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MICHIGAN DEPARTMENT OF ENVIRONMENT, GREAT LAKES, AND ENERGY
WATER RESOURCES DIVISION
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STAFF REPORT

INVESTIGATION OF THE OCCURRENCE AND SOURCE(S) OF PER- AND POLYFLUORINATED SUBSTANCES (PFAS) IN THE HURON RIVER WATERSHED JULY 2018 – DECEMBER 2019

BACKGROUND

Perfluorinated and polyfluorinated alkyl substances (PFAS) are a very large class of man-made organic chemicals that have been used in numerous industrial processes and consumer products for over 60 years. Many PFAS are persistent, some bioaccumulate in the environment, and several are toxic to mammals and/or birds in laboratory tests. Validated analytical methods are available for relatively few of the thousands of compounds. Much of the environmental monitoring of PFAS in Michigan has focused on measuring only perfluorinated chemicals. The toxicities of most PFAS have not been evaluated. Two perfluorinated compounds, perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS), have been the subject of the most toxicological work and environmental monitoring. Both compounds were manufactured intentionally, but they can also be generated as byproducts when other fluorinated compounds break down. In addition, several PFAS are key ingredients in fire-fighting foams. These foams have been used extensively in fire training exercises at military bases nationwide; in recent years PFAS have been detected in surface and groundwater near many military facilities. Many products containing PFAS are used in numerous industrial processes including metal plating, textile production and treatment, and specialty paper production. Industrial and domestic waste containing these compounds can enter the environment through municipal or private waste treatment systems, storm water runoff, venting groundwater, or as deposition after emissions into the atmosphere. Both PFOS and PFOA have been measured in surface waters across the state, and PFOS has been detected in most fish tissue samples from Michigan waters that have been analyzed for PFAS.

The Michigan Department of Environment, Great Lakes, and Energy (EGLE), Water Resources Division (WRD), has generated Rule 57 surface water quality values for the protection of human health for PFOS and PFOA. The Rule 57 Human Non-Cancer Value (HNV) is the maximum ambient water concentration of a substance at which adverse noncancer effects are not likely to occur in the human population from lifetime exposure through either drinking the water, consuming fish from the water, or conducting water-related recreation activities. The HNV for PFOS is 12 nanograms per liter (ng/L; parts per trillion) in surface waters not used as a source of drinking water, and 11 ng/L for those surface waters used as a drinking water source. The HNVs for PFOA are 420 ng/L and 12,000 ng/L for drinking and non-drinking water sources, respectively. Additionally, EGLE has generated Rule 57 surface water quality values for the protection of aquatic life for PFOS and PFOA. The Aquatic Maximum Value (AMV) is the

highest concentration of a substance to which an aquatic community can be exposed briefly without resulting in adverse effects, whereas, the Final Chronic Value (FCV) is the highest concentration of a substance to which an aquatic community can be exposed for a long period of time without experiencing adverse effects. The Rule 57 AMV and FCV for PFOA is 780,000 and 140,000 ng/L, respectively. The Rule 57 AMV and FCV for PFOS is 880,000 and 7,700 ng/L, respectively. The aquatic life values for both PFOS and PFOA are less restrictive than the human health values.

In 2017, EGLE, WRD, added PFAS sampling as a part of routine National Pollutant Discharge Elimination System (NPDES) permit compliance sampling inspections for dischargers that had potential to discharge PFAS at concentrations of concern. Additionally, in 2018 EGLE began a statewide Industrial Pretreatment Program (IPP) PFAS Initiative that required all municipal wastewater treatment plants (WWTP) with required IPPs to determine if they have significant sources of PFOS and/or PFOA discharging to their collection system and potentially passing through the treatment plant to surface waters. Under the IPP PFAS Initiative, if WWTPs identified significant sources of PFOS, they are required to monitor their WWTP effluent and work with their industrial users to control the discharge of PFOS.

The Huron River (HUC 04090005) is located in southeast Michigan and drains portions of seven counties: Ingham, Jackson, Livingston, Monroe, Oakland, Washtenaw, and Wayne. The watershed is more than 900 square miles and consists of hundreds of tributary creeks, lakes, and the Huron River proper. Land use within the watershed includes agriculture, urban, industrial, and forested/natural preserves. The Huron River is a primary source of drinking water for the city of Ann Arbor. There are 24 major tributaries within the Huron River watershed (Huron River Watershed Council [HRWC], 2019). Along the main stem, there are 17 impoundments and numerous dams from the headwaters at Big Lake to Lake Erie.

In 2014, the city of Ann Arbor sampled for PFAS compounds in drinking water under Round 3 of the Unregulated Contaminant Monitoring Rule. PFOS was detected in the drinking water sample (main reservoir – treated water) at 43 ng/L (City of Ann Arbor, 2015). The City of Ann Arbor also conducted limited surface water sampling at five locations within the Huron River (from Ann Arbor, upstream to North Territorial Road in Dexter Township), Barton Pond, and Honey Creek (Washtenaw County) in 2016. PFOS concentrations in the Huron River proper were 25-26 ng/L, 38 ng/L in Barton Pond, and < 4 ng/L in Honey Creek. The City of Ann Arbor has conducted ongoing PFAS sampling of its intake and treated water (for more information, see the City of Ann Arbor's website).

EGLE, WRD, decided to monitor the river and select tributaries to try to identify sources of PFAS and to evaluate the potential risk to human health caused by PFAS in area surface waters. EGLE, WRD, collected surface water samples during nine sampling trips from July 2018 to September 2019.

SUMMARY

1. Ambient PFAS concentrations in surface water can be highly variable depending on the source of contaminant and potential other factors such as flow or rain events. Since fish are continuously exposed, they can offer a longer-term picture of PFOS contamination in

a water body. A combination of water and fish tissue sampling is useful for tracking potential sources of PFAS in a watershed.

2. PFOS was detected in surface water or storm water in 94 of 119 samples (79%), with concentrations ranging from non-detect to 5,600 ng/L.
3. The surface water or storm water concentration of PFOS exceeded the PFOS HNV in 38 of 113 samples (34%). Samples from Norton Creek and Willow Run exceeded the HNV on more than one sampling date. A major source to Norton Creek was identified and corrective measures were taken to minimize the amount of PFAS discharged to the Huron River watershed through the Wixom WWTP. Potential sources were found in Willow Run and will require follow-up work with facilities and potential dischargers in the area to figure out the extent of the problem.
4. PFOA was detected in surface water or storm water in 90 of 119 samples, with concentrations ranging from non-detect to 9.9 ng/L. Surface water or storm water PFOA concentrations did not exceed the PFOA HNV.
5. Surface water or storm water concentrations did not exceed the PFOS or PFOA aquatic life R57 values (i.e., aquatic maximum values or final chronic values).
6. The concentration of PFOS in fish fillets collected from Kent Lake were high enough to warrant the Michigan Department of Health and Human Services (MDHHS) to issue a "Do Not Eat" fish advisory to cover Norton Creek and the Huron River from North Wixom Road (Oakland County) to the river mouth. The advisory includes: Norton Creek (Oakland County), Hubbell Pond (Oakland County), Kent Lake (Oakland County), Ore Lake (Livingston County), Strawberry Lake (Livingston County), Zukey Lake (Livingston County), Gallagher Lake (Livingston County), Loon Lake (Livingston County), Whitewood Lakes (Livingston County), Base Line Lake and Portage Lakes (Livingston/Washtenaw County line), Barton Pond (Washtenaw County), Argo Pond (Washtenaw County), Ford Lake (Washtenaw County), Belleville Lake (Wayne County) and the Flat Rock Impoundment (Wayne County).
7. Of the 7 WWTP effluents monitored, three have exceeded the PFOS HNV (Table 7). Seven WWTPs in the Huron River watershed have an IPP and participated in the IPP PFAS Initiative: South Huron Valley Utility Authority (SHVUA) WWTP (note: discharges to the Detroit River), Ypsilanti Community Utility Authority (YCUA) WWTP (note: discharges to Rouge River and only infrequently to Huron River), Ann Arbor WWTP, Brighton WWTP, Dexter WWTP, Wixom WWTP, and Lyon Township. Three WWTPs had sample results that exceeded the PFOS HNV; Wixom WWTP (range: 17 to 4,800 ng/L PFOS), Ann Arbor WWTP (range: <2.5 to 18.3 ng/L), and Brighton WWTP (range: 11 to 20 ng/L PFOS). Wixom WWTP's effluent was recently monitored at 17 ng/L PFOS in October 2019, a reduction due to the City of Wixom's implementation of the IPP PFAS Initiative. The City of Brighton has not yet identified a source of PFOS and investigations are ongoing as part of the IPP PFAS Initiative. Ann Arbor WWTP participated in the IPP PFAS Initiative and sampled five potential sources as part of its evaluation. No industrial users discharging above the screening level were found. Elevations in WWTP effluent PFOS concentrations have corresponded with elevated PFOS concentrations in the City of Ann Arbor's drinking water source, which is the Huron River.

METHODS

Ambient surface water and storm water sampling

Ambient surface water grab samples collected by EGLE, SWAS, were collected following the General Per- and Polyfluoroalkyl Substances (PFAS) Sampling Guidance (Michigan

Department of Environmental Quality [MDEQ], 2018a) from the Huron River and select tributaries on nine occasions between July 2018 and September 2019. On occasion, storm water samples were also collected during surface water sampling. All samples were analyzed for 24 PFAS analytes, as described in the Quality Assurance Project Plan (QAPP) (MDEQ, 2018b). To date, a total of 119 surface water samples from 79 locations in the Huron River watershed (Table 1; Figure 1) were collected by EGLE, WRD, Surface Water Assessment Section (SWAS) and analyzed for PFAS Analytes by TestAmerica-Sacramento (2018 samples) and Eurofins-Burlington (2019 samples) (Table 2).

Sample Collection

The SWAS samples were collected in two 250 milliliter (mL) high-density polyethylene (HDPE) bottles (laboratory certified as PFAS-free). Sub-surface grab samples in wadeable stream sections were taken by hand or by use of a dip pole, directly into bottles. Field personnel used gloved hands, collected the samples upstream of any sampling equipment or personnel and avoided the collection of surface scums. Stream samples were taken at or near a point of greatest current, and both sample bottles were filled simultaneously. Samples from nonwadeable locations were collected from either a boat or bridge using a weighted, depth-integrating one-liter HDPE bottle. The bottle was lowered with a rope swiftly to depth and gradually retrieved to provide a composite sample approximately representative of the water column. The collected water was then dispensed into the two sample bottles. Outfall or storm water samples were collected in a similar manner by using gloved hands or the dip pole, directly into bottles.

The SWAS samples were preserved on ice and shipped via overnight delivery to the TestAmerica/Eurofins Sacramento laboratory (or another comparable Eurofins analytical laboratory) at the end of the sample collection event. TestAmerica/Eurofins is an EGLE contract laboratory and analyzes surface water samples using a modified version of United States Environmental Protection Agency (USEPA) Method 537 (USEPA, 2009), a process using isotope dilution for analyte quantification. The laboratory provided analytical results for 24 PFAS analytes (Table 2) to the SWAS in an electronic spreadsheet format as well as in a Level 2 report (a Level 2 report includes a brief narrative, results, and basic quality control results). Samples taken by WWTPs participating in the IPP PFAS Initiative used the TestAmerica/Eurofins laboratory or another laboratory for PFAS analysis using an isotope dilution method or ASTM D7979.

Quality Assurance/Quality Control (QA/QC)

All QC objectives and criteria for the PFAS analyses of SWAS ambient water samples are provided in Table 3. Field sampling and analytical quality were assessed using replicate, duplicate, and blank (Trip, Field, Equipment, and Laboratory Method) samples. Replicate samples were taken by collecting two sets of samples in succession at the same sample location. Two replicate samples were collected during the July 24, 2018, August 30, 2018, October 29-30, 2018, and April 29-30, 2019, sampling events. Duplicate samples, each consisting of a one-liter composite sample dispensed into two sets of two 250 mL HDPE bottles, were collected during the July 24, 2018 (one set), August 30, 2018 (two sets), October 29-20, 2018 (two sets), and April 29-30, 2019 (two sets), sampling events. One field blank was

prepared during the July 24, 2018, August 30, 2018, October 29-30, 2018, April 29-30, 2019 (two field blanks), August 21, 2019, and September 27, 2019, sampling events by filling a clean set of sample bottles with PFAS-free deionized water in the field. A trip blank (two trip blanks for April 29-30, 2019), was analyzed for the sampling events and consisted of one laboratory prepared bottle of PFAS-free deionized water that was transported unopened to the field and returned to the lab for analysis. Precision of replicate and duplicate results is calculated by the relative percent deviation (RPD) as defined by 100 times the difference (range) of each sample, X1 and X2, divided by the arithmetic mean of the set and calculated from the following equation:

$$RPD = 100 * \frac{X1 - X2}{(\frac{(X1 + X2)}{2})}$$

For samples that were reported as non-detect, the method detection limit was used as the value for the RPD calculation.

July 2018 Ambient Surface Water Sampling

Initial ambient surface water samples were collected for PFAS analysis on July 24, 2018. Sampling locations were selected near the Ann Arbor drinking water intake, along the length of the main stem of the Huron River, at the confluence of select tributaries with the Huron River, and to bracket potential sources of PFAS (e.g., downstream of WWTPs that participate in the IPP). Grab samples of ambient surface water were collected by the SWAS from 13 locations on the main stem of the Huron River, and three samples from one location on each of the following tributaries: Willow Run, Honey Creek (Washtenaw County), and Norton Creek (Tables 1 and 8).

There are three United States Geological Survey (USGS) stream gaging stations along the main stem of the Huron River (Table 4). At all three stations on July 24, 2018, discharge was below the median daily discharge statistic. According to the University of Michigan Weather Station, precipitation for July 21-24, 2018, was 0.11 inches; and it was not raining during sample collection.

August 2018 Ambient Surface Water, Potential Source Storm Water, and Pond Sampling

A follow-up sampling event occurred on August 30, 2018. The objective of this sampling effort was to track potential sources of PFAS in the Huron River, including an intensive sampling effort in the Norton Creek watershed. Sampling locations were selected to bracket potential sources of PFAS contamination in the Huron River watershed and to repeat collection at sites previously sampled near and within Norton Creek where previous sampling revealed concentrations exceeding the PFOS HNV. Samples were also collected from two site ponds and storm water (in collaboration with EGLE Remediation and Redevelopment Division and site personnel) at the Detroit Wixom, LLC property (former Ford Wixom Assembly, referred to as Wixom Assembly within this report). Grab samples of ambient surface water were collected by the SWAS from four locations on the main stem of the Huron River, one location on Mann Creek and Pettibone Creek, and 13 locations within the Norton Creek watershed (Tables 1 and 8). At all three USGS gaging stations on August 30, 2018, discharge was below the median daily discharge statistic

(Table 4). According to the University of Michigan Weather Station, precipitation for August 27-30, 2018, was zero inches.

September 2018 Ambient Surface Water Sampling

On September 28, 2018, depth-integrated surface water samples were collected from Argo and Barton Ponds near Ann Arbor (Tables 1 and 8) while staff were collecting fish for tissue analysis. Discharge at the Ann Arbor gaging station was below the median daily discharge statistic during this sampling event (Table 4). According to the University of Michigan Weather Station, precipitation for September 25-28, 2018, was 0.73 inches.

October 2018 Ambient Surface Water Sampling

On October 2 and October 4, 2018, depth-integrated surface water samples were collected near Milford on Hubbell Pond and Milford Millpond, respectively (Tables 1 and 8). These samples were collected while staff were collecting fish for tissue analysis. Discharge at the Milford gaging station was below the median daily discharge statistic during this sampling event (Table 4). According to the University of Michigan Weather Station, precipitation for September 29, 2018, to October 2, 2018, was 0.8 inches and from October 1-4, 2018, was 0.64 inches.

A follow-up sampling event occurred on October 29-30, 2018 (Tables 1 and 8). The objective of this sampling effort was to continue to track potential sources of PFAS in the Huron River, including follow-up sampling in the Huron River main stem, Norton Creek, Pettibone Creek, and Mann Creek. A single sample was also collected in each of the following tributaries: Honey Creek (Livingston County), the Portage River, an Unnamed Tributary to Little Portage Lake, Davis Creek, Ore Creek, Woodruff Creek, and Arms Creek. A single sample from Davis Drain (Rouge River watershed) was collected downstream of suspected storm water input from a Tribar facility (Tribar Plant #4) to aid in source-tracking and inform future work in the Rouge River watershed. Grab samples of ambient surface water were collected by the SWAS from 26 sites. Discharge at all gaging stations was well above the median daily discharge statistic during this sampling event (Table 4). According to the University of Michigan Weather Station, precipitation for October 25-30, 2018, was 0.38 inches.

April 2019 Ambient Surface Water and Outfall Sampling

On April 10-11, 2019, AECOM, in coordination with EGLE, collected six surface water samples from the Huron River, Norton Creek, (Table 1 and 8) and a backyard pond. These samples were collected at the same time as residential well water samples to better understand surface water/groundwater connection (see drinking water results section for more information). Samples were analyzed by Vista Analytical Laboratory by the Modified USEPA Method 537 (isotope dilution). While this sampling effort is not the focus of this report, PFOS and PFOA concentrations are included since original SWAS sample sites were revisited during this effort.

A follow-up sampling event occurred from April 29-30, 2019 (Tables 1 and 8). The objective of this sampling effort was to continue to track potential sources of PFAS in the Huron River including follow-up sampling in the Huron River main stem, Norton Creek, Willow Run, and Horseshoe Creek. Sampling sites were chosen to bracket potential sources of PFAS

contamination in the watershed and to repeat collection at sites previously sampled near and within Norton Creek, Pettibone Creek, and Willow Run. Sampling was also conducted along Horseshoe Creek and Hamburg Lake near the sites of historical large fires where PFAS-containing foam may have been used. Opportunistic sampling of two outfalls also occurred along the main stem of Willow Run. Discharge at all gaging stations was well above the daily discharge statistic during this sampling event (Table 4). According to the University of Michigan Weather Station, precipitation for April 26-30, 2019, was 1.94 inches; it was raining during sample collection.

August 2019 Ambient surface water sampling

On August 21, 2019, surface water samples were collected by EGLE staff from two locations along the west branch of Norton Creek and one location on a tributary to Kent Lake during an investigation of the Quality Steel property near Wixom, Michigan.

September 2019 Ambient Surface Water Sampling

On September 27, 2019, surface water samples were collected from Ore Lake, Little Ore Lake, and South Ore Creek. Discharge at all gaging stations was below the daily discharge statistic during this sampling event (Table 4). According to the University of Michigan Weather Station, precipitation for September 23-27, 2019, was 0.22 inches.

Fish tissue

Due to elevated levels of PFOS detected by the city of Ann Arbor in the Huron River, EGLE sent previously collected fish samples from Kent Lake to the lab for analysis. The fish were previously collected by the Michigan Department of Natural Resources (MDNR) as part of routine fish contaminant monitoring. In addition, various fish species were collected from the Huron River and lakes or impoundments within the watershed by MDNR or EGLE staff. All fish samples were prepared as standard edible portion samples following the WRD Procedure WRD-SWAS-004 (MDEQ, 1995). Fish tissue samples were analyzed for 11 perfluorinated analytes by the MDHHS Analytical Chemistry Laboratory (Table 5). Water bodies sampled included: Argo Pond, Barton Pond, Bass Lake, Belleville Lake, Base Line Lake, Kent Lake, Milford Pond, Moraine Lake, Portage Lake, Proud Lake, Sandy Bottom Lake, Whitmore Lake, Woodland Lake, and the Flat Rock Impoundment (Table 6; Figure 1).

Point source discharges/Compliance Sampling Inspections

There were seven WWTPs and six other point sources with discharges to the Huron River watershed whose effluent was sampled for PFAS in 2018-2019 (Table 7). Chelsea, Milford, and South Lyon WWTPs do not have significant industrial users requiring an IPP. The Ann Arbor, Brighton, Dexter, Lyon Township (groundwater discharge only and not covered in this report), and Wixom WWTPs have approved IPP programs and are participating in the statewide IPP PFAS Initiative. Summaries of their work to date for this initiative are discussed in the context of their river reaches in the following section of this report. YCUA also participated in the IPP PFAS Initiative but discharges to the Huron River only in emergency conditions, which are infrequent.

Six other point sources with discharges to the Huron River watershed were sampled in 2018 (Table 7): Coes Cleaners, GM Proving Grounds-Milford, Kelsey Hayes, Pall Life Sciences, Seamless Tube, and Sweepster-Harley Attachments. Effluent samples from Milford WWTP, Seamless Tube, and General Motors Proving Ground-Milford were collected on August 14-15 and 30, 2018.

EGLE collected an effluent sample from Coes Cleaners (a state groundwater cleanup site) on August 30, 2018. AECOM collected an effluent sample and other samples at Coes Cleaners on October 4, 2018. Follow-up sampling was conducted at Coes Cleaners by AECOM for EGLE on October 25, 2018, due to conflicting results from the effluent samples collected by EGLE and AECOM in August and October. This will be discussed in more detail in the following sections.

Effluent samples from Ann Arbor WWTP were taken on November 2, 2018, and at Pall Life Sciences and Sweepster-Harley Attachments on November 27, 2018. Effluent samples were taken from Brighton WWTP and South Lyon WWTP on March 20, 2019. In addition to the EGLE sampling, the municipalities of Ann Arbor, Brighton, Dexter, and Wixom collected effluent samples in 2018 and/or 2019 as noted in Table 7.

