

PFAS in Artificial Turf



Graham Peaslee, University of Notre Dame, gpeaslee@nd.edu

Kristen Mello, WRAFT, klm.wraft@gmail.com

NEWMOA Conference, April 6, 2022

Introductions & Background



Kyla Bennett (left) and Tracy Stewart (right) at used turf piles in Franklin, MA.
Boston Globe, October 9, 2019

Why are there PFAS in my turfgrass?



Graham Peaslee & Heather Whitehead

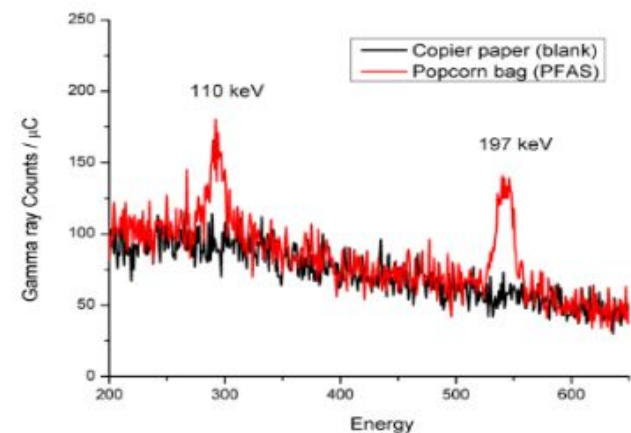
- We have screened dozens of different new and used turfgrass samples for total fluorine....

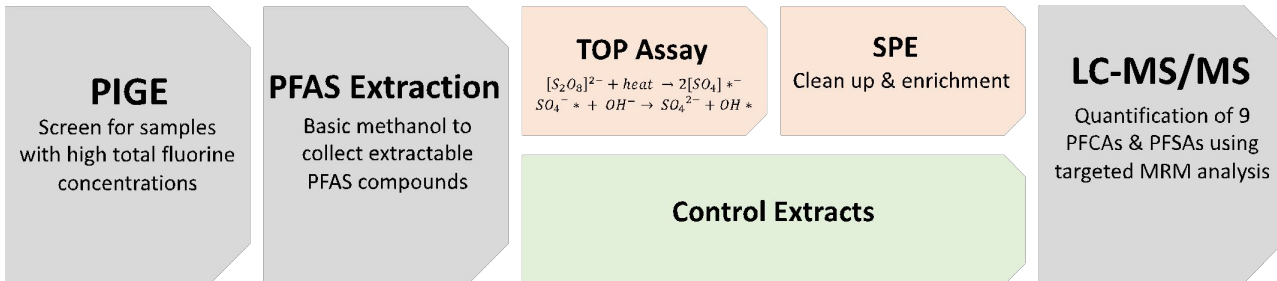
PIGE Analysis of Fluorine



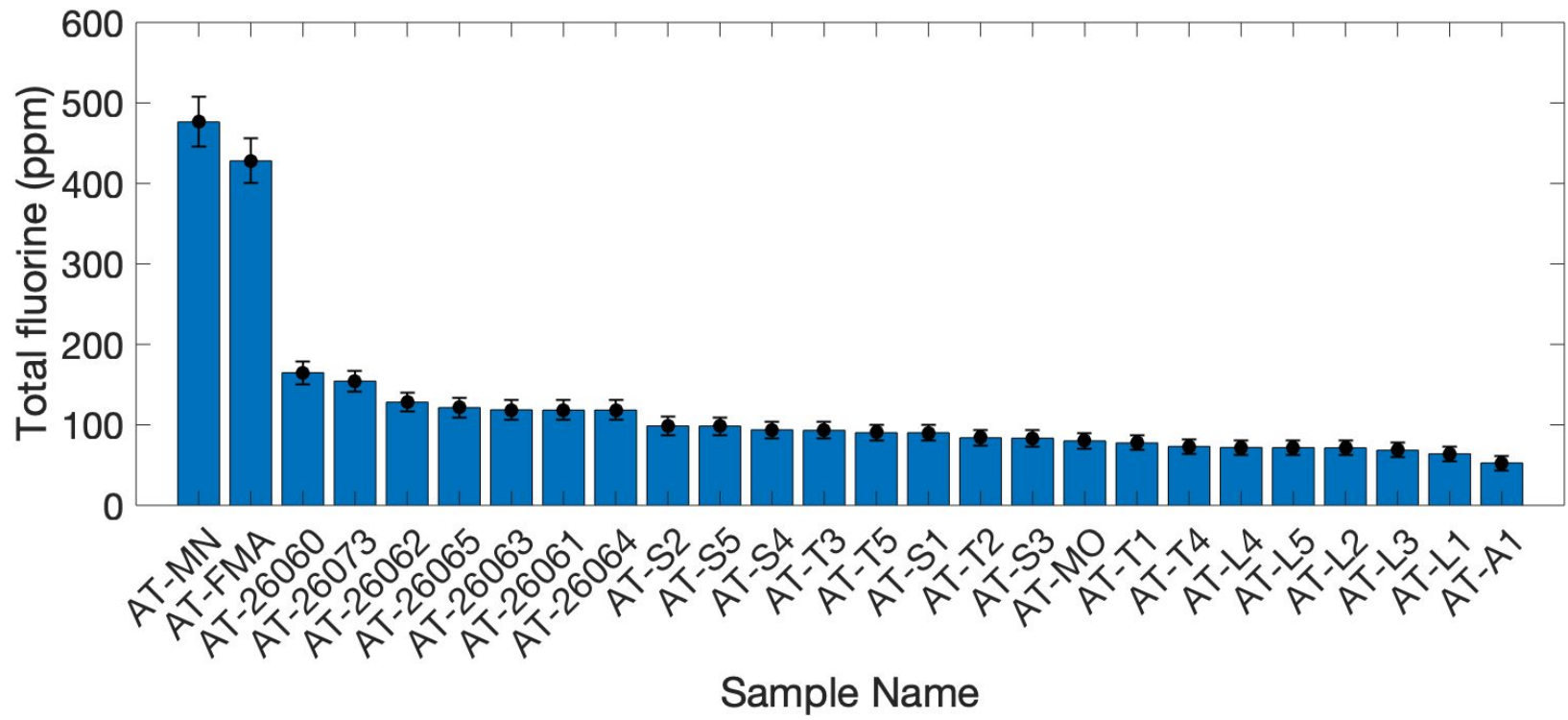
Fig. 3: PFAS-coated paper sample compared with uncoated paper. Irradiation time of 180 second with 9 nA of 3.4 MeV protons.

