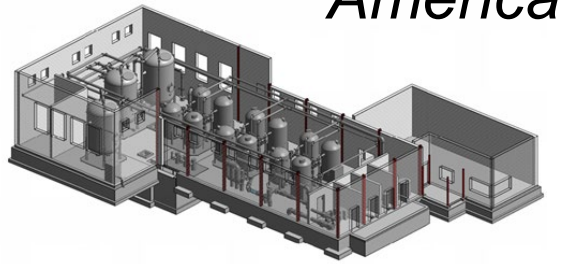
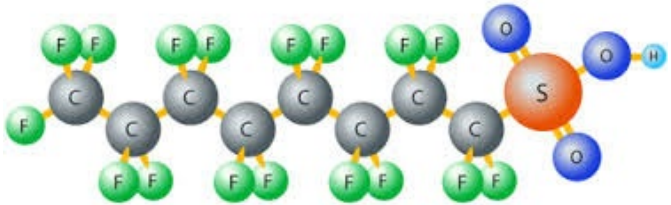
PFAS and Connecticut Activities

Connecticut River Valley Section

American Industrial Hygiene Association

October 25, 2022



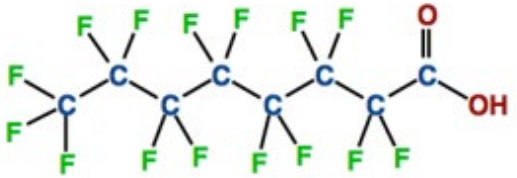


AGENDA

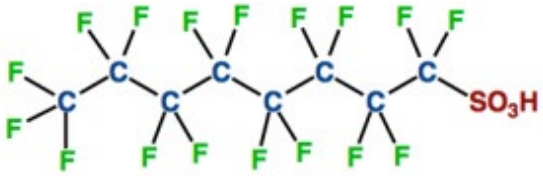
- What are PFAS and why do we care?
- Where are PFAS used for and how do they get into our environment.
- Current Regulatory Status
  - EPA vs State
  - Wastewater/Direct Discharge.
  - Biosolids.
  - Surface Water.
- What are WWTF Studies Showing?

What are PFAS?

- Per- and Polyfluoroalkyl Substances (EPA Definition)
- PFAS are partial to fully fluorinated, organic compounds tha have been produced in the largest amounts within the United States
- PFAS are the family of synthetic chemicals that include long chains of carbon and fluorine
- Have unique lipid- and water-repellent characteristics, and are used as surface-active agents in various high-temperature applications and as a coating on surfaces that contact with strong acids or bases



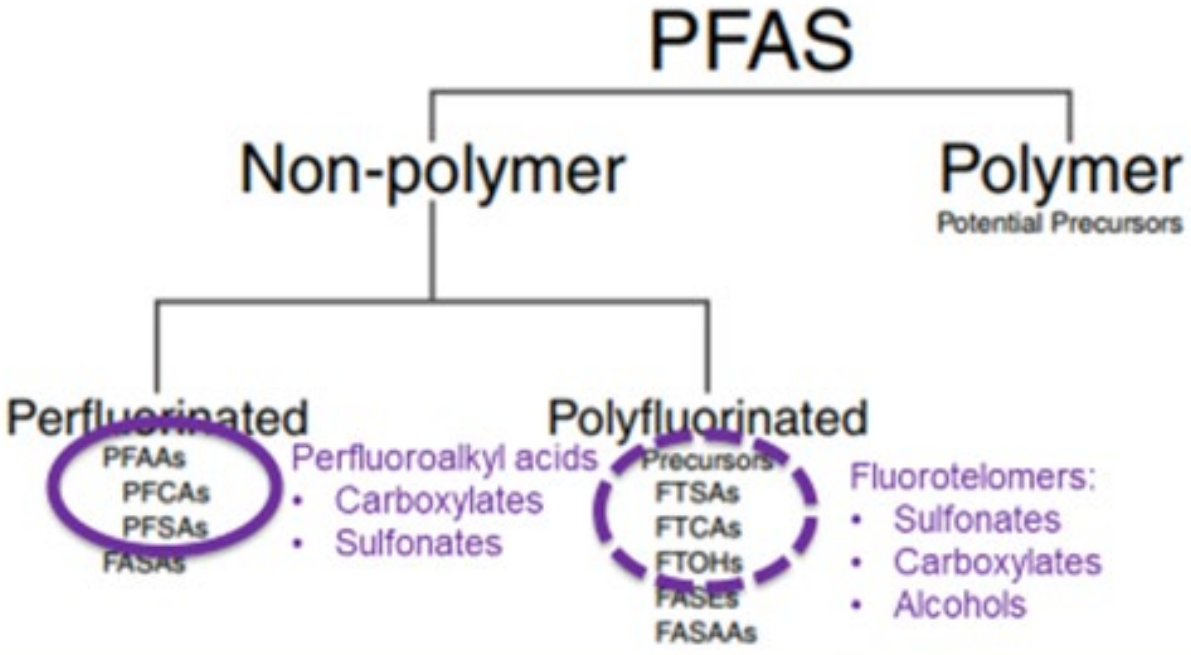
PFOA - perfluorooctanoic acid



PFOS - perfluorooctanesulfonic acid

"FOREVER CHEMICALS"

The General Classes of Per- and Polyfluoroalkyl Substances (PFAS)



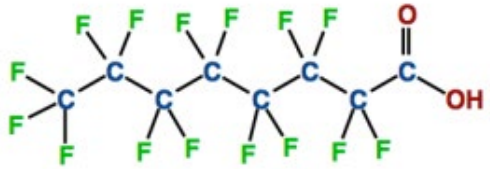
Source: ITRC Naming Conventions and Physical Chemical Properties factsheet

Structural Makeup

- Anionic Perfluorinated Alkyl Acids (Terminal, NO BREAKDOWN)
  - Negatively charged
  - Low vapor pressure
  - Water soluble

PFAAs generally act as surfactants with tail in the air and head in water

Perfluorinated TAIL Anionic HEAD



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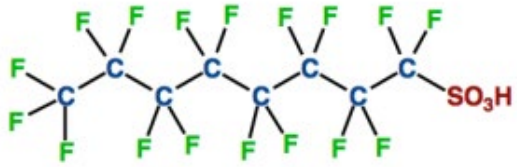

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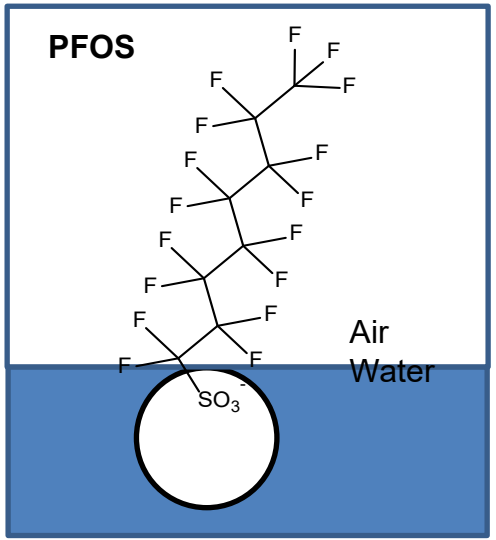
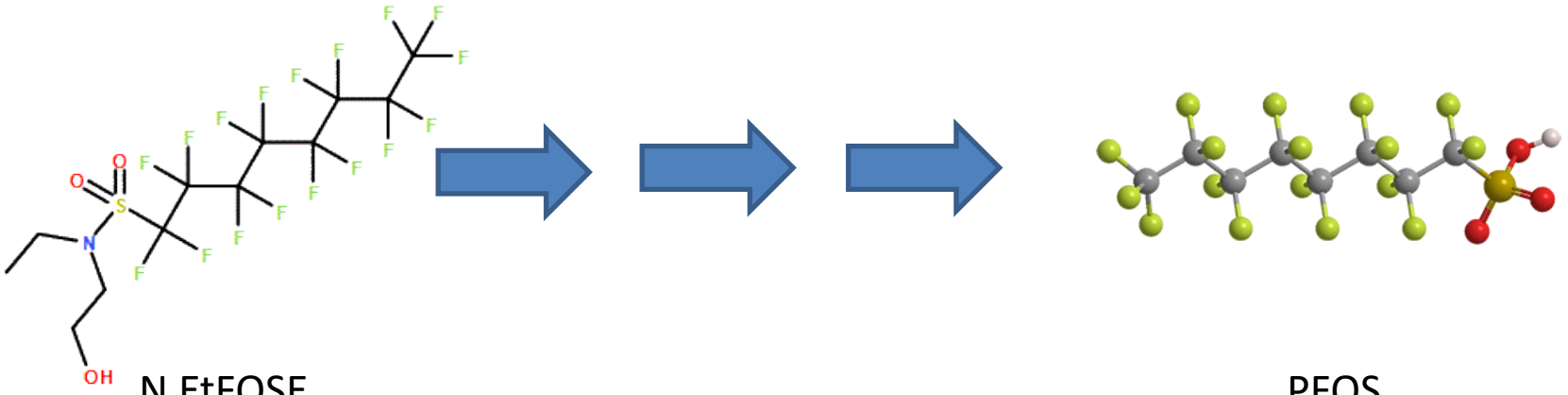


Precursors

- Polyfluorinated Alkyl Substance (Abiotic and Biotic Breakdown Possible)
  - State of charge may dominate retardation
    - Anions > Cations > Zwitterions
  - Short Chains generally migrate faster
  - Cation exchange onto soils may be significant….on par with organic carbon
  - **Transformation into Perfluorinated end products may occur with distance from source and/or oxidization.**



N EtFOSE

PFOS

Historic Uses

- Used in fire fighting and odor control foams, Aqueous Film-Forming Foam (AFFF)
- Also used in industrial and commercial products including:
  - Textiles and leather products (Gore-Tex, Polartec)
  - Metal plating
  - Stain-resistant fabric
  - Photographic industry/photolithography
  - Semi-conductors
  - Paper and packaging (fast food wrappers)
  - Coating additives (Teflon)
  - Cleaning products
  - Pesticides