Effluent grab samples were collected by EGLE point source monitoring staff following the Draft MDEQ Wastewater PFAS Sampling Guidance document (MDEQ, 2018c). Samples were collected in two 250 mL HDPE bottles (laboratory certified as PFAS-free). Samples were collected directly in bottles by hand or via a dip pole. Field personnel used gloved hands, collecting the samples at the effluent monitoring points for wastewater before discharge. Samples were taken from the cascade in most instances. Sample bottles were filled consecutively and double bagged in Ziplocs before storage in a cooler with ice. Sample bottles were delivered to the TestAmerica Brighton location and shipped to the TestAmerica Sacramento laboratory at the end of the sample collection event.

Municipalities that collected PFAS samples as part of the IPP PFAS Initiative were required to follow procedures to prevent cross contamination and submit their procedures to EGLE as part of their reporting requirements. Municipalities used either an isotope dilution method (sometimes called USEPA Method 537, modified) or ASTM D7979 for analysis and used bottles and any additional collection and/or shipment procedures specified by their chosen laboratory.

RESULTS AND DISCUSSION

Drinking Water Sampling

Phase I

During Phase I of the Statewide Testing Initiative, a sample of finished drinking water from the Ann Arbor Public Water Supply was collected by EGLE, Drinking Water and Environmental Health Division (DWEHD), on July 17, 2018. The sample was analyzed via Method USEPA 537 Rev. 1.1. The sum of PFOS and PFOA was 4 ng/L and total tested PFAS was 24 ng/L. The same sample was analyzed via isotope dilution; the sum of PFOA and PFOS was 4 ng/L and total tested PFAS was 39 ng/L.

Quarterly Monitoring
In March 2019 EGLE, DWEHD, began quarterly sampling of Public Water Supplies sampled during Phase I, which had total tested PFAS levels of at least 10 ng/L but did not exceed the USEPA lifetime health advisory (70 ng/L, sum of PFOS and PFOA). EGLE, DWEHD, collected a 1st quarter sample from the Ann Arbor Public Water Supply on April 3, 2019. The sample was analyzed via USEPA Method 537 and was non-detect for the sum of PFOA and PFOS and non-detect for total tested PFAS.

Monthly Monitoring
In April 2019 EGLE, DWEHD, began monthly sampling of Public Water Supplies that were previously sampled during Phase I of the Statewide PFAS Sampling Survey, which utilize surface water as a source. Monthly finished drinking water samples were analyzed from April 2019 to September 2019 via USEPA Method 537. All samples were non-detect for the sum of PFOA and PFOS and total PFAS ranged from non-detect to 10 ng/L.

Phase II
During Phase II of the Statewide Testing Initiative, EGLE, DWEHD, also collected and analyzed samples from childcares, tribal systems, and type II noncommunity water supplies. For more information on drinking water sampling, visit the Michigan PFAS Response website.

City of Ann Arbor
The City of Ann Arbor continues to monitor intake and treated water for PFAS (for more information, see the City of Ann Arbor's website).

Private Well Testing
In April 2019, sampling of select residential wells for PFAS was conducted to evaluate drinking water safety in the vicinity of Norton Creek. AECOM collected the samples in coordination with EGLE. All residential samples collected on April 10-11, 2019, were non-detect for PFOS and PFOA. Two additional residences were sampled in July 2019. These samples were non-detect for PFOS and PFOA.

Proud Lake Well Testing
In April 2019, AECOM collected samples from wells at Proud Lake Recreation Area. One sample from a Proud Lake well (well 7) had 11 ng/L PFOA, the rest of the samples were non-detect for PFOS and PFOA. One well from the Proud Lake Recreation Area was resampled in October 2019 and came back non-detect for PFOS and PFOA.

Milford Groundwater Supply Wells Testing
Milford's supply wells (groundwater, not finished drinking water) were sampled by AECOM in coordination with EGLE in April 2019. Both samples collected on April 10, 2019 were non-detect for PFOS and PFOA.

Point source discharges/Compliance Sampling Inspections

Results of the point source discharges and Compliance Sampling Inspection sampling events are shown in Table 7 and discussed in the context of their river reaches in the following section of this report.

Ambient surface water and storm water sampling

QA/QC

An overview of the data quality objectives from the QAPP (MDEQ, 2018b) as well as results for these objectives from SWAS samples are provided in Table 3. Since this report will focus on PFOS and PFOA, a summary of the data quality objectives for these analytes is included here. Additional details on other analytes can be found in the TestAmerica analytical reports and Table 3.

Two samples exceeded 30% RPD for analysis of PFOS (NC0200 on August 30, 2018, and NC0100 on April 29, 2018). One sample exceeded 30% RPD for analysis of PFOA (WR0010 on April 29, 2018). Laboratory matrix spikes, lab control spikes, and method blanks all passed data quality objectives for PFOS and PFOA. Analyte results for all field blanks, trip blanks, and equipment blanks were below the laboratory reporting limits except for the equipment blank on August 30, 2018.

Table 3 shows the results of EGLE's QA/QC requirements. On occasion, samples did not meet laboratory QA/QC and were left out of the total PFAS calculation in Table 10. The following analytes were affected: 6:2 FtS (July 24, 2018); PFBA (September 28, 2018 and October 29-30, 2018); and PFHxS (October 29-30, 2018).

Many samples required dilution prior to analysis, which resulted in higher reporting limits for analytes. Most notably, many samples from April 29-30, 2019, were non-detect for all 24 analytes, which should be interpreted with caution since reporting limits were higher when dilution was required. Samples that were non-detect for all analytes included: LST0050, HSC0600, HSC0400, HSC0300, HSC0300D, HSC0100, HSC0050, and NC0600. Please see the TestAmerica/Eurofins reports for more details.

The August 30, 2018, sampling event did not meet the completeness objective with only 73% of samples passing quality control criteria. Six samples did not meet data quality objectives for analytes other than PFOS or PFOA including: HR0240 (PFTeA), NC0500 (PFBS), NC0600 (6:2 FtS), OF001 (6:2 FtS), UT0001 (6:2 FtS), and UT0002 (6:2 FtS and 8:2 FtS). Only one sample did not meet quality control criteria for PFOS and that was noted above (NC0200). PFOS was 12 ng/L in the weighted sampler equipment blank (EB001) on August 30, 2018; all other analytes were below laboratory reporting limits. The following samples were collected using the weighted sampler that day: HR0120; HR0235; HR0240; HR0240D; HR0250; PC0010; NC0010; NC0100; NC0100D; and NC0600. Possible contamination of the equipment blank sample came from the rinsing process, the rinse water, or the laboratory. According to the chain of custody (included in the TestAmerica laboratory report), HR0240D was collected (16:57) immediately before rinsing and collecting the equipment blank (17:05). PFOS was

1.1 ng/L in HR0240D, which is between the laboratory reporting limit and method detection limit. The trip and field blanks were both non-detect for PFOS, and the rinse water for the equipment blank was the same as used in the trip and field blanks, so it is unlikely that rinse water was the source of PFOS in the equipment blank sample. Regardless, results from samples collected with the weighted sampler during the August 30, 2018, sampling trip should be interpreted with caution since PFOS in the equipment blank was detected above reporting limits and at the concentration of the PFOS HNV (12 ng/L). During the same sampling trip (August 30, 2018), PFOS was also detected at high concentrations in a sample from Pettibone Creek and one from Mann Creek, these samples are discussed further below.

Sampling Results Overview

A total of 119 samples (114 ambient, 3 outfalls, 2 site ponds) were collected over the 9 sampling events at 79 locations. PFOS was detected in 94 of the 119 collected samples (Table 8; Figures 2-Figure 17). PFOS exceeded the PFOS HNV in 38 out of 119 samples. PFOA was detected in 90 of 119 samples (Table 9); PFOA concentrations were all below the PFOA HNV.

Total PFAS (the sum of 22-24 analytes) ranged from 0 to 8,208.2 ng/L (Table 11). The total number of analytes detected ranged from 0 to 14 (Table 10). Figures 2-Figure 8 show percentages of various analytes for all samples. For specifics on concentrations of analytes not reported in this report, see the TestAmerica/Eurofins laboratory reports. The following analytes were not detected in any samples: PFTriA, FtS 8:2, N-EtFOSAA, and N-MeFOSAA.

Source-tracking investigations were performed in a stepwise fashion in the Huron River watershed. Initial samples were collected along the main stem of the Huron River and in select tributaries where potential sources may be found. Sample results from July 24, 2018, included PFOS HNV exceedances in Norton Creek (1 site), just downstream of Norton Creek on the Huron River main stem (2 sites), and in Willow Run (1 site). More intensive follow-up sampling occurred on August 30, 2018, in Norton Creek, Mann Creek, and Pettibone Creek. August 2018 sampling confirmed previous exceedances in Norton Creek, with additional exceedances throughout the watershed (7 total exceedances out of 14 sites). The August sample results also revealed potential sources in Mann Creek (1 site), Pettibone Creek (1 site), and the Wixom Assembly property (2 samples). On September 28, October 2, and October 4, 2018, samples were collected in tandem with fish tissue on Argo and Barton ponds near Ann Arbor, Hubbell Pond downstream of Milford, and the Milford Mill Pond on Pettibone Creek. These water samples revealed concentrations that exceeded the PFOS HNV at all sites except for the Milford Mill Pond (3 sites out of 4). More intensive source-tracking samples were collected in October 2018 along the main stem of the Huron River (from just upstream of Norton Creek to Base Line and Portage Lakes near Pinckney, Michigan), Mann Creek, Pettibone Creek, tributaries to Portage Lake (Honey Creek in Livingston County and the Portage River) and Norton Creek. All 7 samples downstream of Norton Creek on the Huron River exceeded the PFOS HNV. None of the five samples from Mann Creek or three samples from Pettibone Creek exceeded the PFOS HNV. No samples from Ore Creek, Arms Creek, Portage River, Honey Creek in Livingston County, Davis Creek or Davis Drain (Rouge River watershed) exceeded the PFOS HNV. In Norton Creek, only samples downstream of the WWTP exceeded the PFOS HNV, while samples on the West Branch did not exceed the PFOS HNV. Results from the April 2019 sampling event revealed that concentrations in Norton Creek downstream of

the Wixom WWTP continue to remain low relative to findings from earlier sampling efforts (2 PFOS Rule 57 exceedances out of 5 sites). There may be sources of PFAS in Willow Run between Tyler Road and the I-94 service drive and in the West Tributary of Willow Run (3 samples exceeded the PFOS HNV). This one-time sampling event did not reveal any potential sources in Hamburg Lake, Horseshoe Creek, or the outlet of Lake Sherwood. Additional samples collected along the west branch of Norton Creek and a tributary to Kent Lake (Huron River) in August 2019 did not exceed the PFOS HNV. Additional samples from Ore Creek and Ore Lake collected in September 2019 did not exceed the PFOS HNV.

The following is a more detailed discussion of the investigations, sampling, and results found for various river reaches in the watershed:

Upper Huron (Upstream of Norton Creek)

Two ambient water samples were collected in the upper reaches (upstream of Proud Lake Recreation Area) of the main stem of the Huron River on July 24, 2018 (HR0270), and August 30, 2018 (HR0250; Figure 9). Both samples had PFOS concentrations that were above the method detection limit but below the laboratory reporting limit (Table 8; Figure 9). The 95% Upper Confidence Limits (UCL) for bluegill, rock bass, and largemouth bass collected from Proud Lake were 10, 8.2, and 120 parts per billion (ppb) (nanograms per gram [ng/g]), respectively (Table 6).

Norton Creek Area

All PFOS sample results for the Norton Creek Area are provided in Table 8 and Figure 10. Norton Creek flows through Wixom and enters the Huron River downstream of North Wixom Road and the Proud Lake Recreation Area (and upstream of Milford). Intensive source-tracking has occurred within Norton Creek since high concentrations of PFOS were found in the Wixom WWTP effluent (17-4,800 ng/L PFOS; Table 7). During the initial round of ambient water sampling (July 24, 2018) a single water sample was collected on Norton Creek just upstream of the confluence with the Huron River (NC0010; Figure 8). The ambient PFOS concentration was 5,500 (5,600[D]) ng/L; more than 400 times the PFOS HNV (Table 8; Figure 10). Immediately downstream of Norton Creek on the Huron River main stem (HR0235), the ambient PFOS concentration was 1,400 ng/L on July 24, 2018. Just upstream of Norton Creek, the ambient PFOS concentration in the Huron River was 2.4 ng/L (at HR0240).

The ambient water samples as well as effluent discharge data from Wixom WWTP initiated more intensive source-tracking within the watershed. On August 29, 2018, the Wixom WWTP reported 4,800 ng/L PFOS in the final effluent discharging to Norton Creek. On August 30, 2018, additional ambient water samples were collected throughout the Norton Creek watershed. Samples (NC0010, NC0100, and NC0150) downstream of the Wixom WWTP remained elevated (Table 8; Figure 10). Immediately downstream of Norton Creek on the Huron River main stem (HR0235), the ambient PFOS concentration was 480 ng/L on August 30, 2018. Just upstream of Norton Creek, the ambient PFOS concentration in the Huron River was 1.1 ng/L (at HR0240). Samples (NC0200 and NC0300) on the two branches upstream of the Wixom WWTP were much lower than downstream of the WWTP on August 30, 2018. However, these samples exceeded the PFOS HNV at both sites: NC0300 (26 ng/L PFOS) and NC0200 (8.4 and 13 ng/L

PFOS). Other ambient water samples from Norton Creek that exceeded the PFOS HNV on August 30, 2018, included: NCW0100 (80 ng/L PFOS) and UT0001 (38 ng/L PFOS). Samples were also collected at a suspected potential source (Wixom Assembly). Two site ponds and a storm water outfall were sampled on this property (Pond0001, Pond0002, and OF001). Pond0001 and OF001 exceeded the PFOS HNV at 20 ng/L and 32 ng/L, respectively. Upstream of Wixom Assembly, the surface water concentration was lower than the PFOS HNV (UT0002; 6.5 ng/L PFOS). On August 8, 2018, EGLE staff visited the Wixom Fire Training Center and Fire Department staff indicated that PFAS containing foams have not been used at the site. Limited surface water sampling upstream (NCL0200 and NCE0100) and downstream of this area (NC0200) on August 30, 2018, did not suggest that a major source of PFAS existed in the area (Figure 10).

Additional ambient samples were collected October 29-30, 2018, in the Norton Creek watershed. Samples (NC0010 and NC0100) downstream of the Wixom WWTP remained elevated (but lower than previous sampling dates). Similarly, immediately downstream of Norton Creek, the ambient PFOS concentration in the Huron River was also lower (but still above the PFOS HNV at 21 ng/L PFOS). HR0240 (upstream of Norton Creek) remained low at 1.2 ng/L PFOS. Follow-up samples were collected at NCW0100 (5.2 ng/L PFOS) and further upstream at NCW0400 (1.8 ng/L). These samples were much lower than the August 30, 2018, sample collected at NCW0100. Since storm water discharge from the Tribar Manufacturing Plant 4 facility discharges outside of the Huron River watershed, one sample was collected on the Davis Drain (Rouge Watershed), which revealed 10 ng/L PFOS.

While not the focus of this report, AECOM in coordination with EGLE collected surface water samples in tandem with a groundwater investigation in the Norton Creek area from April 10-11, 2019. Only one Norton Creek sample (NC0010) exceeded the PFOS HNV with 12.6 ng/L PFOS. Other Norton Creek samples did not exceed the PFOS HNV (5.9 and 10.6 ng/L). A sample in the Huron River immediately downstream (HR0235) of Norton Creek was 2.99 ng/L (Table 8; Figure 10). Further downstream on the Huron River (HR0210) the concentration was 5.05 ng/L. A backyard pond sample was non-detect for PFOS.

To monitor progress in the area, additional water samples were collected on April 29-30, 2019, in Norton Creek. Results revealed much lower concentrations of PFOS downstream of the Wixom WWTP in Norton Creek (NC0010 and NC0100) and in the Huron River (HR0235; non-detect PFOS). PFOS concentrations remained below the PFOS HNV at NC0600, NC0400, and HR0240 (upstream of Norton Creek). NCW0100 was non-detect for PFOS during this sampling run. The outlet of Lake Sherwood (LST0050) was also sampled and was non-detect for PFOS (Figure 10).

The Wixom WWTP identified one industrial user as a significant source of PFOS to the collection system in May 2018. The facility, Tribar Manufacturing Plant 4, is a metal finisher that plates chrome on plastic. Their discharge to the WWTP was measured at 28,000 ng/L for PFOS on May 15, 2018. By October 2018, Tribar installed a Granular Activated Carbon system to treat the discharge for PFAS prior to entering the collection system. Subsequent sample results from Plant 4 have ranged from 0.44 to 11 ng/L. The PFOS levels in the WWTP effluent have steadily decreased since August 2018 with the most recent sample result of 26 ng/L in December 2019 (Table 7).

In July 2019, the concentration of PFOS plus PFOA from a drinking water sample from Quality Steel in Milford was 201 ng/L. EGLE conducted a follow-up investigation of the area around Quality Steel in August 2019. During this investigation, two surface water samples were collected by EGLE staff from the west branch of Norton Creek (NCW0500 and NCW0400). Both samples were below the PFOS HNV (Table 8; Figure 10). The east storm water discharge, noncontact cooling water, reverse osmosis reject water, and facility well samples were all non-detect for PFOS. An additional surface water sample was collected from an unnamed tributary that drains to Kent Lake/Huron River (KLT5000), this sample is discussed in the Kent Lake section and appears in Figure 12. EGLE staff are coordinating additional follow-up sampling. For more information, see the MPART Quality Steel Drinking Water Response website.

Pettibone Creek and Milford Area

All PFOS sample results for the Pettibone Creek and Milford Area are provided in Table 8 and Figure 11. The Milford WWTP discharges to the Huron River downstream of Pettibone Creek and Milford, Michigan. The WWTP does not have an IPP. An effluent sample was collected by EGLE on August 14, 2018, and was below the HNVs for PFOS and PFOA.

A single ambient water sample was collected from Pettibone Creek just downstream of the Millpond in Milford, Michigan, on August 30, 2018 (PC0010); the PFOS in this sample was 500 ng/L. A sample of effluent from Coe's Cleaners (a state groundwater cleanup site) was collected by WRD compliance staff on the same day (1,000 ng/L PFOS). The ambient PFOS concentration in the Huron River downstream of Milford (HR0210) was 300 ng/L PFOS on August 30, 2018. These elevated concentrations initiated more intensive sampling within the Pettibone Creek watershed in September and October 2018.

The effluent from Kelsey-Hayes discharges to Pettibone Creek upstream of the Mill Pond. An effluent sample from Kelsey-Hayes (groundwater cleanup site) was collected by EGLE staff on September 17, 2018; the sample was <0.4 PFOS ng/L and <0.7 ng/L PFOA. An ambient water sample from Hubbell Pond (HUBBELL0010; downstream of Milford on the Huron River) collected on October 2, 2018, was 61 ng/L PFOS.

An effluent sample collected by AECOM at the Coes Cleaners site on October 4, 2018, was non-detect for PFOS. On the same day, SWAS staff collected a surface water sample and fish from the Millpond on Pettibone Creek; the water sample (MILL001) was 0.61 ng/L PFOS. A follow-up effluent sample at Coes Cleaners on October 25, 2018, was non-detect for PFOS and PFOA. Other samples collected on Pettibone Creek on October 29-30, 2018, were all <2 ng/L PFOS (PC0010, PC0050, and PC0100). Furthermore, the 95% UCL for bluegill collected from the Millpond was 4 ppb PFOS, below the MDHHS fish consumption screening value (Figure 11; Table 6) and comparable to concentrations measured in bluegill from noncontaminated water bodies. Since PFOS bioaccumulates in fish tissue, the fish samples provide a longer-term snapshot of PFOS within Pettibone Creek. Because the 95% UCL was low, and follow-up ambient water samples were also low, it is unlikely that a significant source of PFAS exists on Pettibone Creek.

On the Huron River downstream of Milford (HR0210), the concentration was lower during the October 29-30, 2018, sampling event (15 ng/L PFOS) than it was during the August sampling event (300 ng/L PFOS).

Mann Creek and Kent Lake Area

All PFOS sample results for the Mann Creek and Kent Lake Area are provided in Table 8 and Figure 12. Due to the elevated levels of PFOS detected by the city of Ann Arbor in the Huron River, WRD sent stored Kent Lake fish samples (that were collected in 2017 by the MDNR as part of routine fish contaminant monitoring) to the MDHHS lab for PFAS analysis. The 95% UCL for 2017 black crappie and largemouth bass from Kent Lake was 1,134 and 1,740 ppb PFOS, respectively. The concentration of PFOS in fish fillets collected from Kent Lake were high enough to warrant the MDHHS to issue a "Do Not Eat" fish advisory. Initially the advisory included Norton Creek and the Huron River from North Wixom Road (Oakland County) downstream to include Base Line and Portage Lakes. The advisory was extended to the river mouth after results from Argo Pond (Washtenaw County) became available (details discussed below). The advisory includes: Norton Creek (Oakland County), Hubbell Pond (Oakland County), Kent Lake (Oakland County), Ore Lake (Livingston County), Strawberry Lake (Livingston County), Zukey Lake (Livingston County), Gallagher Lake (Livingston County), Loon Lake (Livingston County), Whitewood Lakes (Livingston County), Base Line Lake and Portage Lakes (Livingston/ Washtenaw County line), Barton Pond (Washtenaw County), Argo Pond (Washtenaw County), Ford Lake (Washtenaw County), Belleville Lake (Wayne County) and the Flat Rock Impoundment (Wayne County).