Spectroscopic technique
Rapid (<180 seconds)
Non-destructive





PIGE Analysis: Artificial turf



Why are there PFAS in my turfgrass?

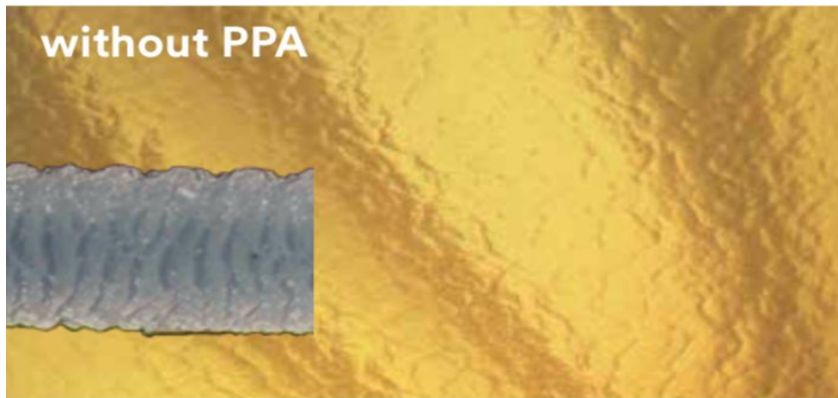


Graham Peaslee & Heather Whitehead

- We have screened dozens of different new and used turfgrass samples for total fluorine....
- **Where does this fluorine come from?**

Polymer Processing Aids

- Improve production efficiency by reducing common issues such as melt fracture, & die build-up

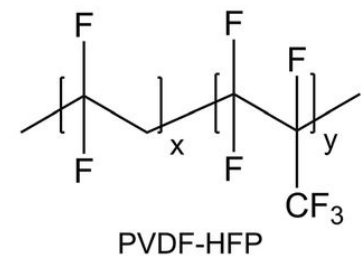
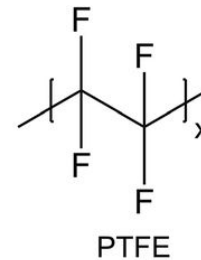
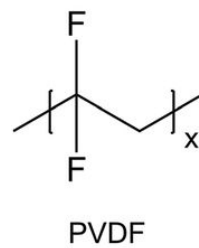