PFAS Production and Use History

Table 2-1. Discovery and manufacturing history of select PFAS

PFAS[1]	Development Time Period							
	1930s	1940s	1950s	1960s	1970s	1980s	1990s	2000s
PTFE	Invented	Non-Stick Coatings			Waterproof Fabrics			
PFOS		Initial Production	Stain & Water Resistant Products	Firefighting foam				U.S. Reduction of PFOS, PFOA, PFNA (and other select PFAS[2])
PFOA		Initial Production		Protective Coatings				
PFNA					Initial Production	Architectural Resins		
Fluoro-telomers					Initial Production	Firefighting Foams		Predominant form of firefighting foam
Dominant Process[3]		Electrochemical Fluorination (ECF)						Fluoro-telomerization (shorter chain ECF)
Pre-Invention of Chemistry /			Initial Chemical Synthesis / Production			Commercial Products Introduced and Used		

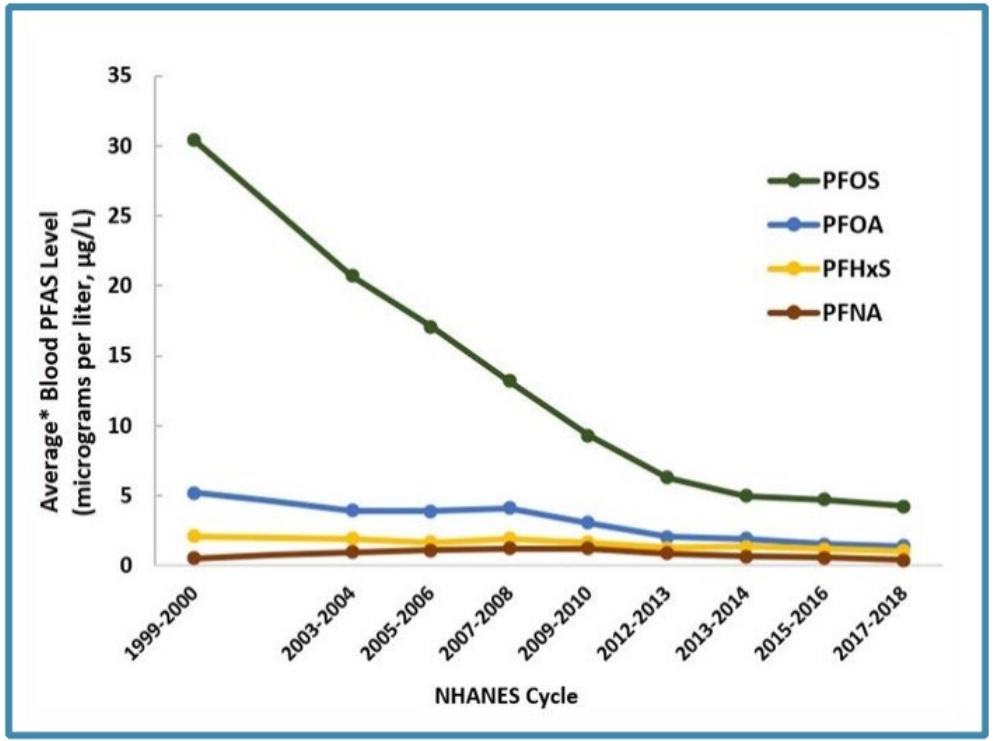
Notes:
1. This table includes fluoropolymers, PFAAs, and fluorotelomers. PTFE (polytetrafluoroethylene) is a fluoropolymer. PFOS, PFOA, and PFNA (perfluorononanoic acid) are PFAAs.
2. Refer to Section 3.4.
3. The dominant manufacturing process is shown in the table; note, however, that ECF and fluorotelomerization have both been, and continue to be, used for the production of select PFAS.

Sources: Prevedouros et al. 2006; Concawe 2016; Chemours 2017; Gore-Tex 2017; US Naval Research Academy 2017

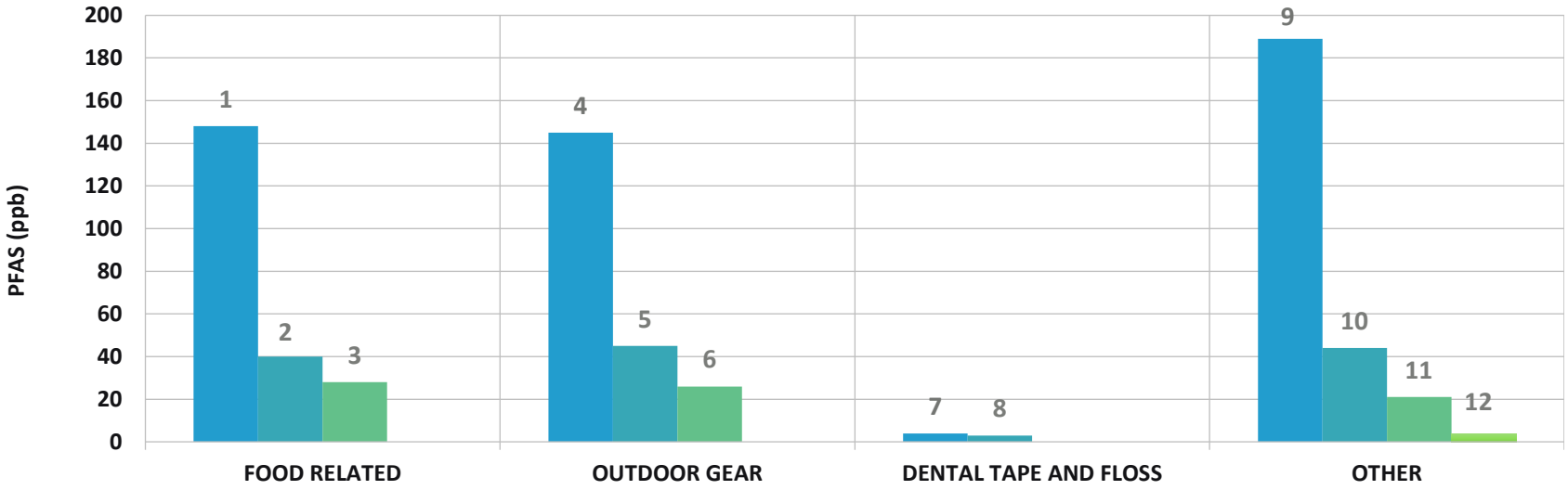
Source: ITRC PFAS Fact Sheet 4/20

Exposure Should Be Decreasing

- Manufacturers in US phased out PFOA production and PFOA usage in 2002.
- Stockpiles of AFFF are slowly decreasing
- PFOA concentrations in blood serum decrease once exposure stopped



Various levels of PFAS in everyday items



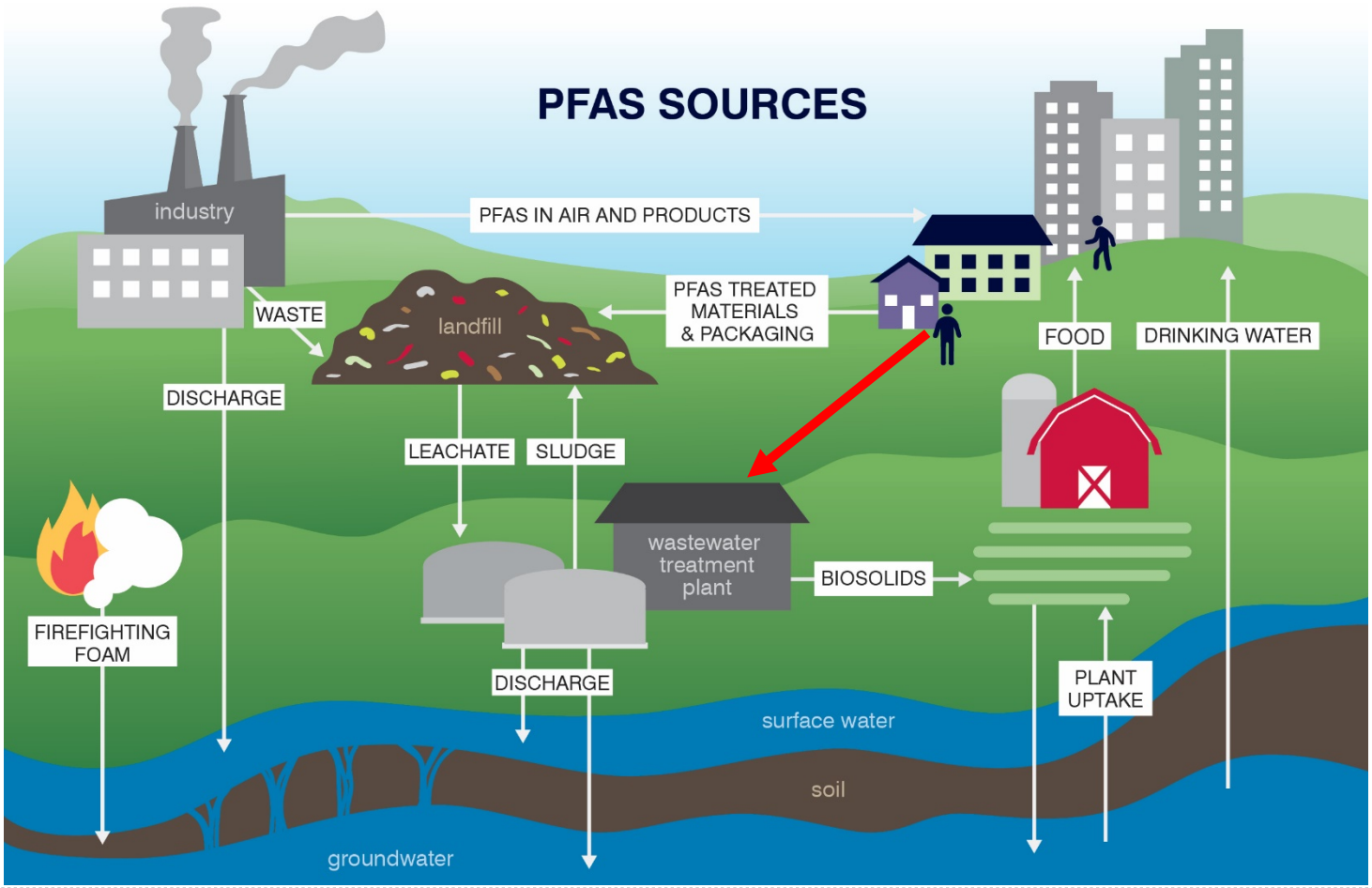
FOOD RELATED		OUTDOOR GEAR		DENTAL TAPE AND FLOSS		OTHER	
Popcorn bags[1]	148	Ski wax[4]	145	Dental tape(PTFE based)[7]	4	Leather[9]	189
PTFE cookware[2]	40	Gloves[5]	45	Dental floss(PTFE based)[8]	3	Impregnation sprays[0]	44
Food packaging materials[3]	28	Waterproof textiles[6]	26			Awning cloth[11]	21
						Carpet & Cleaner[12]	4

Where is it?

