SUMMARY OF 2023 BROADSCAN SURVEY REPORT OF FINDINGS

2023 BROADSCAN SURVEY OVERVIEW

In 2022, ORSANCO's Monitoring Strategy Committee tasked staff with repeating the BroadScan Monitoring effort initiated in 2012. This effort was designed to profile current water quality conditions of ambient surface water at 3 locations on the Ohio River during two different flow conditions and sample for water quality parameters that are not routinely monitored through ORSANCO's core programs. This report will be provided to ORSANCO's Monitoring Strategy Committee and Technical Committee for use in determining whether additional water quality parameters should be considered for incorporation into ORSANCO's existing routine monitoring efforts. This project was funded through a USEPA grant. Analytical costs were approximately $35,000 of the project budget.

ORSANCO maintains Pollution Control Standards for the Ohio River which include 123 priority pollutant water quality criteria for the Ohio River. Many of these pollutants are not routinely monitored in the Ohio River. This list was used to determine whether additional water quality parameters should be added to ORSANCO's core routine monitoring programs. Staff conducted a review of current water quality parameters routinely analyzed and compared them to ambient water quality criteria listed in ORSANCO's 2019 Pollution Control Standards (PCS). Contaminant parameters were selected for the BroadScan Survey (BSS) assessment which did not have current data at reporting levels outlined in Section 3 of ORSANCO's 2019 Pollution Control standards.

ORSANCO's Bi-monthly, Clean Metals, Nutrients, Harmful Algal Bloom (HAB), and Contact Recreation programs conduct frequent monitoring and surface water assessments to provide background conditions of ambient waters for approximately 26 of the priority pollutants. However, several of the priority pollutants are not routinely monitored through ORSANCO core programs due to budget and resource limitations. Twenty three volatiles pollutants listed in the Pollution Control Standards (PCS) are screened for daily through the ORSANCO's Organics Detection System (ODS); however, since nearly all of the ODS monitoring stations are not state certified for many volatile pollutants, volatile pollutants were included in the 2023 BroadScan survey.

Similar to the 2012 BSS project, semi-volatiles, pesticides, PCB's, dioxin, radionuclides, asbestos, certain metals and inorganics were selected for the 2023 BroadScan Survey. PCB congeners and dibenzofurans (DBF's), including dioxin, were not part of the 2012 effort (cost prohibitive and a comprehensive study had been recently completed for those pollutants), but were included in the 2023 BroadScan Survey.

Forty PFAS analytes were added to the BSS to further data collection efforts and increase understanding of these contaminants of concern. PFAS pollutants are of high interest in the Ohio River Basin, but are not currently regulated in ambient surface waters under CWA 304(a), however, proposed regulations for select PFAS in ambient surface water are anticipated by the end of 2024.

Similar to the 2012 BSS, samples were collected at three sites to represent upper, middle and lower river sections during two different seasonal conditions. The same sites were sampled as in the 2012 BSS. Ohio River Miles (ORM) 0192.2 (upper river site), 0633.3 (middle river site), and 0912.0 (lower river site).

Analyses were performed by certified contract laboratories that ORSANCO frequently uses. Two rounds of sampling were used to try and capture a sampling event under higher flow conditions (Round 1) and an event under lower flow conditions (Round 2). The first round of BroadScan Survey was completed in May

2023; the second round was completed in September 2023. Round 1 sampling efforts were under higher flow conditions than round 2.

Fifteen different analytical methods were used to complete the BroadScan Survey with results provided for 95 out of 99 proposed priority pollutants tested for (94.9% complete).

Seventeen dibenzofurans (DBFs) and dioxin-like compounds (DLC) were included along with 2,3,7,8 TCDD (Dioxin). The additional DBF's were used to calculate a Toxic Equivalent (TEQ) value to 2,3,7,8 TCDD, which is the recommended dioxin determinative method under CWA 304(a) for ambient water quality criteria (WQC).

209 PCB congeners were included in this survey. PCB congeners were used rather than Aroclor groups because method sensitivity and detection levels are closer to the current water quality criteria. PCB congener concentrations were added within a congener classification group and congener groups were summarized to yield a total PCB concentration.

In total, 139 different pollutants were tested for (40 PFAS as pollutants of interest included) at three sites along the Ohio River to represent the upper, middle, and lower sections of the Ohio River. The full list of priority pollutants analyzed for can be found in Appendix A. In addition to these three sites, an equipment blank, a field blank, and a duplicate to one of the sample sites (0633 Round1, 0192 Round2) were collected and analyzed. In total, six samples were submitted to the laboratory for each of the two rounds of sample collection. Samples that could not be analyzed in house at the Pace Analytics Englewood Laboratory were subcontracted out to a certified partner laboratory. Estimated costs for BroadScan Survey analyses was roughly $35,000.

SAMPLING METHOD:

Because PFAS samples were also being collected, special handling and considerations were used to eliminate any potential cross contamination between sampler, equipment, containers, and sample. PFAS free approved materials were used in collection and processing of BSS samples.

All samples were collected using an Equal Discharge Increment (EDI) method. This method provides a representative cross-sectional composite sampling result. It is the preferred method for collecting surface water samples on fast moving water rivers (USGS, 2006) and was the sample collection method used in the prior BSS. Precise measurement of river flow, in cubic feet/second (CFS), was obtained by using an Acoustic Doppler Current Profiler (ADCP), which was used to determine the isokinetic (constant flow) midpoint of each of five vertical transects (each vertical transect represents 20% of total flow across bank) spanning from one bank to the opposite bank. Average flow conditions at sample site locations for each round are listed in the Table 1.