The elevated fish tissue concentrations in Kent Lake initiated more intensive follow-up sampling of the Huron River in the vicinity of Kent Lake. HR0210 (upstream of Kent Lake) PFOS was elevated on August 30, 2018 (300 ng/L), and was lower during the October 29-30, 2018, sampling (15 ng/L PFOS). Additional samples were taken along the Huron River near and in Kent Lake from October 29-30, 2018; HR0205 (upstream of Kent Lake) was 17 ng/L PFOS and HR0200 (a depth-integrated sample from Kent Lake) was 22 ng/L PFOS.

Groundwater monitoring wells associated with the closed Lyon Development Landfill were sampled and analyzed for PFAS. PFOA was non-detect in all samples. PFOS was less than 1.7 ng/L in all samples. No surface water samples were collected near this site.

Mann Creek was also sampled because the GM Proving Grounds were identified as a potential source of PFAS. The final outfall from the GM Proving Grounds, which discharges treated sanitary wastewater, noncontact cooling water, treated groundwater cleanup wastewater, and storm water, was sampled by EGLE staff on August 15, 2018; the concentration of PFOS was 3 ng/L. A single sample (MC1000) on Mann Creek from August 30, 2018 (downstream of the GM Proving Grounds), was elevated for PFOS (150 ng/L) and spurred additional sampling within the Mann Creek watershed. Ambient water samples from Mann Creek (MC1000, MC2000, MC5000, MCS0050, and MoraineLake01) were all below the PFOS HNV from October 29-30, 2018. Additionally, black crappie, bluegill, and bass collected from Moraine Lake (on Mann Creek) had 95% UCLs of 7, 5, and 10 ppb, respectively. A sample from Woodruff Creek (downstream of Mann Creek, GM-Proving Grounds Milford, and the Brighton Township WWTP) and upstream of the confluence with the Huron River) was 1.7 ng/L

PFOS in October 2018. Brighton Township WWTP does not have an IPP and has not been sampled for PFAS. Fish tissue data and multiple sets of ambient concentrations suggest that a significant source of PFAS does not exist on Mann Creek.

Brighton and Hamburg Area (Horseshoe Creek, Davis Creek, and Ore Creek)

PFOS sample results for the Brighton and Hamburg area are provided in Table 8 and Figure 13. An elevated ambient concentration of PFOS was found upstream of Strawberry Lake (HR0190; 15 ng/L PFOS on July 24, 2018). Elevated ambient concentrations in the Huron River main stem at McCabe Road (HR0195; 65 ng/L PFOS) and upstream of Strawberry Lake (HR0190; 46 ng/L PFOS) were found during the October 2018 sampling event.

A sample from Ore Creek (OC0010; 2.2 ng/L PFOS) from October 2018 was below the PFOS HNV. Three additional surface water samples collected in Ore Lake and Ore Creek on September 27, 2019, were low (2.4 to 2.6 ng/L). Additionally, the 95% UCLs of fish samples collected in 2019 from Woodland Lake (upstream of Brighton on Ore Creek) were 4 and 15 ppb for bluegill/pumpkinseed and largemouth bass, respectively. Brighton WWTP discharges to South Ore Creek, a tributary to the Huron River. An effluent sample collected by EGLE in March 2019 was 11 ng/L. Additional samples were collected by the municipality or its contractor in May, August, and November 2019 that were 16.1, 20, and 20 ng/L, respectively for PFOS (Table 7). Brighton WWTP has sampled its only categorical user and has sampled in its collection system, but no PFOS source has yet been identified. The WWTP continues to conduct quarterly sampling and is investigating potential sources.

A sample from Davis Creek (DC0010; 1.3 ng/L PFOS) collected in October 2018 was below the PFOS HNV. Additionally, the 95% UCLs of fish samples collected in 2019 from Sandy Bottom Lake (well upstream of DC0010) were 8 and 32 ppb PFOS for bluegill/pumpkinseed and largemouth bass, respectively. These results do not reveal any potential sources in this area. The South Lyon WWTP discharges to Yerkes Drain (and eventually to Davis Creek) within the Huron River watershed. The WWTP does not have an IPP. Effluent samples were collected by EGLE in August 2018 and March 2019 and both were below the PFOS and PFOA HNVs (Table 7). Seamless Tube discharges to Yerkes Drain via an unnamed tributary (and eventually to Davis Creek) and is within the Huron River watershed. An effluent sample was collected by EGLE in August 2018 and was below the HNV for PFOS and PFOA (Table 7).

Information from EGLE, Remediation and Redevelopment Division, was shared with WRD that included anecdotal accounts of large fires that may have been treated with foam along Horseshoe Creek near Hamburg, Michigan. Therefore, more intensive sampling of the Huron River and Horseshoe Creek around Hamburg (and upstream of Base Line and Portage Lakes) occurred in April 2019. All samples from Horseshoe Creek and Hamburg Lake collected in April 2019 were non-detect for PFOS. Downstream of Horseshoe Creek, on the Huron River (at HR0185), PFOS was 4.4 ng/L in April 2019. Samples from this one-time sampling event suggest that a significant source of PFAS does not exist within Horseshoe Creek.

From April to September 2019, DLZ, in coordination with EGLE, Remediation and Redevelopment Division, sampled groundwater from monitoring wells at the Thermofil site

located in Green Oaks Township, Livingston County, Michigan. Out of 37 samples, the concentration of PFOS plus PFOA was greater than 70 ng/L for five samples. The highest sum of PFOS and PFOA was 198 ng/L. See the MPART website for more information on the Thermofil site.

The 95% UCL for bluegill/pumpkinseed fish tissue collected in 2019 from Whitmore Lake was 4 ppb PFOS. This result does not reveal any potential sources of PFAS to Whitmore Lake.

Base Line and Portage Lake Area

All PFOS sample results for the Base Line and Portage Lake Area are provided in Table 8 and Figure 14. Initial samples from July 24, 2018, at HR0165 and HR0160 were 11 ng/L and 8.7|7.8 ng/L PFOS. On August 29, 2018, WRD received results for fish from Base Line and Portage Lakes (collected in May 2018). The 95% UCL for largemouth bass from Portage Lake was 84 ppb PFOS. The 95% UCL for bluegill and largemouth bass from Base Line Lake was 129 and 286 ppb, respectively. The elevated fish tissue concentrations initiated follow-up sampling in the lake tributaries in October 2018. Samples (UTS0050, PR0010, and HCL0100) were all <1 ng/L PFOS. Sampling in Arms Creek (AC0010; non-detect for PFOS) did not reveal any major PFAS sources. The ambient concentration in the Huron River in this area (HR0165; 88 ng/L PFOS) was elevated in October 2018.

Huron River near Dexter and Ann Arbor (Includes Honey Creek and Mill Creek in Washtenaw County)

All PFOS sample results for the Huron River near Dexter and Ann Arbor area are provided in Table 8 and Figure 15. Initial samples (HR0150; HR0140; HR0130; and HR0095) collected on July 24, 2018, did not reveal any major sources of PFAS in the Dexter to Ann Arbor stretch of the Huron River.

All PFOS sample results for point source discharges in this area are provided in Table 7. EGLE sampled Chelsea WWTP, which discharges to Letts Creek upstream of Mill Creek and Dexter WWTP and found PFOS below the reporting level and PFOA at 4.3 ng/L in March 2019.

Dexter WWTP discharges to Mill Creek just upstream of the confluence with Huron River. In July 2018, a surface water sample from Mill Creek (MCW0010), downstream of the Dexter WWTP was non-detect for PFOS. Effluent sampling conducted by Dexter WWTP found 3.6 ng/l of PFOS and 12 ng/l of PFOA in August 2018. Effluent sampling conducted by AECOM for EGLE in November 2018 found 1.51 ng/l PFOS and 7.97 ng/l PFOA. PFOS and PFOA were not detected in samples taken in May 2019. Dexter WWTP participated in the IPP PFAS Initiative and found one industrial user, Alpha Metal Finishing, discharging PFOS at 33 ng/l and PFOA at 15 ng/l in May 2018 and 17.6 ng/l PFOS and 10.9 ng/l PFOA in October 2019. The City of Dexter is requiring ongoing monitoring for PFAS at Alpha Metal Finishing and has requested PFOS reduction activities (e.g., cleaning).

Sweepster-Harley Attachments discharges process wastewater, contact cooling water, noncontact cooling water, reverse osmosis reject water, and an unspecified amount of storm water to the Huron River between Dexter and Ann Arbor. EGLE staff sampled the effluent

in November 2018 and found concentrations below the PFOS and PFOA HNVs. An ongoing groundwater investigation is being conducted at this former Chrysler Scio Introl Division site where PFOS was detected in groundwater monitoring wells above the EGLE Part 201 criteria of 70 ng/L (sum of PFOS and PFOA). Groundwater flows toward the Huron River at this location and is likely venting to the Huron River as a potential source of PFAS.

In July 2018, a surface water sample from Honey Creek (HC0010), near the confluence with the Huron River was 0.73 ng/L PFOS. Follow-up sampling in April 2019 at the same site was non-detect for PFOS. A sample at HCT1000 (a tributary to Honey Creek) was 7.0 ng/L PFOS in April 2019. Pall Life Sciences discharges to an unnamed tributary of Honey Creek and EGLE staff sampled the effluent in November 2018, the sample was <0.35 ng/L PFOS and <0.26 ng/L PFOA.

Fish previously collected from Argo Pond (2015) were sent to the MDHHS lab for analysis. The 95% UCL for rock bass from Argo Pond was 404 ppb PFOS. The MDHHS extended the “Do Not Eat” advisory to Lake Erie based on Argo Pond and Base Line Lake fish results. A surface water sample from Barton Pond was collected in July 2018 (HR0130; 6.6 ng/L PFOS). Fish and ambient water samples were collected from Barton Pond in September 2018. The 95% UCL for Barton Pond bluegill was 17 ppb. September 2018 surface water concentrations in Barton Pond and Argo Pond were 42 ng/L and 37 ng/L, respectively.

Ann Arbor WWTP discharges to the Huron River downstream of Ann Arbor. The effluent was sampled nine times from November 2018 to October 2019. Results ranged from 2.7 to 18.3 ng/L PFOS and 2.5 to 8.62 ng/L PFOA (Table 7). Ann Arbor WWTP participated in the IPP PFAS Initiative and sampled five potential sources as part of its evaluation. No industrial users discharging above the screening level were found. Elevations in WWTP effluent PFOS concentrations have corresponded with elevated PFOS concentrations in the City of Ann Arbor’s drinking water source, which is the Huron River (see discussion and link on page 2 of this report for more information). The SWAS collected a surface water sample downstream of the Ann Arbor WWTP (HR0095) in July 2018 that was 6.5 ng/L for PFOS.

Willow Run and Belleville Lake Area

All PFOS sample results for the Willow Run area are provided in Table 8 and Figure 16. An initial ambient sample collected on Willow Run near the confluence with the Huron River (at Belleville Lake) was elevated above the PFOS HNV (26 ng/L PFOS). Upstream of Belleville Lake on the Huron River (HR0060) and downstream of Belleville Lake (HR0050) were both lower than the PFOS HNV (7.1 and 7.2 ng/L PFOS, respectively). The 95% UCL for bluegill and smallmouth bass collected from Belleville Lake in September 2018 was 33 and 71 ppb PFOS, respectively.

In April 2019, WRD conducted more intensive surface water sampling to follow-up on the elevated concentration of 26 ng/L from July 24, 2018, on Willow Run (just upstream of the confluence with the Huron River). Three samples (WR0500, WR0200, and WR0150) upstream of the Willow Run airport were below the PFOS HNV in April 2019. WROF001 (the emergency discharge from the YCUA) was flowing at the time of sampling, but the PFOS concentration was below the PFOS HNV. YCUA did not report a discharge to Willow Run in all of April 2019 and

the flowing water was most likely groundwater from an underdrain of the original WWTP (correspondence with Jeff Castro, YCUA Director). WROF002 (storm water from the Willow Run Airport) was flowing at the time of sample collection and was 92 ng/L PFOS. Downstream of the airport discharge, WRW0100 and WR0010 exceeded the PFOS HNV at 14 and 33 ng/L, respectively. A sample on the west branch of Willow Run (WRW0100) was 14 ng/L PFOS. These results suggest that there are potential sources of PFAS between the confluence with Belleville Lake and Tyler Road, and also on the west branch of Willow Run.

The RACER Willow Run site is located within the Willow Run and Huron River watersheds. Groundwater samples from the site have exceeded the EGLE Part 201 Criteria of 70 ng/L (the sum of PFOS and PFOA). However, the site discharges groundwater to the YCUA, which discharges treated wastewater outside of the Huron River watershed (main discharge to the Rouge River watershed). Surface water samples collected on Willow Run in the vicinity of the RACER site were below the PFOS HNV in April 2019 (WR0200 and WR0150).

Lower Huron and Flat Rock Area

All PFOS sample results for the Lower Huron River and Flat Rock area are provided in Table 8 and Figure 17. An initial water sample collected near the mouth of the Huron River at HR0010 did not reveal any major sources of PFAS in the lower reach of the Huron River on July 24, 2018. The 95% UCL for Flat Rock channel catfish, and largemouth bass was 11 and 18 ppb, respectively (Table 6; Figure 17). The 95% UCL could not be calculated for black crappie since the sample size was too small.

CONCLUSIONS

Water and fish samples were used to track potential sources of PFAS in the Huron River watershed. A major source to Norton Creek was identified and corrective measures were taken to minimize the amount of PFAS discharged to the Huron River watershed through the Wixom WWTP. Since beginning the water sampling in July 2018, ambient PFOS concentrations in Norton Creek have declined (but are still elevated above the PFOS HNV). Potential sources were found in Willow Run and will require follow-up work with facilities and potential dischargers in the area to figure out the extent of the problem.

Ambient concentrations in surface waters can be highly variable depending on the source of contamination and potential other factors such as flow or rain events. While single surface grab samples can be useful for detecting sources of contamination, they are not always representative of average conditions in a water body and may not detect intermittent sources. Since fish are continuously exposed, they can offer a longer-term picture of PFOS contamination in a water body. The results in this report demonstrate that a combination of water and fish tissue sampling is useful for tracking potential sources of PFAS in a watershed.

FUTURE WORK

1. EGLE will continue to work with the city of Wixom and Tribar to control/reduce discharges to the WWTP with the goal of meeting the PFOS HNV in Norton Creek under the IPP PFAS Initiative.
2. Brighton WWTP is continuing to monitor its effluent and investigate potential sources of PFOS.

3. EGLE will continue to evaluate known sources of environmental contamination, closed landfills, hazardous waste facilities, and facilities that discharge wastewater to the Huron River for PFAS.
4. The use of passive samplers could be useful to show improvements in Norton Creek around the Wixom WWTP and to track potential sources in Willow Run.
5. EGLE intra-division coordination and further source investigation activities are ongoing in Willow Run area to determine the sources and extent of PFOS in the watershed.
6. EGLE will continue to monitor fish from selected water bodies in the Huron River watershed and provide results to the MDHHS as available.

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REFERENCES

City of Ann Arbor. 2015. City of Ann Arbor 2014 Annual Water Quality Report. Available from: https://www.a2gov.org/departments/water-treatment/Documents/2014%20Water%20Quality%20Report.pdf.

MDEQ. 1995. SWAS Procedure WRD-SWAS-004. Fish Contaminant Monitoring Program - Fish Collection Procedures. Reformatted May 2014.

MDEQ. 2018a. General Per- and Polyfluoroalkyl Substances (PFAS) Sampling Guidance.

MDEQ. 2018b. Michigan Surface Water Perfluoroalkyl and Polyfluoroalkyl Compound (PFAS) Investigation: Quality Assurance Project Plan (QAPP).

MDEQ. 2018c. Wastewater PFAS Sampling Guidance. Draft Document.

HRWC. 2019. Our watershed. Available from: https://www.hrwc.org/our-watershed/.

USEPA. 2009. Method 537: Determination of selected perfluorinated alkyl acids in drinking water by solid phase extraction and liquid chromatography/tandem mass spectrometry (LC/MS/MS). USEPA Document #: EPA/600/R-08/092.

TABLES

Table 1. Sample site locations along the Huron River main stem and tributaries. The confluence of the main tributaries and the Huron River are listed below for reference.

Sample ID	Location Description	Latitude	Longitude
Huron River (HR)			
HR0270	HR at White Lake Road	42.6932	-83.49917
HR0250	HR at Benstein Rd.	42.56922	-83.50434
Confluence with Lake Sherwood Tributary		42.57464	-83.55792
HR0240	HR at Wixom Rd	42.57425	-83.5599
Confluence with Norton Creek		42.57413	-83.57092
HR0235	HR at Burns Rd	42.5787	-83.58002
Confluence with Pettibone Creek		42.58719	-83.60251
HUBBELL0010	Hubbell Pond	42.58965	-83.61521
HR0210	HR at GM Road	42.57927	-83.62692
HR0205	Kent Lake at W. Buno Rd	42.54926	-83.63156
HR0200	Kent Lake	42.52845	-83.64574
Confluence with Kent Lake Tributary			
Confluence with Woodruff Creek (includes Mann Creek)		42.51248	-83.70916
HR0195	HR at McCabe Rd.	42.48313	-83.74197
Confluence with Davis Creek		42.47073	-83.74917
Confluence with Ore Creek		42.47326	-83.79685
HR0190	HR US Strawberry Lake	42.46031	-83.82491
Confluence with Horseshoe Creek		42.45153	-83.83003
HR0185	Behind Edgelake Drive	42.45033	-83.83189
Confluence with Arms Creek		42.42703	-83.88348
Portage Lake and Tribs (Portage River, Honey Creek Livingston)		42.41551	-83.90774
HR0165	HR DS Base Line and Portage Lk	42.41488	-83.90695
HR0160	HR at N Territorial Rd	42.38715	-83.91113
Confluence with Mill Creek		42.34286	-83.88472
HR0150	HR at Central Rd	42.34117	-83.87973
HR0140	HR at Delhi Rd	42.3338	-83.80919
Confluence with Honey Creek (Washtenaw)		42.31669	-83.79264
HR0130	Barton Pond	42.31702	-83.77811
BART0010	Barton Pond	42.31791	-83.76618
ARGO0010	Argo Pond	42.29118	-83.74536
HR0095	HR at Stark Strasse	42.27228	-83.65539
HR0060	HR at Rawsonville Rd	42.20961	-83.54343
Confluence with Willow Run (at Belleville Lake)		42.21575	-83.52379
HR0050	HR at E Huron River Dr	42.21079	-83.43472
HR0010	HR at W Jefferson Ave	42.04256	-83.21419
Lake Sherwood Trib (LST)			
LST0050	Lake Sherwood West Trib at Sleeth Rd.	42.58169	-83.5543
Norton Creek (NC)			
NC0600	NC at Grand River Ave	42.50248	-83.5731
NC0500	NC at Oak Crk Dr	42.52099	-83.54469

Sample ID	Location Description	Latitude	Longitude
NC0400	NC at West Maple Rd	42.53142	-83.54761
NC0300	NC US East Branch	42.54257	-83.54716
NC0200	NC US Wixom WWTP	42.54296	-83.54661
NC0150	NC DS Wixom WWTP	42.54433	-83.5516
NC0100	NC at E Buno Rd. (DS Wixom WWTP)	42.5527	-83.56223
NC0010	NC US Huron River (DS Wixom WWTP)	42.57256	-83.57001
NCW0500	WB wetland at Huron Valley Trail	42.52554	-83.59174
NCW0400	WB NC at Old Plank Rd	42.52913	-83.57693
NCW0100	WB NC at E Maple Rd.	42.53542	-83.55863
NCE0100	EB NC at Wixom Habitat trail	42.53837	-83.53852
NCL0200	NC at Charms Rd.	42.54595	-83.54046
UT0001	Unnamed trib at Wixom assem.	42.50731	-83.54631
UT0002	Unnamed trib US Wixom assem.	42.50091	-83.54678
Wixom Assembly Site			
Pond0001	Ford pond 1 (North)	42.50695	-83.54643
Pond0002	Ford pond 2 (South)	42.50593	-83.5466
OF001	Ford storm water outfall to unnamed trib	42.50719	-83.54611
Pettibone Creek (PC)			
PC0100	PC at Reid Rd	42.61785	-83.60624
PC0050	PC US Mill Pond	42.59267	-83.60149
MILL001	Mill Pond	42.58965	-83.60278
PC0010	PC at Liberty St. (DS Mill Pond)	42.58944	-83.60277
Kent Lake Tributary (KLT)			
KLT5000	KLT at West Moore Rd	42.52898	-83.61464
Woodruff Creek (WC)			
WC0050	WC at Grand River Ave	42.51662	-83.70946
Mann Creek (MC)			
MCS0050	MC South Branch at N Hickory Ridge	42.58968	-83.65879
MC5000	MC at Hickory Ridge Road	42.60093	-83.66067
MC2000	MC at Kensington Rd	42.56944	-83.69932
MC1000	MC at Pleasant Valley Rd.	42.56392	-83.71116
MoraineLake 01	Moraine Lake	42.558	-83.71807
Davis Creek (DC)			
DC0010	DC at Silver Lake Rd	42.46885	-83.74407
Ore Creek (OC)			
SO-0050	South Ore Creek at Hamburg Rd.	42.49796	-83.80237
OL-001	Ore Lake South of Brighton	42.47962	-83.80101
OC0010	OC at Riverside Dr.	42.47327	-83.79694
Horseshoe Creek (HSC)			
HSC0600	At Schrum Drive	42.40425	-83.75929
HSC0500	At Barker Road	42.42258	-83.76631
HSC0400	At 8 Mile Road	42.42892	-83.77776
HSC0300	At Northfield Twp. WWTP driveway	42.43597	-83.7817

Sample ID	Location Description	Latitude	Longitude
HSC0100	At Hamburg Road	42.448	-83.80231
HSC0050	At Merrill Road (Manly Bennett Park)	42.45299	-83.82143
Hamburg Lake			
Hamburg Lake 0010	Hamburg Lake	42.43286	-83.79534
Arms Creek (AC)			
AC0010	AC at Strawberry Lk Rd	42.42301	-83.87978
Portage River (PR)			
PR0010	PR US Little Portage Lake	42.41908	-83.9301
UTS0050	Unnamed Trib at D19	42.40728	-83.94222
Honey Creek (HCL; Livingston County)			
HCL0100	HCL at Darwin Rd	42.44285	-83.92494
Mill Creek (MCW)			
MCW0010	MCW in Dexter	42.34204	-83.68602
Honey Creek (HC; Washtenaw County)			
HCT1000	HC Trib behind Stowe St	42.29605	-83.7953
HC0010	HC at Wagner Road	42.31808	-83.79538
Willow Run (WR)			
WRW0100	WR West Trib at McGregor Ave	42.2238	-83.55219
WR0500	WR at dam on ACM property	42.24067	-83.55969
WR0200	WR US Tyler Rd.	42.2341	-83.55023
WR0150	WR just DS Tyler Rd.	42.23283	-83.54724
WR0010	WR at service drive	42.2193	-83.53661
Outfalls to Willow Run			
WROF002	WR Airport SW Outfall 002	42.22799	-83.54363
WROF001	YCUA Outfall	42.23115	-83.54813
Davis Drain (Rouge Watershed)			
Davis Drain	Davis Drain at West Park Dr.	42.50303	-83.505898

Table 2. Perfluoroalkyl and polyfluoroalkyl substances (PFAS) analyzed by the Eurofins/TestAmerica laboratories.

