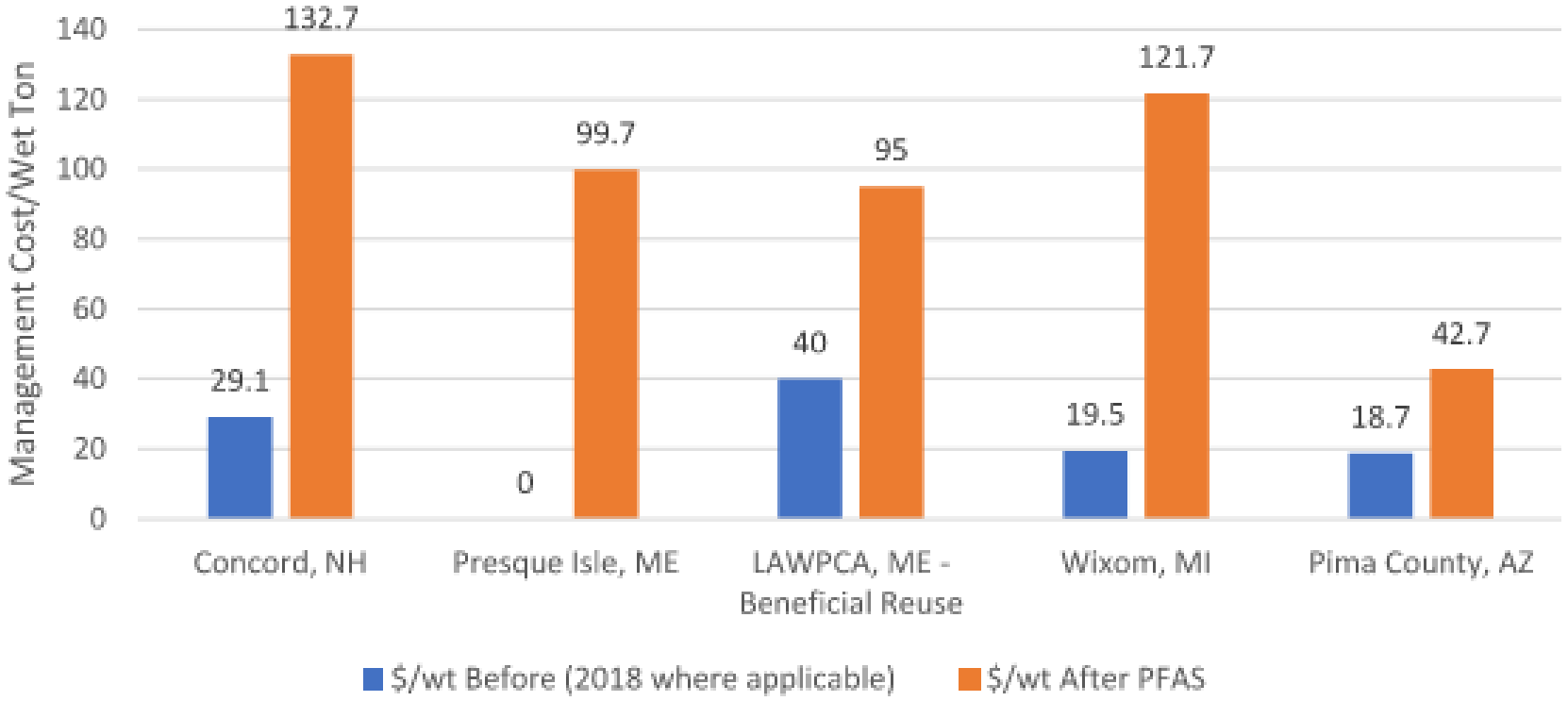


BIOSOLIDS COST IMPACTS TO ADDRESS PFAS



- Collaborative Study
  - NACWA
  - NEBRA
  - WEF
- Inform PFAS Policy Decision Makers
- Identify Unintended Consequences
- “Ensure that WRRFs are not unduly penalized for receiving and processing PFAS that they did not produce while appropriately protecting public health and the environment.”