From the center point of the ambient water vertical transect, the sampling device (the "FISH") is attached with an interchangeable nozzle, selected based on current velocity conditions, to ensure that an isokinetic sample can be captured. a PFAS free sampling bag is attached to nozzle and lies inside the FISH. The FISH is lowered at a constant rate from the water surface to its bottom and back to the surface again to collect the sample.

The PFAS free sampling bag is removed from the FISH and its contents are transferred into the PFAS free Churn Splitter. Once all five vertical transect samples have been collected and added to the Churn Splitter, the Churn mixes samples until homogenized and composited.

Homogenized composite aliquots were portioned into appropriate sample containers, packaged for shipping, and transported to the certified laboratory for analyses. PFAS aliquots were taken prior to any other aliquots for analyses.

2023 BROADSCAN SURVEY ADCP FLOW

Sample Site ID	Sample Date	Sample Time	Avg Flow (CFS)
0192-1-R	5/16/2023	0920a	42,639
0192-1-FB	5/16/2023	0920a	42,639
0633-1-R	5/17/2023	0845a	111,567
0633-1-RD	5/17/2023	0845a	111,567
0912-1-EB	5/18/2023	0926a	174,613
0912-1-R	5/18/2023	0926a	174,613
0192-2-R	9/7/2023	0900a	12,286
0192-2-RD	9/7/2023	0900a	12,286
0912-2-R	9/13/2023	0900a	29,462
0912-2-FB	9/13/2023	0900a	29,462
0633-2-R	9/14/2023	1000a	44,168
0633-2-EB	9/14/2023	1000a	44,168

Table 1. Average flow readings(cfs) from ADCP measurements

QAQC ISSUES

Notable quality assurance/quality control (QA/QC) issues related to sample receipt and analyses for select parameters are indicated below.

Sampling for semi-volatiles by Method 8270C, there were no QAQC issues related to sample collection, extraction or analysis of samples. Internal lab controls regarding Laboratory Spike samples showed a few analytes outside recovery ranges.

One sample for PCB analysis was evaporated to dryness and couldn't be analyzed in Round 1. Fortunately, this sample was collected in duplicate, and the duplicate results for site 0633 were used for PCB determinations in Round 1. In Round 2, this same site 0633, sample 0633-2-R, was dropped in the laboratory and could not be analyzed. There was no PCB data for Round 2 for site 0633.

In Round 1, two samples arrived (0192-EB, 0192-R) for hexavalent chromium analysis exceeding the required temperature range (>4°C); these samples were analyzed at ORSANCO's request and the sample was flagged with the appropriate qualifier by the lab. This holding time exceedance was due to a delay in overnight shipping and ice melting, increasing the sample temperature beyond USEPA maximum allowable temperature for analysis. Additionally, hexavalent chromium samples were also diluted fivefold by the lab technician, which, in turn, raised the minimum detection limit. A non-detect (ND) was reported for all samples at a reporting level 5X higher; samples could not be reanalyzed undiluted.

Regarding hexavalent chromium samples in Round 2, each of the 6 samples had an H1 qualifier flag attached to it indicating that the analytical holding time was exceeded. An H3 qualifier indicates samples were analyzed anyway at ORSANCO's request despite holding time exceedance. Two samples, 0912-2EB and 0912-2R additionally had an H3 qualifier flag attached. The holding time issues were the result of the overnight delivery courier failing to deliver samples within the appropriate time frame.

In Round 1, samples collected for 8081 pesticide analyses were turbid and murky colored; the lab analyst made the decision to dilute samples 1:10 prior to analyses to ensure instrument integrity. However, samples collected were not anticipated to contain high levels of pesticides and the dilution factor increased reporting limits by 10x, so staff notified the lab to request re-analysis at full strength. Full strength analyses determined that no pesticides were detected in Round 1. One sample, 0912-2-R was diluted ten-fold for pesticide analysis in Round 2. No explanation was provided as to why sample was diluted. Dilution of sample subsequently increased the reporting limits by 10, so ND values reported are at levels ten times higher than other samples analyzed. Two volatile pollutants, acrolein (propenal) and acrylonitrile were not analyzed under 8260B and one semi-volatile analyte, 3,3 dichlorobenzidine, was not analyzed under 8270C. These pollutants were not in the laboratory's calibrated list of contaminants. This was consistent for both rounds of analyses. No result was provided for Bis-2-ethylhexyl phthalate because the laboratory could not provide certified results.

In Round 2, the laboratory did not provide combined radionuclide information for radium 226 & radium 228 as requested; staff was able to provide the calculated the combined concentration.

ANALYSIS OF NOTABLE RESULTS

The intent of this project was to provide screening of ambient water quality conditions for a variety of non-routinely monitored parameters to determine if additional parameters should be added to ORSANCO's routine monitoring programs. where possible, staff wanted to ensure that analyses conducted were at appropriate levels, so analytical methods were selected based on detection limit sensitivity and methods that ORSANCO's contract laboratory holds certifications for. A detailed Table of Results is attached in the Appendix. A summary table of those priority pollutants for which there were measurable values is shown in Table 2. at the end of this section.