- Airports
- Air Force Bases
- Naval Facilities
- Fire Fighting Academies
- Manufacturing Facilities
- Wastewater Treatment Facilities
- Landfill Leachate

Source Type

- AFFF Sources
  - AFFF is a mixture of compounds - <5% PFAS
  - There can be many PFAS (short and long) and precursors
  - Hydrocarbons from fire source
  - “Complex Mixture” in source area may effect advection, adsorption, precursor breakdown
- Manufacturing Sources
  - Can have single PFAS source or complex PFAS mixture
  - Additional compounds may be present
- Landfill Leachate
  - “Complex Mixture” in source area may affect advection, adsorption, precursor breakdown
- Wastewater Treatment Facilities
  - Multiple inputs may be present (industries, humans, surface water)
  - Treatment may cause oxidation of precursors
  - Concentration of PFAS in biosolids due to high TOC
  - Biosolids drying, composting, spreading


PFAS SOURCES
industry
PFAS IN AIR AND PRODUCTS
WASTE
landfill
PFAS TREATED MATERIALS & PACKAGING
FOOD
DRINKING WATER
DISCHARGE
LEACHATE
SLUDGE
wastewater treatment plant
BIOSOLIDS
FIREFIGHTING FOAM
DISCHARGE
PLANT UPTAKE
surface water
soil
groundwater

Health Impacts

- Bioaccumulates
- Ubiquitous – found in blood of humans/animals on all continents (and oceans)
- Health Impacts Include:
  - Suppression of Vaccine Response in Children
  - Liver (cholesterol)
  - Immunological (vaccination response)
  - Developmental effects (birth weight)
  - Thyroid
  - Cardiovascular (hypertension)
  - Cancer (testicular, kidney)
- Extremely low levels may cause impact
- Studies are varied and inconsistent conclusions
- Drinking water seen as primary method of exposure

USEPA's Lifetime Health Advisory

- Interim updated health advisory:
  - PFOA = 0.004 ppt
  - PFOS = 0.02 ppt
    - Assumed 20% of exposure from drinking water

- Final health advisory:
  - GenX chemicals = 10 ppt
  - PFBS = 2,000 ppt

USEPA's Lifetime Health Advisory

- The interim updated health advisories for **PFOA** and **PFOS** are based on **human epidemiology** studies in populations exposed to these chemicals. Based on the new data and EPA's draft analyses, the levels at which negative health effects could occur are much lower than previously understood when EPA issued the 2016 health advisories for PFOA and PFOS (70 parts per trillion or ppt) – including near zero for certain health effects.

- The final health advisories for **GenX chemicals** and **PFBS** are based on **animal toxicity** studies following oral exposure to these chemicals. GenX chemicals have been linked to health effects on the liver, the kidney, the immune system, and developmental effects, as well as cancer.

Who's Driving Regulation?

OEPA

United States
Environmental Protection
Agency

PFAS Strategic Roadmap:
EPA's Commitments to
Action 2021-2024

EPA's integrated approach to PFAS is focused on three central directives:

- **Research.** Invest in research, development, and innovation to increase understanding of PFAS exposures and toxicities, human health and ecological effects, and effective interventions that incorporate the best available science.
- **Restrict.** Pursue a comprehensive approach to proactively prevent PFAS from entering air, land, and water at levels that can adversely impact human health and the environment.
- **Remediate.** Broaden and accelerate the cleanup of PFAS contamination to protect human health and ecological systems.

EPA Updates ~~as of June 2022~~

- Released *Advanced Notice of Proposed Rule Making*
  - ~~Considering~~ designation of PFOA, PFOS, GEN-X and PFBS as hazardous substances
  - "Release" = 1lb/24hrs
  - WWTF ARE going to be impacted
- ~~Released pre-publication notice for proposed~~ UCMR 5
  - 29 PFAS including 6 PFAS that were part of UCMR 3 using new analytical methods

31 Key EPA Actions

Publish national PFAS testing strategy	*Expected Fall 2021*
Ensure a robust review process for new PFAS	*Efforts Ongoing*
Review previous decisions on PFAS	*Efforts Ongoing*
Close the door on abandoned PFAS and uses	*Expected Summer 2022*
Enhance PFAS reporting under the Toxics Release Inventory	*Expected Spring 2022*
Finalize new PFAS reporting under TSCA Section 8	*Expected Winter 2022*
Undertake nationwide monitoring for PFAS in drinking water	*Final Rule Expected Fall 2021*
Establish national primary drinking water reg for PFOA and PFOS	*Proposed Rule Fall 2022, Final Rule Expected Fall 2023*
Publish the final toxicity assessment for GenX and five additional PFAS	*Expected Fall 2021 and Ongoing*
Publish health advisories for GenX and PFBS	*Expected Spring 2022*
Restrict PFAS discharges from industrial sources	*Expected 2022 and Ongoing*
Leverage NPDES permitting to reduce PFAS discharges to waterways	*Expected Winter 2022*
Publish multi-laboratory validated analytical method for 40 PFAS	*Expected Fall 2022*
Publish updates to PFAS analytical methods to monitor drinking water	*Expected Fall 2024*
Publish final recommended ambient water quality criteria for PFAS	*Expected Winter 2022 and Fall 2024*
Monitor fish tissue for PFAS and evaluate human biomarkers for PFAS	*Expected Summer 2022*
Finalize list of PFAS for use in fish advisory programs	*Expected Spring 2023*
Finalize risk assessment for PFOA and PFOS in biosolids	*Expected Winter 2024*
Propose to designate certain PFAS as CERCLA hazardous substances	*Proposed rule expected Spring 2022; Final rule expected Summer 2023*

31 Key EPA Actions

Issue advance notice of proposed rulemaking on various PFAS under CERCLA	*Expected Spring 2022*
Issue updated guidance on destroying and disposing of certain PFAS-containing materials	*Expected by Fall 2023*
Build the technical foundation to address PFAS air emissions	*Expected Fall 2022 and Ongoing*
Develop and validate methods to detect and measure PFAS in the environment	*Ongoing Actions*
Advance the science to assess human health and environmental risks from PFAS	*Ongoing Actions*
Evaluate and develop technologies for reducing PFAS in the environment	*Ongoing Actions*
Engage directly with affected communities in every EPA Region	*Expected Fall 2021 and Ongoing*
Use enforcement tools to better identify and address PFAS releases at facilities	*Ongoing Actions*
Accelerate public health protections by identifying PFAS categories	*Expected Winter 2021 and Ongoing*
Establish a PFAS Voluntary Stewardship Program	*Expected Spring 2022*
Educate the public about the risks of PFAS	*Expected Fall 2021 and Ongoing*
Issue an annual public report on progress towards PFAS commitments	*Winter 2022 and Ongoing*