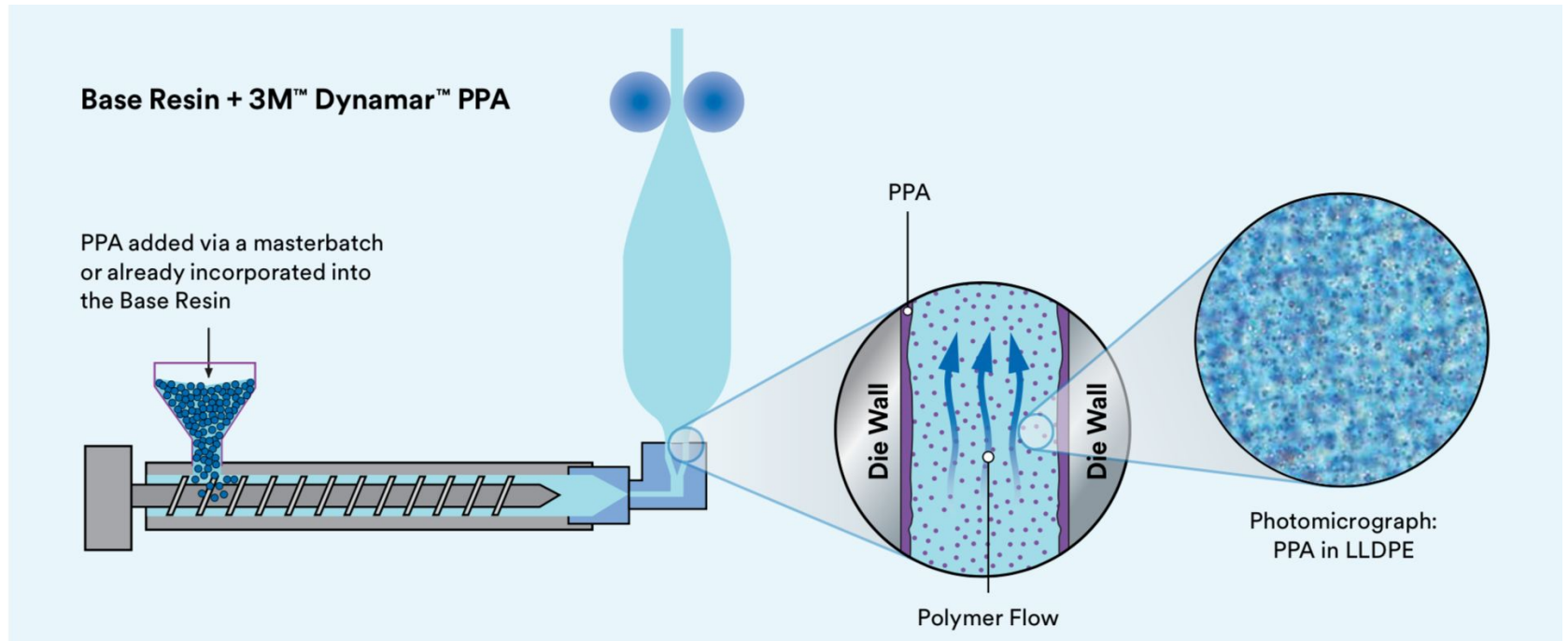
Vinylidene Fluoride & Hexafluoropropylene

- 50-95 weight % VDF
- 5-50 weight % HFP
- Ideal Fluorine to Carbon ratio is 1:2

Special Cases

- 100% VDF is PVDF
- > 65% VDF is PVDF Copolymer
- > 35% HFP is Fluoroelastomer (FKM)*
 - Chemical resistant O-rings, seals, tubing (Viton by DuPont)





- PPA is immiscible with the polymer and has a higher affinity for the metal surface, creating a slip surface
- Used at 20-2000 ppm in masterbatch depending on the application, type and concentration requires optimization

PPA Applications & Producers

- Food packaging
- Produce, grocery, and department store bags
- Liquids packaging
- 3M: Dynamar, Dyneon
- DuPont: Viton, Viton Free Flow
- Arkema: Kynar
- Daikin: Dai-El

Artificial Turf

3M FX-5911: Copolymer of VDF, HFP, & TFP

3M FX-9613: Copolymer of VDF & HFP + additives

Consultants Confirm

“...there is [*sic*] PFAS used in the extrusion of the fibers. That’s true. There is. It’s a polymeric compound called PVDF.”

David Teter, at the meeting of the Standing Building Committee, Sharon, MA on January 21, 2020.

(<https://sharontv.com/programs/government-meeting/>)

“The PFAS in Synthetic Turf is not a contaminant. It is a slip agent that is intentionally added to the molten hydrocarbons in order to make the plastic grass blades free of defects.”

Laura Green, at the meeting of the Board of Health, Oak Bluffs, MA on November 9, 2021.

(https://oakbluffs.zoom.us/rec/share/VNVkEYuze0E-gzoYmUi8umSRsOmAE-dUt1t92wo9s9Tzdf4UVW5jW5Dfw9hQMVc2.ZL_TP0WGKGIPLwcu)

Manufacturer Documents

City of
Portsmouth
Department of Public Works



MEMORANDUM

TO: Suzanne Woodland, Acting Deputy City Manager
FROM: Peter Rice, Director of Public Works
DATE: 12/6/21
SUBJECT: Updated Information Regarding Manufacturing Process and New Athletic Field

In follow up to the Memorandum of December 1, 2021 which is part of the City Council pack staff has obtained the following additional information.

1. The manufacturer in Germany has produced Material Safety Data Sheets and the 3M additives used in their processes. Those MSDS sheets are attached.

PVDF-HFP is a component of the additive. As was discussed at the Work Session, PVDF-HFP is a polymeric PFAS, namely a part of that very broad class of thousands of compounds covered under the general term of PFAS. It is not one of the PFAS of Concern for which the City tested.

3M™ Dynamar™ Polymer Processing Additive FX 5920A 08/21/18



Safety Data Sheet

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Document Group: 06-2189-6 **Version Number:** 44.05
Issue Date: 08/21/18 **Supersedes Date:** 08/21/18

SECTION 1: Identification

1.1. Product identifier
3M™ Dynamar™ Polymer Processing Additive FX 5920A

SECTION 3: Composition/information on ingredients

Ingredient	C.A.S. No.	% by Wt
Calcium Carbonate	471-34-1	< 5
Polyethylene Glycol	25322-68-3	60 - 70
Vinylidene Fluoride-Hexafluoropropylene Polymer	9011-17-0	25 - 35
Talc	14807-96-6	0.1 - 5 Trade Secret *

*The specific chemical identity and/or exact percentage (concentration) of this composition has been withheld as a trade secret.

