PFAS (perfluoroalkyl) Compounds Found In Deadman's Brook

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Deadman's Brook Site DM-3.5 showing fallen trees blocking flow

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)Analysis of PFAS Compounds in Deadman's Brook, Westport, CT on 5/24/24 by East Norwalk Blue (ENB), a 501 c 3 Nonprofit Dedicated to a Cleaner Long Island Sound.

Abstract: A study of nine pre-determined testing sites, (established by Harbor Watch (HW) at Earthplace), in Deadman's Man Brook (DMB), Westport, CT was conducted by ENB on 5/24/24 to determine if and to what extent PFAS (per and polyfluoroalkyl) compounds had infiltrated the waterway. ENB and the Westport Shellfish Commission chose DMB because it is a slow-moving, low-volume tributary which flows through a highly developed suburban landscape before discharging to the Saugatuck Estuary (Figure 1) where water from DMB could ultimately be a possible source of PFAS pollution to the marine environment. Up to seven PFAS compounds were extracted from Cyclopure test filters (Appendix 1) at each of the nine sampling stations (Table 1). Two of these compounds PFOS (perfluoro octane sulfonate) and PFOA (perfluorooctanoic acid) create up to half the weight (49%) of the PFAS products observed at nine stations in DMB (Table 1). This may be of concern because the federal Environmental Protection Agency (EPA) finalized a rule (4/19/24) making both products hazardous materials under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) claiming there is no safe level for PFOS or PFOA and that both compounds can remain in the human body from 3 to 5 years (EPA 2023a, Table 2). Although DMB is a small brook and PFAS loading in parts per trillion (ppt) is extremely small, the brook is like other small feeder streams weaving through the highly developed areas of Westport and Fairfield County (Figure 2) which raises concern about a possible multiplier effect of PFAS compounds entering the marine environment. Toxic PFOS and PFAS and other "forever" PFAS compounds infiltrating DMB waters will enter marine waters and the food chain at some point raising the ultimate threat of consumption by humans (Hedspeth *et al*, 2023).

Table 2. National Primary Drinking Water Regulations (NPDWR) released by EPA on 4/24/24 for the regulation of six PFAS "forever chemicals" in drinking water for all public water supplies with a customer base greater than 300,000 people (EPA 2023b).

PFAS Compounds	Maximum Contaminant Level Goal (MCLG)	Maximum Contaminant Level (MCL)
PFOA	0	4.0 ppt
PFOS	0	4.0 ppt
PFNA	10 ppt	10 ppt
PFHxS	10 ppt	10 ppt
HFPO-DA (GenX chemicals)	10 ppt	10 ppt
Mixture of two or more: PFNA, PFHxS, HFPO-DA, and PFBS	Hazard Index of 1	Hazard Index of 1
Maximum Contaminant Level Goal (MCLG): The level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety and are non-enforceable public health goals.		

There are two columns in the new EPA drinking water regulations. The right-hand side of Table 2 shows the PFAS compounds with their *Maximum Containment Levels (MCLs)*. This list is enforceable after five years. The first three years are for suppliers to determine if their public water

Figure 1. Map provided by Westport Shellfish Commission showing watershed area of Deadman's Brook and nine testing sites used by ENB for PFAS (perfluoroalkyl) compounds and sewered versus septic areas of the surrounding landscape.

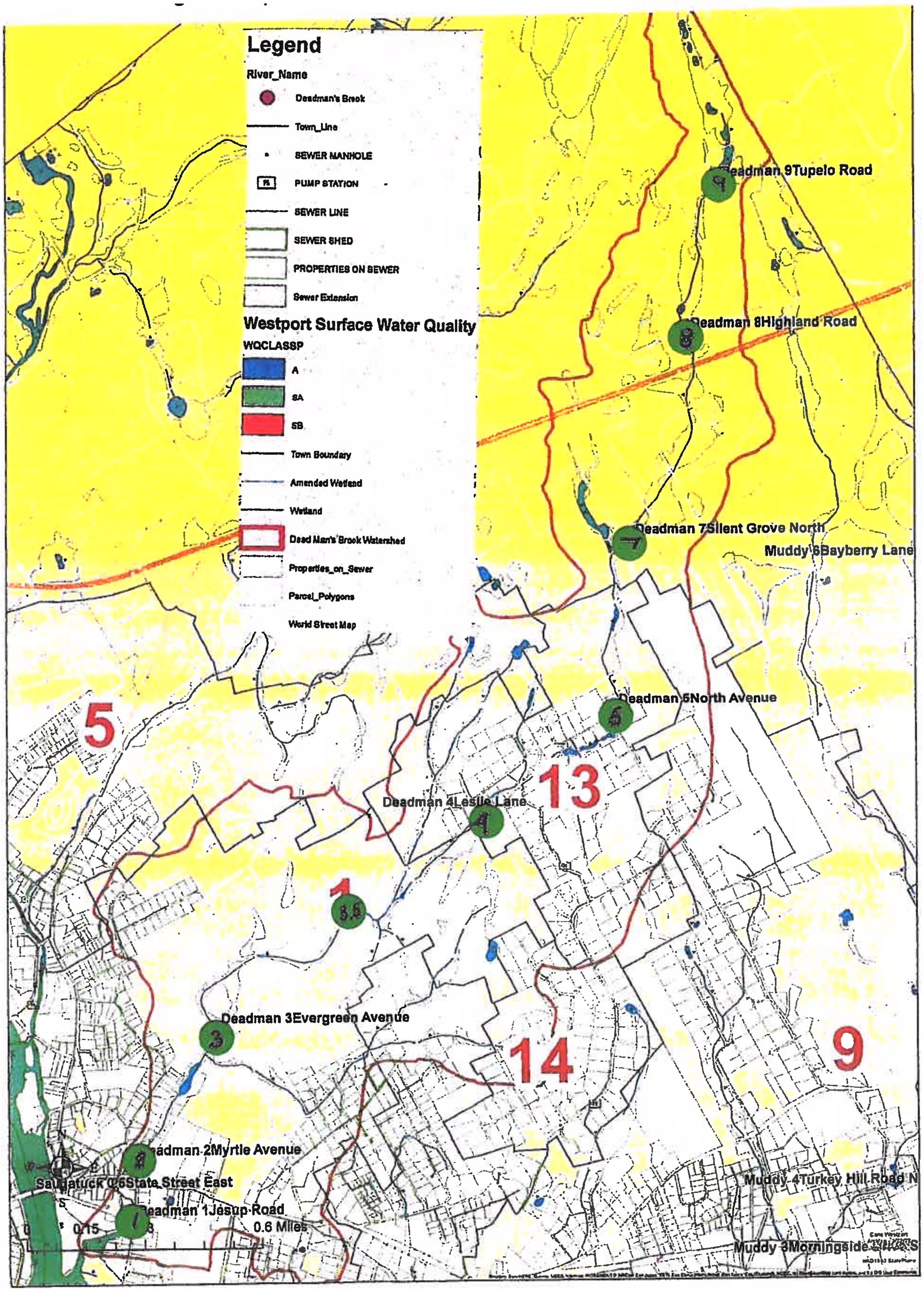
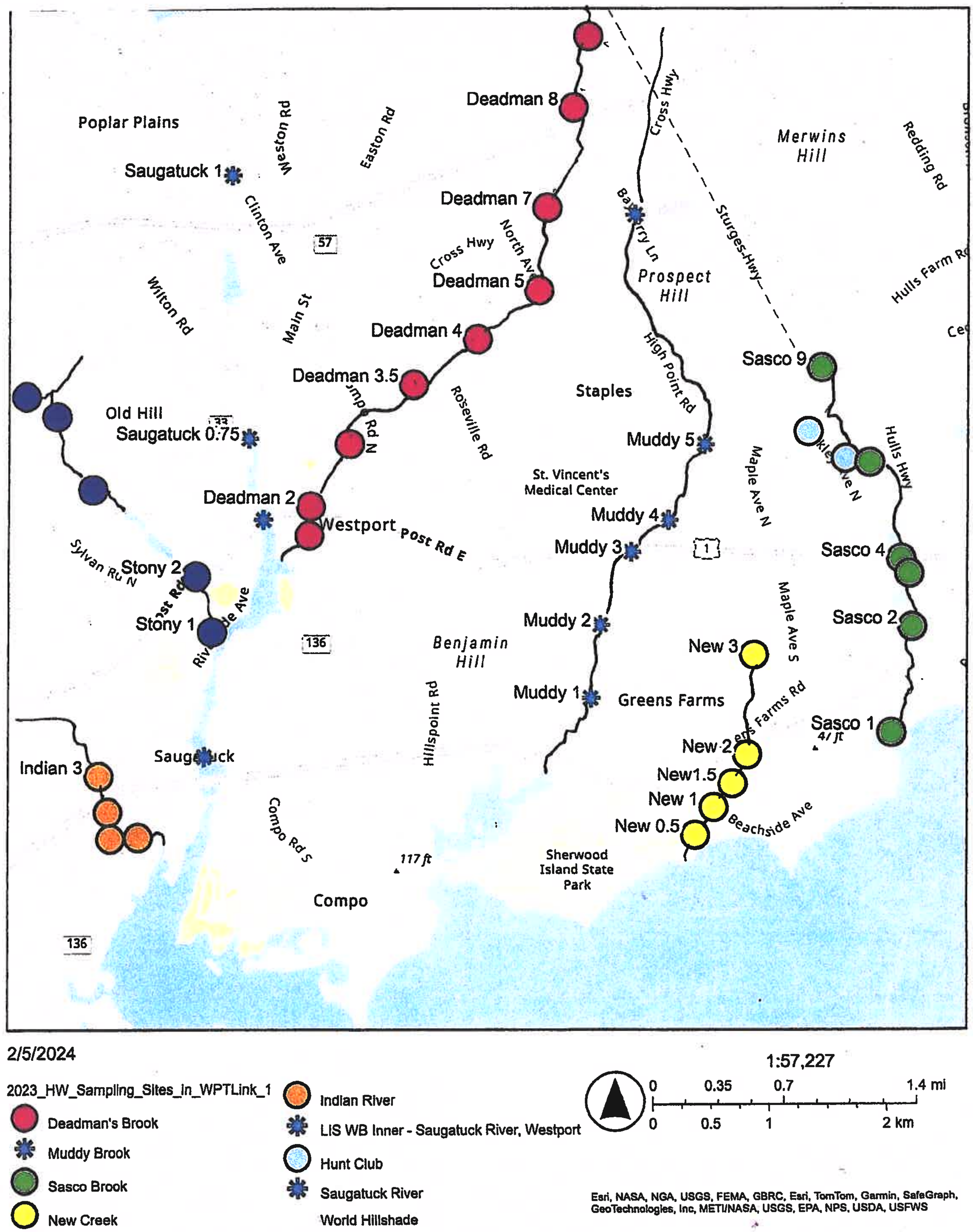