COST IMPACTS OF FACILITIES THAT SWITCHED FROM BENEFICIAL REUSE TO LANDFILL DISPOSAL IN RESPONSE TO PFAS REGULATIONS



Source: Cost Analysis of the Impacts on Municipal Utilities and Biosolids Management to Address PFAS Contamination, October 2020

CONCLUSIONS

- Average Biosolids Management Cost Increased by 74%
- Beneficial Reuse Programs Appear to Experience the Most Significant Cost Impacts Due to PFAS
- Common Concerns
  - Lack of Capacity for Biosolids Disposal
  - Public Perception: Scrutiny Over Land Application Practice
  - Liability Concerns
  - Basis of Decisions: Political vs Science vs Fiscal Feasibility

Source: Cost Analysis of the Impacts on Municipal Utilities and Biosolids Management to Address PFAS Contamination, October 2020

TECHNOLOGIES TO DESTROY PFAS IN BIOSOLIDS:

- Incineration with excess oxygen
- Super Critical Water Oxidation (SCWO) – 374 Water
- Pyrolysis – Bioforcetech, PYREG, Anaergia, CharTech
- Gasification – Aries Environmental

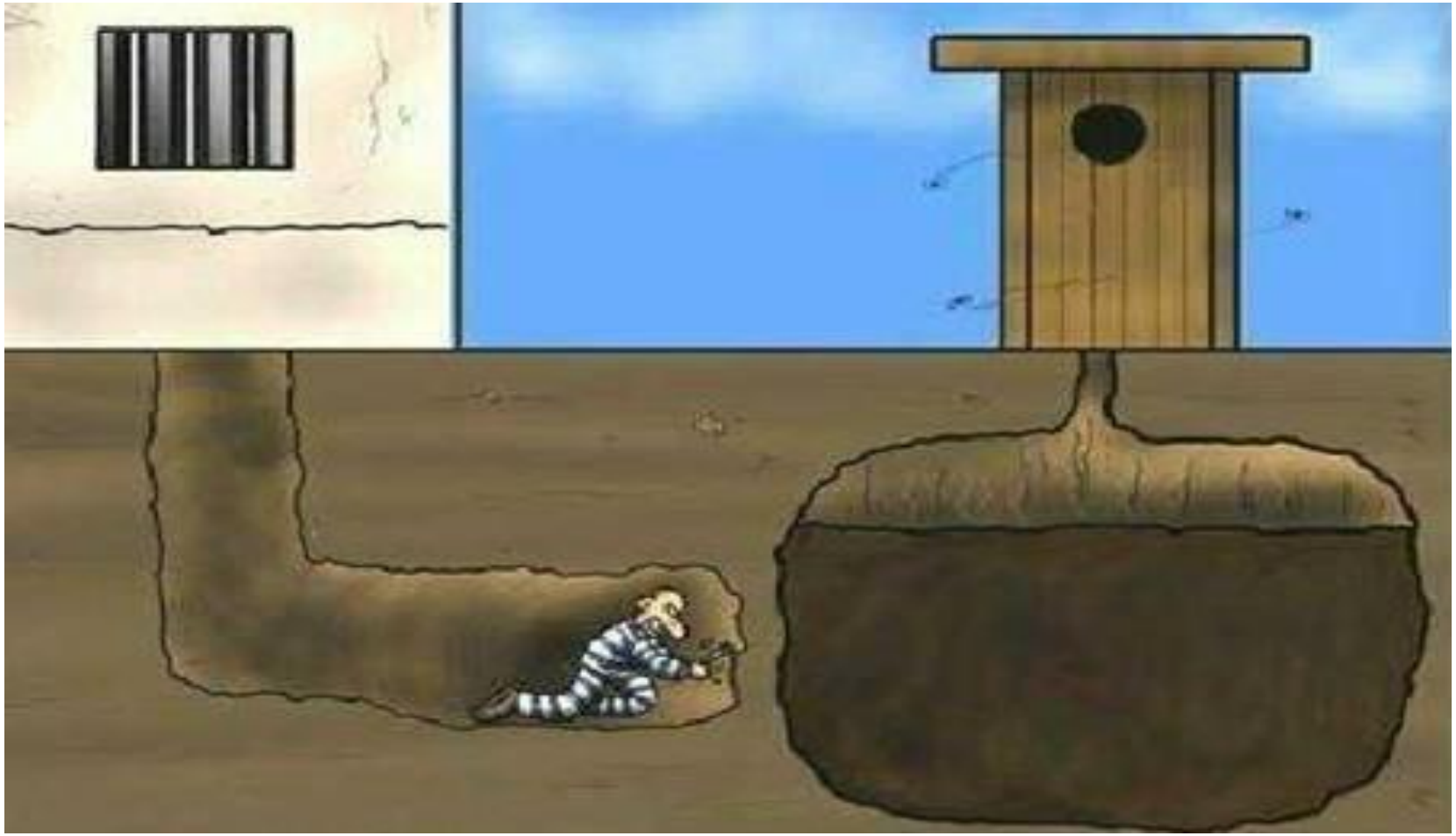
TECHNOLOGIES TO DESTROY PFAS IN BIOSOLIDS:

- To date most of the work has been done using standard incineration.
- Full-scale biosolids trials using gasification and pyrolysis completed.
- Concerns related to off-gases expressed
- **Further scientific validation** of PFAS thermal treatment technologies is needed.

MAIN TAKEAWAYS

- **Tennessee Water Utilities Are Water and Environmental Stewards That Garner Public Trust.**
- **PFAS in Water and Biosolids are in Trace Amounts and Reflect the “Everywhere” Nature of PFAS**
- **PFAS Monitoring Must Begin; Treatment Requirements by 2029**
- **Communicate to the Communities You Serve; Be Proactive; Consider Public Fact Sheets**
- **Compelling Public Policy Reasons to Maintain a Full Range of Biosolids Management Options**

SOMETIMES PROGRESS CAN BE HEADED IN THE WRONG DIRECTION



When it comes to PFAS, a cautious, reasoned approach is warranted.

QUESTIONS

PFAS IN MUSIC CITY GOLD, NASHVILLE BIOSOLIDS

Metro Water Services voluntarily tested a fresh unbagged representative sample of our finished Class A EQ Biosolids earlier this year, using a third-party State certified laboratory.

In their analysis, only 5 of the 36 chemicals were at levels that could be accurately quantified - 17 of the 36 chemicals were undetected, and 14 were detected but below the instrument's ability to accurately quantify (LOQ).

Class A EQ biosolids	PFOA	PFOS
Level	Non-Detect	3.72 PPB

Reference: Per- and polyfluoroalkyl substances (PFAS) in Davidson County Drinking Water | Nashville.gov

RECENT CALIFORNIA LEGISLATIVE ACTIONS

- Assembly Bill 2771 updates existing law beginning Jan. 1, 2025, to prohibit the sale, delivery, holding, or offering for sale of any cosmetic product that contains intentionally added PFAS.

- AB 1817 expands an existing law governing food packaging that contains regulated PFAS substances to include textile articles as well. The new law, which also goes into effect in 2025, requires the manufacturer to use the least toxic alternative when replacing the PFAS in the product.