10.6. Hazardous decomposition products

Substance	Condition
Carbonyl Fluoride	At Elevated Temperatures
Formaldehyde	At Elevated Temperatures
Carbon monoxide	At Elevated Temperatures
Carbon dioxide	At Elevated Temperatures
Hydrogen Fluoride	At Elevated Temperatures
Toxic Vapor, Gas, Particulate	At Elevated Temperatures

Extreme heat arising from situations such as misuse or equipment failure can generate hydrogen fluoride as a decomposition product.

Pause for a little bit of detail...

Talkin' nerdy

Detection Limits vs Reporting Limits and Regulatory triggers

Constraints of Commercial Laboratory Requirements and Academic/Research Laboratory Flexibility with respect to protocol, sample prep, and matrix effects.

Limited data.

Field Component Test Results

Sharon, MA

TABLE 2 - Leachable SPLP PFAS results for the tested synthetic turf carpets by EPA Method 537(M). All results are in parts per trillion.

Analyte Class	Analyte Name	FieldTurf Vertex	FieldTurf Vertex Prime	SprintTurf 46-oz DFE
Perfluoroalkane Sulfonic Acids	Perfluorobutane sulfonic acid (PFBS)	< 4.8 U	< 4.6 U	< 4.9 U
	Perfluoropentane sulfonic acid (PFPeS)	< 4.8 U	< 4.6 U	< 4.9 U
	Perfluorohexane sulfonic acid (PFHxS)	< 4.8 U	< 4.6 U	< 4.9 U
	Perfluoroheptane sulfonic acid (PFHpS)	< 4.8 U	< 4.6 U	< 4.9 U
	Perfluorooctane sulfonic acid (PFOS)	< 4.8 U	< 4.6 U	< 4.9 U
	Perfluorononane sulfonic acid (PFNS)	< 4.8 U	< 4.6 U	< 4.9 U
	Perfluorodecane sulfonic acid (PFDS)	< 4.8 U	< 4.6 U	< 4.9 U
	Perfluorobutanoic acid (PFBA)	< 4.8 U	< 4.6 U	< 4.6 U
	Perfluoropentanoic acid (PFPeA)	< 4.8 U	< 4.6 U	< 4.6 U
	Perfluorohexanoic acid (PFHxA)	< 9.6 U	< 9.3 U	< 9.3 U
Perfluoroalkyl Sulfonamides	Perfluoroheptanoic acid (PFHpA)	< 4.8 U	< 4.6 U	< 4.6 U
	Perfluorooctanoic acid (PFOA)	< 1.9 U	< 1.9 U	< 1.9 U
	Perfluorononanoic acid (PFNA)	< 4.8 U	< 4.6 U	< 4.6 U
	Perfluorodecanoic acid (PFDA)	< 4.8 U	< 4.6 U	< 4.6 U
	Perfluoroundecanoic acid (PFUnDA)	< 4.8 U	< 4.6 U	< 4.6 U
	Perfluorododecanoic acid (PFDoDA)	< 4.8 U	< 4.6 U	< 4.6 U
	Perfluorotridecanoic acid (PFTrDA)	< 4.8 U	< 4.6 U	< 4.6 U
	Perfluorotetradecanoic acid (PFTeDA)	< 4.8 U	< 4.6 U	< 4.6 U
	Perfluorooctane sulfonamide (FOSA)	< 4.8 U	< 4.6 U	< 4.6 U
	N-Methyl perfluorooctane sulfonamide (MeFOSA)	< 4.8 U	< 4.6 U	< 4.6 U
(n:2) Fluorotelomer Sulfonic Acids	N-Ethyl perfluorooctane sulfonamide (EtFOSA)	< 4.8 U	< 4.6 U	< 4.6 U
	N-Methyl perfluorooctane sulfonamidoethanol	< 4.8 U	< 4.6 U	< 4.6 U
	N-Ethyl perfluorooctane sulfonamidoethanol	< 4.8 U	< 4.6 U	< 4.6 U
	N-Methyl perfluorooctane sulfonamidoacetic acid	< 4.8 U	< 4.6 U	< 4.6 U
	N-Ethyl perfluorooctane sulfonamidoacetic acid	< 4.8 U	< 4.6 U	< 4.6 U
	4:2 Fluorotelomer sulfonic acid (4:2 FTS)	< 4.8 U	< 4.6 U	< 4.6 U
	6:2 Fluorotelomer sulfonic acid (6:2 FTS)	< 4.8 U	< 4.6 U	< 4.6 U
	8:2 Fluorotelomer sulfonic acid (8:2 FTS)	< 4.8 U	< 4.6 U	< 4.6 U
	10:2 Fluorotelomer sulfonic acid (10:2 FTS)	< 4.8 U	< 4.6 U	< 4.6 U
	PFAS6 Total			