Table 2. Cyclopure analysis of PFAS compounds in parts per trillion (ppt) observed at nine surface water sites in Deadman's Brook showing percentages of PFOA and PFOS found in each sample. For comparison, the left-hand column shows the existing CT DPH criteria for drinking water as compared to the recently mandated safety limits set for drinking water by EPA (April 2024). Percentages of PFOS and PFOA are noted for each sample and as a percentage of all nine samples.

Deadman Brook	Sites	DM-1	DM-2	DM-3	DM-3.5	DM-4	DM-5	DM-7	DM-8	DM-8dupe	DM-9	FTB
CT DPH Action Levels -ppt	Component	ppt	ppt	ppt	ppt	ppt	ppt	ppt	ppt	ppt	ppt	ppt
	PFBA	< 1.0 ppt	< 1.0 ppt	< 1.0 ppt	< 1.0 ppt	< 1.0 ppt	< 1.0 ppt	< 1.0 ppt	< 1.0 ppt	< 1.0 ppt	< 1.0 ppt	< 1.0 ppt
	PFPeA	2.4	3.3	2.2	< 1.0 ppt	1.8	2.3	3.3	1.3	2.5	1.9	< 1.0 ppt
	PFHxA	2.6	3.6	2.8	1.7	2.4	2.8	3.4	1.9	2.9	2.4	< 1.0 ppt
	PFHpA	1.3	2.0	1.6	1.0	1.4	1.7	2.1	1.1	1.8	1.4	< 1.0 ppt
16	PFOA	4.7	7.0	6.1	4.8	5.5	6.2	7.3	4.7	6.5	5.1	< 1.0 ppt
12	PFNA	< 1.0 ppt	< 1.0 ppt	< 1.0 ppt	< 1.0 ppt	< 1.0 ppt	< 1.0 ppt	< 1.0 ppt	< 1.0 ppt	< 1.0 ppt	< 1.0 ppt	< 1.0 ppt
	PFDA	< 1.0 ppt	< 1.0 ppt	< 1.0 ppt	< 1.0 ppt	< 1.0 ppt	< 1.0 ppt	< 1.0 ppt	< 1.0 ppt	< 1.0 ppt	< 1.0 ppt	< 1.0 ppt
	GenX	< 1.0 ppt	< 1.0 ppt	< 1.0 ppt	< 1.0 ppt	< 1.0 ppt	< 1.0 ppt	< 1.0 ppt	< 1.0 ppt	< 1.0 ppt	< 1.0 ppt	< 1.0 ppt
	PFBS	1.8	2.2	2.1	1.6	1.9	2.1	2.0	1.4	1.6	1.7	< 1.0 ppt
49	PFHxS	1.9	2.4	2.3	1.9	2.3	2.3	2.5	1.0	1.1	1.2	< 1.0 ppt
10	PFOS	3.6	4.7	3.8	3.3	4.1	4.3	5.0	3.0	3.6	3.1	< 1.0 ppt
	Total PFAS	18.3	25.2	20.9	14.3	19.4	21.7	25.6	14.4	20.0	16.8	0
	% PFOA	25.7	27.8	29.1	33.5	28.4	28.6	28.5	32.6	32.5	30.3	29.4%
	%PFOS	19.7	18.7	18.2	23.0	21.1	19.8	19.5	20.8	18.0	18.4	19.6%