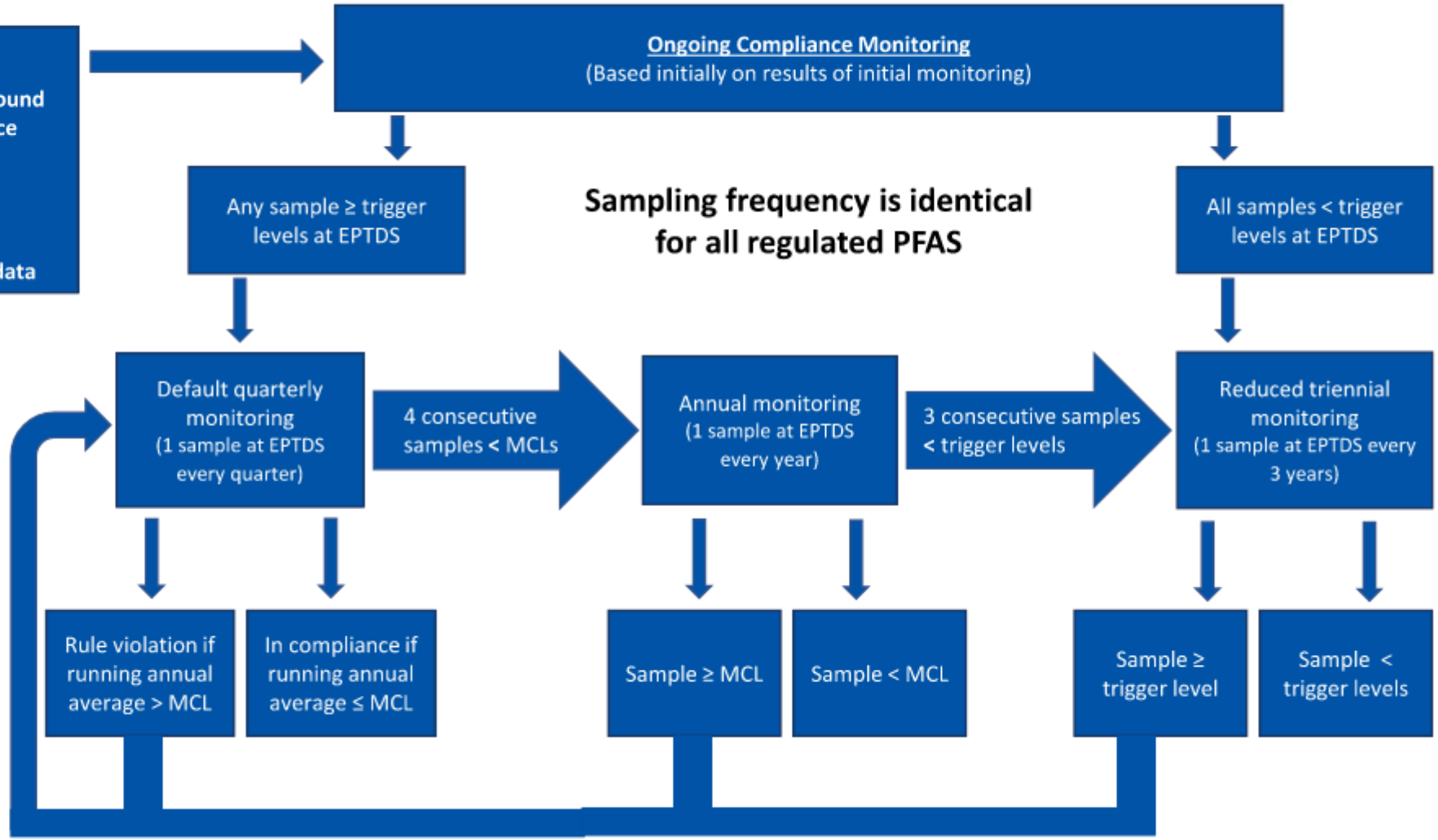
Implementation: Monitoring Requirements Summary

Initial Monitoring

- Four quarterly samples within a 12-month period for ground water systems serving greater than 10,000 and all surface water systems
- Two semi-annual samples within a 12-month period for ground water systems serving 10,000 or fewer

OR

- Use of recent, existing PFAS drinking water occurrence data



Rule Trigger Levels (1/2 MCLs)

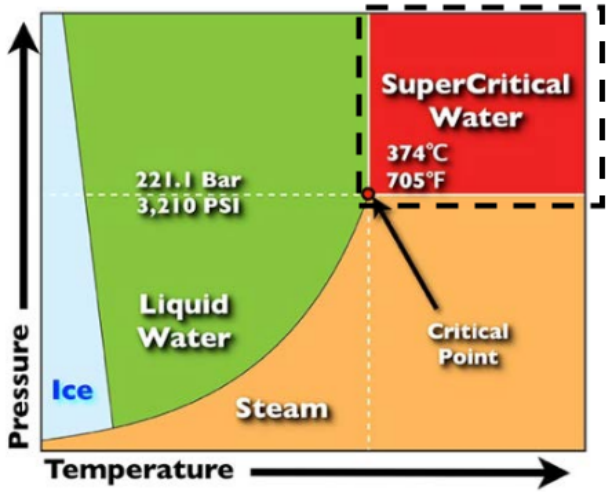
- PFOA and PFOS = 2.0 ppt
- PFHxS, HFPO-DA, and PFNA = 5 ppt
- Hazard Index = 0.5 (unitless)