Under Methods 8260B, 8270C, and 8081, no priority pollutant volatiles, semi-volatiles, or pesticides were detected in any samples at the laboratory's reporting level in either Round1 or Round 2. There were no QAQC issues related to sample collection.

Under method SM4500 Fl-, fluoride was not detected in any samples in Round 1, but was detected in samples 0192 an 0912 at roughly 0.30 mg/L Round 2. This was below the water quality criteria level for fluoride of 1 mg/L.

Chromium III was present at site 0912, with a detection of 5.7 ug/L in Round 1. This level was well below the HHC criteria of 74.1 ug/L for chromium III. In Round 2, chromium III was present at very low levels at each site; 0.0007 mg/L at site 0192, 0.0009 mg/L at site 0633, and 0.0011 mg/L at site 0912. These values are below the Water Quality Criteria of 0.0741 mg/L (74.1 ug/L).

In Round 1, hexavalent chromium was present at site 0912 in the amount of 0.0810 mg/L. This was slightly above water quality criteria of 0.0157 mg/L. In Round 2, hexavalent chromium was determined not present in any samples. However, these samples were flagged due to analysis outside the USEPA maximum holding time guidelines. Results may not be an accurate reflection of conditions at the time of sample collection. Note: Hexavalent chromium results may be biased (values under-reported) since samples exceeded USEPA holding times and were diluted prior to analysis.

Samples tested for radionuclides included combined radium 226 & 228, gross alpha, gross beta, and strontium-90.

Combined radium 226 & 228 was found at low levels in each sample in both rounds of sampling, including equipment blanks and field blanks. In Round 1, combined radium 226 & 228 measured values ranged from

1.199 pCi/L to 2.65 pCi/L at sample sites. Values did not exceed water quality criteria of 4 pCi/L. The highest measured value, at site 0912 measured 66.3% (2.65/4 pCi/L) of water quality criteria. For Round 2, combined radium 226 & 228 measured lower than Round 1, with the recorded the highest value for sample 0192-2-RD at 1.00 pCi/L, below the 4 pCi/L water quality standard for combined radium 226 & 228. Sample 0192-RD measured 25% of water quality standard for combined radium 226 & 228.

Round 1 results for gross alpha and gross beta radionuclides showed low level detections in each sample, including the equipment and field blanks (0.59 pCi/L for gross alpha and 0.47 pCi/L, 0.51 pCi/L for gross beta respectively). Site samples measured < 1pCi/L for gross alpha with reported values of 0.881pCi/L, 0.849 pCi/L (0192); 0.967 pCi/L (0912). For gross beta, results were slightly lower <0.6 pCi/L with measured values at 0.481 pCi/L (0192); 0.503 pCi/L and 0.561 pCi/L (0633) and 0.506 pCi/L (0912). In Round 2, the highest gross alpha value came from sample the field blank at 1.96 pCi/L. Site samples showed lower measured values, <1pCi/L, for gross alpha; 0.858 pCi/L (0192); 0.898 (0633); and 0.1910 pCi/L (0912). Gross beta results yielded higher measured values, < 3.3 pCi/L; 3.1 pCi/L and 1.41 pCi/L (0192); 2.93 pCi/L (0633); and 3.29 pCi/L (0912). Radionuclide values reported did not exceed the water quality criteria for gross alpha of 15 pCi/L or 50pCi/L for gross beta radionuclides.

Strontium-90 was tested and similarly, all samples were measured at less than 1pCi/L with Round 1 measured values slightly higher than observed than in Round 2. Site 0192 reported 0.788 pCi/L; 0633 had 0.922 pCi/L and its duplicate 0.805 pCi/L and site 0912 had 0.755 pCi/L. Round 2 had one detection at site 0192 with 0.039 pCi/L. The water quality criteria standard for strontium-90 is 8 pCi/L and none of the samples tested exceeded 8 pCi/L.

Samples were also collected for asbestos testing. Asbestos fibers were determined to be present in each sample at low levels in both rounds. The equipment blank and field blank also showed the presence of asbestos fibers at 0.18 MFL/L in Round1 and 0.42 MFL/L in Round 2. Results ranged from 1.05 MFL/L (0192 and 0633) and 2.11 MFL/L (0912) for each of the site samples. Similarly, in Round 2, asbestos was present at measured values of 2.11 MFL/L at sites 0633 and 0912 and 0.42 MFL/L at site 0192. The water quality criteria for asbestos is <7 million fibers. The highest measured value, 2.11 MFL/L, was about 30% of water quality standard for asbestos.

For PCBs, Method 1668A was used to evaluate each of the 209 PCB congeners instead of PCB Aroclor groups. Method 1668A is more sensitive and reporting limits are closer to water quality criteria levels. The sum of each of the PCB congeners was used to determine PCB concentration at each site location. Analytical reports sorted PCB congeners into their respective biphenyl groups. The sum of PCB congener groups provides the Total PCB concentration of in the sampled river water. A Summary of PCB data is found in Appendix B.

Both the field blank (0912-FB) and the equipment blank rinse (0912-EB) had traces for Total PCB's. 0912-2-EB exceeded the water quality criteria of 0.064 ng/L, but both the field blank and equipment blank were less than 10x the value found in the method blank (ND).