Notes and Abbreviations

PFAS: Per- and Polyfluoroalkyl Substances

SPLP: Synthetic Precipitation Leachate Procedure

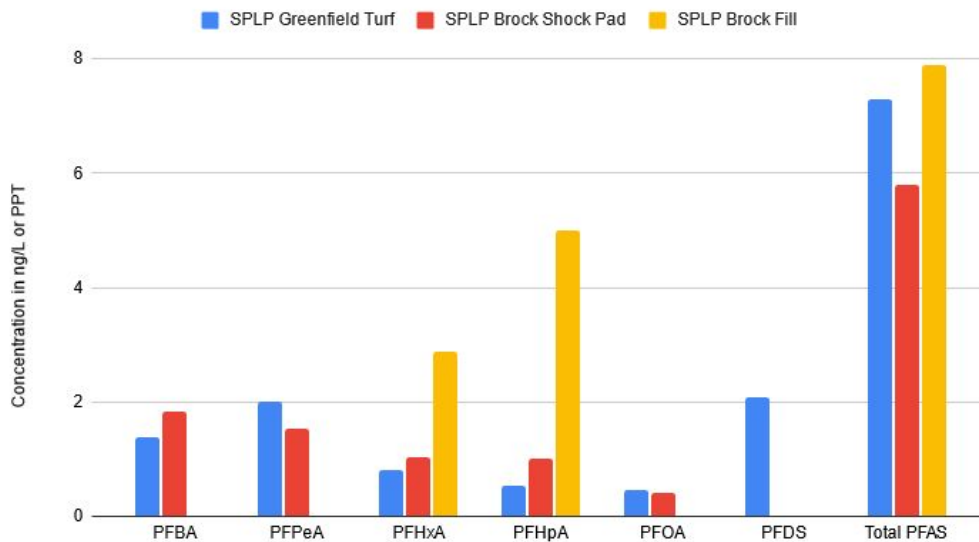
U: Not Detected Above the MDL

<https://drive.google.com/drive/folders/1ZgqrgLKBRLMJr-PdG8GF7R0p26qUnvBO>

Field Component Test Results

Martha's Vineyard, MA

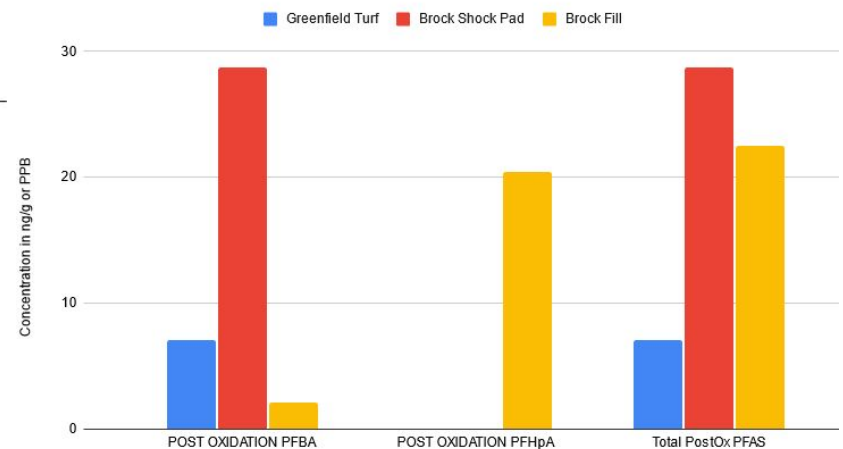
MV PFAS Results after Synthetic Precipitation Leaching Procedure (SPLP)



https://www.mvcommission.org/sites/default/files/docs/2021-02-26%20%28TurfAnalysisReport_FINAL%29.pdf

MV Turf Total Oxidizable Precursor Assay PFAS Results

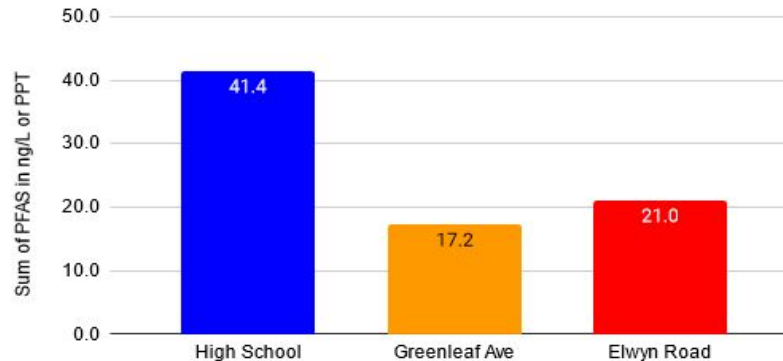
PFAS analysis after precursors are oxidized.