Status of PFAS Wastewater Regulations

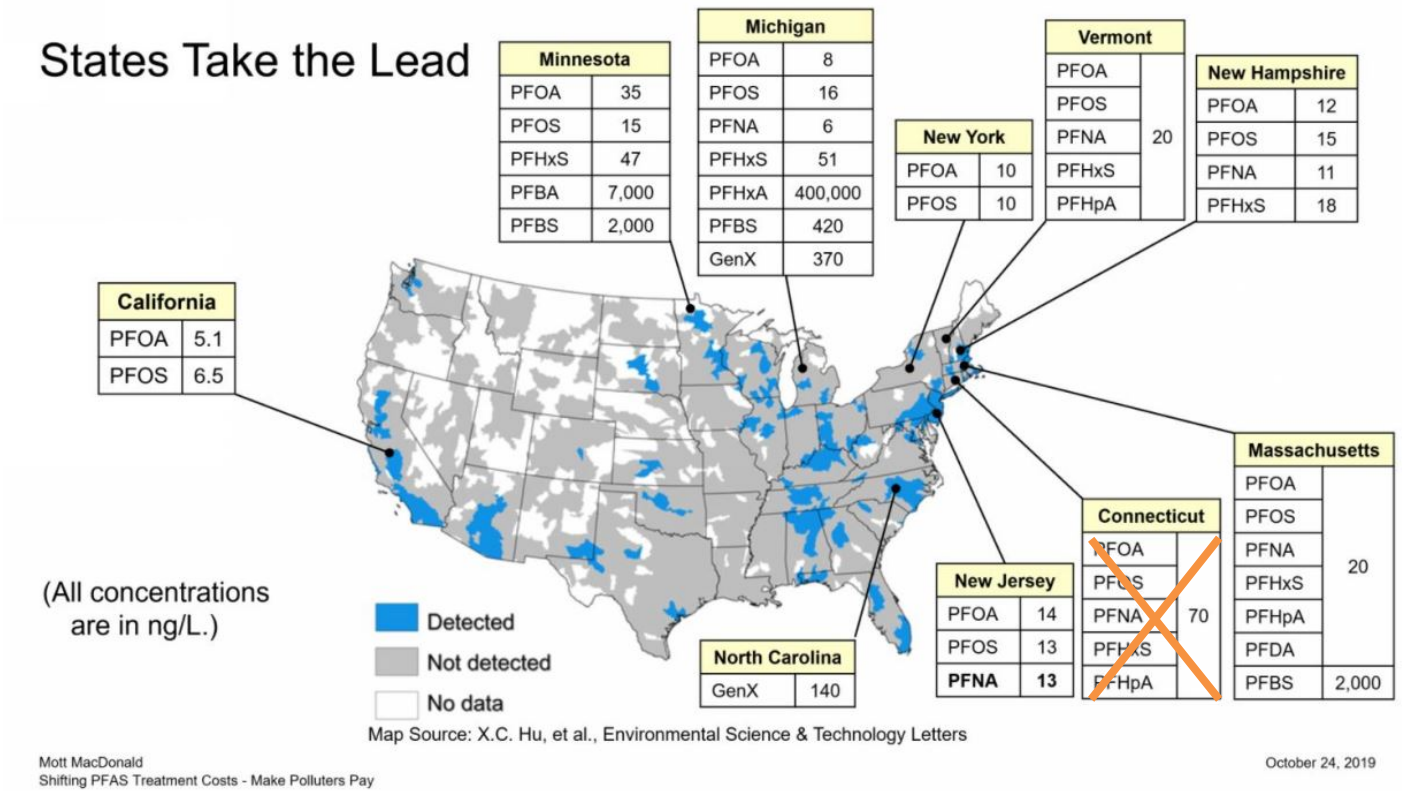
EPA Discharge Permits

NPDES PERMITS (EPA Region 1)

- Many ~~DRAFT~~ NPDES permits recently issued with Per- and Polyfluoroalkyl substances sampling requirements (Report Only)
  - Quarterly Sampling – Influent, Effluent and Sludge - PFHxS, PFHpA, PFNA, PFOS, PFOA, PFDA
  - Sludge Disposal Concerns - dried sludge from $18 to $38 dry ton, $140/ton wet sludge
  - Targeting specific industries via Industrial Pretreatment Program (IPP) Requirements

WHAT ARE THE REGULATORY LEVELS?.....none defined as yet

Who's Driving Regulation?

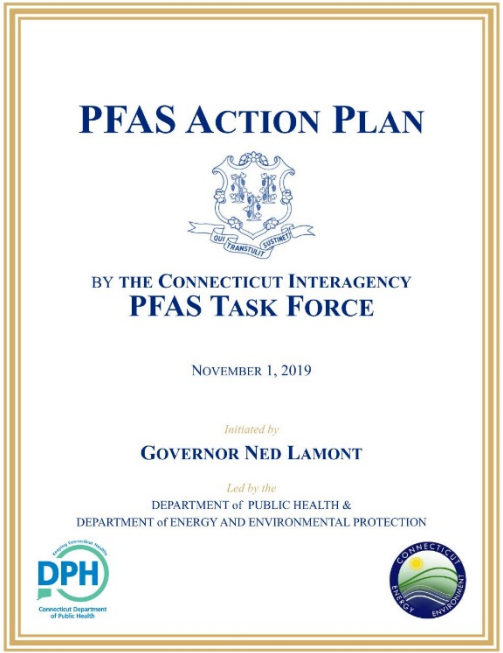


Anticipate regulations continuing to change in the future.

State Standards and Guidelines

Drinking Water	PFAS Listed	Concentration
• EPA Health Advisory	PFOS	0.020 ng/L (ppt)
	PFOA	0.004 ng/L
	PFBS	2,000 ng/L
	"GenX"	10 ng/L
• Connecticut DWAL	PFHxS	49 ng/L
	PFOS	10 ng/L
	PFOA	16 ng/L
	PFNA	12 ng/L
• Vermont Standard	Sum of 5	20 ng/L
• New Hampshire Standard	PFOS & PFOA	12 ng/L & 15 ng/L
• Massachusetts Standard	Sum of 6	20 ng/L
• Rhode Island Standard	Sum of 6	20 ng/L
• New Jersey Standard	PFOS & PFOA	13 ng/L & 14 ng/L
• New York Standard	PFOA & PFOS	10 ng/L & 10 ng/L
• Illinois Health Advisory	PFOA	2ng/L
• North Carolina IMAC/Goal	PFOA & GenX	2,000ng/L & 140ng/L
• California – Notification Level	PFOS & PFOA	5.1 & 6.5 ng/L

Connecticut Actions



- **Connecticut Interagency PFAS Task Force**

Final PFAS Action Plan – 2019

20191101-CT-Interagency-PFAS-Task-Force-Action-Plan.pdf

This workgroup will collaborate to provide a State Action Plan for PFAS, which we anticipate will include an assessment of:

- Potential sources of PFAS contamination
- Potential impacts on drinking water resources
- PFAS concentrations in our local environment
- Alternatives to PFAS-containing products

In addition to DPH and DEEP, the agencies in this Task Force will include, but are not limited to the:

- Department of Agriculture
- Department of Administrative Services
- Public Utilities Regulatory Authority
- Department of Consumer Protection
- Department of Emergency Services and Public Protection

Connecticut PFAS Action Plan

STRATEGIC FOCUS 1 - PROTECT THE HEALTH OF CONNECTICUT'S CITIZENS: MINIMIZING ENVIRONMENTAL EXPOSURE TO PFAS

- Test Drinking Water (public, private, bottled)
- Establish MCLs (CT4)
- Support Financial Assistance to PWS
- And several other things…
- Identify, prioritize, and evaluate other potential sources of PFAS exposure to humans, including but not limited to fish, shellfish, dairy, other agricultural products, and food service ware

Connecticut PFAS Action Plan

STRATEGIC FOCUS 2 - POLLUTION PREVENTION: MINIMIZING FUTURE RELEASES OF PFAS TO THE ENVIRONMENT – (JUST The WW related)

- Establish standards and discharge/emission limits for PFAS in air and water.
- Implement baseline sampling at wastewater treatment plants.
- Evaluate biosolids' PFAS levels and ultimate use and/or disposal.
- Evaluate PFAS levels in compost derived from food waste containing compostable food containers, disposable cutlery, and/or PFAS-treated paper products.
- Convene an ad hoc group to review the most current research and nationwide actions regarding food packaging, consumer products, and the recycling thereof. Develop recommendations for reducing PFAS exposures, such as considering an Extended Producer Responsibility (EPR) program for effective management of waste from PFAS-containing products.
- Educate Connecticut residents, businesses, and local officials on best management practices to reduce PFAS discharges to subsurface sewage disposal systems.

Connecticut PFAS Action Plan

STRATEGIC FOCUS 3 - REMEDIATION:IDENTIFYING, ASSESSING, AND CLEANING UP HISTORICAL RELEASES OF PFAS TO THE ENVIRONMENT – (JUST The WW related)

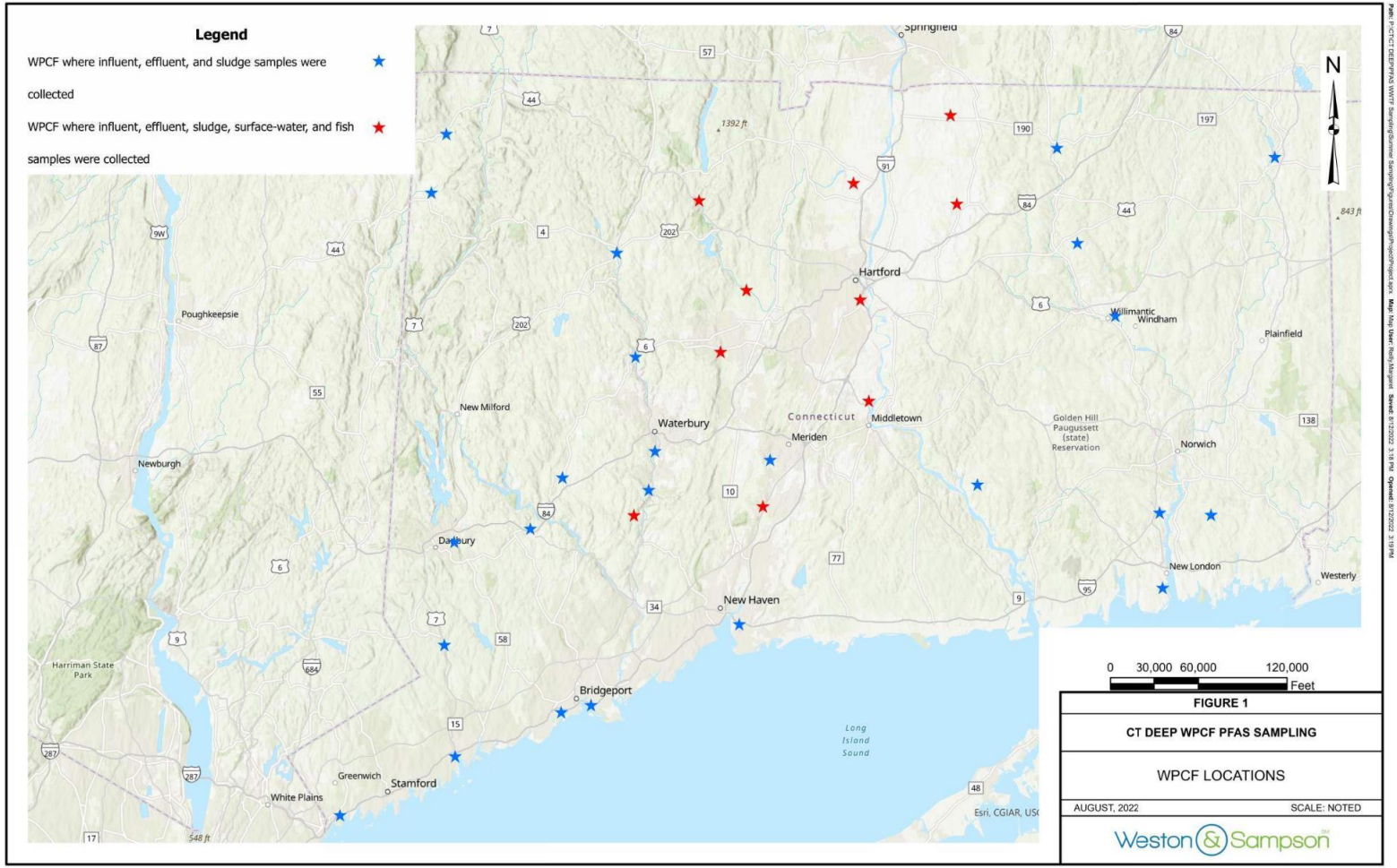
- Develop an interagency geographic information system (GIS) database that identifies the universe of potential source sites and threatened receptors, including sensitive areas such as high-quality drinking water sources, Outstanding National Resource Waters, wild and scenic rivers, and habitats for endangered, threatened, and special concern species that may be vulnerable to PFAS.