Low level total PCB concentrations were found at each site location analyzed. One site sample, 0633-1-R, was unable to be analyzed; a lab error in sample processing resulted in loss of sample. Four out of the five samples tested showed detections just above the water quality criteria level of 0.064 ng/L, but under 1ppb in Round 1. These were sites 0192-1-R (0.736 ng/L), Site 0633-1-RD (0.575 ng/L) and Site 0912-1-R (0.600 ng/L). Quality control blanks, 0912-1-EB and 0192-1-FB showed the presence of PCB at estimated concentrations of 0.0717 ng/L and 0.0489 ng/L, with the field blank below the water quality criteria value of 0.064 ng/L.

In Round 2, sample 0-633-2-R was dropped in the laboratory and could not be analyzed due to loss of sample and thus no PCB results. For the remaining five sites, total PCB concentration exceeded the PCS HHC water quality criteria, the equipment blank (0633-2-EB) and the field blank (0912-2-FB) indicated the presence of trace PCBs (0.336 ng/L and 0.0857 ng/L respectively), above the established water quality criteria levels for total PCB's. The field blank, 0912-2-FB was an estimated concentration as its measured value was above the laboratory's detection limit and reporting limit and flagged with a "J" qualifier.

The laboratory provided toxin equivalency factors (TEF) and toxin equivalents (TEQ) as part of dibenzofuran analyses. TEF's are based on using 2,3,7,8 TCDD as the reference index chemical. The dioxin TEF is used to determine dioxin toxin equivalents (TEQ), frequently used for CERCLA and RCRA sites (2013) and is considered an appropriate method for calculating total dioxin in surface water quality samples.

2,3,7,8 TCDD was not present in any of the samples in Round 1 or Round 2. However, in both Rounds 1 and 2, OCDD was the only dioxin like compound (DLC) for which a TEF was calculated; this was for site 0912.

For the TEQ/TEF calculations, the analytical laboratory used TEQ Calculations from Ohio Wastewater administrative Code 3745-2-07(C)(1-4), using an OCDD TEF of 0.00001 for the results. The 2005 USEPA TEF for OCDD is 0.0003 pg/L. This factor was used by staff in determining water quality criteria for dioxin and dioxin like compounds (DLCs) in the Summary Table for Dibenzofurans in Appendix C.

Using the 2005 USEPA TEQ recommendations, the 2,3,7,8 TCDD TEQ for this site for Round 1 was (170*0.0003)= 0.051 pg/L, which is greater than the 0.005 pg/L for 2,3,7,8 TCDD TEQ. Round 2 showed similar results with the DLC OCDD present in sample 0912 at 0.033 pg/L (110 X 0.0003), also exceeding the water quality criteria for TCDD of 0.005 pg/L.

Regarding individual DBF contaminants, a few of the other individual dibenzofurans tested for had detections, however, these detections were all flagged with a "J" as their presence was positively identified and an estimated concentration provided. For TEQ calculations, "J" flagged estimations are not part of the TEQ calculation.

Table 2. shows each pollutant that was detected at or above the laboratory's minimum reporting level in at least one site per round of sampling. Measured values that are shaded in RED indicate those samples where the reported value exceeds current water quality criteria standards. "**ND**" is used to designate results where pollutant tested was confirmed not present. "NS" indicates no sample results available. Areas shaded out are used to show where no sample was collected.

Table 2. Summary of Measurable Results	SAMPLE SITE LOCATION ID										
Pollutants Found	WQC	0192	>WQC	0192 DUP	>WQC	0633	>WQC	0633 DUP	>WQC	0912	>WQC
Hexavalent Chromium*	0.0157 mg/L										
Round 1		ND	No			ND	No	ND	No	0.0810	Yes
Round 2		ND	No	ND	No	ND	No			ND	No
Chromium III	0.0741 mg/L										
Round 1		ND	No			ND	No	ND		5.7	No
Round 2		0.0007	No	ND	No	0.0009				0.0011	No
PCB's	0.064 ng/L										
Round 1		0.7360	Yes			NS	---	0.575	Yes	0.6000	Yes
Round 2		0.7340	Yes	0.7310	Yes	NS	---			0.3360	Yes
Arsenic, total recoverable	0.010 mg/L										
Round 1		ND	No			ND	No	ND	No	ND	No
Round 2		0.0010	No	0.0011	No	0.0012	No			0.0014	No
Arsenic, dissolved	0.010 mg/L										
Round 1		ND	No			ND	No	ND	No	ND	No
Round 2		0.0011	No	0.0011	No	0.0010	No			0.0011	No
Fluoride	1 mg/L										
Round 1		ND	No			ND	No	ND	NO	ND	No
Round 2		0.31	No	0.22	No	ND	No			0.30	No
Asbestos	7 MFL										
Round 1		1.05	No			1.05	No	2.11	No	2.11	No
Round 2		0.42	No	0.42	No	2.11	No			2.11	No
2,3,7,8 TCDD TEQ	0.005 pg/L										
Round 1		ND	No			ND	No	ND	No	0.051	Yes
Round 2		ND	No	ND	No	ND	No			0.033	Yes
Gross Alpha	15 pCi/L										
Round 1		0.8810	No			0.8490	No	0.7840	No	0.9670	No
Round 2		-0.4760	No	0.8580	No	0.8980	No			0.1910	No
Gross Beta	50 pCi/L										
Round 1		0.4810	No			0.5030	No	0.5610	No	0.5060	No
Round 2		3.100	No	1.41	No	2.93	No			3.29	No
Radium 226 & 228	4 pCi/L										
Round 1		1.199	No			2.134	No	1.920	No	2.650	No
Round 2		0.428	No	1.0010	No	0.7810	No			0.1470	No
Strontium 90	8 pCi/L										
Round 1		0.788	No			0.922	No	0.805	No	0.755	No
Round 2		0.390	No	-0.103	No	-0.118	No			-0.237	No

PFAS ANALYSIS

The 2023 BroadScan survey included testing for 40 PFAS analytes using draft method 1633. PFAS samples were collected at the same three sites, 0192, 0633, and 0912 representing the upper, middle and lower reaches of the Ohio River.