Real World Data Portsmouth, NH

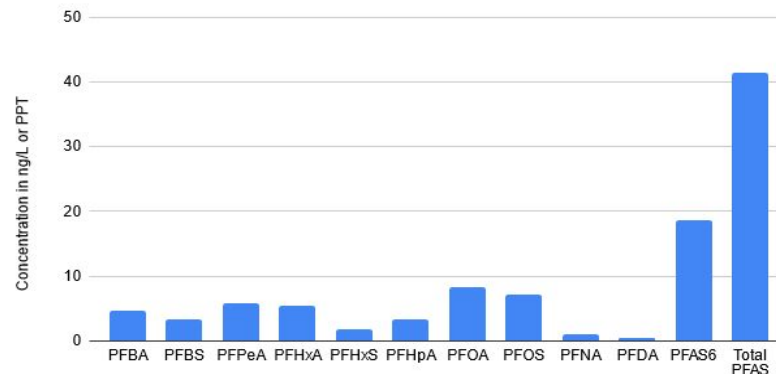
Sum of All PFAS Detected at Each Location

NH DES Data for Sagamore Creek, Portsmouth, NH, Collected Oct 2021



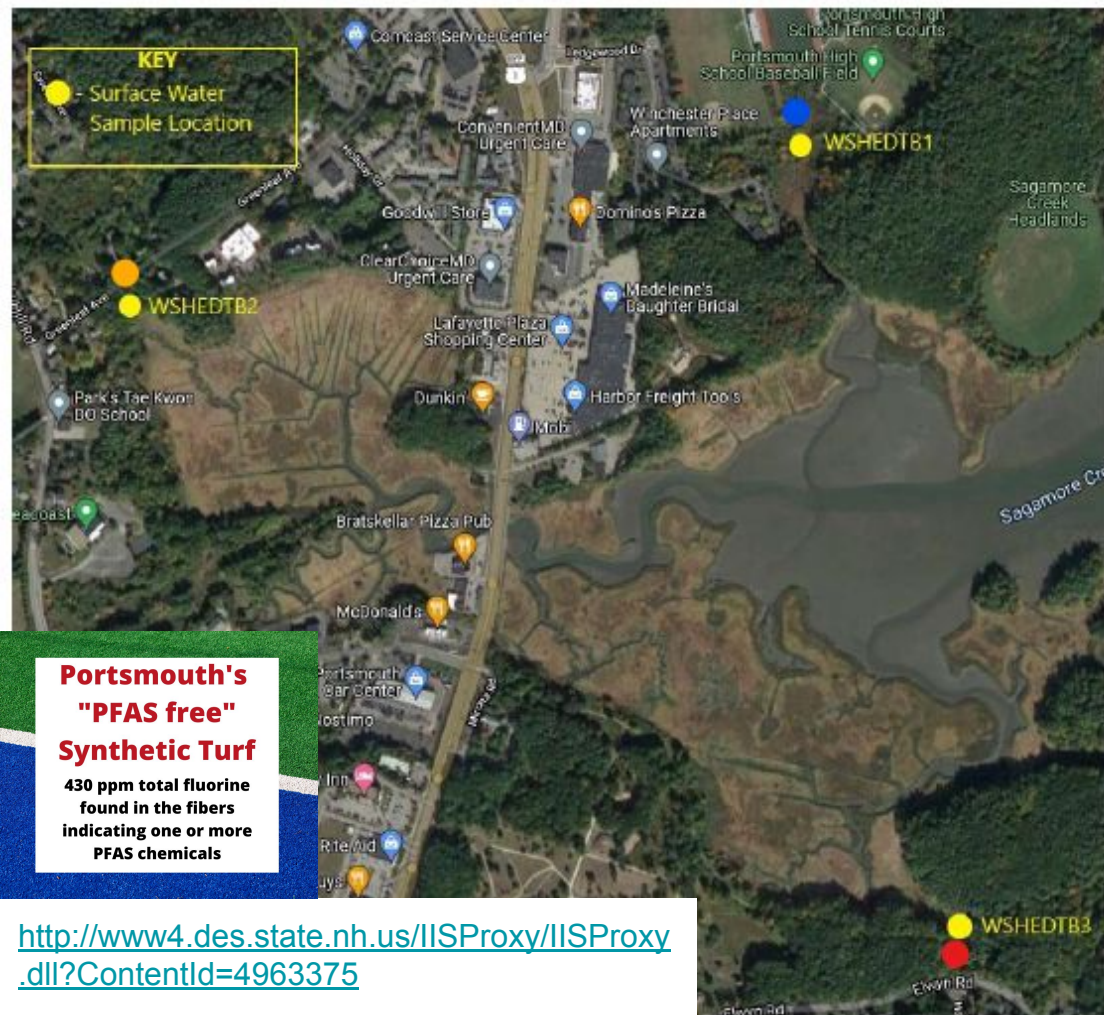
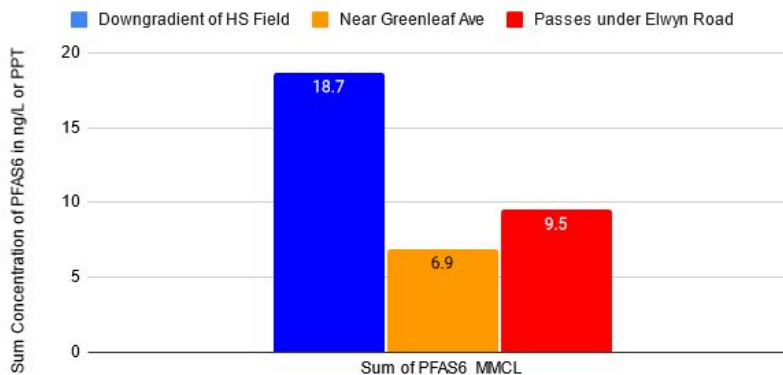
Sagamore Creek Downgradient of High School Field

Portsmouth, NH



How does NH DES Sagamore Creek data compare with MA Maximum Contaminant Level of 20PPT for Sum of PFAS 6?