Analyte	Acronym	CAS #
Perfluorotetradecanoic acid	PFTeA	376-06-7
Perfluorotridecanoic acid	PFTriA	72629-94-8
Perfluorododecanoic acid	PFDoA	307-55-1
Perfluoroundecanoic acid	PFUnA	2058-94-8
Perfluorodecanoic acid	PFDA	335-76-2
Perfluorononanoic acid	PFNA	375-95-1
Perfluorooctanoic acid	PFOA	335-67-1
Perfluoroheptanoic acid	PFHpA	375-85-9
Perfluorohexanoic acid	PFHxA	307-24-4
Perfluoropentanoic acid	PFPeA	2706-90-3
Perfluorobutanoic acid	PFBA	375-22-4
Perfluorodecanesulfonic acid	PFDS	335-77-3
Perfluorononanesulfonic acid	PFNS	68259-12-1
Perfluorooctanesulfonic acid	PFOS	1763-23-1
Perfluoroheptanesulfonic acid	PFHpS	375-92-8
Perfluorohexanesulfonic acid	PFHxS	355-46-4
Perfluoropentanesulfonic acid	PFPeS	2706-91-4
Perfluorobutanesulfonic acid	PFBS	375-73-5
Perfluorooctanesulfonamide	PFOSA	754-91-6
Fluorotelomer sulphonic acid 8:2	FtS 8:2	39108-34-4
Fluorotelomer sulphonic acid 6:2	FtS 6:2	27619-97-2
Fluorotelomer sulphonic acid 4:2	FtS 4:2	757124-72-4
2-(N-Ethylperfluorooctanesulfonamido) acetic acid	N-EtFOSAA	2991-50-6
2-(N-Methylperfluorooctanesulfonamido) acetic acid	N-MeFOSAA	2355-31-9

Table 3. Data quality objective results for surface water and storm water sampled by EGLE in the Huron River watershed.

Data Quality Indicator	Measurement	Data Quality Objective	Results
Precision	1 Matrix Spike/Matrix Spike (MS/MSD) Duplicate per preparation batch	%RPD < 30%	RPD ranged from 0-39.0% for all analytes. RPD < 30% except: 1. LCS 320-258298/2-A (10/30/18) 8:2 FtS = 39.0%
Precision	Field Sample Replication/Duplication	%RPD < 30%	RPD < 30 % except: 1. HR0050 (7/24/18) PFuNA = 78.8 %[1] 2. HR0050 (7/24/18) FtS 6:2 = 140.4% 3. HR0240 (8/30/18) PFTeA = 42.1% **4. NC0200 (8/30/18) PFOS = 42.3%** 5. NC0200 (8/30/18) PFBS = 94.3% 6. NC0500 (8/30/18) PFBS = 33.3% 7. HCL0100 (10/29/18) PFHpA=33% 8. WR0150 (4/29/19) PFPeA = 77.6% 9. WR0150 (4/29/19) PFHxS = 47.1% 10. WR0150 (4/29/19) PFBS = 83.5% **11. WR0010 (4/29/19) PFOA = 46.8%[2]** 12. WR0010 (4/29/19) PFBA = 66.7% 13. WR0010 (4/29/19) PFBS = 37.5% **14. NC0100 (4/30/19) PFOS 39.6%** 15. NC0100 (4/30/19) PFBA = 38.5% 16. NC0100 (4/30/19) PFBS = 50.8%
Accuracy/Bias	1 Lab Control Spike (LCS) and 1 MS/MSD per preparation batch	60 to 140 % recovery[3]	Analyte spike recovery was 72-147%. All recoveries were within range except: 1. LCSD 200-142591/3-A (4/30/19) PFPeA = 147% 2. LCSD 200-142638/3-A (4/30/19) 4:2 FtS = 145%
Accuracy/Bias	1 method blank per preparation batch	No target analytes greater than or equal to	Analyte detection in all method blanks below reporting limits except for the following analytes:

[1] Method detection limit used as replicate/duplicate value for RPD calculation since duplicate/replicate was not detected.
[2] For both samples, the results were less than the laboratory reporting limit, but greater than or equal to the method detection limit; therefore, the concentrations are approximate values.
[3] For some analytes, the acceptable laboratory recovery limits were more stringent than the data quality objectives in the QAPP (MDEQ 2018). Therefore, some analyte spike results passed QAPP data quality objectives, but were flagged by the lab. Details are not included in this report but are available in the TestAmerica analytical reports. Analytes affected are 6:2 FtS and 8:2 FtS.

Data Quality Indicator	Measurement	Data Quality Objective	Results
		the laboratory reporting limit	1. FtS 6:2 (10/4/2018; 27 ng/L) 2. PFBA (9/28/2018; 7.55 ng/L)
Accuracy/Bias	Every sample (spiked, standard or method blank) will receive an internal standard	25 to 150 % recovery[4]	Analyte recovery was 35-220%. All recoveries were within range except: 1. NC0600 (8/30/18) 6:2 FtS = 162% 2. OF001 (8/30/18) 6:2 FtS = 174% 3. UT0001 (8/30/18) 6:2 FtS = 194 % 4. UT0002 (8/30/18) 6:2 FtS = 220%; 8:2 FtS = 160 5. MC50050 (10/30/18) 6:2 FtS = 170%
Comparability	LC/MS Analytical work to be conducted by the TestAmerica LCMS West Sacramento Laboratory	Laboratory will provide verification that methods were properly implemented, and results meet QA/QC standards	All samples analyses were conducted by TestAmerica LCMS West Sacramento Laboratory or Eurofins Burlington Laboratory and met laboratory QA/QC standards for PFOS and PFOA. Please see individual reports for instances where laboratory QA/QC were not met for other analytes.
Completeness	[Total number of samples analyzed found to meet or exceed quality control criteria / total number of samples analyzed] * 100	90% samples should pass quality control criteria[5]	7/24/2018: 95% **8/30/2018: 73%** 9/28/2018: 100% 10/2/2018: 100% 10/4/2018: 100% 10/29-30/2018: 94% 4/29-30/2019: 90% 8/21/2019: 100% 9/27/2019: 100%
Sensitivity	LC/MS/MS is tested daily or as needed following WS-LC-0025 SOP	Each analyte will pass continuing calibration verification (CCV) criteria of 40 or 50 % difference (analyte specific)	Not requested from or provided by lab

[4] For some analytes, the acceptable laboratory recovery limits were more stringent than the data quality objectives in the QAPP (MDEQ 2018). Therefore, some analyte spike results passed QAPP data quality objectives, but were flagged by the lab. Details are not included in this report but are available in the TestAmerica analytical reports. Analytes affected are: NMeFOSAA, PFBS, and PFHxS,

[5] Only ambient water samples or outfall samples were included in the total count (trip blanks, field blanks, and equipment blanks were not included).

Table 4. USGS gaging station daily mean discharge data and median daily discharge statistic for three stations on the main stem of the Huron River in cubic feet per second (cfs).

Location (USGS gage number)	Mean 24-hour discharge (cfs)										Median daily discharge statistic (cfs)[6]
	7/24/18	**8/30/18**	**9/28/18**	**10/2/18**	**10/4/18**	**10/29/18**	**10/30/18**	**4/29/19**	**4/30/19**	**9/27/19**	
Ann Arbor, Michigan (04174500)	148	164	341	300	262	443	412	1,460[7]	1,630[7]	304[7]	394
	111	125	169	211	271	242	233	579[7]	613[7]		
Milford, Michigan (04170000)	55.0	53.4	63.4	142	165	130	159	242[7]	243[7]	80.5[7]	114

[6] Median discharge data as of January 2, 2020. Median based on 103 years of data for Ann Arbor gage and 67 years of data for the Hamburg and Milford gages.
[7] Provisional USGS data subject to revision (as of January 2, 2020).

Table 5. Perfluorinated compounds analyzed in fish tissue by the MDHHS Analytical Chemistry Laboratory.

Analyte	Acronym	CAS #
Perfluorooctanoic acid	PFOA	335-67-1
Perfluorooctane sulfonate	PFOS	1763-23-1
Perfluorononanoic acid	PFNA	375-95-1
Perfluorodecanoic acid	PFDA	335-76-2
Perfluoroundecanoic acid	PFUnA	2058-94-8
Perfluorododecanoic acid	PFDoA	307-55-1
Perfluorotridecanoic acid	PFTriA	72629-94-8
Perfluorotetradecanoic acid	PFTeA	376-06-7
Perfluorohexane sulfonate	PFHxS	355-46-4
Perfluorodecane sulfonate	PFDS	335-77-3
Perfluorooctane sulfonamide	PFOSA	754-91-6

Table 6. Fish tissue concentrations. Water bodies in *italics* are currently part of the MDHHS "Do not eat" advisory for the Huron River.

Water body	Location	Year	Latitude	Longitude	Species	95% UCL
Huron River						
Proud Lake	Oakland County	2019	42.56839	-83.52087	Bluegill	10
Proud Lake	Oakland County	2019	42.56839	-83.52087	Rock Bass	8.2
Proud Lake	Oakland County	2019	42.56839	-83.52087	Largemouth Bass	120
Kent Lake	*Oakland County*	2017	42.52957	-83.64402	Black Crappie	1134
Kent Lake	*Oakland County*	2017	42.52957	-83.64402	Largemouth Bass	1740
Kent Lake	*Oakland County*	2019	42.52957	-83.64402	Pumpkinseed	115
Kent Lake	*Oakland County*	2019	42.52957	-83.64402	Largemouth Bass	387
Base Line Lake	*Livingston/Washtenaw County*	2018	42.42779	-83.89471	Bluegill	129
Base Line Lake	*Livingston/Washtenaw County*	2018	42.42779	-83.89471	Largemouth Bass	286
Portage Lake	*Washtenaw/Livingston County*	2018	42.42177	-83.91758	Largemouth Bass	84
Huron River	*Barton Pond*	2018	42.31332	-83.78766	Lepomis	17
Huron River	*Argo Pond*	2015	42.29262	-83.74523	Rock Bass	404
Huron River	*Belleville Lake*	2018	42.21447	-83.47022	Bluegill	33
Huron River	*Belleville Lake*	2018	42.21447	-83.47022	Smallmouth Bass	71
Huron River	*Wayne County, Flat Rock*	2017	42.10459	-83.30521	Channel Catfish	11
Huron River	*Wayne County, Flat Rock*	2018	42.10459	-83.30521	Black Crappie	--
Huron River	*Wayne County, Flat Rock*	2018	42.10459	-83.30521	Largemouth Bass	18
Pettibone Creek						
Pettibone Creek	Milford Pond	2018	42.59023	-83.60261	Bluegill	
Mann Creek						
Mann Creek	Moraine Lake	2018	42.55914	-83.7171	Black Crappie	
Mann Creek	Moraine Lake	2018	42.55914	-83.7171	Bluegill	
Mann Creek	Moraine Lake	2018	42.55914	-83.7171	Largemouth/Smallmouth Bass	
Davis Creek						
Sandy Bottom Lake	n.e. of Whitmore Lake	2019	42.45203	-83.71462	Bluegill/Pumpkinseed	
Sandy Bottom Lake	n.e. of Whitmore Lake	2019	42.45203	-83.71462	Largemouth Bass	
Ore Creek						
Woodland Lake	Livingston County	2019	42.55445	-83.78155	Bluegill/Pumpkinseed	4
Woodland Lake	Livingston County	2019	42.55445	-83.78155	Largemouth Bass	15

Water body	Location	Year	Latitude	Longitude	Species	95% UCL
Horseshoe Creek						
Whitmore Lake	Livingston County	2019	42.4287	-83.75379	Bluegill/Pumpkinseed	4
Hay Creek						
Bass Lake	s.e. of Brighton	2019	42.45425	-83.86102	Bluegill	5
Bass Lake	s.e. of Brighton	2019	42.45425	-83.86102	Largemouth Bass	8

Table 7. Point source discharges/compliance sampling results. All samples collected by EGLE, unless otherwise noted. Bold values exceed the HNV for PFOS.

Facility Name	Sampling Date	PFOS (ng/L)	PFOA (ng/L)	Σ PFAS (ng/L)
Huron River Discharges				
Milford WWTP	8/14/2018	3	12	103
Pall Life Sciences				ND
Sweepster-Harley Attachments	11/27/2018	1.3[J]	2.7	22
Ann Arbor WWTP[8]				123.5
Ann Arbor WWTP[9]	11/2/2018	**14.8**	4.42	112.85
Ann Arbor WWTP[8]				42
Ann Arbor WWTP[8]	4/10/2019	<2.5	3.8	44
Ann Arbor WWTP[8]				67.39
Ann Arbor WWTP[8]	8/27/2019	3.30[J]	5.20	171.93
Ann Arbor WWTP[8]				161.5
Ann Arbor WWTP[8]	8/29/2019	2.84[J]	4.74[J]	155.07
Ann Arbor WWTP[8]				134.6
Norton Creek Discharges				
Wixom WWTP[8]				10,927
Wixom WWTP[8]	8/29/2018	**4,800**	12	16,751
Wixom WWTP[8]				11,872
Wixom WWTP[8]	10/11/2018	**940**	11	7,720
Wixom WWTP[8]				3,279
Wixom WWTP[8]	11/6/2018	**240**	6.2	3,229
Wixom WWTP[9]				4,950
Wixom WWTP[8]	12/4/2018	**150**	9.8	6,020
Wixom WWTP[8]				8,222
Wixom WWTP[8]	2/13/2019	**53**	7.4	5,913
Wixom WWTP[8]				3,824
Wixom WWTP[8]	4/3/2019	**19**	5.2	3,402
Wixom WWTP[8]				3,492
Wixom WWTP[8]	6/12/2019	**73**	11	3,626
Wixom WWTP[8]				3,431.17
Wixom WWTP[8]	8/21/2019	**36**	7.9	4,396.90
Wixom WWTP[8]				4,955.40
Wixom WWTP[8]	10/8/2019	**17**	5.6	2,183
Wixom WWTP				5,387
Wixom WWTP	12/10/2019	**26**	6.6	2,459
Pettibone Creek Discharges				
Coes Cleaners	8/30/2018	**1,000**	1	1,675
Coes Cleaners[9]				6.99
Kelsey Hayes	9/17/2018	< 0.4	< 0.7	10
Mann Creek Discharges				
GM Proving Grounds	8/15/2018	3	6.4	59
Yerkes Drain Discharges				
South Lyon WWTP	8/14/2018	4	72	466
South Lyon WWTP	3/20/2019	0.99[J]	6.3	76

[8] Sample collected by the municipality or its contractor
[9] Sample collected by AECOM for EGLE
[J] Concentration at a level that was above the method detection limit but below the laboratory reporting limit.

Facility Name	Sampling Date	PFOS (ng/L)	PFOA (ng/L)	Σ PFAS (ng/L)
Seamless Tube	8/14/2018	< 0.4	< 0.7	11
South Ore Creek Discharges				
Brighton WWTP	3/20/2019	11	19	163
Brighton WWTP[8]	5/15/2019	**16.1**	17.9	179.16
Brighton WWTP[8]	8/16/2019	**20**	19	200.2
Brighton WWTP[8]	11/14/2019	**20**	17	201.5
Letts Creek Discharges				
Chelsea WWTP	3/20/2019	1[J]	4.3	46
Mill Creek Discharges				
Dexter WWTP[8]	8/14/2018	3.6	12	127.6
Dexter WWTP[8]	11/2/2018	1.51	7.97	104.92
Dexter WWTP[8]	5/30/2019	<8.2	<8.2	66
Dexter WWTP[8]	11/25/2019	2.5[J]	6.7	74

Table 8. PFOS (ng/L) concentrations. All samples were sub-surface samples except for depth-integrated composite samples where an asterisks (*) follows the sample ID and outfall samples where a dagger (†) follows the sample ID. Concentrations flagged with J were at a level that was above the method detection limit but below the reporting limit. Concentrations flagged with a "D" and "R" are duplicate and replicate samples, respectively.

	PFOS (ng/L)								
Sample ID	**7/24/2018**	**8/30/2018**	**9/28/2018**	**10/2 to 10/4/2018**	**10/29 to 10/30/2018**	**4/11/2019[10]**	**4/29 to 4/30/2019**	**8/21/2019**	**9/27/2019**
Huron River (HR)									
HR0270	0.58[J]								
HR0250		1.5[J]							
HR0240	2.4	1.1[J] | 1.1[JD]			1.2[J]		ND		
HR0235	**1,400**	**480**			**21 | 21[R]**	2.99[J]	ND		
HUBBELL0010				**61**					
HR0210		**300**			**15**	5.05			
HR0205					**17**				
HR0200					**22**				
HR0195					**65**				
HR0190	**15**				**46**		6.4[J]		
HR0185							4.4[J]		
HR0165	11				**88**				
HR0160	8.7 | 7.8[R]								
HR0150	7.5								
HR0140	7.1								
HR0130	6.6								
BART0010			**42**						
ARGO0010			**37**						
HR0095	6.5								
HR0060	7.1								
HR0050	7.2 | 7.4[R]								
HR0010	6.9								

[10] Samples collected by AECOM for EGLE, Materials Management Division, provided here for reference.

	PFOS (ng/L)								
Sample ID	**7/24/2018**	**8/30/2018**	**9/28/2018**	**10/2 to 10/4/2018**	**10/29 to 10/30/2018**	**4/11/2019[10]**	**4/29 to 4/30/2019**	**8/21/2019**	**9/27/2019**
Lake Sherwood Trib (LST)									
LST0050							ND		
Norton Creek (NC)									
NC0600		4.1					ND		
NC0500		10 | 10[R]							
NC0400		5.1					ND		
NC0300		**26**							
NC0200		8.4 | **13[R]**							
NC0150		**190**				5.9			
NC0100		**1,900 | 1,800[D]**			**75**	10.6	**13** | 8.7[R]		
NC0010	**5,500 | 5,600[D]**	**1,500**			**88**	**12.6**	**13**		
NCW0500								3.5	
NCW0400					1.8			0.52[J]	
NCW0100		**80**			5.2		ND		
NCE0100		7.7							
NCL0200		11							
UT0001		**38**							
UT0002		6.5							
Wixom Assembly Site									
Pond0001		**20**							
Pond0002		5.7							
OF001		**32**							
Pettibone Creek (PC)									
					1.3[J]				
PC0050					0.75[J]				

	PFOS (ng/L)								
Sample ID	**7/24/2018**	**8/30/2018**	**9/28/2018**	**10/2 to 10/4/2018**	**10/29 to 10/30/2018**	**4/11/2019[10]**	**4/29 to 4/30/2019**	**8/21/2019**	**9/27/2019**
PC0010		**500**			ND | ND[R]		ND		
(KLT)									
KLT5000								1.7	
Woodruff Creek (WC)									
WC0050					1.7[J]				
Mann Creek (MC)									
MCS0050					9.5				
MC5000					ND				
MC2000					ND | ND[D]				
MC1000		**150**			0.98[J]				
MoraineLake 01					1.1[J]				
Davis Creek (DC)									
DC0010					1.3[J]				
Ore Creek (OC)									
SO-0050									2.5
OC0010					2.2				2.4
HSC0600							ND		
HSC0500							ND		
HSC0400							ND		
HSC0300							ND | ND[D]		
HSC0100							ND		
HSC0050							ND		
Hamburg Lake									
Hamburg Lake 0010							ND		
Arms Creek (AC)									
AC0010					ND				

	PFOS (ng/L)								
Sample ID	**7/24/2018**	**8/30/2018**	**9/28/2018**	**10/2 to 10/4/2018**	**10/29 to 10/30/2018**	**4/11/2019[10]**	**4/29 to 4/30/2019**	**8/21/2019**	**9/27/2019**
Portage River (PR)									
PR0010					0.85[J]				
UTS0050					ND				
Honey Creek (HCL; Livingston Co.)									
HCL0100					0.58[J] | 0.65[JD]				
Mill Creek (MCW)									
MCW0010	ND								
Honey Creek (HC; Washtenaw Co.)									
HCT1000							7.0		
HC0010	0.73[J]						ND		
Willow Run (WR)									
WRW0100							**14**		
WR0500							4.1[J]		
WR0200							6.1[J]		
WR0150							3.7[J] | ND[R]		
WR0010	**26**						**33 | 32[D]**		
Outfalls to Willow Run									
WROF002							**92**		
WROF001							5.4[J]		
Davis Drain (Rouge Watershed)									
Davis Drain					10				

Table 9. PFOA (ng/L) concentrations. All samples were sub-surface samples except for depth-integrated composite samples where an asterisks (*) follows the sample ID and outfall samples where a dagger (†) follows the sample ID. Concentrations flagged with J were at a level that was above the method detection limit but below the reporting limit. Concentrations flagged with a "D" and "R" are duplicate and replicate samples, respectively.