The objective for acquiring PFAS data was to increase understanding of concentration levels in the ambient waters of the Ohio River and the BroadScan Survey provided the opportunity to acquire more data and information relating to PFAS compounds and Ohio River water quality.

Samples were contracted out to the same certified laboratory that ORSANCO had previously used for PFAS studies. The newer method, USEPA 1633, contained an expanded PFAS parameter list. This method was in final draft stage at the time of analyses, but has now been approved (January 2024) by the USEPA for surface water (and other non-potable) testing.

To date, no final ruling on ambient water quality criteria for PFAS analytes has been issued. However, the final ruling for PFAS in finished water has been released with PFOA and PFOS finished water quality criteria of 4 ng/L. HFPO-DA, PFNA, and PFHxS were set at 10 ng/L. A Hazard Index (HI) of 1 has also been established for PFAS mixtures in finished water (at least two of named PFAS must be present; HFPO-DA, PFNA, PFHxS and PFBS). An HI formula has been established to evaluate the Hazard Index of PFAS pollutants in finished water.

ORSANCO's BSS Field team used Equal Discharge Increment (EDI), a constant flow based methodology to collect samples for PFAS analysis. This is the recommended sampling protocol, developed and used by the United States Geological Survey (USGS). It is the preferred method for dynamic river systems such as the Ohio River. Five transect samples, spanning bank to bank, were collected and composited; once homogenized, aliquots were portioned out in 500mL HDPE (PFAS free) bottles and preserved on ice until receipt by analytical laboratory. PFAS samples were the first samples partitioned out from the homogenous composite, using "clean hands, dirty hands" technique under USEPA method 1669 (USEPA, 1996).

Non-detect data were reported by the laboratory as numeric values using the specific compound detection limit (DL) with a "U" qualifier flag to indicate that the PFAS analyte was not detected.

The analytical laboratory indicated the presence of an analyte (detection) where its value was at or above the DL and below the minimum level of quantitation (LOQ) reporting level by stating the reported value and including a "J" flag qualifier to indicate that the value was an approximate, estimated concentration but is a positive qualitative identification. "J" flags indicate that the false (+) rate is <1% and considered a true positive.

The table below summarizes the presence of PFAS pollutants found at each of the sample sites. For each round of sample collection, duplicate samples (from one of the three sample sites) were collected and analyzed. Duplicate samples are represented as DUP after Sample ID. For each sampling event, one field blank and one equipment blank was submitted as field QAQC samples. For the 2023 BroadScan Survey, neither the equipment blank nor the field blank showed the presence of any PFAS compounds in either round, indicating that the likelihood of contamination in the field, due to equipment and/or sampling issues was negligent.

Results shaded in RED indicate quantifiable detections at, or above the established laboratory minimum LOQ. PFAS analytes reported by the laboratory as not detected are designated with "ND" in this table for simplicity. Qualified data with "J" flags are presented to show the presence of that PFAS pollutant, with an

estimated approximate concentration. Detailed PFAS information can be found in the detailed Table of Analytical Results in the table 3. below.

2023 BSS PFAS RESULTS

Table 3. PFAS Results	SITE LOCATION ID									
PFAS ANALYTE	0192 ng/L		0192 DUP ng/L		0633 ng/L		0633 DUP ng/L		0912 ng/L	
PFBA										
Round 1	1.65	J			1.85	J	2.02	J	2.87	J
Round 2	3.76	J	3.77	J	3.33	J		J	3.17	J
PFPeA										
Round 1	0.819	J			1.02	J	1.03	J	1.17	J
Round 2	1.83	J	1.81	J	3.22				3.08	J
PFPHxA										
Round 1	0.795	J			1.42	J	1.33	J	ND	
Round 2	2.07		2.17		2.86				3.03	
PFHpA										
Round 1	ND				ND		ND		ND	
Round 2	1.37	J	1.39	J	1.44	J			1.65	
PFOA										
Round 1	2.63				2.20		2.27		2.43	
Round 2	5.60		5.06		6.12				5.49	
PFNA										
Round 1	ND				ND		ND		0.516	J
Round 2	0.614	J	0.638	J	0.663	J			0.673	J
PFDA										
Round 1	ND				ND		ND		ND	
Round 2	ND		ND		ND				0.262	J
PFBS										
Round 1	1.04	J			1.20	J	1.32	J	1.62	
Round 2	4.05		4.17		3.15				2.93	
PFHxS										
Round 1	ND				0.577	J	0.395	J	ND	
Round 2	1.16	J	0.968	J	0.692	J		J	0.685	J
PFOS										
Round 1	1.14	J			1.50	J	1.38	J	1.43	J
Round 2	3.12		2.62		2.54				2.36	
HFPO-DA (Gen X)										
Round 1	ND				1.09	J	0.777	J	ND	
Round 2	7.65		8.40		2.39	J			1.49	J

All PFAS contaminants reported present in the ambient water samples were at very low levels and reported in parts per trillion concentration (ng/L) when quantifiable. Some PFAS compounds were found to be present, in slightly higher amounts, but at very low levels, in Round 2.