* EPTDS = Entry point to the distribution system

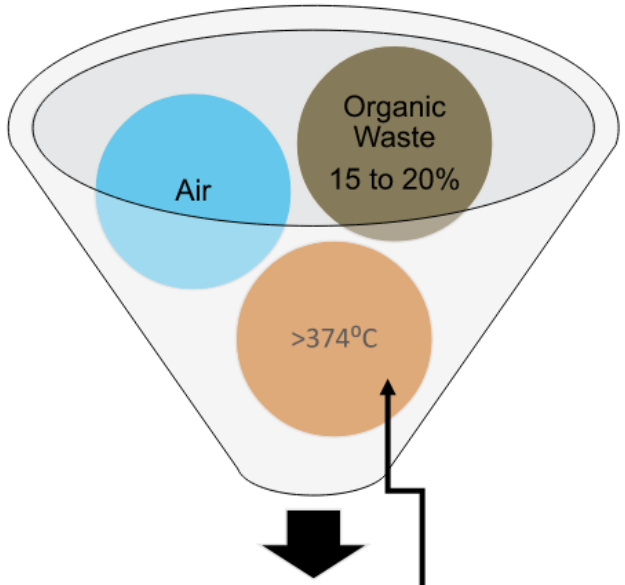
TECHNOLOGIES TO DESTROY PFAS IN BIOSOLIDS:

- SCWO
  - Uses a combination of heat and pressure to destroy PFAS and other organic materials and has demonstrated destruction of short-chain PFAS.
  - It is most applicable for wastes that have high energy contents, such as biosolids or sorption media.
  - SCWO also has the potential to be energy-positive through recovery of heat from high-energy feedstocks.
  - Biosolids introduced as dewatered cake (15% solids)

SUPERCRITICAL WATER OXIDATION:



Source: *Adapted from 374WATER AirSCWO™*



Water + Air + Minerals + Heat + Electricity

Merrell Bros. and 374Water entered into a manufacturing and service agreement in 2021.

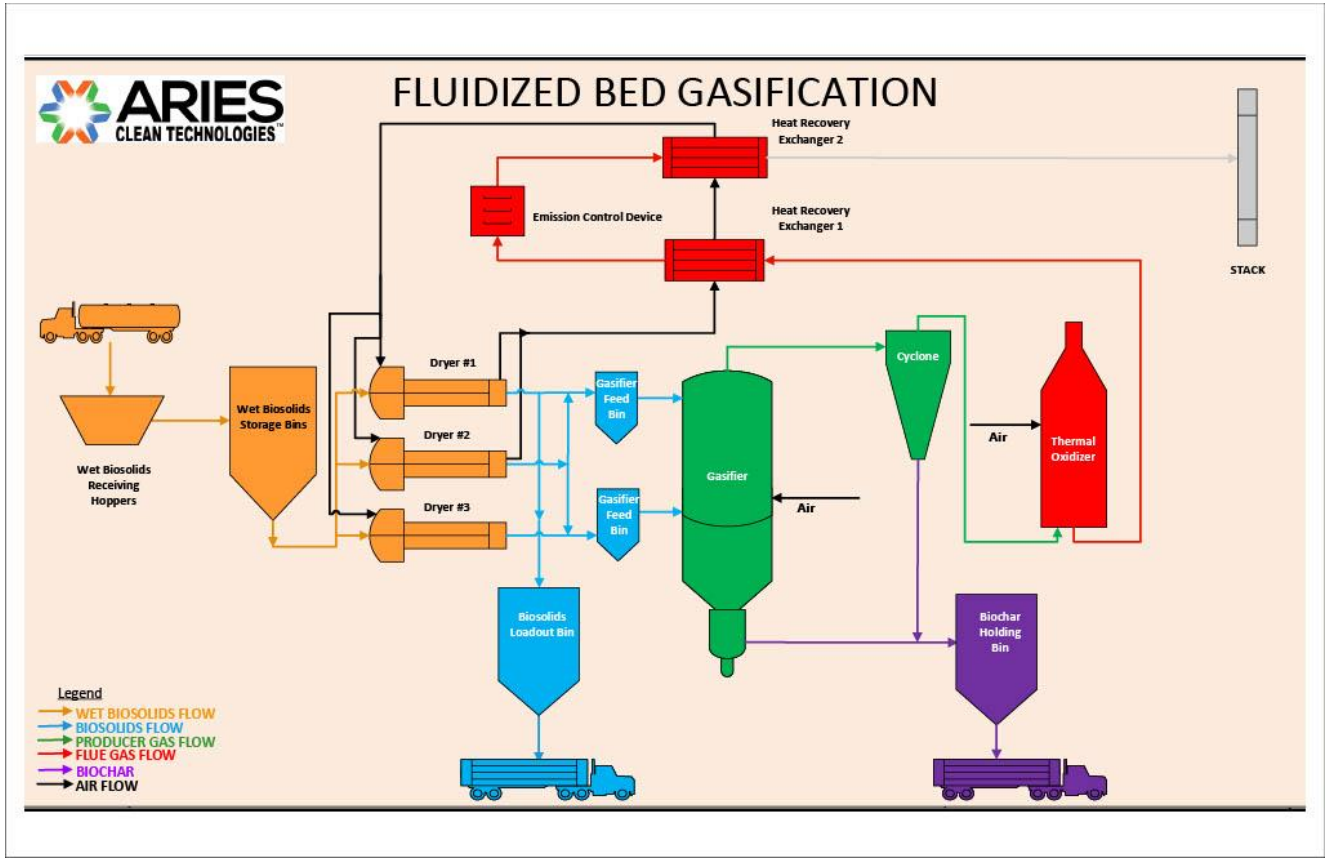
OCSD teamed with 374Water and Merrell Brothers to commission six (6) wtpd commercial unit.