	PFOA (ng/L)								
Sample ID	**7/24/2018**	**8/30/2018**	**9/28/2018**	**10/2 to 10/4/2018**	**10/29 to 10/30/2018**	**4/11/2019**	**4/29 to 4/30/2019**	**8/21/2019**	**9/27/2019**
Huron River (HR)									
HR0270	ND								
HR0250		2.6							
HR0240	2.4	2.8 | 2.8			2.9		ND		
HR0235	3.2	3.8			2.6 | 3.0[R]	ND	ND		
HUBBELL0010				2.2					
HR0210		3.0			2.1	1.76[J]			
HR0205					2.4				
HR0200					2.4				
HR0195					2.8				
HR0190	3.8				2.5		ND		
HR0185							ND		
HR0165	3.4				1.7[J]				
HR0160	2.8 | 2.8[R]								
HR0150	2.7								
HR0140	2.7								
HR0130	2.5								
BART0010			3.0						
ARGO0010			3.4						
HR0095	2.8								
HR0060	2.8								
HR0050	2.9 | 2.8[R]								
HR0010	2.6								
Lake Sherwood Trib (LST)									
LST0050							ND		

	PFOA (ng/L)								
Sample ID	**7/24/2018**	**8/30/2018**	**9/28/2018**	**10/2 to 10/4/2018**	**10/29 to 10/30/2018**	**4/11/2019**	**4/29 to 4/30/2019**	**8/21/2019**	**9/27/2019**
Norton Creek (NC)									
NC0600		2.0					ND		
NC0500		5.2 | 5.5[R]							
NC0400		2.8					ND		
NC0300		2.9							
NC0200		1.4[J] | 1.3[JR]							
NC0150		2.6				ND			
NC0100		5.5 | 5.7[D]			3.3	1.7[J]	ND | ND[R]		
NC0010	4.7 | 4.8[D]	5.2			3.5	2.12[J]	2.7[J]		
NCW0500								2.6	
NCW0400					1.4[J]			1.2[J]	
NCW0100		4.0			3.7		ND		
NCE0100		5.1							
NCL0200		1.4[J]							
UT0001		15							
UT0002		4.3							
Wixom Assembly Site									
Pond0001		20							
Pond0002		9.3							
OF001		12							
Pettibone Creek (PC)									
PC0100					1.8[J]				
MILL001				1.9					
PC0050					1.5[J]				
PC0010		3.2			1.6[J] | 1.7[JR]		ND		
Kent Lake Tributary (KLT)									
KLT5000								1.7	

Sample ID	PFOA (ng/L)								
	7/24/2018	8/30/2018	9/28/2018	10/2 to 10/4/2018	10/29 to 10/30/2018	4/11/2019	4/29 to 4/30/2019	8/21/2019	9/27/2019
Woodruff Creek									
WC0050					2.6				
Mann Creek (MC)									
MCS0050					6.7				
MC5000					ND				
MC2000					1.0[J] | ND[D]				
MC1000		0.98[J]			0.85[J]				
MoraineLake 01					0.99[J]				
Davis Creek (DC)									
DC0010					2.9				
Ore Creek (OC)									
SO-0050									2.9
OC0010					2.9				2.7
HSC0600							ND		
HSC0500							ND		
HSC0400							ND		
HSC0300							ND | ND[D]		
HSC0100							ND		
HSC0050							ND		
Hamburg Lake									
Hamburg Lake 0010							ND		
Arms Creek (AC)									
AC0010					ND				
Portage River (PR)									
PR0010					1.3[J]				
UTS0050					1.5[J]				

Sample ID	PFOA (ng/L)								
	7/24/2018	8/30/2018	9/28/2018	10/2 to 10/4/2018	10/29 to 10/30/2018	4/11/2019	4/29 to 4/30/2019	8/21/2019	9/27/2019
HCL0100					ND | ND[D]				
MCW0010	1.1[J]								
HCT1000							ND		
HC0010							ND		
Willow Run (WR)									
WRW0100							9.9		
WR0500							ND		
WR0200							5.7[J]		
WR0150							3.0[J] | 3.0[JR]		
WR0010	6.3						3.6[J] | 5.8[JD]		
Outfalls to Willow Run									
WROF002							6.1[J]		
WROF001							5.8[J]		
Davis Drain					5.1				

Table 10. Number of analytes detected in all samples (total number reported in parentheses after date) for that sample run (analytes were excluded if they did not meet QA/QC requirements – see text for details). All samples were sub-surface samples except for depth-integrated composite samples where an asterisks (*) follows the sample ID and outfall samples where a dagger (†) follows the sample ID. Samples flagged with a "D" and "R" are duplicate and replicate samples, respectively.

	Number PFAS analytes detected							
Sample ID	**7/24/2018 (23)**	**8/30/2018 (24)**	**9/28/2018 (24)**	**10/2 to 10/4/2018 (24)**	**10/29 to 10/30/2018 (22)**	**4/29 to 4/30/2019 (24)**	**8/21/2019 (24)**	**9/27/2019 (24)**
Huron River (HR)								
HR0270	6							
HR0250		12						
HR0240	11	11 | 10^{D}			8	2		
HR0235	12	13			10 | 9^{R}	5		
HUBBELL0010				12				
HR0210		12			9			
HR0205					9			
HR0200					8			
HR0195					10			
HR0190	11				10	6		
HR0185						5		
HR0165	10				8			
HR0160	10 | 10^{R}							
HR0150	10							
HR0140	10							
HR0130	10							
BART0010			10					
ARGO0010			10					
HR0095	10							
HR0060	10							
HR0050	12 | 11^{R}							
HR0010	10							
Lake Sherwood Trib (LST)								
LST0050						0		
Norton Creek (NC)								

Sample ID	Number PFAS analytes detected							
	7/24/2018 (23)	8/30/2018 (24)	9/28/2018 (24)	10/2 to 10/4/2018 (24)	10/29 to 10/30/2018 (22)	4/29 to 4/30/2019 (24)	8/21/2019 (24)	9/27/2019 (24)
		9				0		
NC0500		11 | 11[R]						
NC0400		10				1		
NC0300		9						
NC0200		9 | 9[R]						
NC0150		11						
NC0100		13 | 13[D]			9	6 | 7[R]		
NC0010	13 | 13[D]	13			10	8		
NCW0500							9	
NCW0400					7		8	
NCW0100		10			7	1		
NCE0100		9						
NCL0200		8						
UT0001		14						
UT0002		10						
Wixom Assembly Site								
Pond0001		11						
Pond0002		9						
OF001		12						
Pettibone Creek (PC)								
PC0100					8			
MILL001				9				
PC0050					7			
PC0010					6 | 6[R]	1		
Kent Lake Tributary (KLT)								
KLT5000							8	
Woodruff Creek (WC)								
WC0050					8			
Mann Creek (MC)								

Sample ID	Number PFAS analytes detected							
	7/24/2018 (23)	8/30/2018 (24)	9/28/2018 (24)	10/2 to 10/4/2018 (24)	10/29 to 10/30/2018 (22)	4/29 to 4/30/2019 (24)	8/21/2019 (24)	9/27/2019 (24)
MCS0050					8			
MC5000					4			
MC2000					5 | 4[D]			
MC1000		8			6			
MoraineLake 01					7			
DC0010					7			
SO-0050								8
OC0010					8			8
HSC0600						0		
HSC0500						1		
HSC0400						0		
HSC0300								
HSC0100						0		
HSC0050						0		
Hamburg Lake								
Hamburg Lake 0010						2		
Arms Creek (AC)								
AC0010								
Portage River (PR)								
PR0010					7			
UTS0050					5			
Honey Creek (HCL; Livingston County)								
HCL0100					4 | 4[D]			

Sample ID	Number PFAS analytes detected							
	7/24/2018 (23)	8/30/2018 (24)	9/28/2018 (24)	10/2 to 10/4/2018 (24)	10/29 to 10/30/2018 (22)	4/29 to 4/30/2019 (24)	8/21/2019 (24)	9/27/2019 (24)
Mill Creek (MCW)								
MCW0010	7							
Honey Creek (HC; Washtenaw County)								
HCT1000						6		
HC0010	8					1		
Willow Run (WR)								
WRW0100						6		
WR0500						6		
WR0200						7		
WR0150						5 | 5[D]		
WR0010	12					11 | 10[R]		
Outfalls to Willow Run								
WROF002						11		
WROF001						9		
Davis Drain (Rouge Watershed)								
Davis Drain					9			

Table 11. Sum PFAS (ng/L) for all sample dates. All samples were sub-surface samples except for depth-integrated composite samples where an asterisks (*) follows the sample ID and outfall samples where a dagger (†) follows the sample ID. Concentrations flagged with J were at a level that was above the method detection limit but below the reporting limit. Concentrations flagged with a "D" and "R" are duplicate and replicate samples, respectively.

Sample ID	Total PFAS (Σ PFAS; ng/L)							
	7/24/2018 Σ23 PFAS	8/30/2018 Σ24 PFAS	9/28/2018 Σ24 PFAS	10/2 to 10/4/2018 Σ24 PFAS	10/29 to 10/30/2018 Σ22 PFAS	4/29 to 4/30/2019 Σ24 PFAS	8/21/2019 Σ24 PFAS	9/27/2019 Σ24 PFAS
Huron River (HR)								
HR0270	3.5							
HR0250		29.4						
HR0240	20.9	17.5 | 17.5[D]			16.0	9.5		
HR0235	1,750.7	2,001.7			197.1 |199.1[R]	129.6		
HUBBELL0010				466.8				
HR0210		957.6			215.6			
HR0205					242.8			
HR0200					155.6			
HR0195					234.8			
HR0190	139.6				177.5	52.4		
HR0185						47.9		
HR0165	81.3				110.5			
HR0160	70.72 | 71.02[R]							
HR0150	60.8							
HR0140	57.7							
HR0130	56.6							
BART0010			126.9					
ARGO0010			133.6					
HR0095	61.1							
HR0060	53.9							
HR0050	52.86 | 51.99[R]							

Sample ID	Total PFAS (Σ PFAS; ng/L)							
	7/24/2018 Σ23 PFAS	8/30/2018 Σ24 PFAS	9/28/2018 Σ24 PFAS	10/2 to 10/4/2018 Σ24 PFAS	10/29 to 10/30/2018 Σ22 PFAS	4/29 to 4/30/2019 Σ24 PFAS	8/21/2019 Σ24 PFAS	9/27/2019 Σ24 PFAS
HR0010	48.8							
Lake Sherwood Trib (LST)								
LST0050						0.0		
Norton Creek (NC)								
NC0600		15.1				0.0		
NC0500		44.1 | 42.3[R]						
NC0400		32.5				4.8		
NC0300		47.5						
NC0200		16.7 | 24.5[R]						
NC0150		916.3						
NC0100		8,208.2 | 8,107.8[D]			761.1	426.0 | 477.2[R]		
NC0010	6656.91 | 6812.35[D]	6,023.1			842.1	439.1		
NCW0500							44.9	
NCW0400					10.0		9.3	
NCW0100		96.1			18.7	3.4		
NCE0100		48.8						
NCL0200		18.5						
UT0001		114.6						
UT0002		49.4						
Wixom Assembly Site								
Pond0001		71.6						
Pond0002		33.5						
OF001		103.5						

Sample ID	Total PFAS (Σ PFAS; ng/L)							
	7/24/2018 Σ23 PFAS	8/30/2018 Σ24 PFAS	9/28/2018 Σ24 PFAS	10/2 to 10/4/2018 Σ24 PFAS	10/29 to 10/30/2018 Σ22 PFAS	4/29 to 4/30/2019 Σ24 PFAS	8/21/2019 Σ24 PFAS	9/27/2019 Σ24 PFAS
Pettibone Creek (PC)								
PC0100					12.9			
MILL001				16.1				
PC0050					11.3			
PC0010		1,814.5			10.7 | 10.8[R]	5.7		
KLT5000							16.6	
WC0050					21.0			
MCS0050					38.2			
MC5000					2.9			
MC2000					4.3 | 3.9[D]			
MC1000		156.5			4.9			
MoraineLake 01					6.2			
DC0010					22.9			
SO-0050								31.6
OC0010					22.6			26.1
HSC0600						0.0		
HSC0400						0.0		
HSC0100						0.0		

Sample ID	Total PFAS (Σ PFAS; ng/L)							
	7/24/2018 Σ23 PFAS	8/30/2018 Σ24 PFAS	9/28/2018 Σ24 PFAS	10/2 to 10/4/2018 Σ24 PFAS	10/29 to 10/30/2018 Σ22 PFAS	4/29 to 4/30/2019 Σ24 PFAS	8/21/2019 Σ24 PFAS	9/27/2019 Σ24 PFAS
HSC0050								
Hamburg Lake								
Hamburg Lake 0010						6.3		
Arms Creek (AC)								
AC0010					3.0			
Portage River (PR)								
PR0010					6.3			
UTS0050					14.3			
Honey Creek (HCL; Livingston County)								
HCL0100					2.3 | 2.8[D]			
Mill Creek (MCW)								
MCW0010	12.9							
Honey Creek (HC; Washtenaw County)								
HCT1000						31.4		
HC0010	11.1					8.0		
Willow Run (WR)								
WRW0100						73.5		
WR0500						40.8		
WR0200						67.4		
WR0150						27.2 | 44.5[D]		
WR0010	152.8					256.1 |		
Outfalls to Willow Run								
WROF002						621.2		
WROF001						55.2		

Sample ID	Total PFAS (Σ PFAS; ng/L)							
	7/24/2018 Σ23 PFAS	8/30/2018 Σ24 PFAS	9/28/2018 Σ24 PFAS	10/2 to 10/4/2018 Σ24 PFAS	10/29 to 10/30/2018 Σ22 PFAS	4/29 to 4/30/2019 Σ24 PFAS	8/21/2019 Σ24 PFAS	9/27/2019 Σ24 PFAS
Davis Drain (Rouge Watershed)								
Davis Drain					45.2			

FIGURES

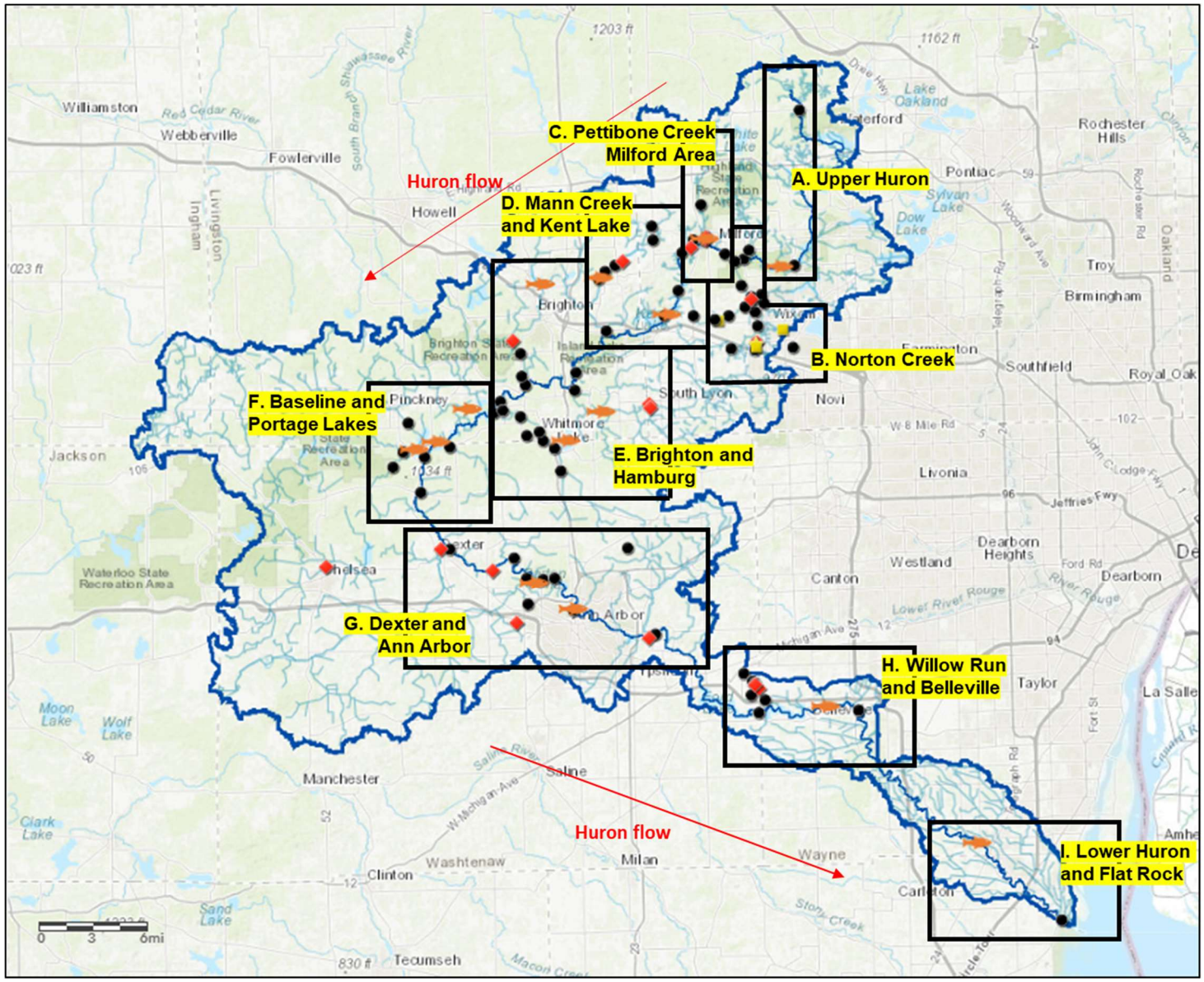

Figure 1. Overview map of the Huron River watershed (dark blue boundary line) showing sample locations for ambient surface water samples (black circles), fish tissue samples (orange fish symbols), discharges (red diamonds), site ponds (yellow stars), and facilities (yellow squares). Insets provide sampling results for the following: (A) Upper Huron; (B) Norton Creek area; (C) Pettibone Creek and Milford area; (D) Mann Creek and Kent Lake area; (E) Brighton and Hamburg area; (F) Base Line and Portage Lakes area; (G) Dexter and Ann Arbor area; (H) Willow Run and Belleville area; (I) Lower Huron and Flat Rock area.

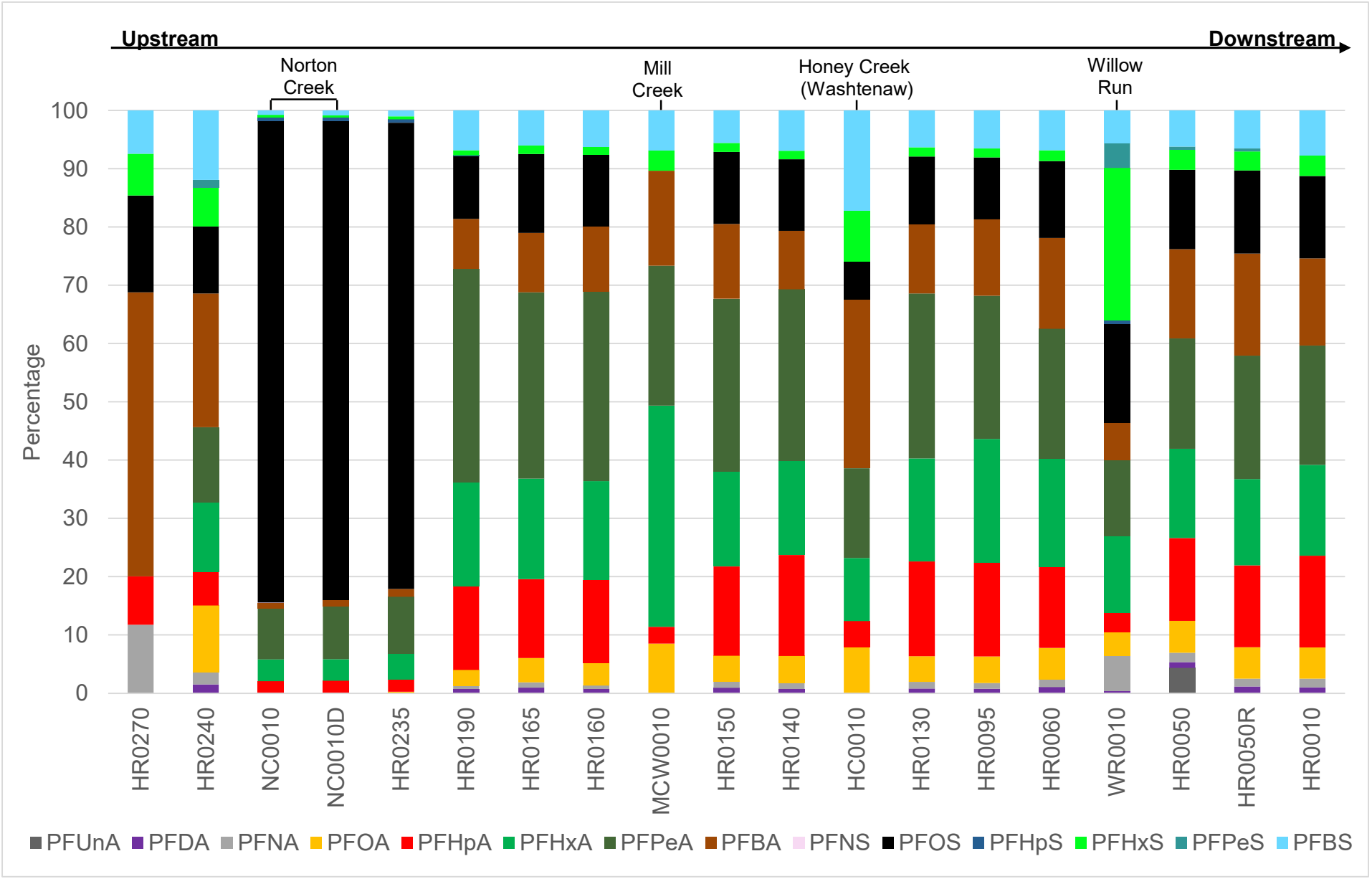

Figure 2. Percent composition of detected PFAS measured in surface water collected in the Huron River watershed July 24, 2018. A sample ID followed by the letter 'D' indicates a duplicate sample and 'R' indicates a replicate sample. FtS 6:2 was left out of totals because it did not meet laboratory QA/QC for multiple samples on this date.