Figure 2. Map of southeast Westport showing small feeder streams to Saugatuck Estuary, Deadman's Brook. Stony Brook and Indian River. Streams discharging to Long Island Sound Include Muddy Brook, New Creek and Sasco Brook. Map provided by Harbor Watch at Earthplace,



supply routinely exceeds PFAS levels specified by the EPA. If so, a water company then has two more years to find and employ the needed technology to meet the EPA criteria (EPA 2023b). The MCLS are enforceable. The center column of Table 2 shows a *Maximum Containment Level Goal (MCLG)*. Note that the goal for PFOS and PFOA in MCLG is zero contamination based on a no-safe-level designation confirmed by EPA toxicity research (EPA 2023a). A zero level in ppt for PFOS and PFAS in filtered drinking water is unattainable with present technology, so the MCLG listings for PFOA and PFOS are future goals until suitable technology is developed to close the 4 ppt gap on both compounds. The MCLG list is not enforceable. The present EPA mandate for PFAS in drinking water can allow up to five years for a water company to begin removing PFAS from raw water contamination which means that the public would be exposed to PFAS products in drinking water until the needed filtration is in place (EPA 2023b). Once the EPA mandated treatment begins, there is still a gap of 4 ppt for PFOS and PFOA to meet a desired EPA zero tolerance for both compounds (Table 2)

Lacking guidelines from EPA, the CT DPH, is presently operating on its own PFAS regulations for drinking water (Table 3). The State of Connecticut is now obligated under the EPA NPDWR to meet the new drinking water requirements within a five-year period beginning 4/24/24 (Table 2). Lacking guidance from the EPA, the State of Connecticut has no system in place to safely classify aquatic and marine waters for PFAS compounds.

Figure 3. Current CT DPH drinking water regulations for PFAS products in drinking water marks an improvement over EPA regulations set in 2016 0f 70 ppt. The CT DEH criteria is presently based on those PFAS compounds most frequently found in blood and those compounds found at higher concentrations than other PFAS products.

Analyte	CT Drinking Water Action Level (parts per trillion, ppt)
Perfluorooctane sulfonic acid (PFOS)	10
Perfluorononanoic acid (PFNA)	12
Perfluorooctanoic acid (PFOA)	16
Perflurohexane sulfonic acid (PFHxS)	49

Background Discussion, PFAS Compounds in the Environment:

PFAS compounds are now universally being found in the waters by the EPA and other water quality minded organizations of many rivers and lakes throughout the United States while evolving scientific research is currently highlighting the dangers of these toxic products to public health and the environment (ATSDR 2023a, ATSDR 2023b). Based on increasingly active scientific research and the improved ability of scientists to routinely measure PFAS compounds in the parts/trillion (ppt) range, PFAS compounds have already been identified in over 14,000 commercial and consumer products (EPA 2021.2023a). Simultaneously, a widening range of health issues currently being identified with PFAS compounds includes a variety of cancers and developmental problems (EPA 2023a). Almost any product advertised as greaseproof, stain resistant, waterproof and fireproof may contain one or more PFAS compounds. While PFAS contaminants measured in ppt may seem like a negligible amount of toxicity to the human body, they are known as "forever chemicals" based on their almost indestructible bonding of fluorine and carbon. Human cells readily accept trace amounts of PFAS compounds which can remain in the body for up to 8 years (EPA 2023a). In addition, PFOS and PFOA compounds have been rated by the EPA as zero tolerance to humans, 4/10/24. PFAS compounds can now be found in not only the blood of most Americans (EPA 2023a) but in animals as well (Death *et al* 2021), (Brake *et al* 2023).

PFAS Compounds in the Saugatuck River:

Based on support from the Westport Shellfish Committee, ENB first screened the waters of the Saugatuck River System, 2/24/24 using Cyclopure sampling technology (Appendix 1) to determine if PFAS compounds were a possible threat to marine life in the Saugatuck River Estuary. Accordingly, 33 freshwater sites (previously established by Harbor Watch for monitoring indicator bacteria, Appendix 1, Figure1) were surveyed with Cyclopure test kits (Appendix 1). Of the three Saugatuck branches, only trace amounts (1 to 2 ppt) of PFOS and PFOA were identified by ENB in the Main Branch and the West Branch (www.eastnorwalkblue.org). No PFOS or PFOA compounds were found in the Aspetuck River. There were trace amounts of PFBA (perflurorbutanoic acid) ranging from 2.1 to 4.0 ppt were found at three testing sites only in the Aspetuck river from unknown sources. There is presently no EPA safety alert for PFBA. Based on ENB research, water quality in all three reservoirs in the Saugatuck River system during the testing period is below the new EPA NPDWR mandates for the six PFAS compounds in drinking water (Table 2).

The limited amounts of both PFOS and PFOA in the Saugatuck River system may be due in large measure to the extensive protected forests around the reservoirs and the mostly undisturbed naturally occurring riparian buffer along many miles of the riverbanks. The known sources for PFAS input to a waterway are limited for the Saugatuck River System; there are few storm drains discharging effluent from wastewater treatment plants, no fire department training areas where AFFF foam was used, no riverside landfills, no artificial turf (Peaslee and Heather 2022) near the brook and only limited residential development in proximity to the riverbanks which consists of widely scattered housing on 2 or more acre lots. The actual sources of trace amounts PFOS and PFOA in the Saugatuck River system are presently unknown.

PFAS Compounds in Deadman's Brook

ENB having completed a preliminary assessment of the three branches of the Saugatuck (Feb 2024), The Westport Shellfish Commission raised the question about possible PFAS concentrations to be found in the small (low volume) feeder creeks in Westport that discharge to the main river system (Figure 2). Deadman Brook was chosen because of its proximity to a fully developed suburban landscape which is the opposite of the natural landscape observed comprising most of the Saugatuck River System. DMB is located amid developed residential properties where its naturally occurring riparian buffer has been disturbed or totally removed (Appendix 2 photos, Site DM- 4, Site DM- 9) by development of private homes. Numerous storm drains serve local roadways and discharge directly to DMB (Appendix 2 photos, Site DM- 5, Site DM- 7). A variety of insecticide and growth compounds (some of these reportedly contain PFAS compounds) are used on ornamental shrubbery and large lawns. The flow of DMB is interrupted with at least one large snag (Appendix 2 photo, Site DM-3.5). DMB terminates in downtown Westport where it receives more stormwater drainage and runoff from paved surfaces and a variety of commercial sources before discharging to the Saugatuck Estuary (Appendix 2 photo, Site DM-1). DMB is representative of many small brooks and feeder streams threading through densely populated, suburban areas across Westport (Figure 2).

Procedures:

Accordingly, all nine DMB monitoring sites were surveyed on 5/24/24 beginning at 09:32 and ending at 11:40 (Appendix 2, Figure1). Each site was simultaneously monitored for dissolved oxygen (DO), conductivity, water and air temperature (Appendix 2, Table1) with a calibrated, YSI ProSolo DO meter. No rainfall was recorded on the three days prior to sampling. DMB surface samples were collected with Cyclopure cups containing Dexsorb® filters according to manufacturer's directions and in accordance with ENB's Standard Operating Procedures for Sampling Surface Waters. (Appendix 1). All PFAS samples were then sent by UPS to Chicago on 5/24/24 for analysis by Cyclopure.