PFAS6 are PFHxS, PFHpA, PFOA, PFOS, PFNA, and PFDA

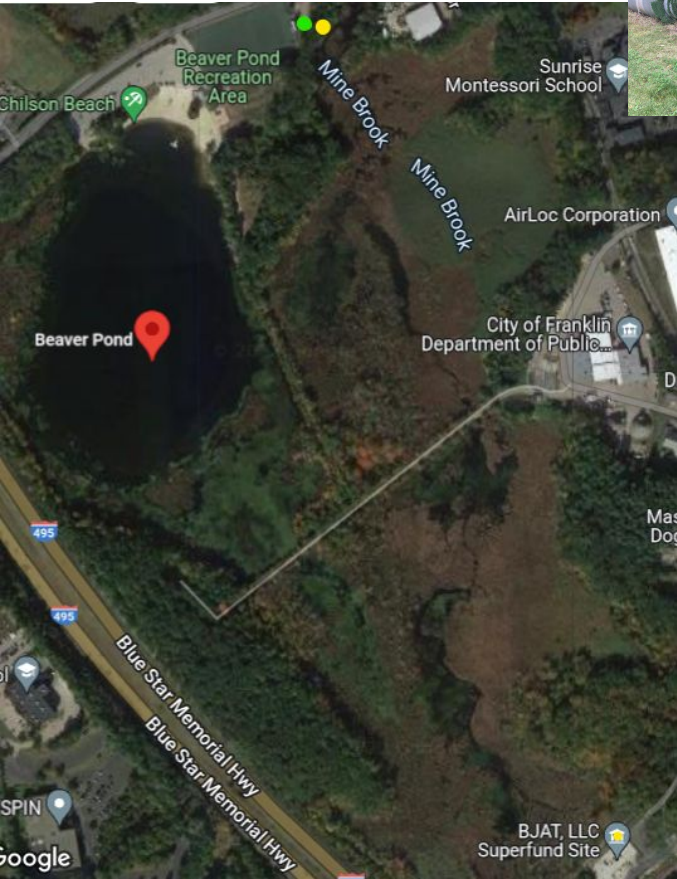


**Portsmouth's
"PFAS free"
Synthetic Turf**

430 ppm total fluorine found in the fibers indicating one or more PFAS chemicals

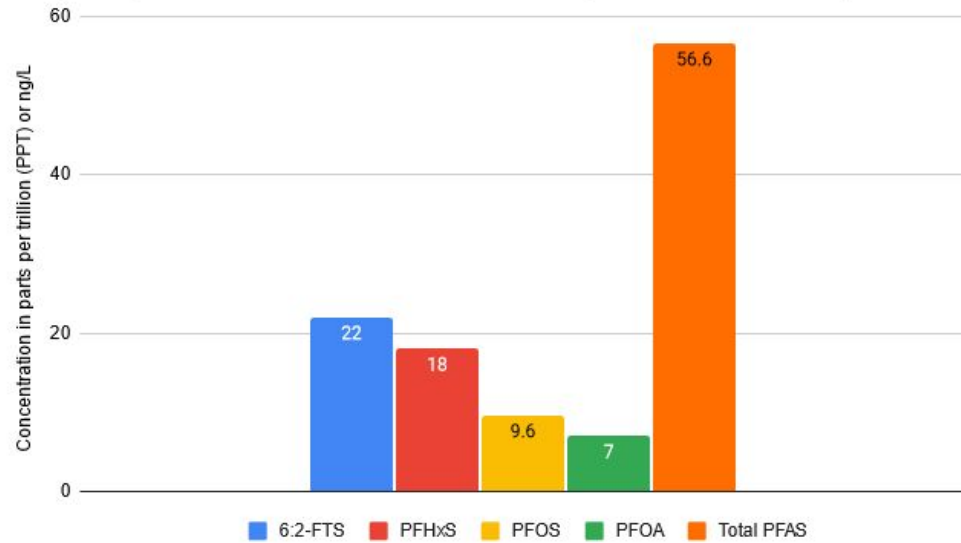
<http://www4.des.state.nh.us/IIProxy/IIProxy.dll?ContentId=4963375>