- Develop and implement a strategy for random and targeted sampling of environmental media and aquatic organisms to determine ambient conditions and identify impacted areas. Consult with federal agencies and other parties conducting environmental sampling to share information on sample locations and analytical results.

- Sample and analyze various environmental media at and surrounding landfills using a tiered approach, prioritizing landfills located near potential human receptors.

- Establish PFAS cleanup standards for direct exposure to soil, soil leaching to groundwater, groundwater, surface water, and aquatic biota.

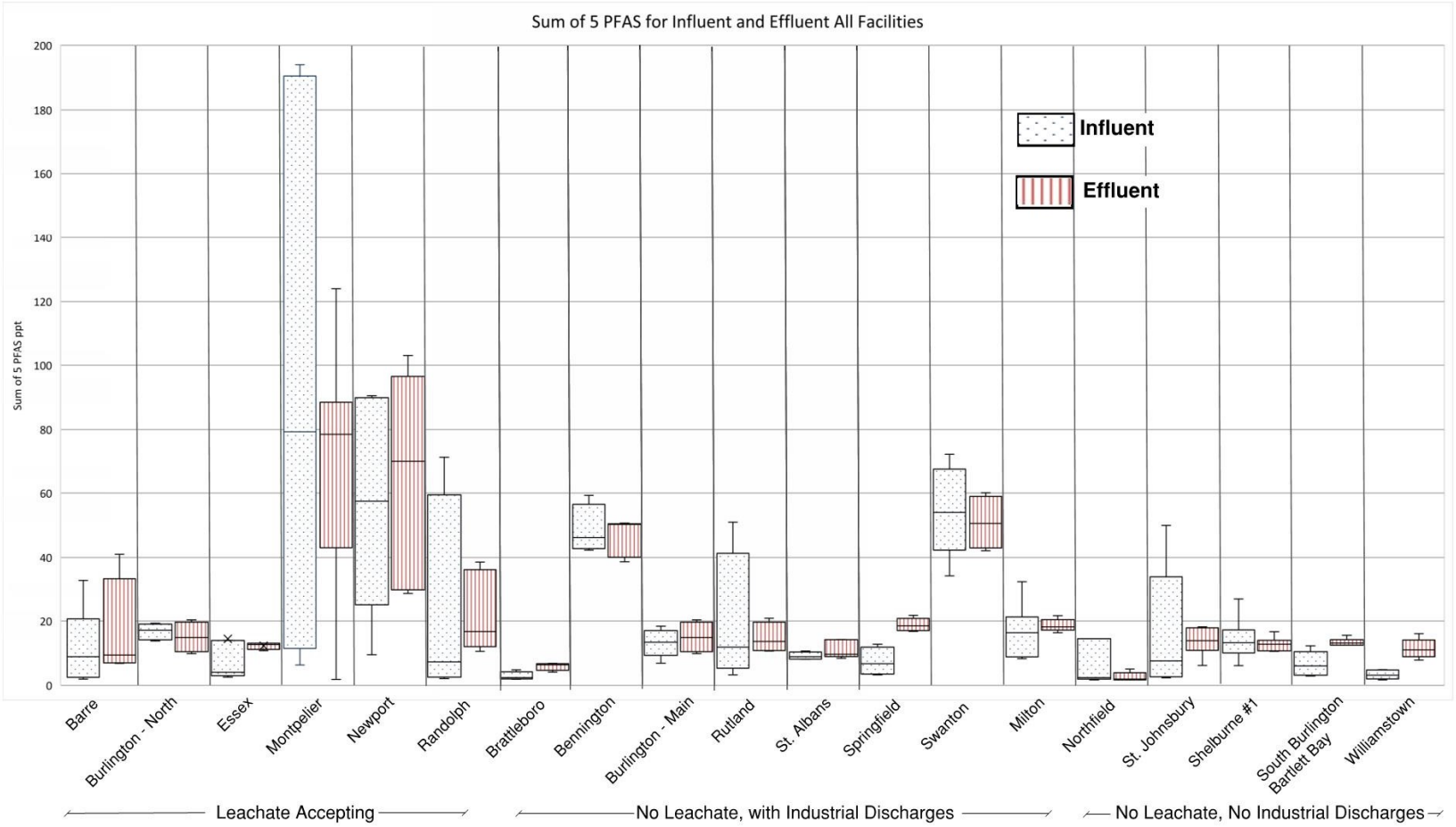
- Establish an academic roundtable that periodically meets to share research and enhance knowledge of the impacts of PFAS on aquatic life and other wildlife

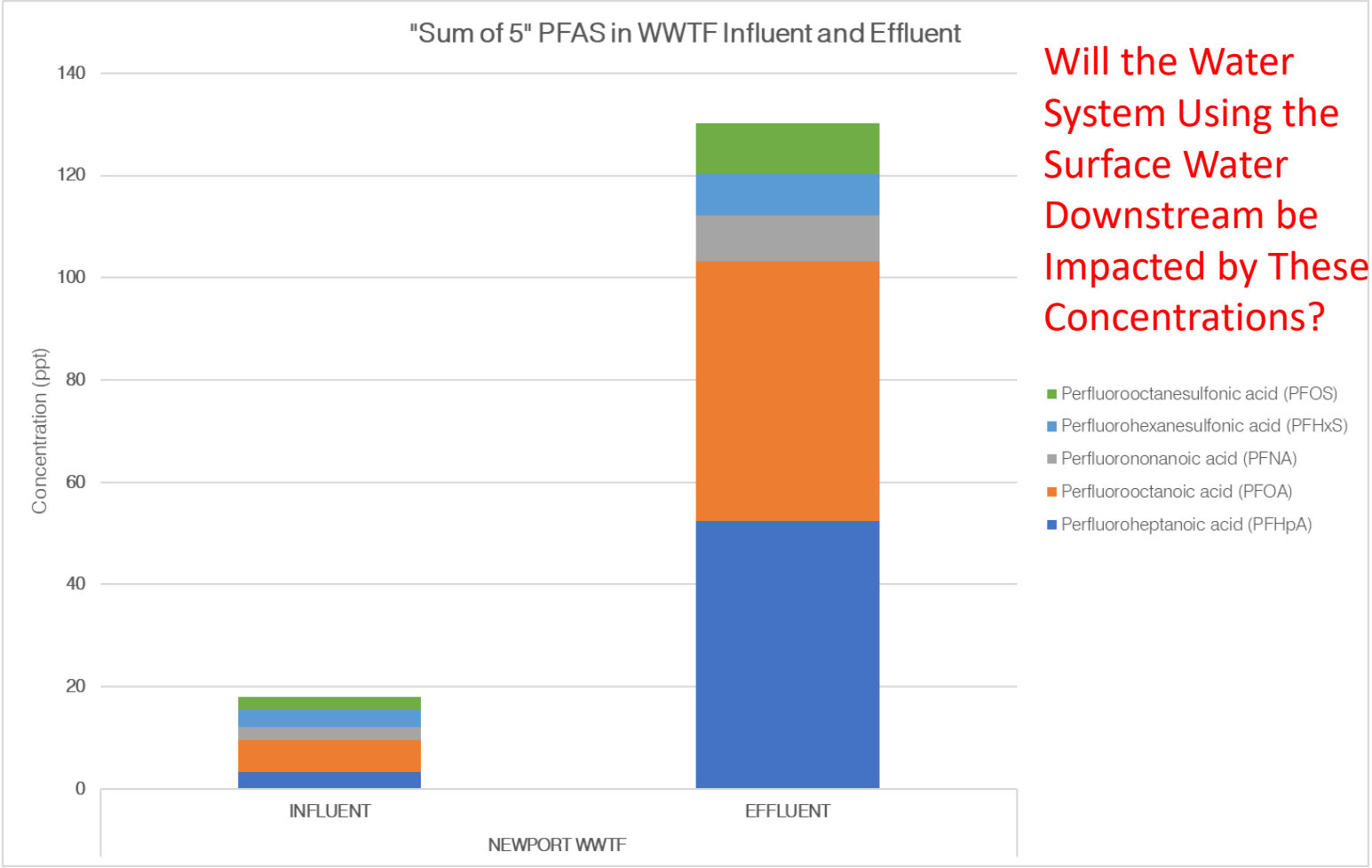

Legend
WPCF where influent, effluent, and sludge samples were collected
WPCF where influent, effluent, sludge, surface-water, and fish samples were collected
N
Springfield
Hartford
Willimantic
Windham
Plainfield
Poughkeepsie
New Milford
Waterbury
Connecticut
Middletown
Meriden
Golden Hill Paugussett (state) Reservation
Norwich
Newburgh
Danbury
New London
Westerly
New Haven
Bridgeport
Harriman State Park
Greenwich
Stamford
White Plains
Long Island Sound
1392 ft
843 ft
548 ft
0 30,000 60,000 120,000
Feet
FIGURE 1
CT DEEP WPCF PFAS SAMPLING
WPCF LOCATIONS
AUGUST, 2022
SCALE: NOTED
Weston & Sampson
Esri, CGIAR, USG