Findings:

Deadman's Brook waters were observed to be well oxygenated, averaging 6.7 ppm with an average water temperature of 17.4 degrees C (Appendix 2, Table 1). Conductivity levels were elevated at testing sites DM-1 and DM-2 at 09:32 during sampling due to limited tidal incursion at DMB's mouth with flood tide due to arrive at 12:11 in the Saugatuck Estuary (Appendix 2, Table 1). Up to seven PFAS compounds were detected in the Cyclopure samples (Table 1) for eight of the nine stations with total averages of PFOA at19.6% and PFOA at 29.4% for all PFAS compounds reported by Cyclopure for the nine stations in DMB (Table 1). The EPA has yet to issue mandates for PFAS compounds in surface waters, leaving the states to set their own benchmarks. The CT DPH has yet to set any PFAS guidelines or benchmarks for certifying surface waters as they wait for guidance from EPA. Actual observed input sources for PFAS products at any given DMB station based on slightly elevated input numbers are not evident. There are slight increases in total PFAS compounds observed at station DM-1 and DM-2 and again at stations DM-7, DM-8 (Appendix 2, Table 1) which are attributable to slightly increased levels of PFOA and PFOS at those same testing sites. Based on input levels alone they do not appear indicative of any significant point sources for PFOS or PFOA. The near steady state of most PFAS concentrations in the surface waters from Station Dm-1 to Station DM-9 suggests that the bulk of identified PFAS sources may possibly be infiltrating DMB waters farther north of Station DM- 9 or may be due to ground water infiltration or both (Table 1).

Conclusions:

Possible suspects for the observed PFAS compounds in DMB may be insecticides, fertilizers, ground water from non-sewered and sewered areas (Figure1, Table 1) and runoff from local roadways. With over 14,000 commercial and consumer products available, the root causes of DMB contamination may remain elusive. Until levels of PFAS compounds in waterways are classified and mandated by EPA, little action will be taken at the state level to quantify PFAS compounds with needed action items in freshwater rivers and lakes and Long Island Sound. The CT DPH has placed limited consumption warnings, 6/15/24, for fish in eleven bodies of water in the center of the state based on PFAS research by Weston and Sampson, (2023). Other rivers in the state will possibly share the same fate once funding is available to continue evaluating rivers for PFAS contamination. The technology for reliably removing PFAS compounds from rivers and streams, other than eliminating new sources in proximity to the waterway has yet to be proven. The predominating PFAS compounds observed in local testing by ENB are PFOS and PFOA compounds (Table 1). The EPA posted health advisory warnings for both products (5/22/24) stating there are no safe levels for human exposure for PFOA and PFOA. The most important steps should now be taken at the local public works and municipal planning levels to exclude projects of all kinds presently in the planning phase currently known to be sources of PFAS compounds such as artificial turf, new landfill sites and polluting industries in proximity to surface waters. The State of CT. has removed AFFF foam from all fire departments and has continued to evaluate and recently regulate some commercial and consumer products containing PFAS compounds (CT Senate Bill #292, April 2024}. Forever chemicals will not disappear on their own. Any developmental project that disturbs naturally occurring riparian buffer should be revised or not allowed. Any small stream or river flowing through well-developed suburbia will possibly be subject to some form of PFAS contamination for the foreseeable future.

Future Planning:

A future DMB field testing plan should be revised to locate new testing sites north of Station DM- 9 to determine whether any additional sources of PFAS compounds are infiltrating the brook. The large snag at Station DM- 3.5 (Appendix 2, Site DM- 3.5) should be removed prior to a continuation of PFAS sampling which should be accomplished just prior to low tide. These measures will improve flow in DMB and may allow a truer picture of PFAS contamination in the waterway. Other small brooks such in Westport such as Muddy Brook should be tested for PFAS to better understand the extent of pollution by "forever chemicals".

ENB was grateful to Staples High School for sending two senior interns (Staples High School Senior Intern Program) to assist with the research project on 5/20 for three weeks. Both Alex Berkley and Gabriela de Brito are interested in pursuing careers in marine sciences and were a great help to ENB in completing the work. Both students showed an unusual degree of interest and enthusiasm and in all probability may be leaders in solving the evolving threat of PFAS and other newly recognized pollutants to our waterways. ENB would not have made progress in several other areas such as the initial findings of neonicotinoid pesticides in DMB (report to follow) without their help.

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Appendix 1. Standard Operating Procedures (SOPs) for Sampling Surface Waters for PFAS (per and polyfluoroalkyls) compounds found in Deadman's Brook, part of the Saugatuck Watershed in Westport, CT

With recent scientific discoveries concerning PFAS products in the aquatic environment and a growing list of associated human illnesses ranging from cancers to developmental problems in young people, East Norwalk Blue, (ENB) a 501 c 3 non-profit, has been screening local rivers to determine if PFAS compounds are present in surface waters and discover possible sources causing PFAS contamination. Based on support from the Westport Shellfish Commission, ENB embarked on a full survey of the Saugatuck River system (2/24) including the West Branch, the Main Branch and the Aspetuck River (Figure 1). The Main Branch and the West branch were found to contain trace amounts of PFOS (perfluorooctanoic sulfonate) at < 1.0 to 2.2 ppt and PFOA (perfluorooctanoic acid) at < 1.0 to 1.7 ppt while the Aspetuck River showed only PFBA at < 1.0 to 4.0 ppt at just three testing sites (www.eastnorwalkblue.org, about us). Much of Saugatuck watershed contains protected or lightly developed landscape with few known sources of PFAS compounds. Much of the naturally occurring, riparian buffer remains intact. Based on the relatively light pollution by PFAS compounds found in the main river system, the Shellfish Commission then decided to look at some of the tributaries to the Saugatuck Estuary that run through highly developed sections of Westport. Deadman's Brook watershed area was chosen as an example (Figure 2) of dense residential development with little riparian buffer still in place to support the waterway (Appendix 2, photos DM-1 to DM-9).

The Cyclopure Water Sampling Kits for PFAS:
The Cyclopure kit for sampling PFAS compounds in surface water is packed in a small cardboard container and contains a plastic cup with a DEXSORB® (Figure 3) filter attached to the bottom of the cup. An abbreviated instruction manual Is enclosed along with a site identification card and a pair of nitrile gloves (Figure 3). The kits are relatively inexpensive ($79 USD). The price includes return postage and all processing costs at Cyclopure. The sampling procedure is straight forward, and the nitrile gloves are used in all testing steps to avoid any possible contamination from extraneous PFAS compounds in the environment (Figure 3). Cyclopure does not have approval from the National Environmental Laboratory Accreditation Program (NELAP) which standardizes laboratory procedures for all 50 states for PFAS research (Appendix 1, Pg. 7). It does follow NELAP guidelines and practices in the lab according to EPA 533, 537 and the 1633 draft.

Figure 3. Components of a Cyclopure PFAS test kit.