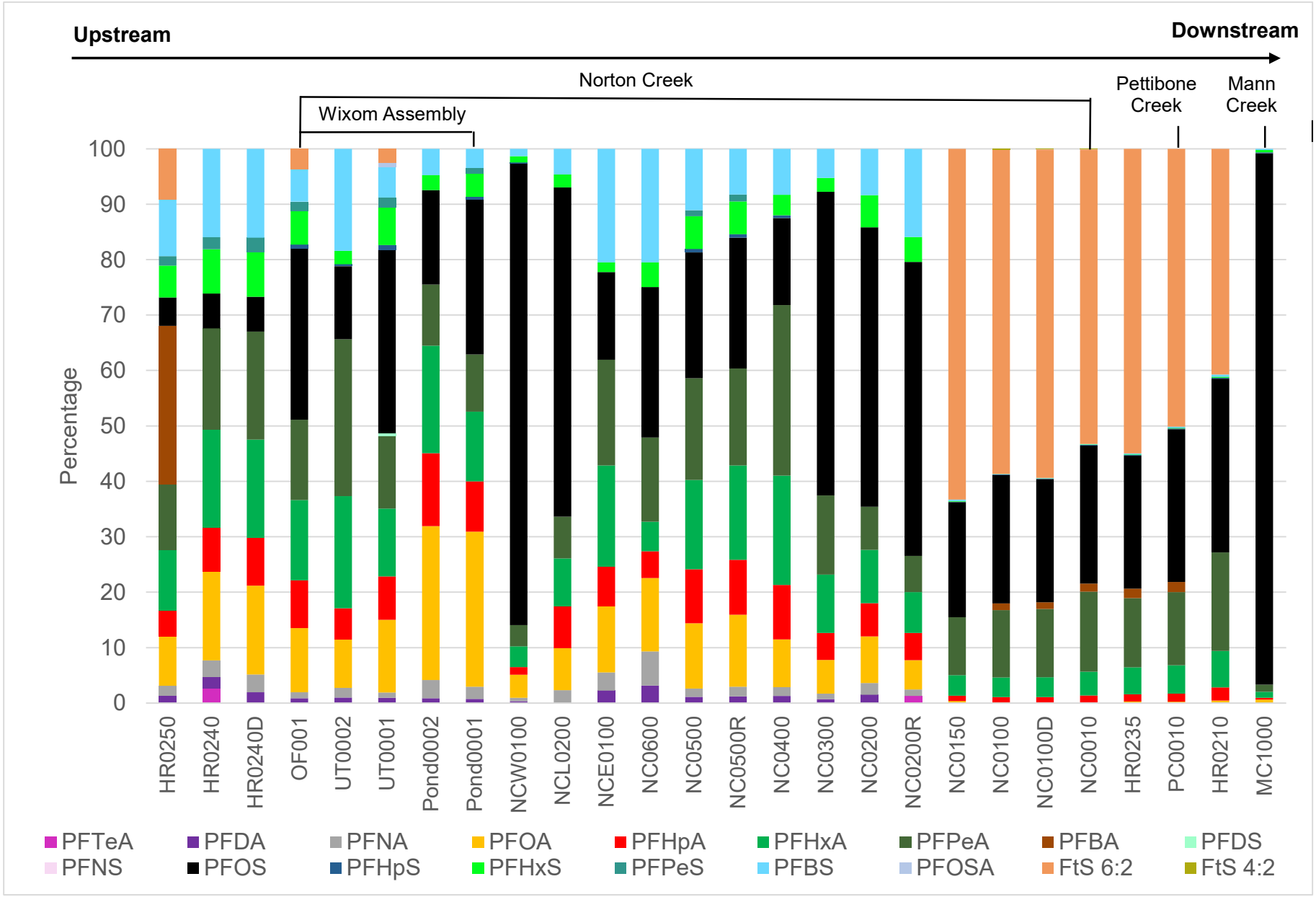

Figure 3. Percent composition of detected PFAS measured in surface water collected in the Huron River watershed August 30, 2018. A sample ID followed by the letter 'D' indicates a duplicate sample and 'R' indicates a replicate sample.

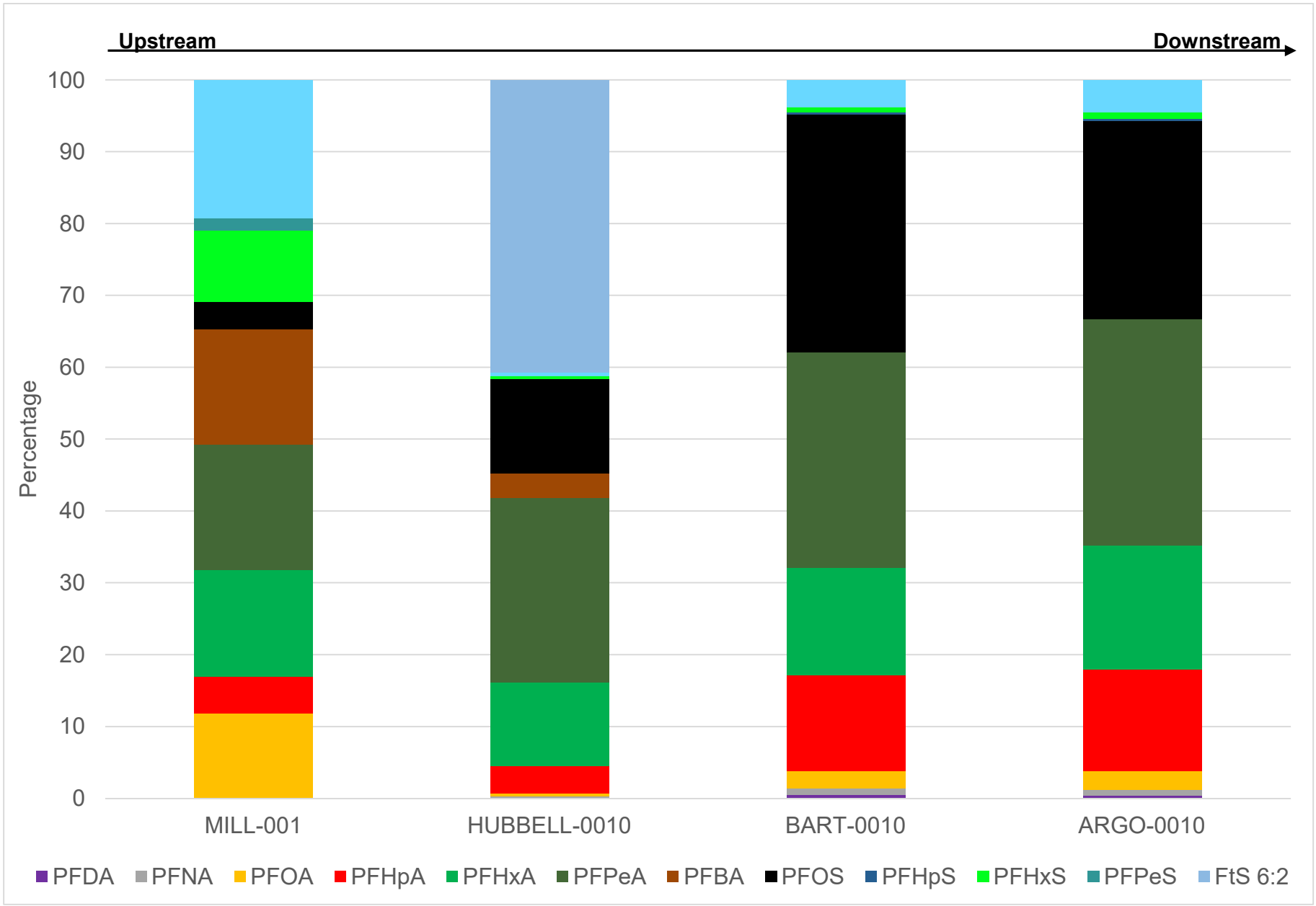

Figure 4. Percent composition of detected PFAS measured in surface water collected from the Milford Millpond (October 4, 2018), Hubbell Pond (October 2, 2018), Barton Pond (September 28, 2018) and Argo Pond (September 28, 2018). PFBS was left out of totals for September 28, 2018 because it did not meet laboratory QA/QC for samples on this date.

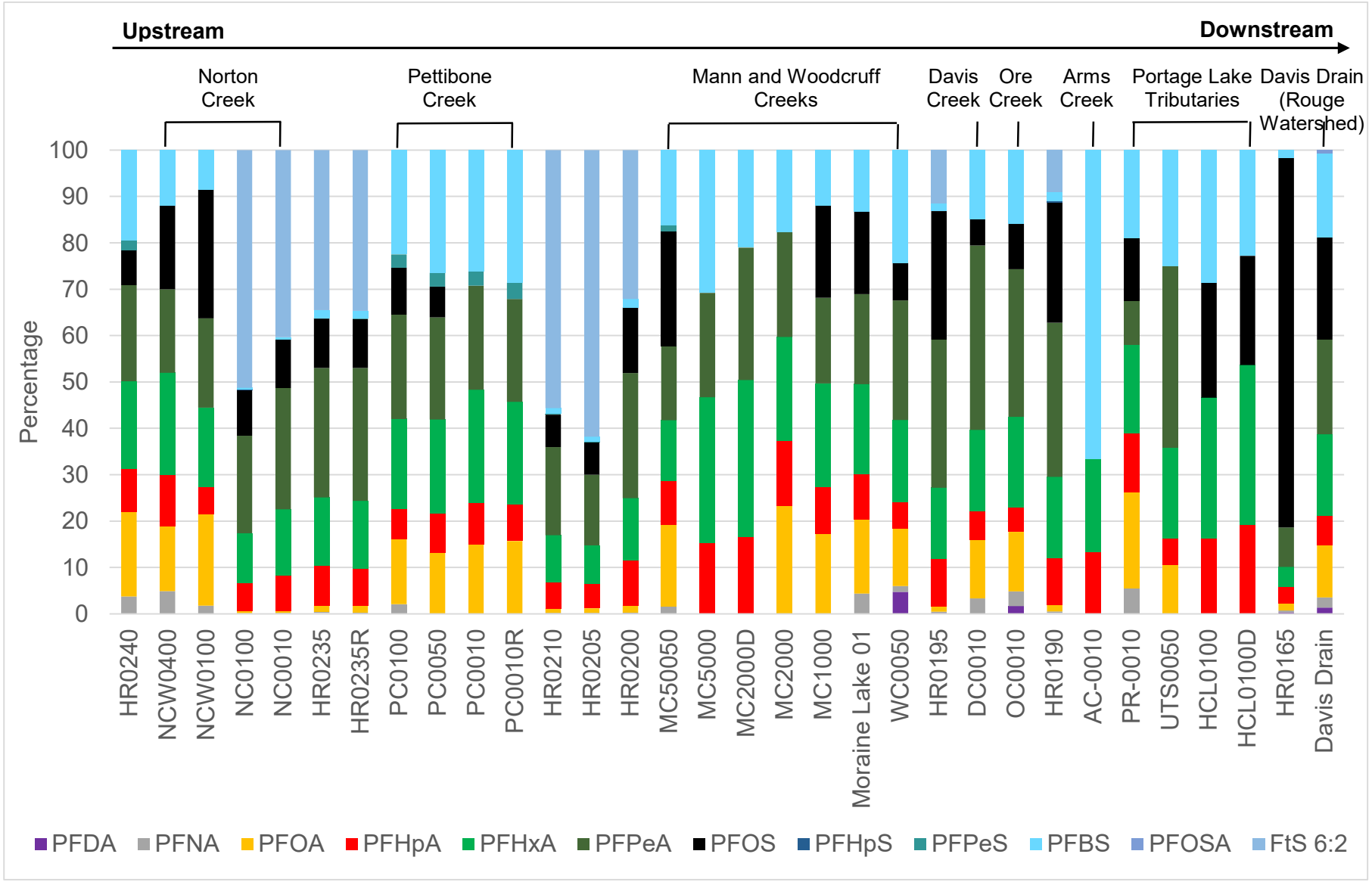

Figure 5. Percent composition of detected PFAS measured in surface water collected in the Huron River watershed (and one site in the Rouge River watershed; Davis Drain) October 29-30, 2018. A sample ID followed by the letter 'D' indicates a duplicate sample and 'R' indicates a replicate sample. PFBA and PFHxS were left out of totals because they did not meet laboratory QA/QC for multiple samples on this date.

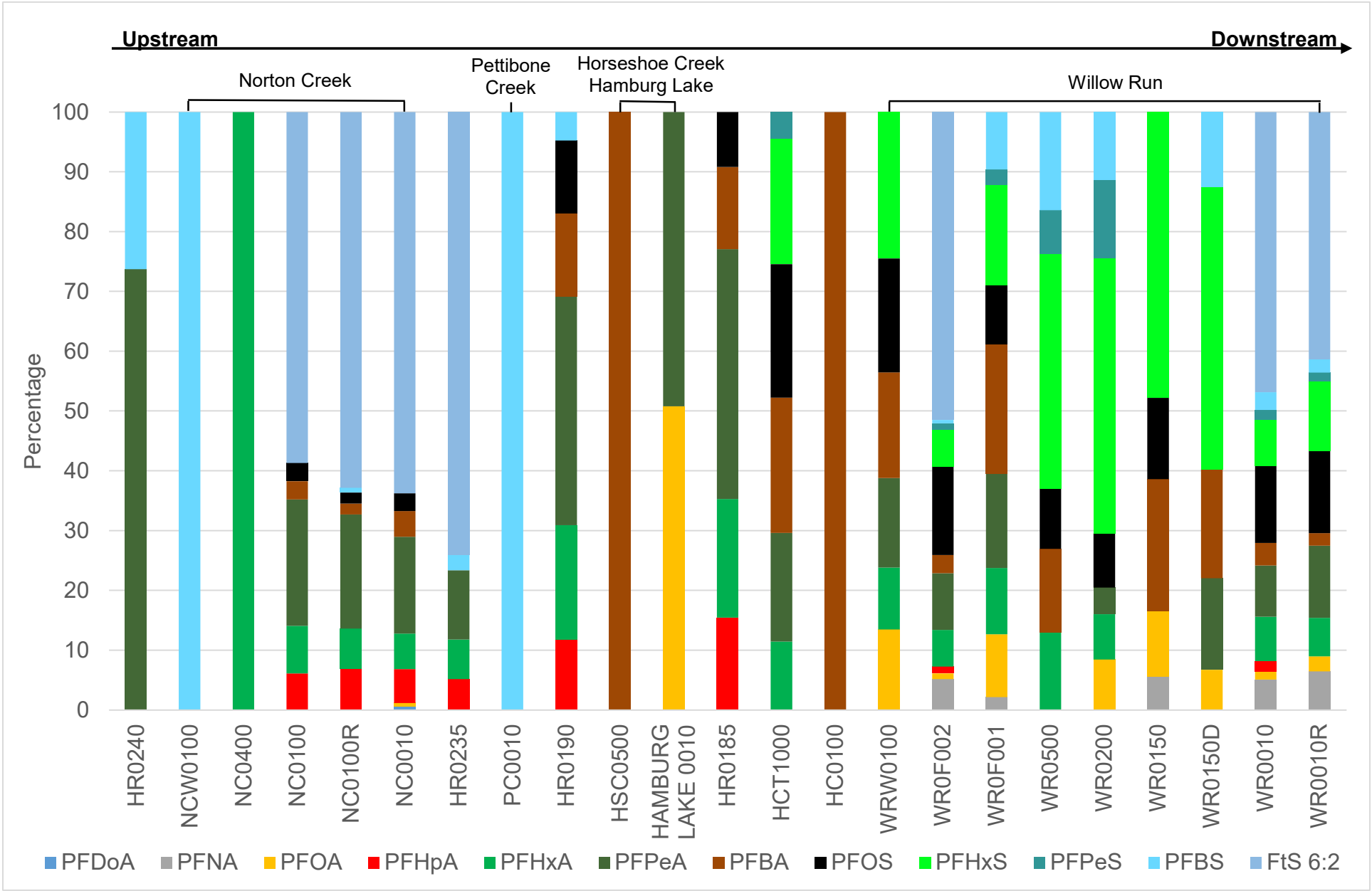

Figure 6. Percent composition of detected PFAS measured in surface water collected in the Huron River watershed April 29-30, 2019. A sample ID followed by the letter 'D' indicates a duplicate sample and 'R' indicates a replicate sample. The following samples were non-detect for all analytes and not included in figure: LST0050, HSC0600, HSC0400, HSC0300, HSC0300D, HSC0100, HSC0050, and NC0600.

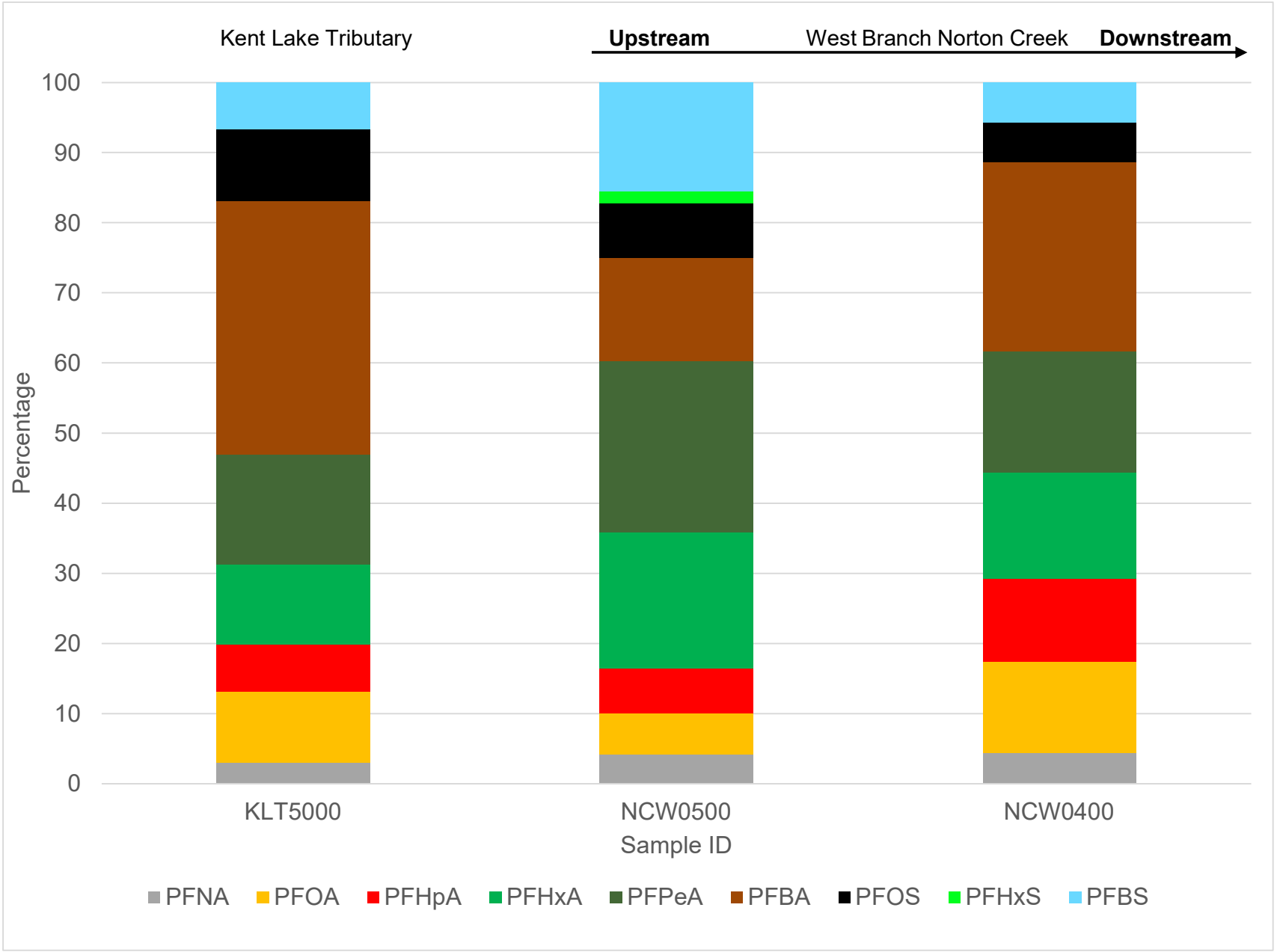

Figure 7. Percent composition of detected PFAS measured in surface water collected from a Kent Lake tributary (KLT5000), and two sites on the west branch of Norton Creek (NCW0500; NCW0400) in the Huron River watershed; August 21, 2019.