Case Study PFAS Inputs to Wastewater Facilities

- 1st Sampled WWTF Influent and Effluent at many WWTF
  - Analyses showed widespread impacts from PFAS
  - Potential link to landfill leachate

- 2nd Sampled “sewersheds” representing unique use areas
  - residential, commercial, or industrial
  - Analyzed samples for “Standard” and Total Oxidizable Precursors (TOP) Assay

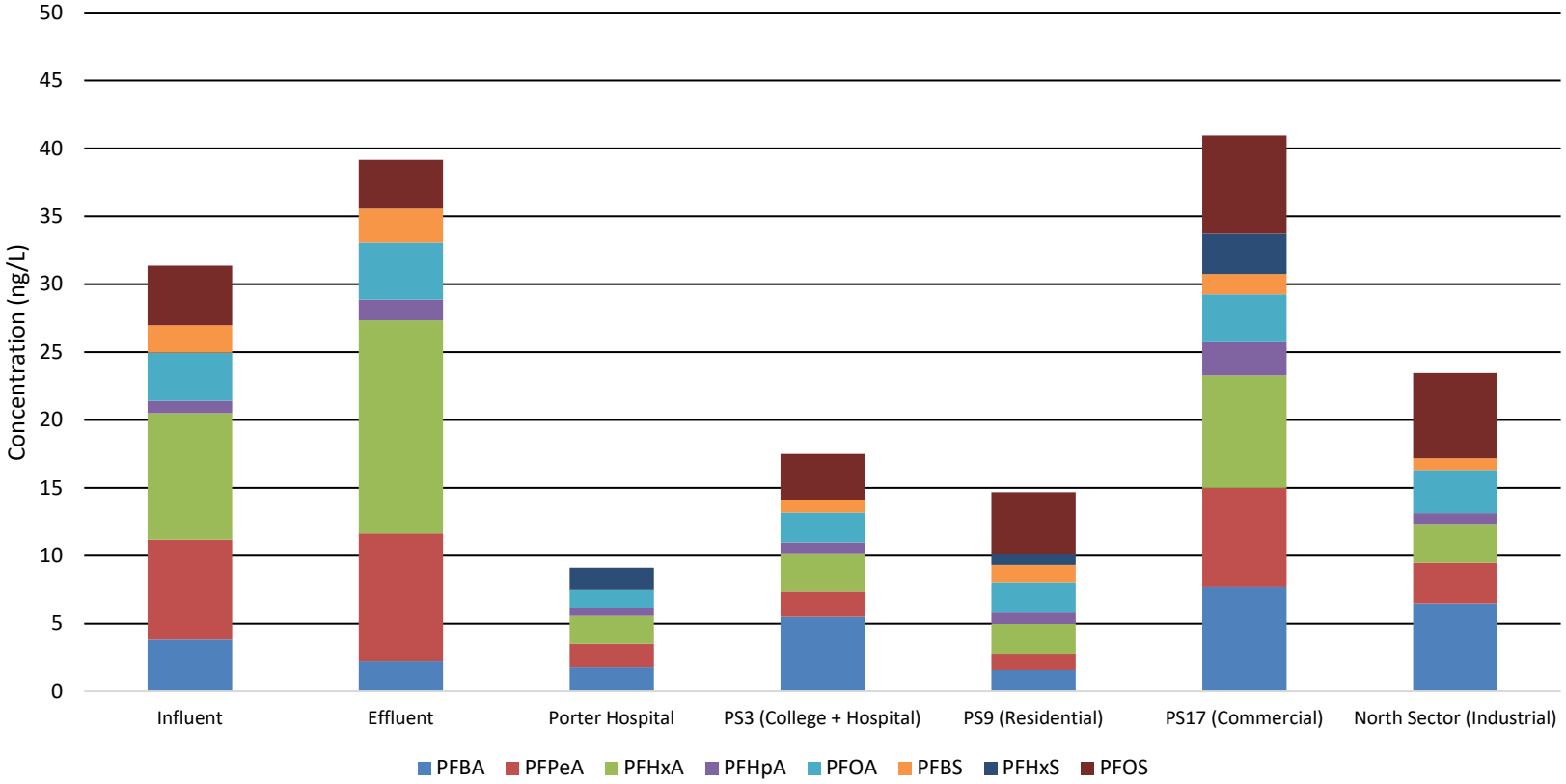

Sum of 5 PFAS for Influent and Effluent All Facilities
Sum of 5 PFAS ppt
200
180
160
140
120
100
80
60
40
20
0
Influent
Effluent
Barre
Burlington - North
Essex
Montpelier
Newport
Randolph
Brattleboro
Bennington
Burlington - Main
Rutland
St. Albans
Springfield
Swanton
Milton
Northfield
St. Johnsbury
Shelburne #1
South Burlington
Bartlett Bay
Williamstown
Leachate Accepting
No Leachate, with Industrial Discharges
No Leachate, No Industrial Discharges

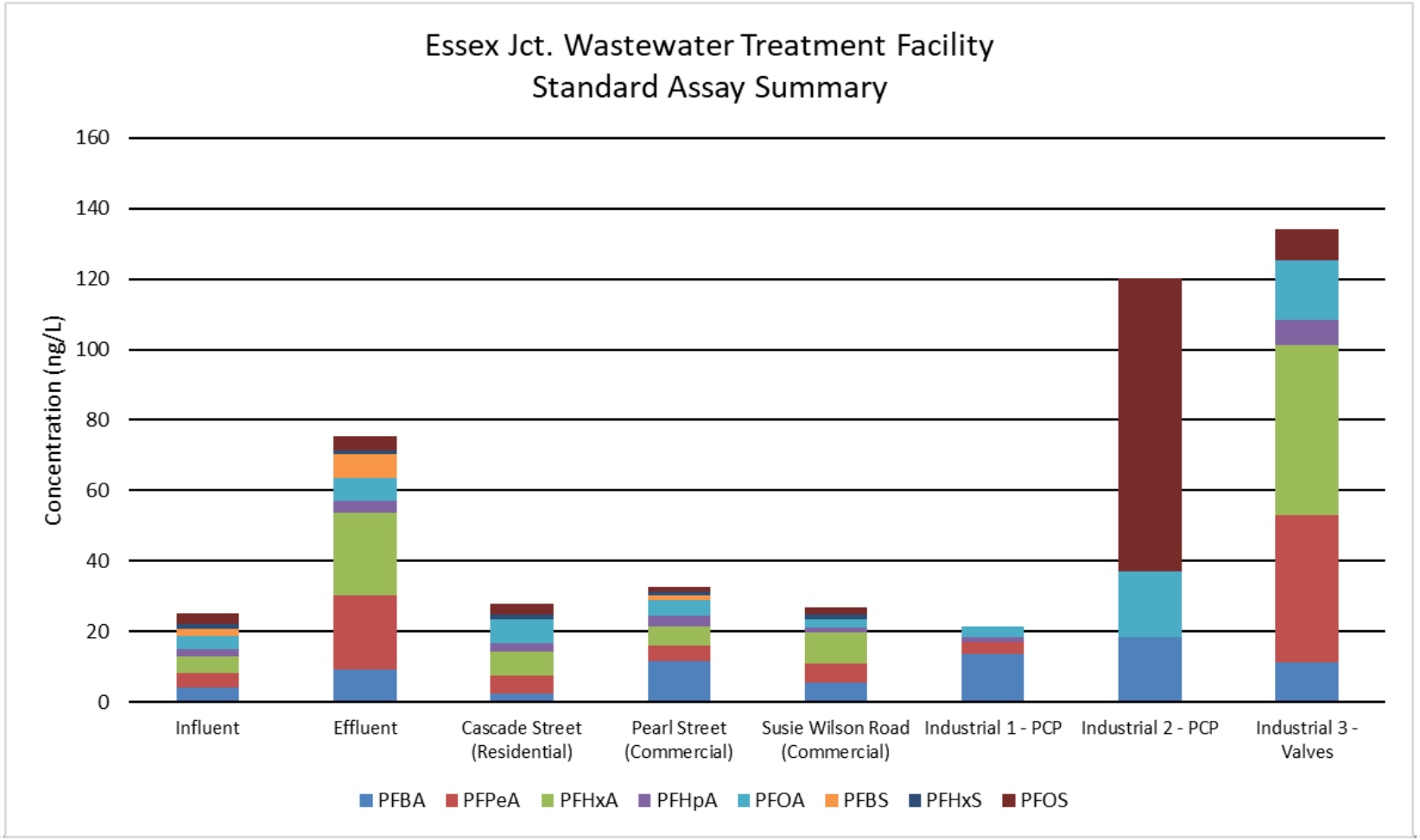


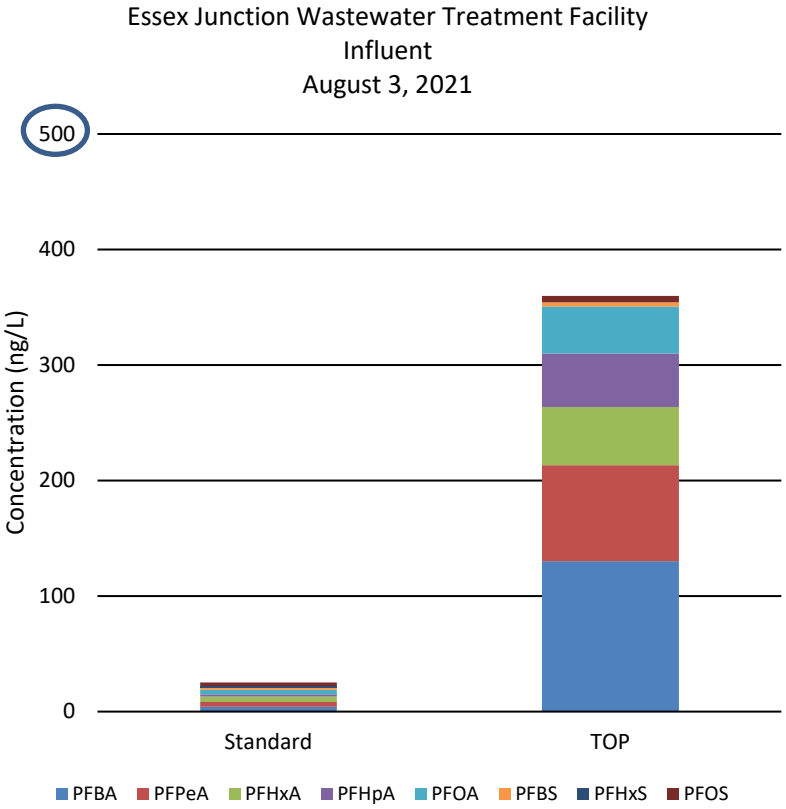
Will the Water System Using the Surface Water Downstream be Impacted by These Concentrations?