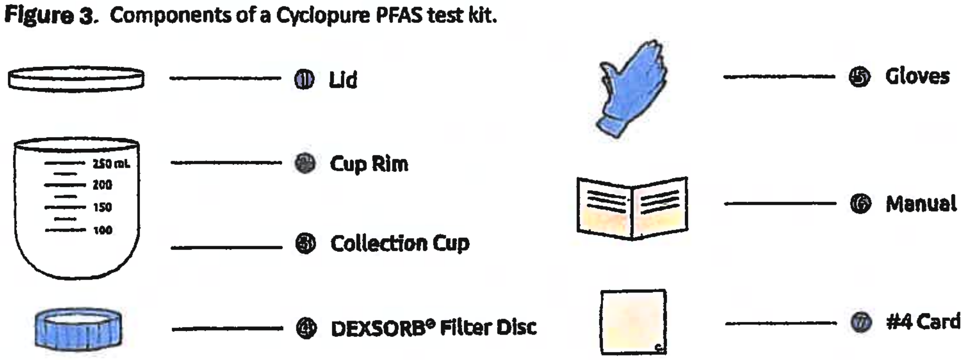


Figure 1. Harbor Watch (HW) Map showing site detail for the Saugatuck Main Branch, the West Branch and the Aspetuck River

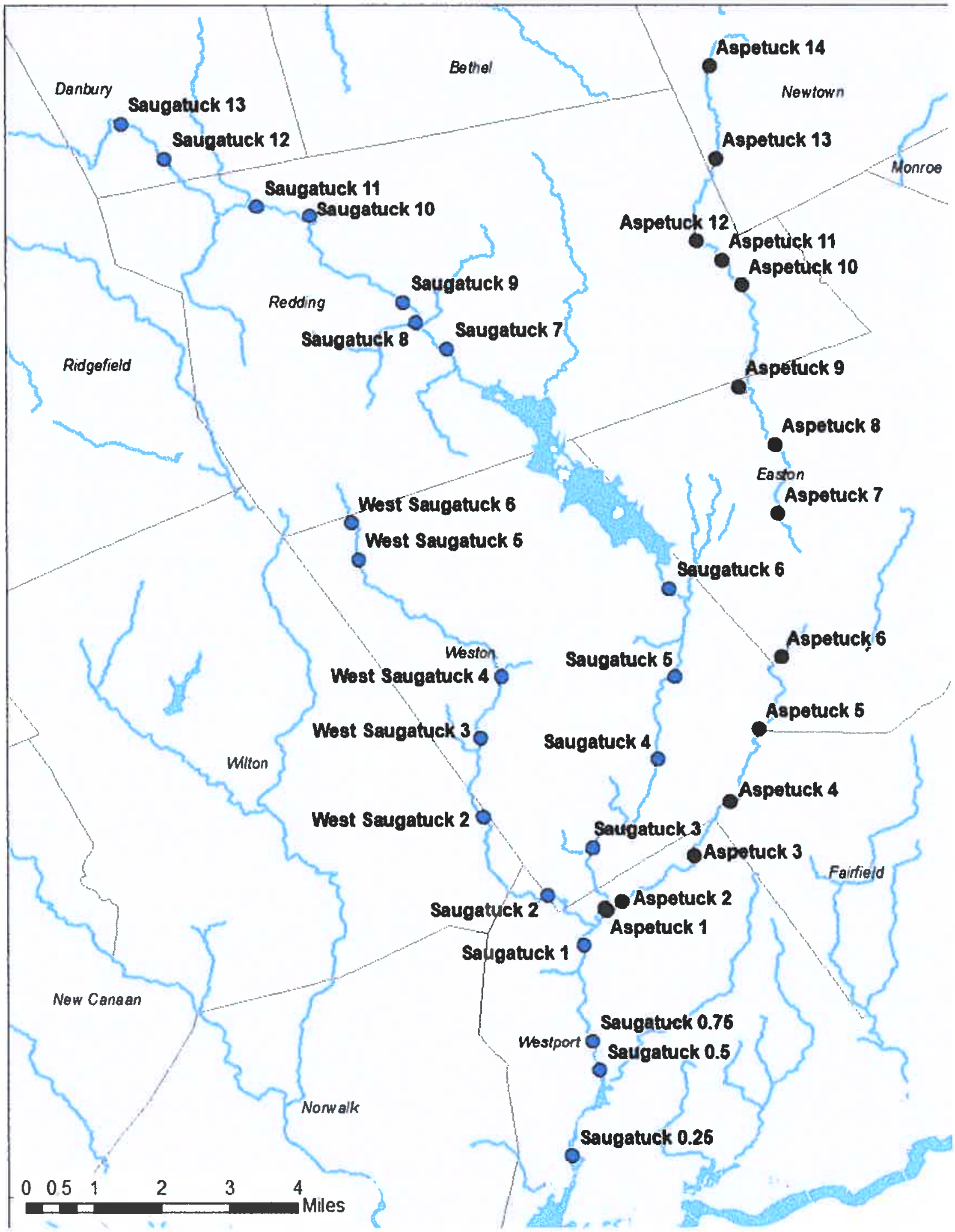
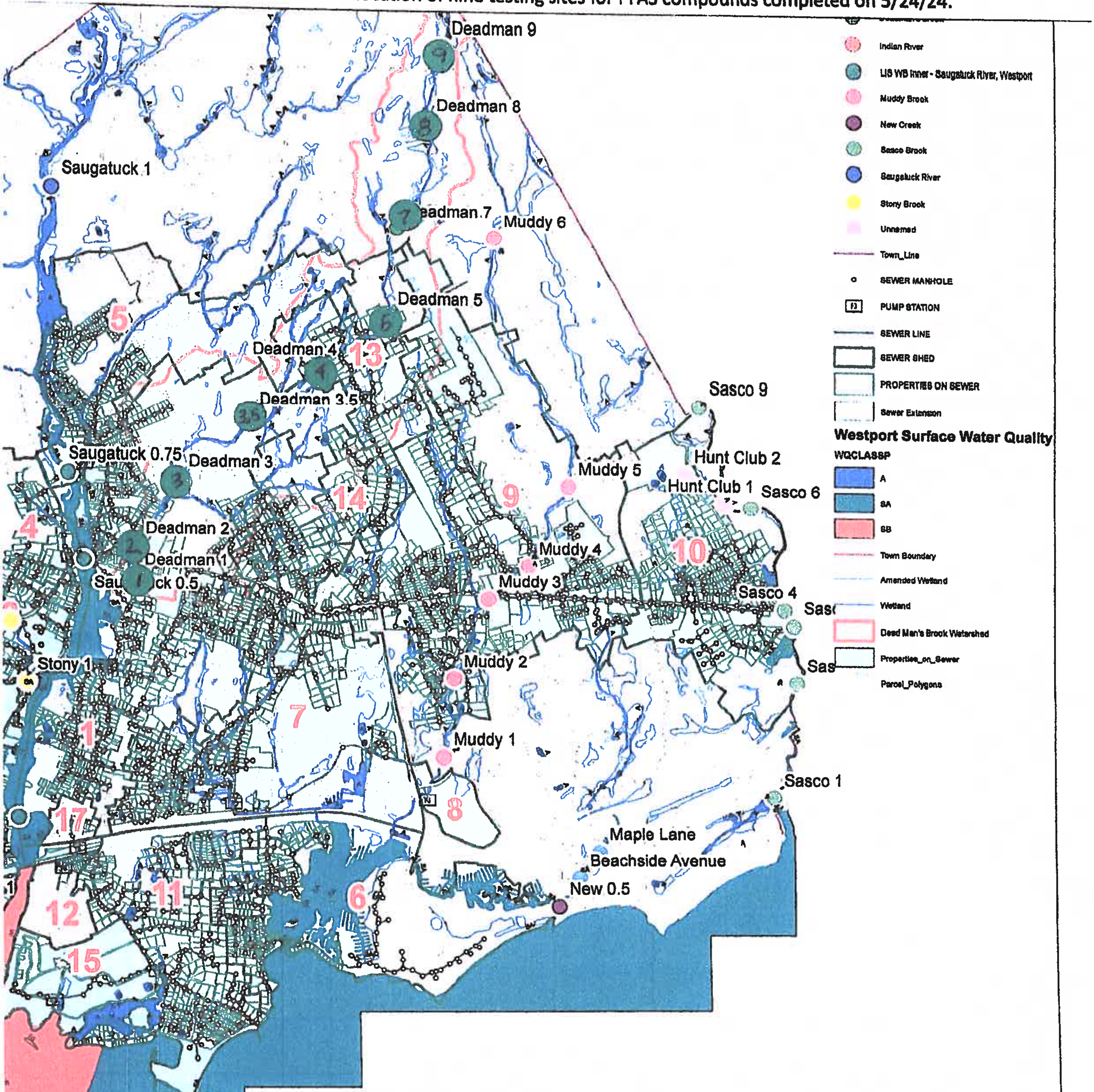