PYROLYSIS AND GASIFICATION:

- Technologies that limit oxygen inputs during high-temperature treatment.
- Pyrolysis at 1100 Deg F. Biochar results in PFAS ND (< 2 ppb)
- However, the destruction efficacy of PFAS in the gas phase needs further evaluation.
- May use dewatered cake or dried solids

PYROLYSIS AND GASIFICATION:

- **Project Snapshot**
- Patented fluidized bed facility located at the City of Taunton, MA Sanitary Landfill
- Permitting underway
- Process 470 tons per day of biosolids
- Produce 25 tons of beneficial biochar daily



WHAT ABOUT MUSIC CITY GOLD, NASHVILLE'S BIOSOLIDS?

Metro Water Services voluntarily tested a fresh unbagged representative sample of our finished Class A EQ Biosolids earlier this year, using a third-party State certified laboratory.

Class A EQ biosolids	PFOA	PFOS
Level	Non-Detect	3.72 PPB

PFAS

- 1000’s of chemical compounds
- Long Chain not equal to Short Chain
- Long Chain
  - Generally More Toxic
  - PFOS, PFOA
  - Industry Suspension of PFOS/PFOA Compounds phased out of U.S. Production in 2002 and 2015, respectively
  - Less Plant Uptake
- Short Chain
  - Generally Less toxic (not GENx)
  - Greater plant uptake

TESTING METHODS

- EPA Method 1633: Test Method PFAS in LL, WW, SW, GW and Biosolids
  - Collaboration between EPA and DOD to analyze 40 PFAS compounds;
  - Single lab validated (1st Draft 2021; 2nd Draft July 2022);
  - Multi-lab validation (Late 2022)

- EPA Method 1621: Screening Method for the Determination of Adsorbable Organic Fluorine (AOF)
  - Draft Method (April 2022)

PFAS AND BIOSOLIDS

PFAS Potential Exposure from Biosolids

- Direct exposure (minimal risk)
- Indirect exposure
  - Drinking water
  - Plant/animal uptake
- Bioaccumulation

THE ISSUE

- PFAS identified as causing adverse human health effects
- PFAS known to be present in wastewater and ultimately in biosolids

THE QUESTION

- Does land application of biosolids result in significantly increased human exposure to PFAS?
- **Will it lead to national or state bans or severe restrictions?**

ROUTES OF EXPOSURE:

- Exposure to PFAS in groundwater (leaching through soil)
- Exposure to PFAS in crops (plant uptake)

CLASSIC RESEARCH MISTAKES

Research Mistake #1:

Pot studies instead of field studies

Research Mistake #2:

10x agronomic rate is not the same as 10 years at 1x rate

Research Mistake #3:

Spiked chemicals not the same as chemicals within biosolids