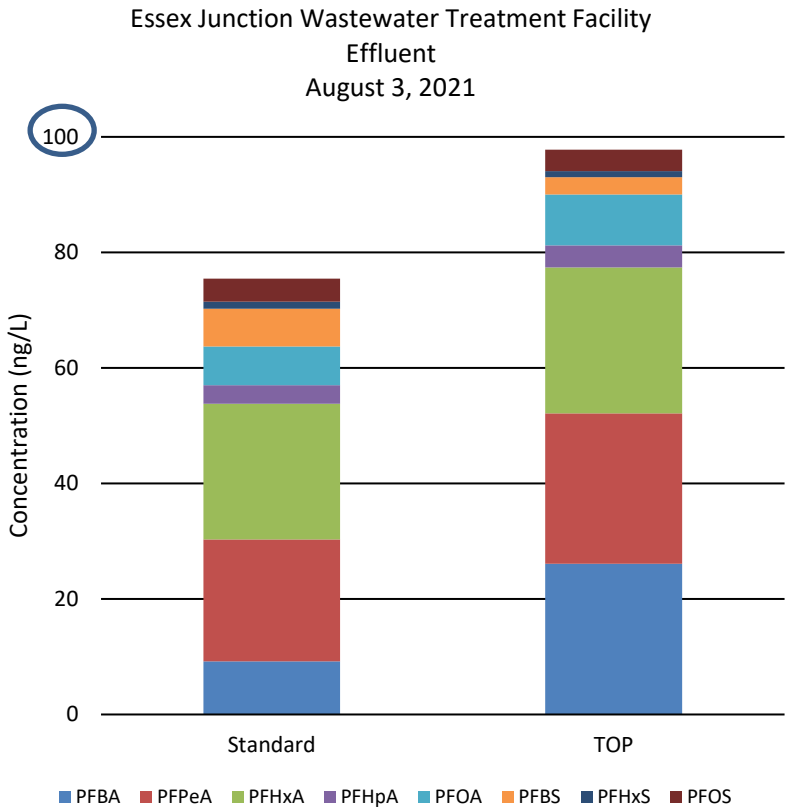
Town	Site	Sample Type/Freq	Sources
Essex Junction	Suzie Wilson Road	Grab (3)	retail, gas stations, restaurants, beauty salons
	Pearl Street (gravity)	Grab (3)	retail, gas stations, restaurants, automotive services
	Cascade Street	Grab (3)	residential only
	PCP-1	Grab (3)	Personal care product manufacturer
	PCP-2	Grab (3)	Personal care product manufacturer
	Industrial Valve-1	Grab (3)	Industrial valve manufacturer
	POTW Influent	Time Comp (3)	all the above
	POTW Effluent	Time Comp (3)	all the above
Middlebury	Rogers Rd/PS 7	Grab (3)	residential
	Porter	Grab (3)	hospital, medical clinics
	Pump Station 3	Grab (3)	hospital, college dorms
	Pump Station 9	Grab (3)	residential
	North Sector (gravity)	Grab (3)	restaurants, food & beverage manufacturers, fitness gym
	POTW Influent	Time Comp (3)	all of the above
	POTW Influent	Time Comp (3)	all of the above
	Total:	**45 Samples**	**Analysis: EPA M537 (Isotope Dilution), TOP Assay, TSS**

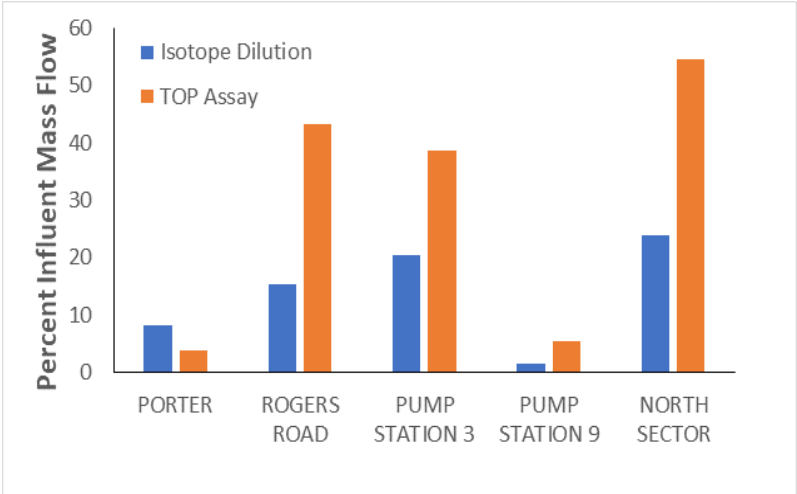
Middlebury Wastewater Treatment Facility
Standard Assay Summary

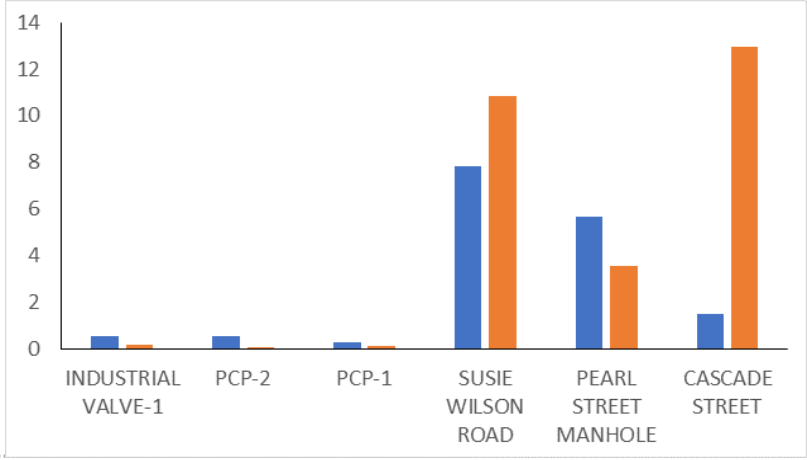



Essex Jct. Wastewater Treatment Facility
Standard Assay Summary
Concentration (ng/L)
160
140
120
100
80
60
40
20
0
Influent
Effluent
Cascade Street (Residential)
Pearl Street (Commercial)
Susie Wilson Road (Commercial)
Industrial 1 - PCP
Industrial 2 - PCP
Industrial 3 - Valves
PFBA
PFPeA
PFHxA
PFHpA
PFOA
PFBS
PFHxS
PFOS

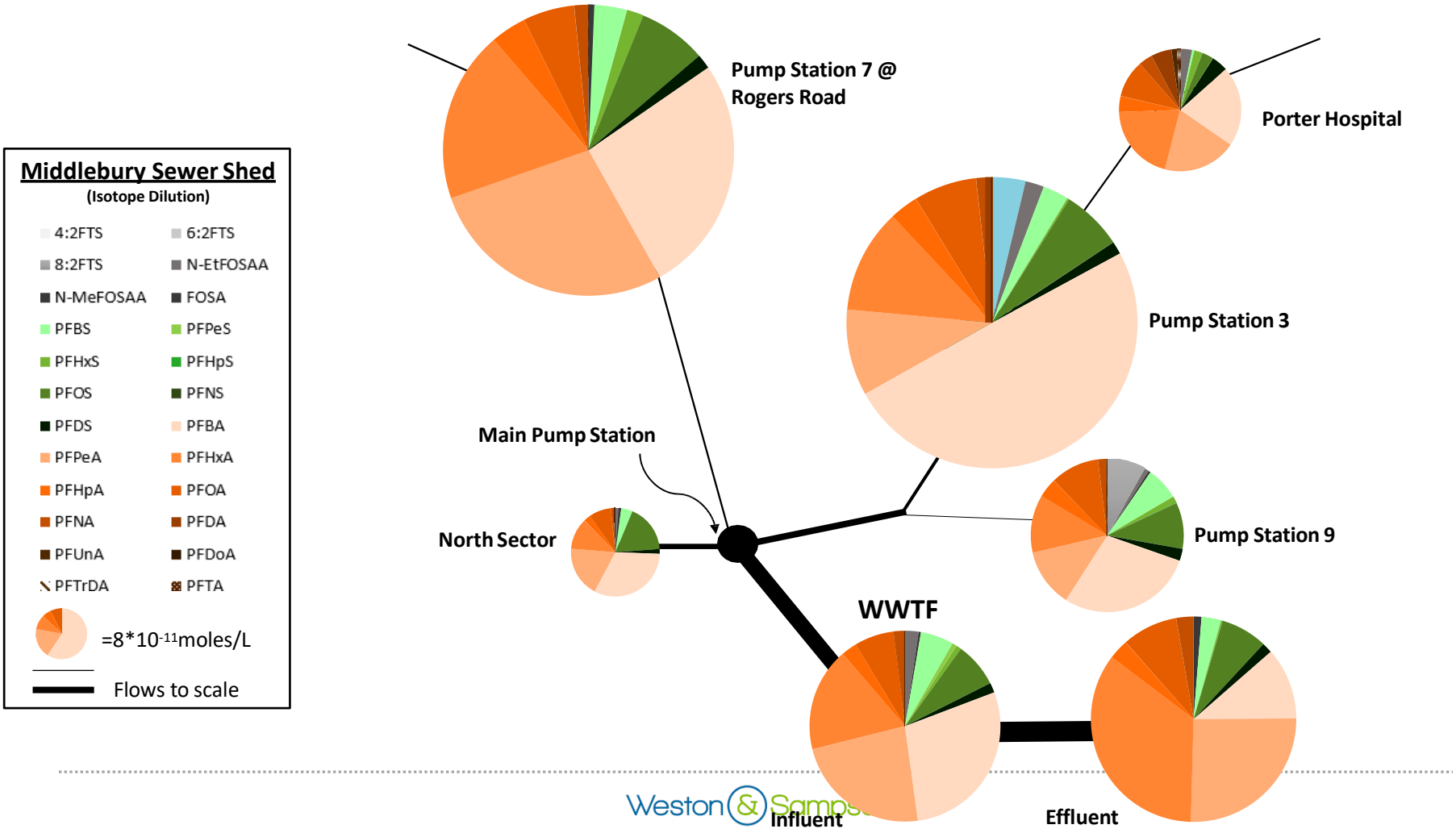

Essex Junction Wastewater Treatment Facility
Influent
August 3, 2021
500
400
300
200
100
0
Concentration (ng/L)
Standard
TOP
PFBA
PFPeA
PFHxA
PFHpA
PFOA
PFBS
PFHxS
PFOS