Figure 2. Map prepared by Westport Conservation Department showing the highly developed watershed for Deadman's Brook with the location of nine testing sites for PFAS compounds completed on 5/24/24.



Connecticut Water Quality Standards and Classifications

Class AA
Designated uses: existing or proposed drinking water supply, fish and wildlife habitat, recreational use (may be restricted,) agricultural and industrial supply.
Discharges restricted to: discharges from public or private drinking water treatment systems, dredging and dewatering, emergency and clean water discharges.

Class A
Designated uses: potential drinking water supply; fish and wildlife habitat; recreational use; agricultural and industrial supply and other legitimate uses including navigation.
Discharges restricted to: same as allowed in AA.

Class B
Designated uses: recreational use: fish and wildlife habitat; agricultural and industrial supply and other legitimate uses including navigation.
Discharges restricted to: same as allowed in A and cooling waters, discharges from industrial and municipal wastewater treatment facilities (providing Best Available Treatment and Best Management Practices are applied), and other discharges subject to the provisions of section 22a-430 CGS.

Coastal and Marine Surface Waters

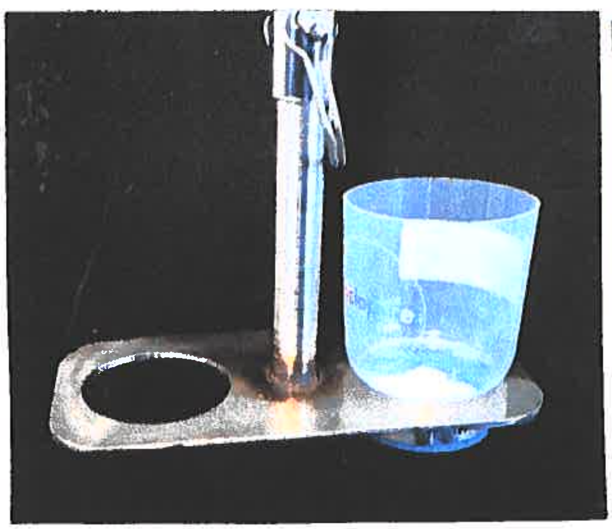
Class SA
Designated uses: marine fish, shellfish and wildlife habitat, shell fish harvesting for direct human consumption, recreation and all other legitimate uses including navigation.
Discharges restricted to: same as for AA or A surface waters.

Class SB
Designated uses: marine fish, shellfish and wildlife habitat, shellfish harvesting for transfer to approved areas for purification prior to human consumption, recreation,

Based on previous field experience, ENB staff designed a stainless-steel collection tool to minimize PFAS contamination and to provide accuracy when duplicate samples are taken. Tools were fabricated in Norwalk by Artistic Iron Works.

Once a sampling site and sample cup is selected, the nitrile gloves (included with each kit) are placed on each hand and are worn for the duration of that test. The filtration cup is removed from the box and is placed in the stainless-steel collection fixture. Once the cup is seated, a stainless-steel pipe clamp is positioned on the blue filter disk (now below the fixture deck) and tightened to keep the cup in place when it is submerged (Figure 4). The cap is removed from the cup and the fixture is lowered on an adjustable handle into the water to collect the sample. Once the sample is retrieved, the cap is placed back on the cup. The stainless-steel clamp is removed, and the cup is then placed on a 500ml PP bottle for drainage. After the water sample filters through the cup (approximately 25 minutes), the cup is removed from the 500 mL bottle, shaken lightly to remove any remaining water and placed back in the original shipping container along with the completed identification card. The entry on the identification card will show city, state, zip code, collection date and time of collection. It is important to keep this card and the sample cup in the original box as all three are identified with the sample order number. The box is now closed and ready for the return shipment to the Cyclopure processing center. The nitrile gloves and the drainage water can now be safely discarded.

Figure 4, Shows the collection cup placed in the fixture and then positioned on the 500 mL drainage bottle:



Field Trip Blanks.

As part of quality control, a previously prepared (250 mL HDPE bottle containing filtered and sterile water) field trip blank (FTB) is taken on each sampling trip to the field to assure that it can be transferred in the field to a sterile Cyclopure sampling cup without attracting any PFAS contamination when subsequently processed with other samples in the laboratory. One of the Cyclopure sample kits serves as the field trip blank. The cup is removed from the box using the provided nitrile gloves and placed on top of a 500 mL HDPL drainage bottle. The lid is removed, and the cup is filled with 250 mLs of PFAS free water. The FTB is allowed to drain (Figure 5) until the cup is empty (approximately 25 minutes). The cup is then lightly shaken to remove any residual water and the cap is replaced. The cup is returned to the original shipping container, the enclosed identification card is completed, and the box is closed for shipment. The nitrile gloves and drainage water used for the FTB can now be safely discarded. An FTB is to be taken each time ENB collects samples from a designated water body.

Figure 5, Preparation of a field trip blank showing the cup placed on a drainage bottle and filled with 250 mLs of PFAS free water.

Duplicate samples:

To promote quality control, duplicate samples are taken on each field sampling trip to assure accuracy. Two Cyclopure cups are removed from their respective containers with the provided nitrile gloves and placed in the two openings on the sampling fixture deck and secured underneath with stainless-steel pipe clamps (Figure 6). Each clamp on the underside of the fixture deck is tightened with a screwdriver around the projecting blue filter holder to keep the sampling cup from floating free. The fixture is then secured to an aluminum handle (Figure 6) and the caps on each sampler are removed. The apparatus is then lowered under the surface where both sampling cups are filled to the top with water. The collected samples are withdrawn, both sampler caps are carefully replaced on the cups, and the pipe clamps are removed with the screwdriver. Both sampling cups are then placed on the 500 mL drainage bottles where the sample passes through the DEXSORB® filters (Figure 6). Once both sample cups have drained (Approximately 25 minutes) they are removed, lightly shaken to remove any residual water, caps are replaced, and the cups returned to the original shipping containers. Both information cards are completed and returned to their respective shipping containers. The containers are closed and prepared for shipping to Cyclopure. At this time the nitrile gloves and filtered sample water from both cups can be safely discarded.