Comparing PFAS results from Rounds 1 and 2, PFOA and PFBS were the only PFAS analytes detected at or above the LOQ in both rounds from at least one site in a measurable amount. PFOA was detected at all three sampling locations (0192, 0633, 0912) at low levels, ranging from 2.20 ng/L to 2.6 ng/L. PFOA was the only PFAS analyte detected in reportable, low level quantities in both rounds. PFBS (considered the "replacement" chemical for PFOS) was detected at reportable levels at site 0912 with 1.62 ng/L present in

the first round of sampling and at all three sites at reportable levels in round 2 with 2.93 ng/L (0912); 3.15 ng/L (0633); and 4.05 ng/L & 4.17 ng/L (0192).

During the second round of BSS sampling, in addition to PFOA and PFBS, five other PFAS analytes were present at or above the laboratory level of quantitation (LOQ) in at least one of the sampled sites: HFPO-DA, PFHpA, PFHxA, PFPeA, and PFOS. PFHxA and PFOS were found at each of the sites at or above their LOQ.

HFPO-DA (GenX) was found at one site (0192) at or above its LOQ in Round 2. Both the original sample and its duplicate at site (0192) had the highest reported concentrations of 7.65 and 8.40 ng/L, respectively, with the HFPO-DA LOQ at 6.45 ng/L. These were the highest reported individual analyte PFAS concentrations for either round of sampling. The presence of HFPO-DA was detected and qualitatively identified at sites 0633 and 0912.

1.65 ng/L of PFHpA was present at site 0912 (just above the LOQ of 1.61 ng/L); other sites indicated the presence of this compound with an estimated concentration.

***Conclusion*:**

The objective of this project was to collect and analyze representative samples, under ambient conditions, to determine if those Priority Pollutants listed in the 2019 Revision of ORSANCO's Pollution Control Standards for Discharges to the Ohio River (Chapter 3, Water Quality Control Criteria) which are not routinely examined through ORSANCO's Core monitoring programs, should be considered for inclusion based, in part, on results from the 2023 BroadScan Survey. This project is a repeat of the BroadScan Survey completed in 2013. Recommendation(s) to ORSANCO's Monitoring Strategy Subcommittee will be provided for consideration.

Additionally, 40 PFAS pollutants were also tested for in the 2023 BroadScan survey in order to expand ORSANCO's data collection efforts on these persistent, synthetic chemicals of concern.

Two rounds of sampling occurred to try and capture effects from two different seasonal conditions. The May 2023 sampling event (Round 1) was representative of higher flow conditions and the September 2023 (Round 2) was representative of lower flow conditions.

Nearly all of the priority pollutant analytes ORSANCO does not routinely monitor for that were tested for in the 2023 BroadScan Survey were not present in the two rounds of sampling at sites representing the upper (ORM 0192) middle (ORM 0633) and lower (ORM 0912) sections of the Ohio River.

Semi-volatile, volatile, pesticide, or 2,3,7,8-TCDD (dioxin) Priority Pollutants were not detected in any samples in either Round 1 or Round 2. This accounted for about 84.8% of pollutants reported back as not detected (ND) based on the laboratory's reporting levels. While dioxin was not detected in any samples in either rounds, the TCDD TEQ was found just above the water quality criteria (when calculated based on USEPA TEF) in both rounds. Dioxin determinations based on TEQ is the preferred method of dioxin contamination in surface waters.

For the remaining Priority Pollutants, reportable detections were observed at, at least one site in either of two sampling rounds. Table 1. in the Results Section summarizes BSS pollutants that had at least one reportable detection for at least one sampling site.

Total recoverable and dissolved arsenic, total silver, and chromium III were present in very low amounts. While arsenic and chromium III are screened for under the clean metals monitoring program, the analytical method currently used has a higher reporting level than the water quality criteria standard, so these metals were included to ensure that current monitoring methods strategies are sufficient. Similarly, total silver was not present in any of the samples collected. Current monitoring of these metals under the Clean Metals program appears sufficient at this time.

Fluoride, an inorganic ion, was not found at any sites in Round 1 of sampling and at very low levels (<0.33 mg/L) in upper and lower river samples in Round 2 sampling. Reported values were about 30% of the 1 mg/L water quality standard for fluoride.

Hexavalent chromium (chromium 6) was found in one lower river sample in Round 1 at 0.0810 mg/L, just *above* the water quality criteria of 0.0157 mg/L. However, results may have been potentially compromised and biased due to holding time exceedances and in both rounds of

sampling. Round 1 samples were also diluted by 5x. Hexavalent chromium is most commonly produced through industrial processes and is considered more hazardous than the naturally occurring chromium III. Chromium III is currently monitored through the Clean Metals program.

Asbestos fibers were present in all samples including equipment and field blanks. Blanks contained much lower counts of fibers than samples and samples ranged from 1-2 MFL of sample. The highest value, 2.11 MFL at site 0912, was appx 28% of the water quality standard of 7 MFL.

The radionuclides group includes gross alpha, gross beta, Radium 226 & Radium 228 (combined) and strontium-90.