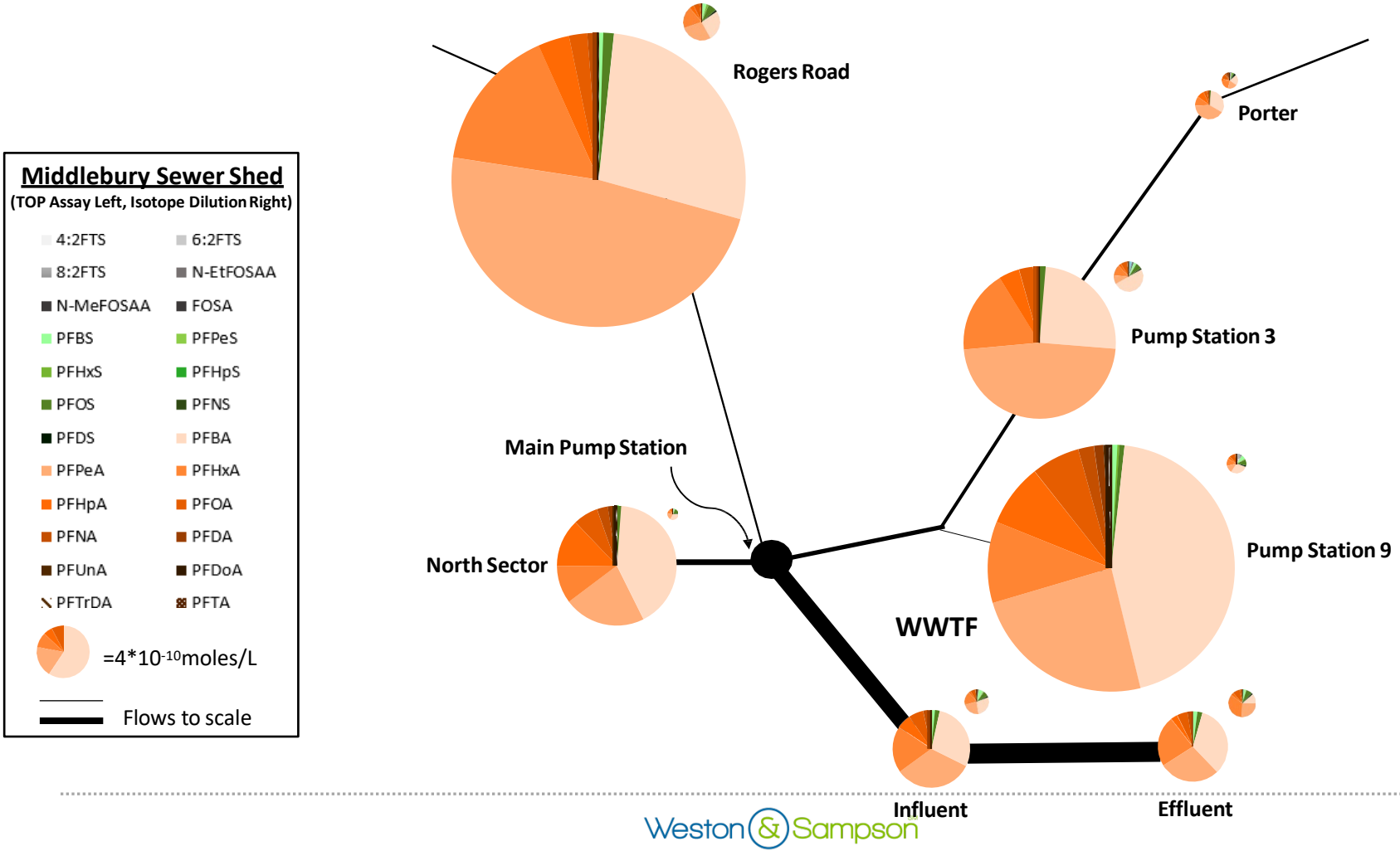

Essex Junction Wastewater Treatment Facility
Effluent
August 3, 2021
100
80
60
40
20
0
Concentration (ng/L)
Standard
TOP
PFBA
PFPeA
PFHxA
PFHpA
PFOA
PFBS
PFHxS
PFOS



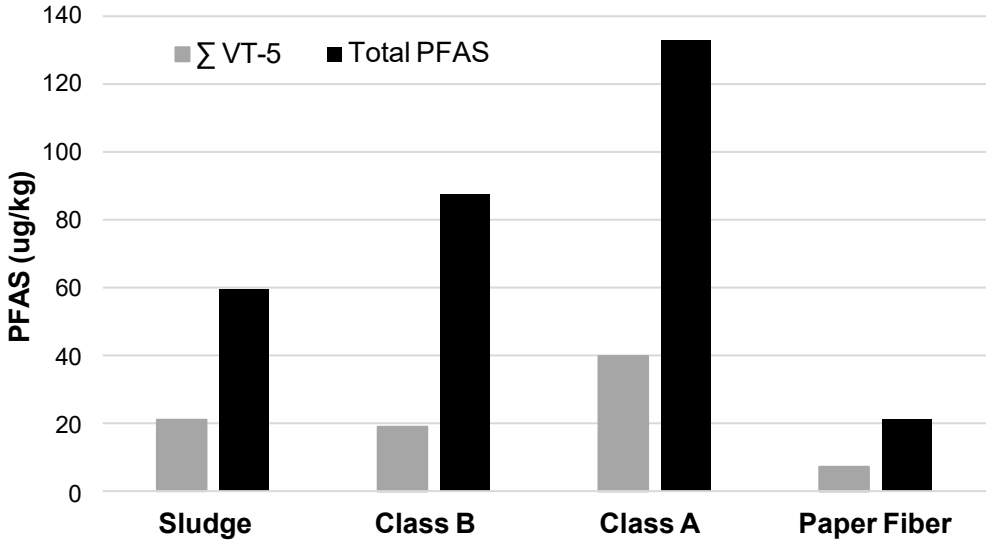


TOP Assay Measurements	
Middlebury	**% of Influent Mass**
NORTH SECTOR	54.4
PORTER	3.9
PUMP STATION 9	5. 5
ROGERS ROAD	43.3
PUMP STATION 3	38.5
SUM	**146**
Essex Junction	
PCP-1	0.11
CASCADE STREET	12.9
PEARL STREETMANHOLE	3.5
SUSIE WILSON ROAD	10.9
PCP-2	0.04
INDUSTRIAL VALVE-1	0.19
SUM	**27.5**
Based on flows from day of TOPsampling	


Middlebury Sewer Shed
(Isotope Dilution)
4:2FTS
6:2FTS
8:2FTS
N-EtFOSAA
N-MeFOSAA
FOSA
PFBS
PFPeS
PFHxS
PFHpS
PFOS
PFNS
PFDS
PFBA
PFPeA
PFHxA
PFHpA
PFOA
PFNA
PFDA
PFUnA
PFDoA
PFTrDA
PFTA
=8*10-11moles/L
Flows to scale
Pump Station 7 @ Rogers Road
Porter Hospital
Pump Station 3
Main Pump Station
North Sector
Pump Station 9
WWTF
Influent
Effluent


Middlebury Sewer Shed
(TOP Assay Left, Isotope Dilution Right)
4:2FTS
6:2FTS
8:2FTS
N-EtFOSAA
N-MeFOSAA
FOSA
PFBS
PFPeS
PFHxS
PFHpS
PFOS
PFNS
PFDS
PFBA
PFPeA
PFHxA
PFHpA
PFOA
PFNA
PFDA
PFUnA
PFDoA
PFTrDA
PFTA
=4*10-10moles/L
Flows to scale
Rogers Road
Porter
Pump Station 3
Main Pump Station
North Sector
Pump Station 9
WWTF
Influent
Effluent

Average PFAS (ppb) in Samples of Residual Materials



PFAS Presence in Biosolids

	Solid (ng/g)	Leachate (ng/L)
WWTF Sludge	7.5	66
Composted Sludge	ND/<0.9	61
Residential	69	430
VTDEC Screening/Std	300	20

Wastewater Issues

- If you look for it, you will find it.
- No known WW related limits yet in any state.
- EPA requiring testing for PFAS though NPDES
- Many impacted downstream surface water (and groundwater) supplies “blame” WWTF Discharges
- Sludge handling pricing already going up and PFAS exclusions and/or surcharge clauses showing up in hauling and disposal contracts.

Important Websites

DPH Drinking Water Section	https://portal.ct.gov/DPH/Drinking-Water/DWS/Per--and-Polyfluoroalkyl-Substances
DEEP Emerging Contaminants webpage	https://www.ct.gov/deep/emergingcontaminants
EPA PFAS webpage	https://www.epa.gov/pfas
EPA PFAS Action Plan	https://www.epa.gov/pfas/epas-pfas-action-plan
Interstate Technology and Regulatory Council (ITRC) PFAS Fact Sheets	https://pfas-1.itrcweb.org

Questions?