Figure 6 Two Cyclopure sampling cups are placed on the stainless-steel fixture plate and secured with stainless-steel pipe clamps. The protective caps on both samplers are removed prior to sampling. Once the samples are retrieved, the caps are carefully replaced, the pipe clamps are removed and both Cyclopure cups are transferred to the 500mL drainage bottles.

Conclusion:

ENB believes that lhe approach outlined in this sampling SOP document is a reasonable approach to preserving the integrity of PFAS samples which are known to be easily contaminated from other PFAS. compounds in the environment. The use of an all-metal fixture with stainless-steel pipe clamps as well as using a dedicated pair of nitrile gloves for handling each sample container should provide a true assessment of PFAS products in the sample. In addition, the short interval between gathering samples and the processing by Cyclopure in Chicago and the fact that samples are shipped dry should help keep samples from possible changing composition sometimes found in liquid samples due to holding times..

Richard Harris

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Cyclopure Product and Testing Description

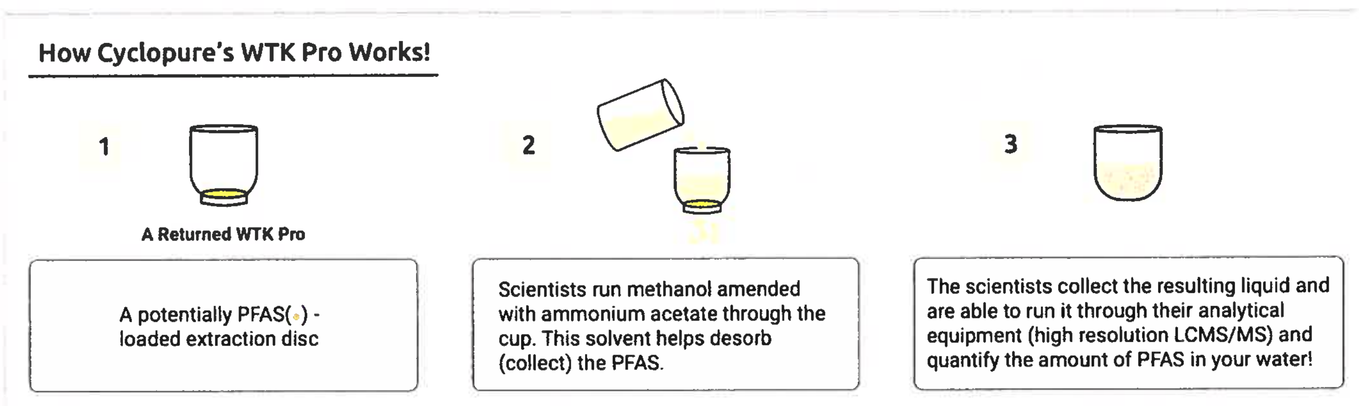
1. Description of the Cyclopure Water Test

The Cyclopure Test Kit Pro is designed to test for 55 PFAS Analytes using a DEXSORB® loaded extraction disc in the bottom filter. Using DEXSORB®, Cyclopure can accurately measure and quantify the presence of short and long chain PFAS in a convenient point of site, time-specific extraction method.

2. PFAS recovery at the Cyclopure lab

When the WTK is received, Cyclopure analytical chemists perform standard solid-phase extraction (SPE) to recover PFAS compounds collected in the DEXSORB® extraction disc. The eluted PFAS sample is subsequently analyzed on a HPLC-MS/MS (QExactive Orbitrap, ThermoFisher).

Analytical procedures use isotope dilution for PFAS measurement and quantification. The analysis of water samples has been validated to the requirements of EPA Methods 533, 537 and 1633 (draft), and follow instrument procedures for internal standardization and calibration.



3. PFAS compounds recovered by Cyclopure testing

Cyclopure tests for 55 PFAS structures, including 21 precursors and all PFAS listed under EPA Methods 533, 537 and 1633 draft.

Reporting limits of Cyclopure analytical methods

The limit of quantification (LOQ) for all 55 PFAS tested under Cyclopure analytical methods is 1.0 ppt (ng/L) for all PFAS. Reporting limits have been validated to the accuracy criteria of EPA methods, including Minimum Reporting Limit (MRL) confirmation.

4. Cyclopure testing differences

Cyclopure testing for PFAS follows the same analytical methods as other commercial labs, and have been validated to EPA's Demonstration of Capability Quality Control

5. Using Cyclopure's Water Test Kit Pro to test surface waters

Cyclopure's Water Test Kit Pro can be used with equal performance and accuracy for surface waters, well water and tap water. Sample collection follows the same procedure of passing 250 mL of water through the collection cup.

6. PFAS testing methods Cyclopure uses

Cyclopure has developed its own PFAS test method using its DEXSORB® adsorbent. The method is consistent and highly accurate. It is used by homeowners to test their tap water, by environmental organizations like the Waterkeeper Alliance, Sierra Club and others to test surface waters, and it is recommended and used by Michigan State to monitor PFAS operations.

7. An assessment of safety or risk

There is a box in the lower right of the reports which notes EPA lifetime health advisory levels (HALs) for PFOA, PFOS, PFBS, and GenX. EPA has a detailed FAQ regarding its PFAS HALs that you can access by this link.

8. NELAP Certification

NELAP (National Environmental Laboratory Accreditation Program) was developed by the NELAC (National Environmental Laboratories Accreditation Conference) institute (TNI). This program is a national set of standards accredited at the state level that ensures laboratories across the United States use the same EPA testing methods. These testing methods establish practices and quality control requirements to laboratories analyzing environmental samples.

While Cyclopure is not NELAP certified, we take pride in being a water technology laboratory that provides drinking water solutions at an affordable price for everyone through extensive research and development. Our DEXSORB material allows for accurate point-of-site PFAS extraction making it unnecessary to ship water. We provide quality products and services while staying friendly to your wallet and following NELAP guidelines and practices in the lab according to EPA Methods 533,537 and 1633 draft.

Requirements.
Prior to analysis on HPLC-MS/MS, Cyclopure and other commercial labs process water samples using standard SPE methods to extract and recover PFAS.

The difference in methods is that other labs peform PFAS extractions in lab on water samples collected by customers, while Cyclopure customers perform PFAS extractions in the field using the company's DEXSORB®- loaded extraction disc. Field extraction avoids trip contamination; PFAS are adsorbed and securely locked into DEXSORB®'s cyclodextrin cups.

10. Possible contamination due to plastic filtration parts

All components of the WTK are pre-conditioned and validated to be trace clean, analytical grade for accurate PFAS sampling, including the filter cup, glassfiber membranes, and the DEXSORB®-loaded PFAS extraction disc. No leaching of any other contaminants like plastics will occur during the PFAS sampling activities using our WTK.

11. Certified Container (filter cup)

Cyclopure WTK employs NalgeneTM Single Use Analytical Filter Funnels as the filter cup to house the DEXSORB® extraction disc. Made with highly rigid polypropylene and polystyrene, this filter cup by Thermo Fisher is sterilized, certified, and purposed for water analysis in full compliance with EPA methods.

12. Glassfiber Membranes

Two 47-mm analytical grade glassfiber membranes are incorporated into the bottom of the WTK, before and after the DEXSORB® extraction disc. When water sample passes through the extraction disc, this unique design by Cyclopure provides a robust mechanical barrier, and prevents any possible particulates from getting into the DEXSORB® extraction disc and PFAS eluent sample.