All radionuclide pollutants were present in low level quantities, but none exceeded respective water quality criteria. The highest gross alpha radioactivity was <1 pCi/L, 6% of the water quality standard. The highest gross beta activity was at 3.29 pCi/L was just 6% of the water quality standard of 50 pCi/L. Combined radium 226 & 228 showed similar results, under the water quality criteria of 4pCi/L, however, Round 1 sampling indicated that one sample yielded a result of 2.65 pCi/L, which was roughly 66.3% of the water quality standard for combined radium 226 & 228. Strontium-90 had reported results of <1pCi/L, below the water quality criteria of 8 pCi/L.

PCB's were consistently found at low levels at all sites (<1 ng/L), but just above the water quality standard. PCB's are considered known persistent synthetic legacy pollutants, with a long half life and are an important factor in determining fish consumption advisories. ORSANCO PCB data has not been updated (prior to the BSS Survey) for more than a decade and used a different sampling protocol (high volume sampling at fixed locations) to determine relative concentrations of PCB's in ambient waters.

Finally, data was collected for informational purposes for forty PFAS pollutants using method 1633 (draft at the time of analysis). PFOA and PFBS were the most common PFAS present with measurable detections in both rounds. The presence of nine additional PFAS were identified as present with low, estimated quantities.

Recommendations:

Staff recommends that the priority pollutants analyzed in the 2023 BSS that are not currently routinely monitored for, and, which have a measured value at or above the minimum reporting level be considered by the Monitoring Strategy Committee for inclusion into ORSANCO's core routine monitoring programs. Table 1. (Results Section) shows the list of pollutants present at measurable levels. A list of those pollutants by analytical method used and approximate analytical costs for Bi-monthly inclusion (based on 2022 BSS contract) are found in Table 4. below:

Table 4: Estimated Analytical Costs for Additional Parameters to ORSANCO Routine Programs

QUANTITY	ANALYTICAL METHOD	POLLUTANT PARAMETER DESCRIPTION	COST	TOTAL COST
6	SM3500 CR-B	Hexavalent Chromium (CR VI)	$25.00	$150.00
6	SM 4500 F-C	Fluoride by ISE	$18.00	$108.00
6	EPA 1668B	PCB'S (209 Congeners)	$810.00	$4,860.00
6	EPA 1613B	2,3,7,8 TCDD (Dioxin) +16	$700.00	$4,200.00
6	EPA 900.0	Gross Alpha/Beta radionuclides	$50.00	$300.00
6	EPA 903.1	Radium 226	$90.00	$540.00
6	EPA 904.0	Radium 228	$90.00	$540.00
6	Eichrom SR	Strontium-90 Total Gross	$90.00	$540.00
6	Transmission Electron Microscopy	Asbestos	$250.00	$1,500.00
6		Environmental Impact Fee	$12.00	$72.00
6		Sample disposal	$3.00	$18.00
		PACE Analytical Estimated Costs	**$2,138.00**	**$12,828.00**
	BATTELLE NORWELL MA LABORATORY			
6	METHOD 1633 PFAS BY ISO-DIL	PFAS BY ISO-DIL (40) PFAS	$445.00	$2,670.00
		Total Estimated Analytical Costs	**$2,583.00**	**$15,498.00**

Based on an every other month (bi-monthly) sampling schedule. Estimates do not include additional program costs such as staff time, shipping, QAQC field samples or travel expenses.

References

1) Pollution Control Standards, ORSANCO, 2019

2)USGS Manual, Techniques for Water Resource Investigations, 2006, United States Geological Survey

3) Recommended Toxicity Equivalence Factors (TEFs) for Human Health Risk Assessments of 2,3,7,8Tetrachlorodibenzo-p-dioxin and Dioxin-Like Compounds, EPA/100/R 10/005 | December 2010, https://www.epa.gov/sites/default/files/2013-09/documents/tefs-for-dioxin-epa-00-r-10-005-final.pdf

APPENDICES

Appendix A: Table of Priority Pollutants and Laboratory Criteria

Appendix B: Summary of PCB Data

Appendix C: Summary of Dibenzofuran Data

Appendix D: Detailed Table of Results (Separate attachment as Excel Spreadsheet)