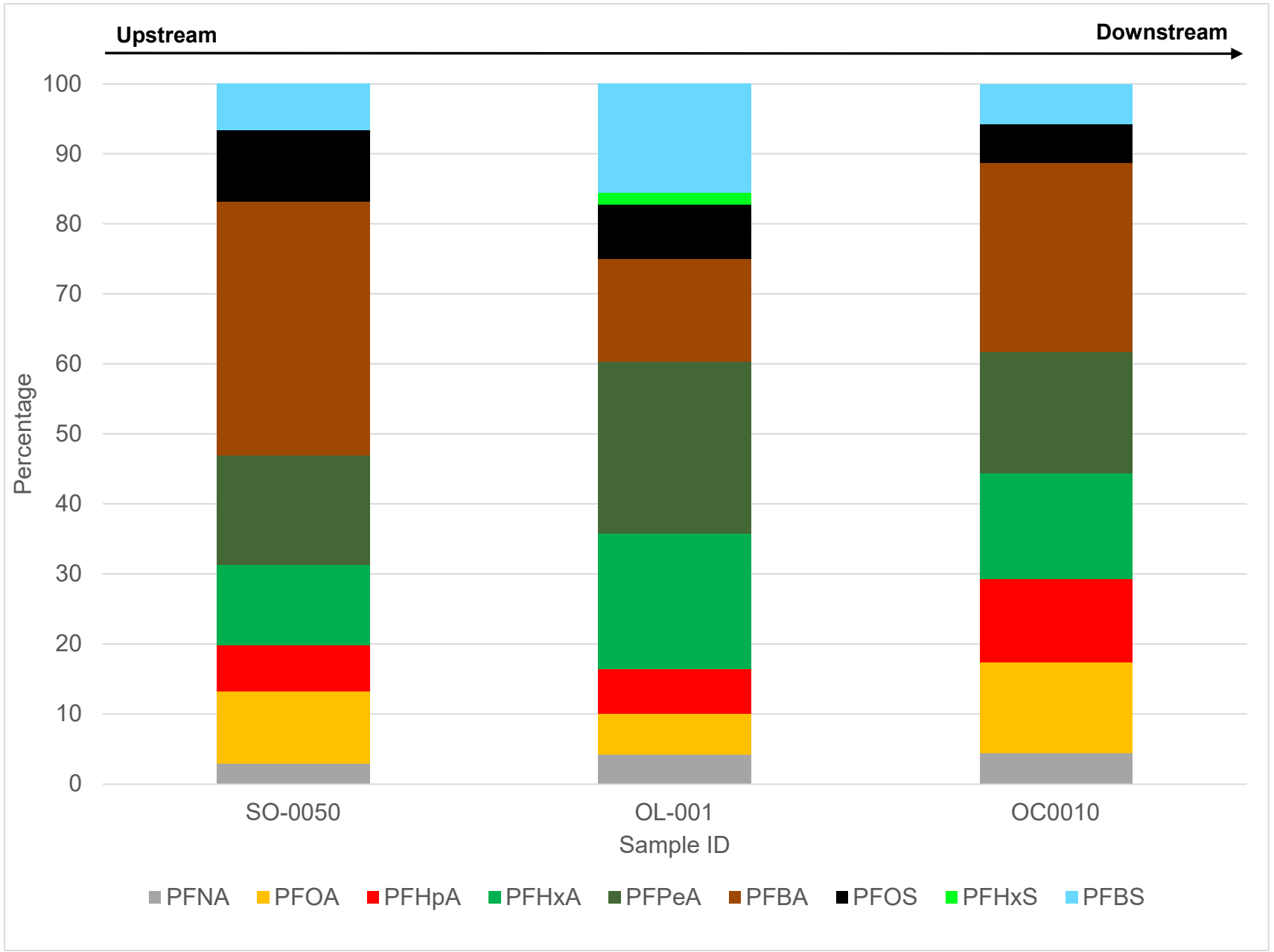

Figure 8. Percent composition of detected PFAS measured in surface water collected from South Ore Creek (SO-0050), Ore Lake (OL-001), and Ore Creek (OC0010) in the Huron River watershed; September 27, 2019.

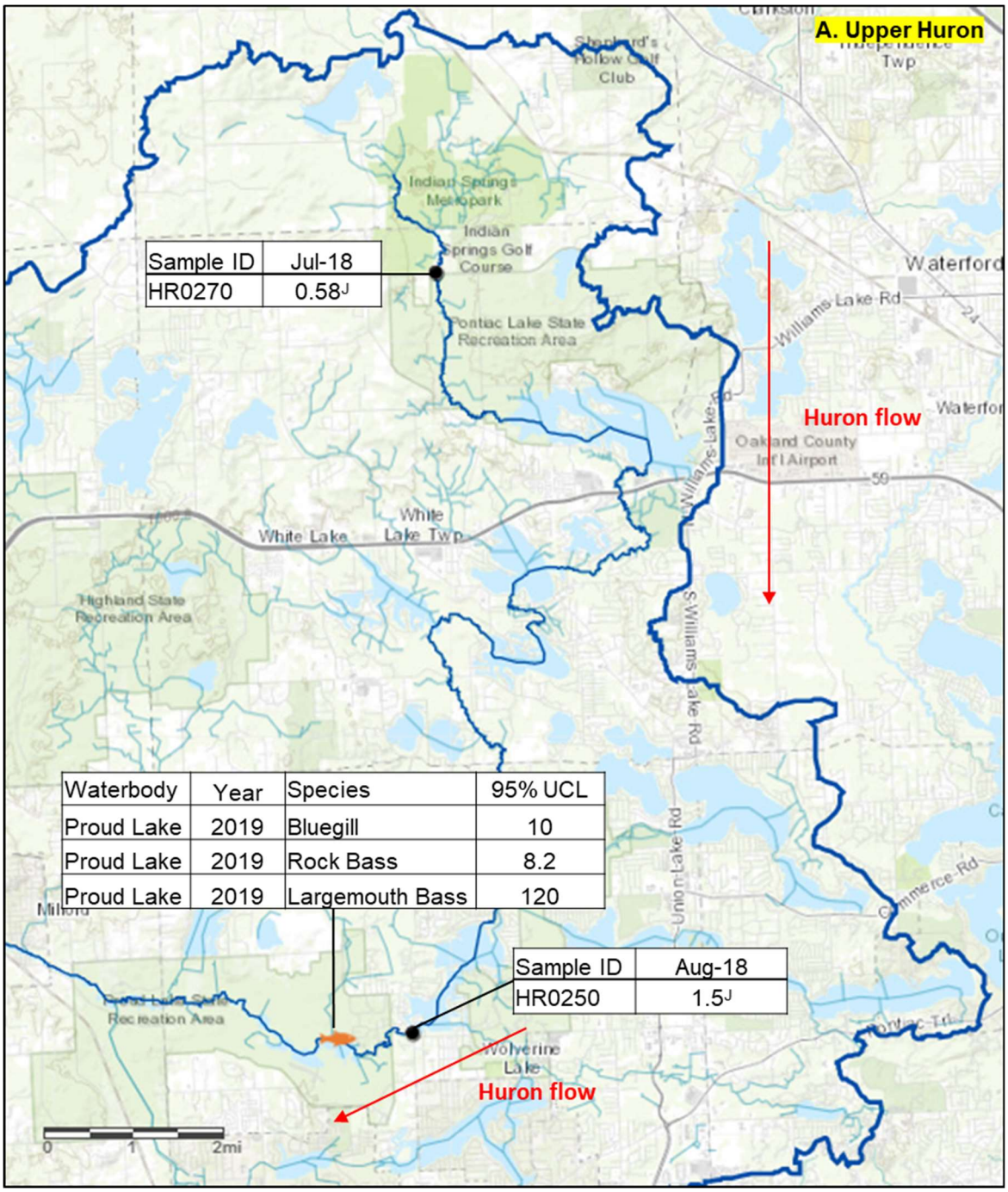

Figure 9. PFOS concentration results for the upper Huron River sampling sites (corresponds to inset A from Figure 1). Ambient surface water results (black circles) are shown as nanograms per liter (ng/L) for each date sampled. The 95% upper confidence limit (UCL) is reported as parts per billion (ppb) for fish tissue samples (orange fish icons). Concentrations with "J" indicate a concentration at a level that was above the method detection limit (MDL) but below the laboratory reporting limit (RL).

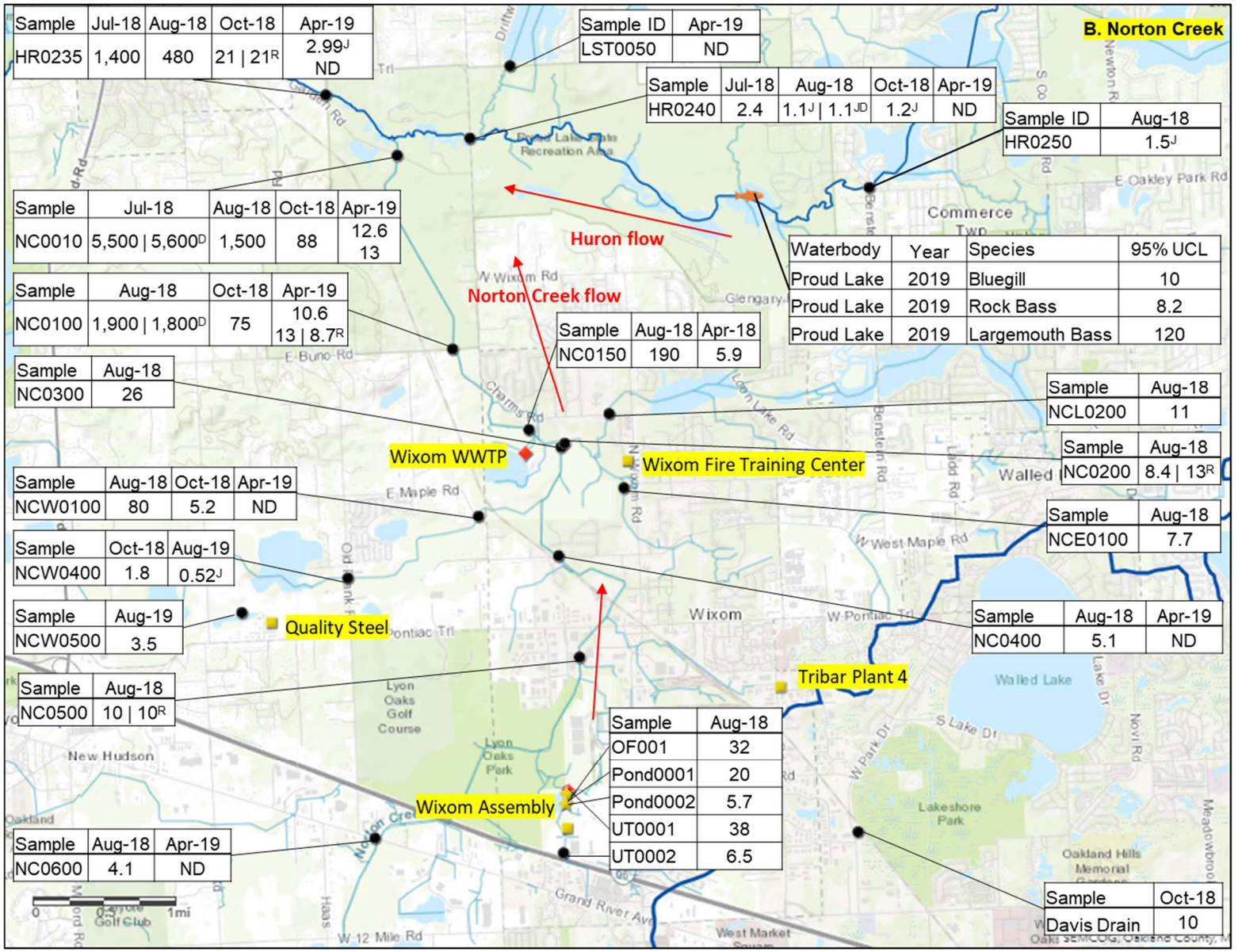

Figure 10. PFOS concentration results for the Norton Creek area (corresponds to inset B from Figure 1). Ambient surface water results (black circles), outfall samples (red diamonds), and site ponds (yellow stars) are shown as nanograms per liter (ng/L) for each date sampled. Concentrations with "J" indicate a concentration at a level that was above the method detection limit (MDL) but below the laboratory reporting limit (RL). Concentrations with a "D" indicate a duplicate and concentrations with an "R" indicate a replicate. Non-detects are reported as "ND."

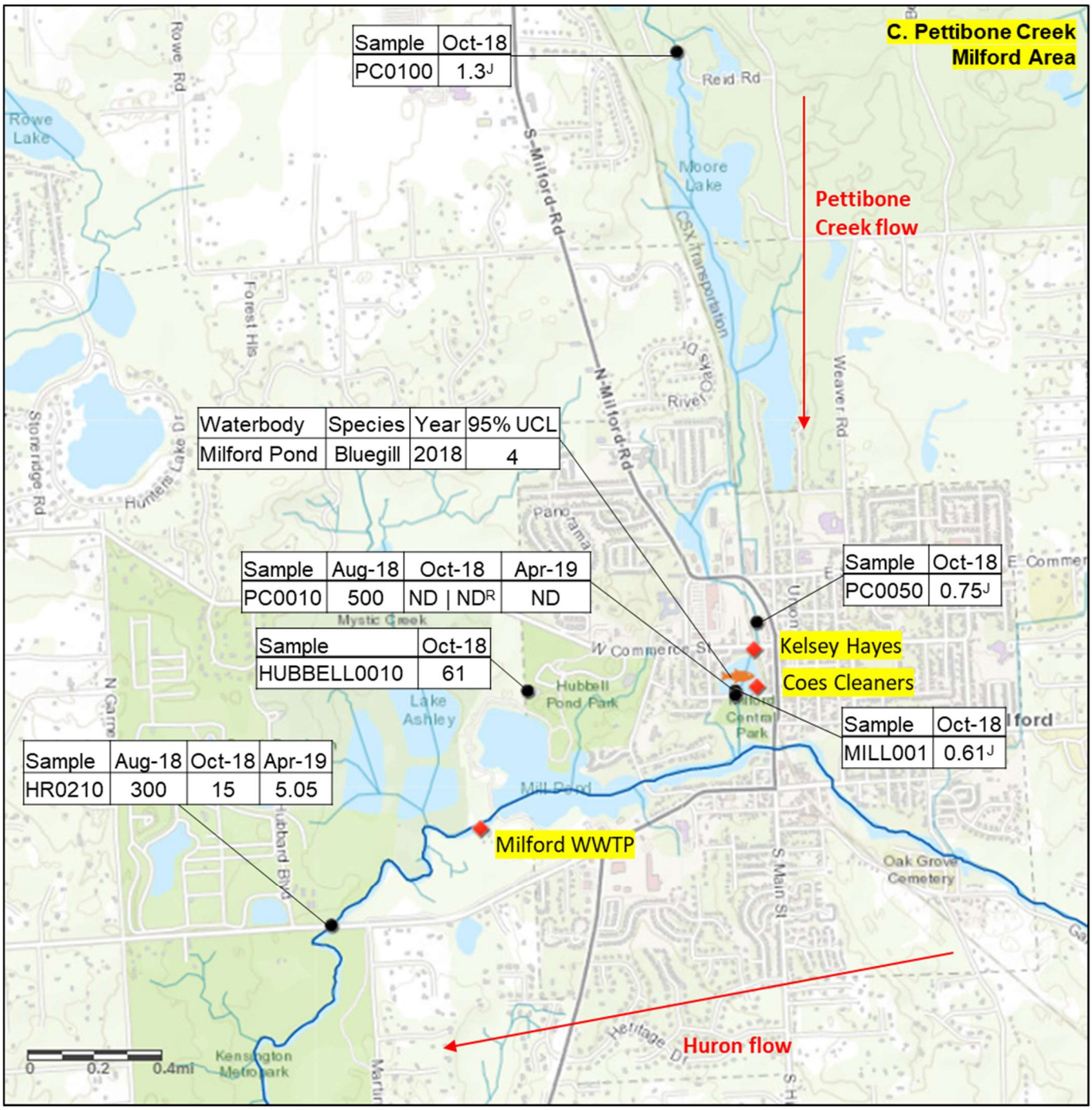

Figure 11. PFOS concentration results for the Pettibone Creek area (corresponds to inset C from Figure 1). Ambient surface water results (black circles), outfall samples (red diamonds), and site ponds (yellow stars) are shown as nanograms per liter (ng/L) for each date sampled. The 95% upper confidence limit (UCL) is reported as parts per billion (ppb) for fish tissue samples (orange fish icons). Concentrations with "J" indicate a concentration at a level that was above the method detection limit (MDL) but below the laboratory reporting limit (RL). Concentrations with a "D" indicate a duplicate and concentrations with an "R" indicate a replicate. Non-detects are reported as "ND."

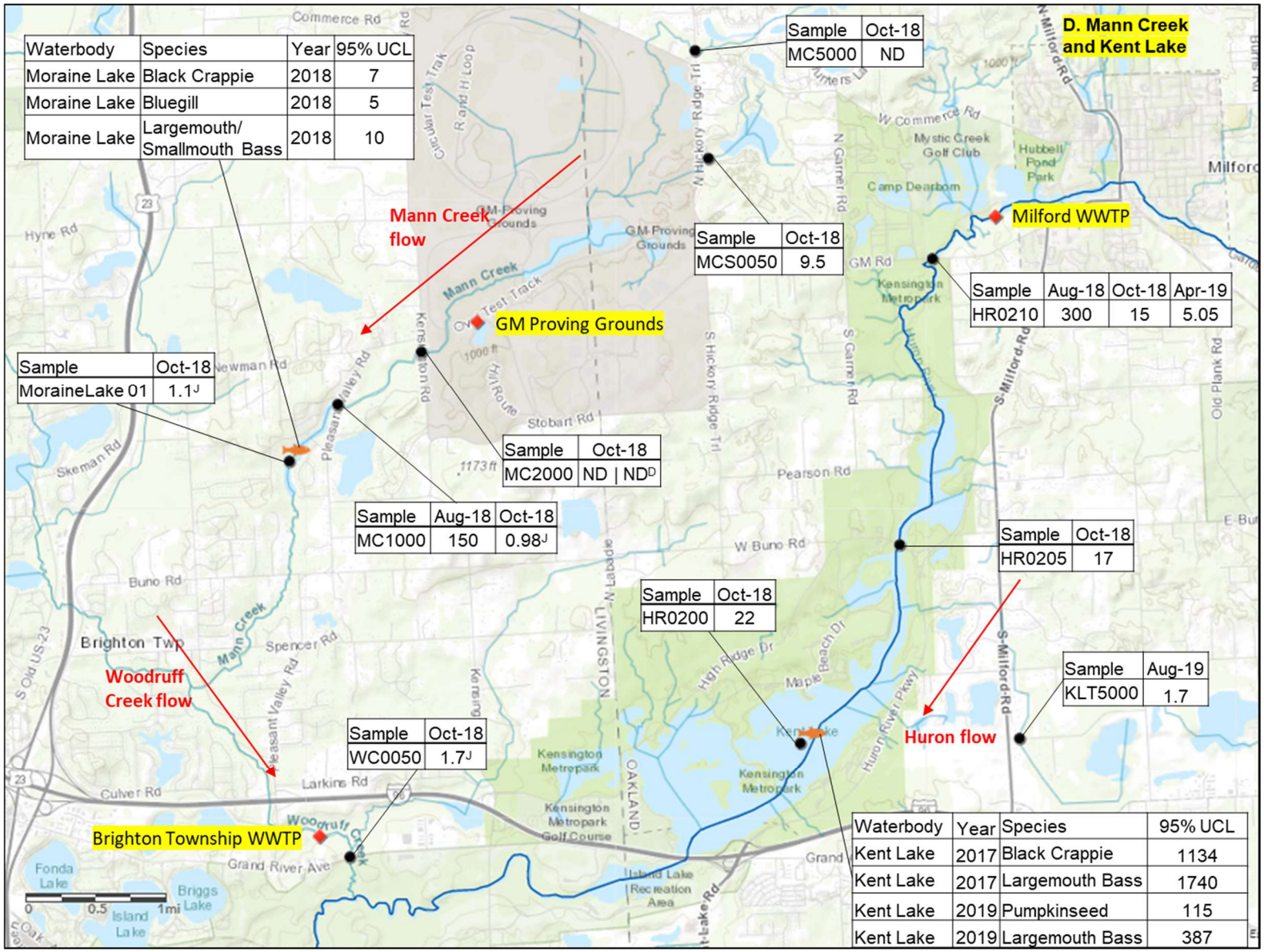

Figure 12. PFOS concentration results for the Mann Creek and Kent Lake area (corresponds to inset D from Figure 1). Ambient surface water results (black circles) are shown as nanograms per liter (ng/L) for each date sampled. The 95% upper confidence limit (UCL) is reported as parts per billion (ppb) for fish tissue samples (orange fish icons). Concentrations with "J" indicate a concentration at a level that was above the method detection limit (MDL) but below the laboratory reporting limit (RL). Concentrations with a "D" indicate a duplicate and concentrations with an "R" indicate a replicate. Non-detects are reported as "ND."