13. DEXSORB® extraction disc

In addition, the highly selective PFAS extraction by our DEXSORB® media guarantees that other contaminates will not interfere with PFAS measurement. DEXSORB® media extracts PFAS from contaminated waters through
a unique adsorption mechanism – host-guest complexations. This occurs in the uniform 0.78-nm hydrophobic cavities of DEXSORB®, which are ideally suited to PFAS through size-inclusion, and excluding other contaminants like plastic particulates that are too large to fit (size-exclusion).

Appendix 2, Data sheets for each testing site includes physical data (Table 1), site photo, test results, GPS coordinates, description of location.

Figure 1. Physical Data Taken on 5/24 to support PFAS Monitoring in Deadman's Brook

Site	Time	Air Temp	Water Temp	D.O. mg/L	Cond.uS	Page
DM 1	9:32	24.4	17.1	9.32	347.8	2-1
DM 2	9:48	24.4	17.7	8.35	236.5	2-2
DM 3	10:02	24.4	17.9	8.59	236.2	2-3
DM 3.5	10:23	24.4	17.0	8.87	243.7	2-4
DM 4	10:40	24.4	17.2	8.74	246.6	2-5
DM 5	10:52	24.4	17.4	7.87	255.2	2-6
DM 7	11:10	24.4	17.2	5.93	253.0	2-7
DM 8	11:24	24.4	14.0	6.24	198.4	2-8
DM 9	11:40	24.4	21.0	4.60	201.5	2-9

Deadman Brook Site DM-1

Component	ppt
PFBA	< 1.0
PFPeA	2.4
PFHxA	2.6
PFHpA	1.3
PFOA	4.7
PFNA	< 1.0
PFDA	< 1.0
GenX	< 1.0
PFBS	1.8
PFHxS	1.9
PFOS	3.6
Total PFAS	18.3

GPS: 41.1397499, -73.3584280

Date &Time: 5/24/24, 0932

Sample was collected off the bridge on Jesup Road, at junction with Imperial Avenue in Westport.

Seven PFAS compounds were detected with the total concentration of 18.3 ppt.

Deadman Brook Site DM-2

Component	ppt
PFBA	< 1.0
PFPeA	3.3
PFHxA	3.6
PFHpA	2.0
PFOA	7.0
PFNA	< 1.0
PFDA	< 1.0
GenX	< 1.0
PFBS	2.2
PFHxS	2.4
PFOS	4.7
Total PFAS	25.2

GPS: 41.1419941, -73.3583411

Date & Time: 5/24/24, 0948

Sample collected off an ivory covered stone bridge on Myrtle Ave, near intersection of Myrtle Ave and Route US 1, near Sconset Square shopping district in Westport

Seven PFAS compounds were detected with the total concentration of 25.2 ppt.

Deadman Brook Site DM-3

Component	ppt
PFBA	< 1.0
PFPeA	2.2
PFHxA	2.8
PFHpA	1.6
PFOA	6.1
PFNA	< 1.0
PFDA	< 1.0
GenX	< 1.0
PFBS	2.1
PFHxS	2.3
PFOS	3.8
Total PFAS	20.9

GPS: 41.1468180, -73.3543419
Date & Time: 5/24/24, 1002
Sample collected off of a stone bridge where the brook crosses Evergreen Avenue, near house #52 and #49 in Westport
Seven PFAS compounds were detected with the total concentration of 20.9 ppt.

Deadman Brook Site DM-3.5

Component	ppt
PFBA	< 1.0
PFPeA	< 1.0
PFHxA	1.7
PFHpA	1.0
PFOA	4.8
PFNA	< 1.0
PFDA	< 1.0
GenX	< 1.0
PFBS	1.6
PFHxS	1.9
PFOS	3.3
Total PFAS	14.3

GPS: 41.1514130, -73.3478212
Date & Time: 5/24/24, 1023
Sample collected off a wooden bridge on Deerwood Road in Westport
Six PFAS compounds were detected with the total concentration of 14.3 ppt.

Deadman Brook Site DM-4

Component	ppt
PFBA	< 1.0
PFPeA	1.8
PFHxA	2.4
PFHpA	1.4
PFOA	5.5
PFNA	< 1.0
PFDA	< 1.0
GenX	< 1.0
PFBS	1.9
PFHxS	2.3
PFOS	4.1
Total PFAS	19.4

GPS: 41.1548660, -73.3413010
Date & Time: 5/24/24, 1040
Sample collected off a concrete abutment before the brook crosses under Leslie Lane in Westport
Seven PFAS compounds were detected with the total concentration of 19.4 ppt.

Deadman Brook Site DM-5

Component	ppt
PFBA	< 1.0
PFPeA	2.3
PFHxA	2.8
PFHpA	1.7
PFOA	6.2
PFNA	< 1.0
PFDA	< 1.0
GenX	< 1.0
PFBS	2.1
PFHxS	2.3
PFOS	4.3
Total PFAS	21.7

GPS: 41.1586881, -73.3349741
Date & Time: 5/24/24, 1052
Sample collected off of culvert, where the brook crosses under North Avenue, near Pleasant Valley Lane in Westport
Seven PFAS compounds were detected with the total concentration of 21.7 ppt.

Deadman Brook Site DM-7

Component	ppt
PFBA	< 1.0
PFPeA	3.3
PFHxA	3.4
PFHpA	2.1
PFOA	7.3
PFNA	< 1.0
PFDA	< 1.0
GenX	< 1.0
PFBS	2.0
PFHxS	2.5
PFOS	5.0
Total PFAS	25.6

GPS: 41.1650239, -73.3341929
Date & Time: 5/24/24, 1110
Sample collected off of a fieldstone header, where the brook crosses under Silent Grove North (House #6) in Westport
Seven PFAS compounds were detected with the total concentration of 25.6 ppt.

Deadman Brook Site DM-8 & DM-8 Dupe

Component	ppt	ppt
PFBA	< 1.0	< 1.0
PFPeA	1.3	2.5
PFHxA	1.9	2.9
PFHpA	1.1	1.8
PFOA	4.7	6.5
PFNA	< 1.0	< 1.0
PFDA	< 1.0	< 1.0
GenX	< 1.0	< 1.0
PFBS	1.4	1.6
PFHxS	1.0	1.1
PFOS	3.0	3.6
Total PFAS	14.4	20.0

GPS: 41.1726710, -73.3315160
Date & Time: 5/24/24, 1124
Sample collected where the brook crosses Highland Road, near the intersection of Bayberry Lane in Westport
Seven PFAS compounds were detected with the total concentration of 14.4 and 20.0 (Dupe) ppt.

Deadman Brook Site DM-9

Component	ppt
PFBA	< 1.0
PFPeA	1.9
PFHxA	2.4
PFHpA	1.4
PFOA	5.1
PFNA	< 1.0
PFDA	< 1.0
GenX	< 1.0
PFBS	1.7
PFHxS	1.2
PFOS	3.1
Total PFAS	16.8

GPS: 41.1782550, -73.3300609
Date & Time: 5/24/24, 1140
Sample collected after the flow exited a dammed pond and crosses under the road on Tupelo Road in Westport
Seven PFAS compounds were detected with the total concentration of 16.8 ppt.