Real World Data Franklin, MA



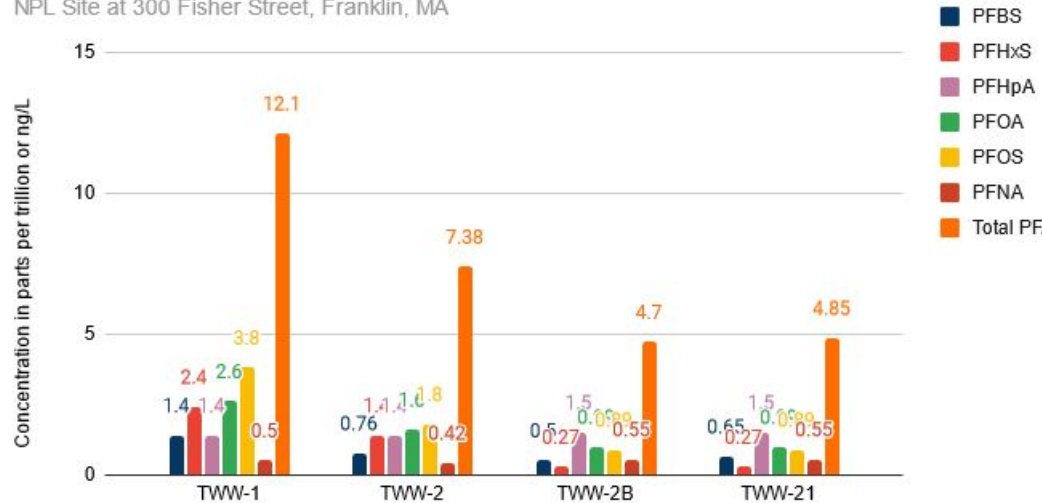
Wetlands Sample downgradient from Used Turf Piles in Franklin, MA

Sampled July 9, 2019 Wetlands of Mine Brook Franklin MA (Boston Globe Oct 9, 2019)



EPA PFAS Sampling at BJAT, LLC

NPL Site at 300 Fisher Street, Franklin, MA

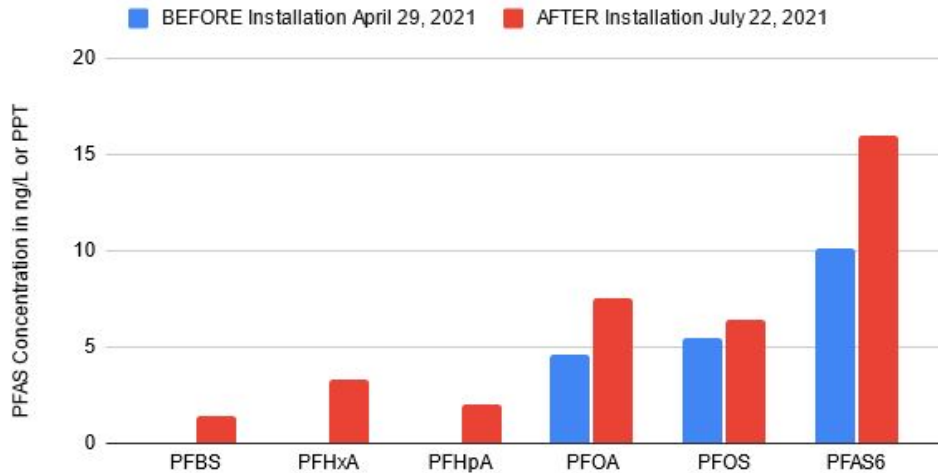


https://www.peer.org/wp-content/uploads/2019/10/10_10_19_Franklin_Wetland_Complaint-1.pdf

Real World Data Woodbridge, CT

Amity Field PFAS Testing

Woodbridge, CT



Metals: RCRA 6020	4/29/21	7/22/21
Arsenic	ND	ND
Barium	7.02 ug/L	6.99 ug/L
Cadmium	ND	ND
Chromium	ND	ND
Lead	ND	ND
Selenium	ND	1.18 ug/L
Silver	ND	ND

Neighbors File Appeal To Stop Artificial Turf Field

Date: September 03, 2020 | in: Top Stories, Town Depts. & Agencies



Two neighbors of Amity High School filed an appeal in New Haven Superior Court regarding the Town Plan and Zoning Commission decision to allow excavating and moving of earth materials for construction of an artificial turf field at the Johnson Football Field. The appeal states that the use of an athletic stadium employing artificial turf poses “unreasonable impacts to the health, safety and welfare of the community and the appellants.”

<https://woodbridgetownnews.com/neighbors-file-appeal-to-stop-artificial-turf-field/>

Why are there PFAS in my turfgrass?



Graham Peaslee & Heather Whitehead

- We have screened dozens of different new and used turfgrass samples for total fluorine...
- Where does this fluorine come from?
- Likely that some fraction of PPAs sticks to or interlocutes in the plastic used in synthetic turf...
- We measure some short-chain PFCAs in run-off but there are a lot of polymer and polymer degradation products we do not measure by LC-MS/MS...

Unanswered Questions

Which PFAS are coming off the synthetic field system components? How much? How fast? By what mechanism(s)?

Eventual fate & transport? Bioavailability and toxicity?

How to safely recycle? How to phase out?

How to remediate?

Who is responsible?

Acknowledgements

Heather Whitehead, Jeff Gearhart, Tracy Stewart, Kyla Bennett, Rebekah Thomson, Diana Carpinone, Ayesha Khan, Ted Jankowski, Chandra Prasad, Susan Desmarais, Meegan Lancaster

NH DES

MassDEP

TURI

ITRC

Questions?