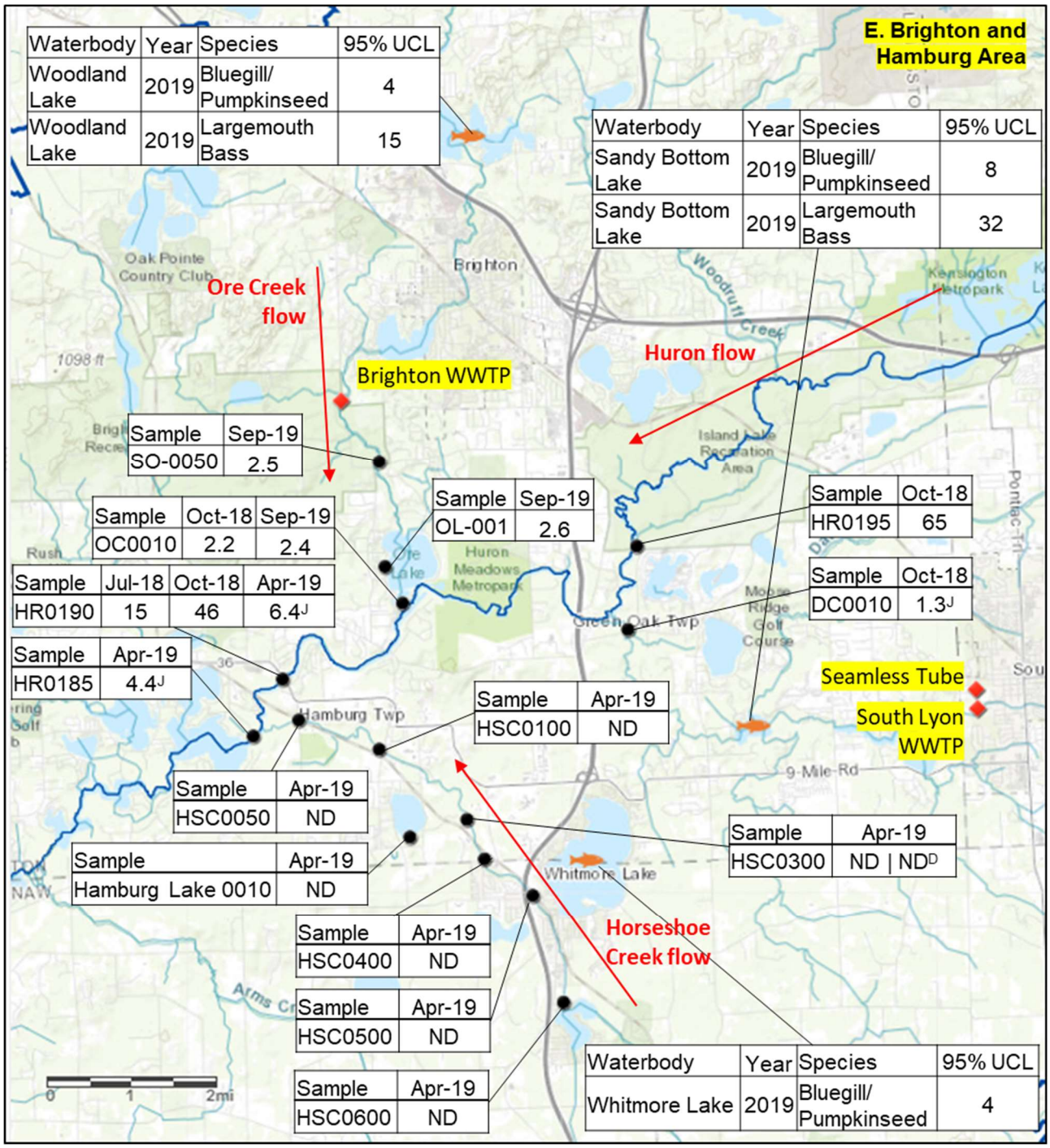

Figure 13. PFOS concentration results for the Horseshoe Creek area (corresponds to inset E from Figure 1). Ambient surface water results (black circles) are shown as nanograms per liter (ng/L) for each date sampled. Concentrations with "J" indicate a concentration at a level that was above the method detection limit (MDL) but below the laboratory reporting limit (RL). Concentrations with a "D" indicate a duplicate and concentrations with an "R" indicate a replicate. Non-detects are reported as "ND."

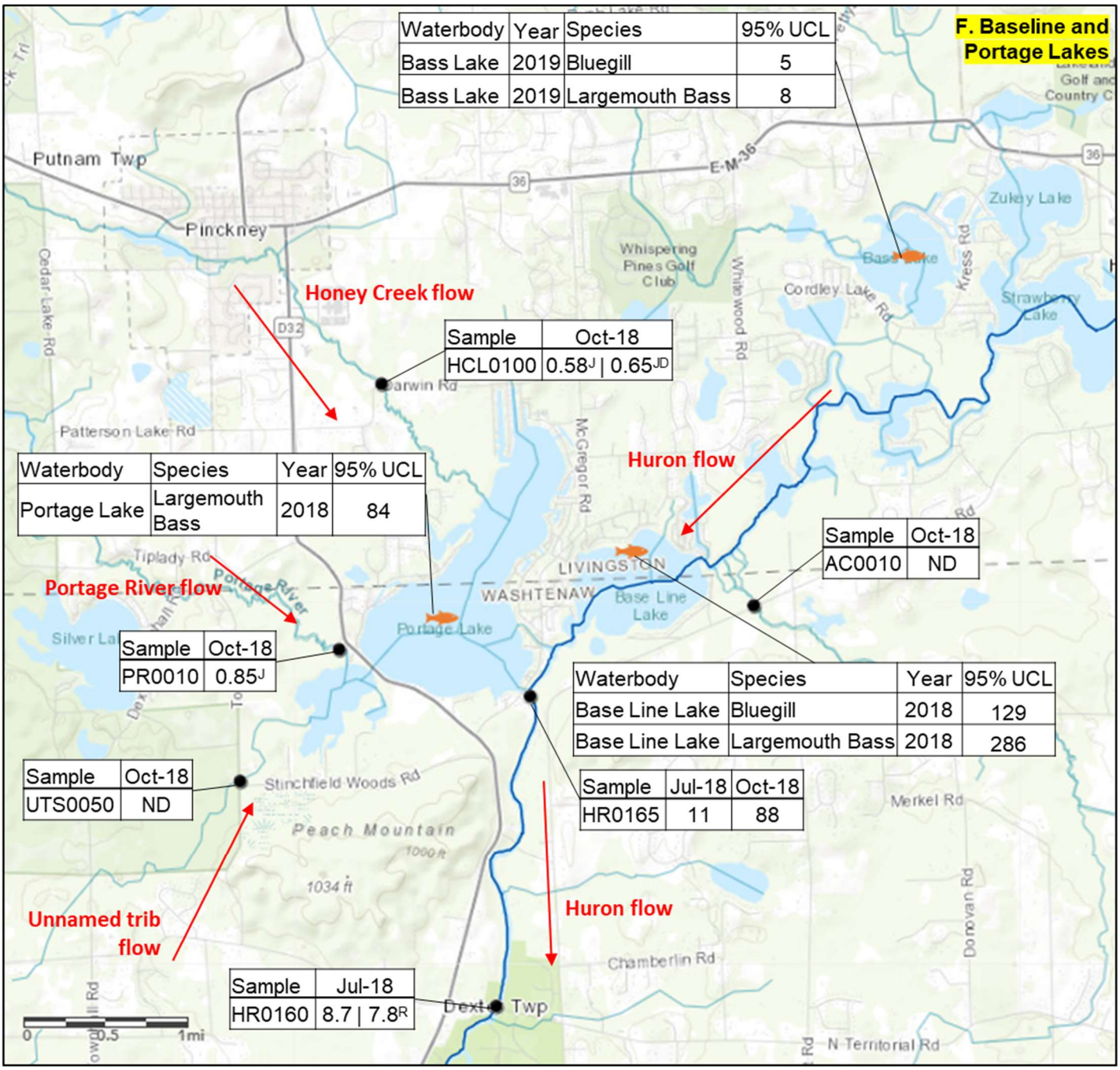

Figure 14. PFOS concentration results for the Base Line and Portage Lake area (corresponds to inset F from Figure 1). Ambient surface water results (black circles) are shown as nanograms per liter (ng/L) for each date sampled. The 95% upper confidence limit (UCL) is reported as parts per billion (ppb) for fish tissue samples (orange fish icons). Concentrations with "J" indicate a concentration at a level that was above the method detection limit (MDL) but below the laboratory reporting limit (RL). Concentrations with a "D" indicate a duplicate and concentrations with an "R" indicate a replicate. Non-detects are reported as "ND."

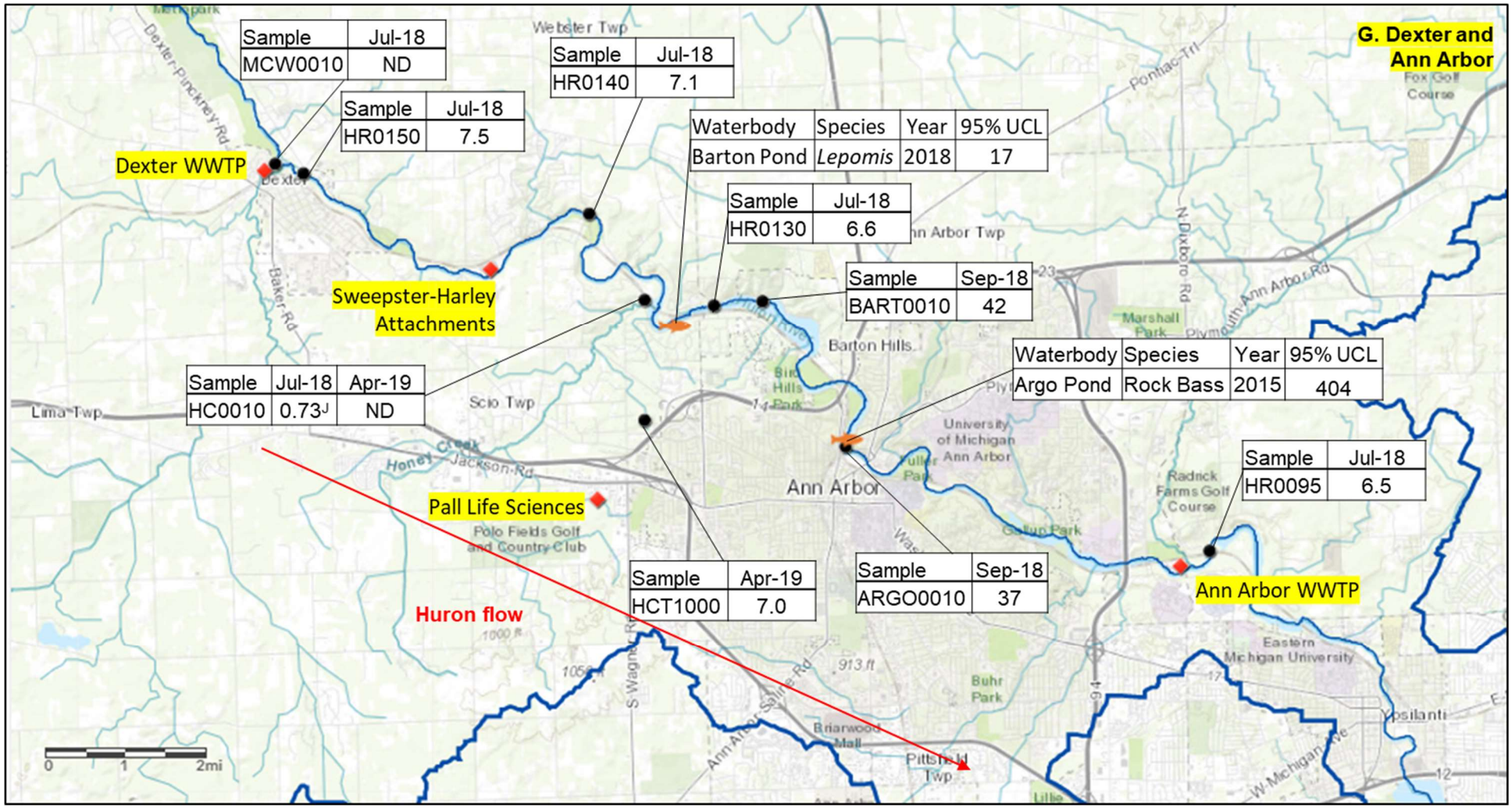

Figure 15. PFOS concentration results for the Huron River near Dexter and Ann Arbor (corresponds to inset G from Figure 1). Ambient surface water results (black circles) are shown as nanograms per liter (ng/L) for each date sampled. The 95% upper confidence limit (UCL) is reported as parts per billion (ppb) for fish tissue samples (orange fish icons). Concentrations with "J" indicate a concentration at a level that was above the method detection limit (MDL) but below the laboratory reporting limit (RL). Non-detects are reported as "ND."

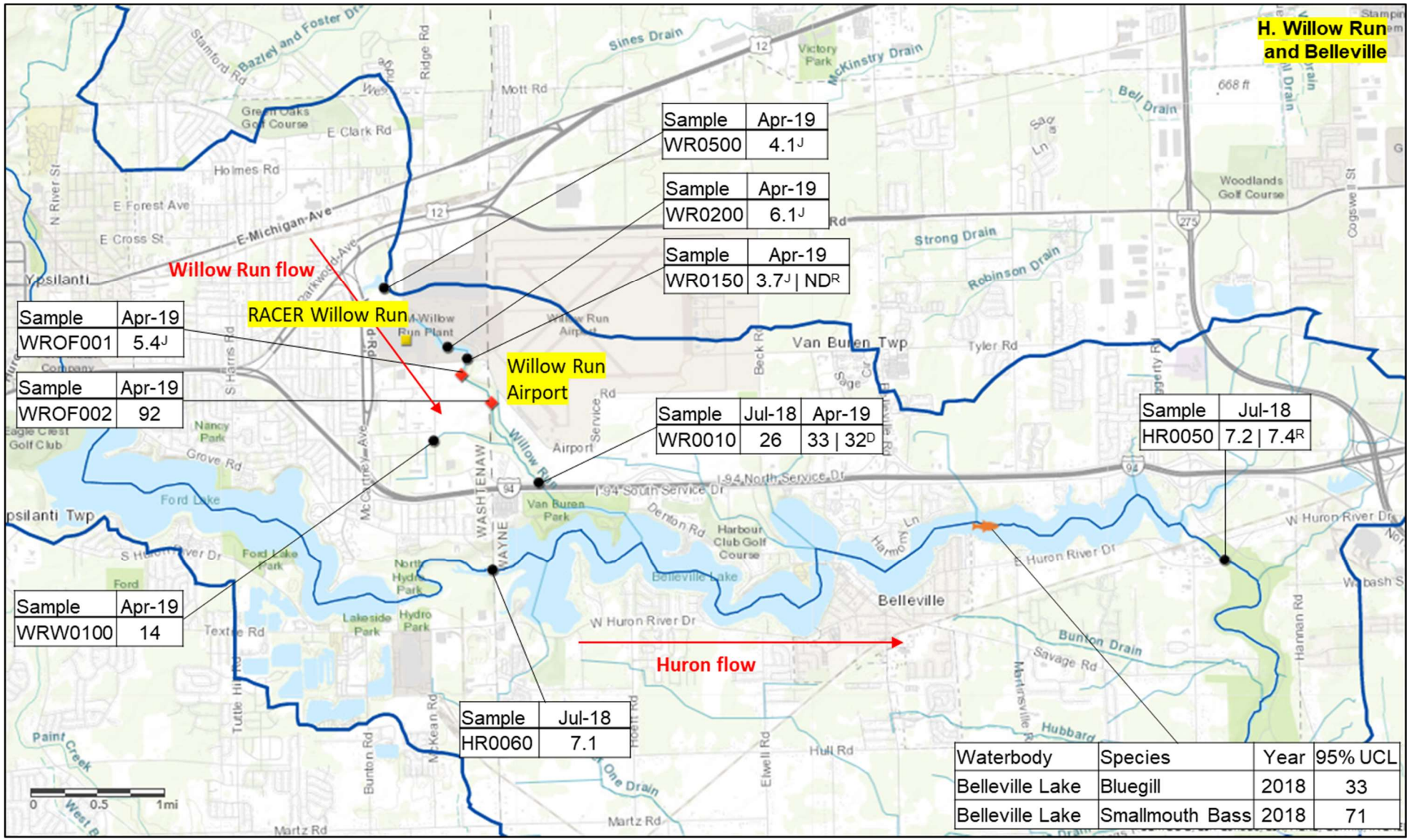

Figure 16. PFOS concentration results for the Huron River and Willow Run (corresponds to inset H from Figure 1). Ambient surface water results (black circles), and outfalls (red diamonds) are shown as nanograms per liter (ng/L) for each date sampled. The 95% upper confidence limit (UCL) is reported as parts per billion (ppb) for fish tissue samples (orange fish icons). Concentrations with "J" indicate a concentration at a level that was above the method detection limit (MDL) but below the laboratory reporting limit (RL). Concentrations with a "D" indicate a duplicate and concentrations with an "R" indicate a replicate. Non-detects are reported as "ND."

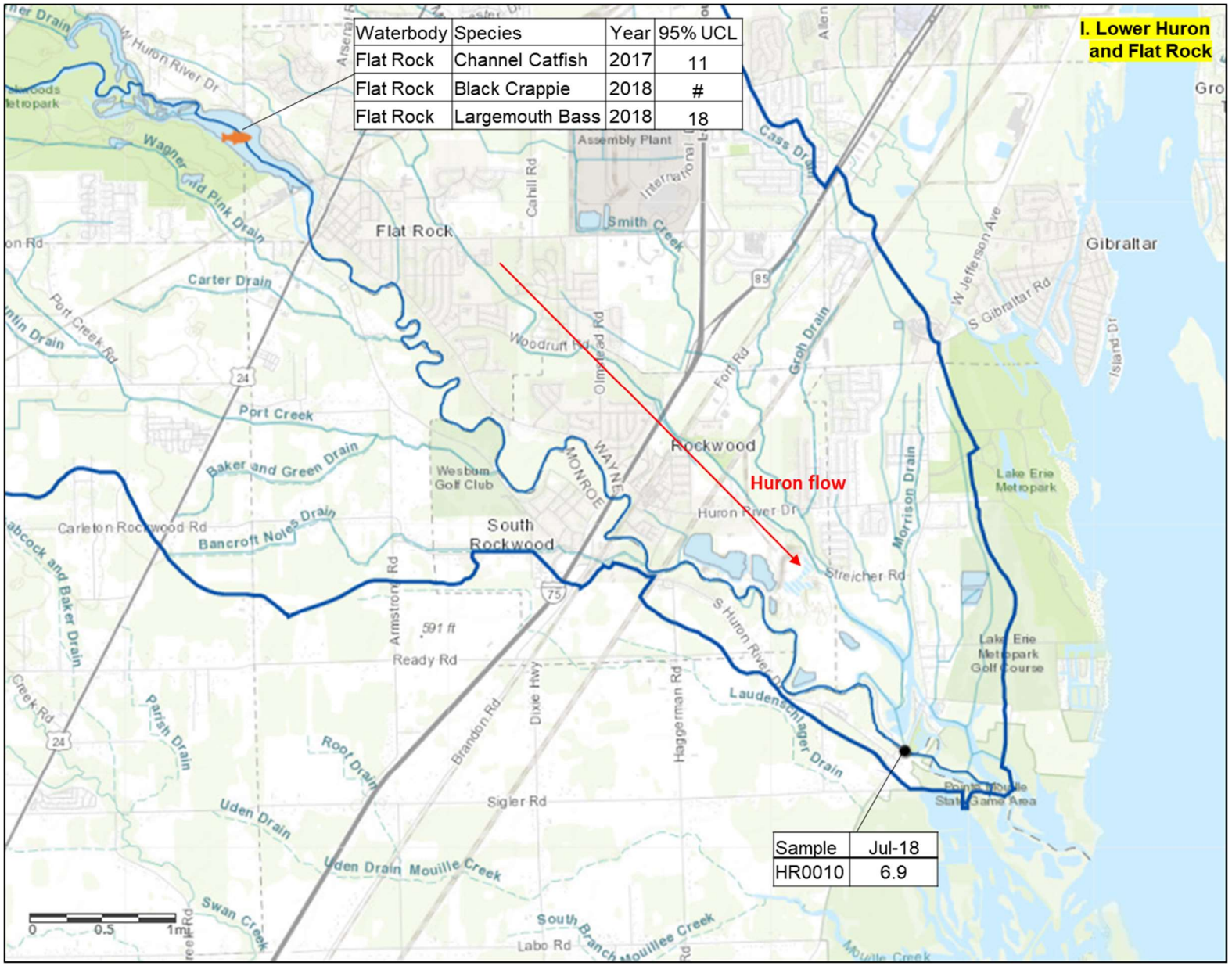

Figure 17. PFOS concentration results for the lower Huron River and Flat Rock (corresponds to inset I from Figure 1). Ambient surface water results (black circles) are shown as nanograms per liter (ng/L) for each date sampled. The 95% upper confidence limit (UCL) is reported as parts per billion (ppb) for fish tissue samples (orange fish icons). The sample size of Black Crappie was not large enough to calculate a 95% UCL (indicated by "#" on figure).