Appx A	PRIORITY POLLUTANT LIST					
METHOD	ANALYTE/TEST PARAMETER	LAB PQL	UNITS	PCS WQC	UNITS	MEETS PCS*
8260B	Acrolein (Propenal)	NA	ug/L	190	ug/L	NA
8260B	Acrylonitrile (2-Propenenitrile)	NA	ug/L	0.051	ug/L	NA
8260B	Benzene	1.00	ug/L	2.2	ug/L	NO
8260B	Bromoform	1.00	ug/L	4.3	ug/L	NO
8260B	Carbon Tetrachloride	1.00	ug/L	0.23	ug/L	YES
8260B	Chlorobenzene	1.00	ug/L	130	ug/L	YES
8260B	Chlorodibromomethane (DBCM)	1.00	ug/L	0.4	ug/L	NO
8260B	Chloroform (TCM)	1.00	ug/L	5.7	ug/L	YES
8260B	Dichlorobromomethane (BDCM)	1.00	ug/L	0.55	ug/L	NO
8260B	Ethylbenzene	1.00	ug/L	530	ug/L	YES
8260B	Hexachlorobutadiene	1.00	ug/L	0.44	ug/L	NO
8260B	Methyl Bromide (Bromomethane)	1.00	ug/L	47	ug/L	YES
8260B	Methylene Chloride	1.00	ug/L	4.6	ug/L	YES
8260B	Tetrachloroethylene	1.00	ug/L	0.69	ug/L	NO
8260B	Toluene	1.00	ug/L	1300	ug/L	YES
8260B	Trichloroethylene	1.00	ug/L	2.5	ug/L	YES
8260B	*Vinyl Chloride	1.00	ug/L	0.025	ug/L	NO
8260B	1,1,2,2-Tetrachloroethane	1.00	ug/L	0.17	ug/L	NO
8260B	1,1,2-Trichloroethane	1.00	ug/L	0.59	ug/L	NO
8260B	1,1-Dichloroethylene	1.00	ug/L	330	ug/L	YES
8260B	1,2,4-Trichlorobenzene	1.00	ug/L	35	ug/L	YES
8260B	1,2-Dichlorobenzene	1.00	ug/L	420	ug/L	YES
8260B	1,2-Dichloroethane	1.00	ug/L	0.38	ug/L	NO
8260B	1,2-Dichloropropane	1.00	ug/L	0.5	ug/L	NO
8260B	1,2-Trans-Dichloroethylene	1.00	ug/L	140	ug/L	YES
8260B	1,3-Dichlorobenzene	1.00	ug/L	320	ug/L	YES
8260B	1,3-Dichloropropene	1.00	ug/L	0.34	ug/L	NO
8260B	1,4-Dichlorobenzene	1.00	ug/L	63	ug/L	YES
8270C	Acenapthene	0.20	ug/L	670	ug/L	YES
8270C	Anthracene	1.00	ug/L	8300	ug/L	YES
8270C	Benzidine	2.00	ug/L	0.000086	ug/L	NO
8270C	Benzo(a) Anthracene	0.20	ug/L	0.0038	ug/L	NO
8270C	Benzo(a) Pyrene	0.20	ug/L	0.0038	ug/L	NO
8270C	Benzo(b) Fluoranthene	0.50	ug/L	0.0038	ug/L	NO
8270C	Benzo(k) Fluoranthene	0.50	ug/L	0.0038	ug/L	NO
8270C	Bis(2-Chloroethyl) Ether	1.00	ug/L	0.03	ug/L	NO
8270C	Bis(2-Chloroisopropyl) Ether	1.00	ug/L	1400	ug/L	YES
8270C	Bis(2-Ethylhexyl) Pthalate	5.00	ug/L	1.2	ug/L	NO
8270C	Butylbenzyl Phthalate	1.00	ug/L	1500	ug/L	YES
8270C	2-Chloronapthalene	1.00	ug/L	1000	ug/L	YES
8270C	2-Chlorophenol	1.00	ug/L	81	ug/L	YES
8270C	Chrysene	0.20	ug/L	0.0038	ug/L	NO
8270C	Dibenzo(a,h) Anthracene	1.00	ug/L	0.0038	ug/L	NO
8270C	Di-n-Butyl Pthalate	1.00	ug/L	2000	ug/L	YES
8270C	3,3-Dichlorobenzidine	NA	ug/L	0.021	ug/L	NO
8270C	2,4-Dichlorophenol	1.00	ug/L	77	ug/L	YES
8270C	2,4-Dimethylphenol	1.00	ug/L	380	ug/L	YES
8270C	Diethyl phthalate	1.00	ug/L	17000	ug/L	YES

METHOD	ANALYTE/TEST PARAMETER	LAB PQL	UNITS	PCS WQC	UNITS	MEETS PCS*
8270C	Dimethyl Pthalate	1.00	ug/L	270000	ug/L	YES
8270C	2,4-Dinitrophenol	2.00	ug/L	69	ug/L	YES
8270C	2-Methyl-4,6-Dinitrophenol	2.00	ug/L	13	ug/L	YES
8270C	2,4-Dinitrotoluene	1.00	ug/L	0.11	ug/L	NO
8270C	1,2-Diphenylhydrazine	1.00	ug/L	0.036	ug/L	NO
8270C	Fluoranthene	0.20	ug/L	130	ug/L	YES
8270C	Fluorene	0.20	ug/L	1100	ug/L	YES
8270C	Hexachlorobenzene	1.00	ug/L	0.00028	ug/L	NO
8270C	Hexachlorocyclopentadiene	1.00	ug/L	40	ug/L	YES
8270C	Hexachloroethane	1.00	ug/L	1.4	ug/L	YES
8270C	Indeno(1,2,3-cd) Pyrene	1.00	ug/L	0.0038	ug/L	NO
8270C	Isophorone	1.00	ug/L	35	ug/L	YES
8270C	Nitrobenzene	1.00	ug/L	17	ug/L	YES
8270C	N-Nitrosodiumethylamine	1.00	ug/L	0.00069	ug/L	NO
8270C	N-Nitrosodi-n-Propylamine	1.00	ug/L	0.005	ug/L	NO
8270C	N-Nitrosodiphenylamine	1.00	ug/L	3.3	ug/L	YES
8270C	Pentachlorophenol	1.00	ug/L	0.27	ug/L	NO
8270C	Phenol	1.00	ug/L	21000	ug/L	YES
8270C	Pyrene	0.20	ug/L	830	ug/L	YES
8270C	1,2,4-Trichlorobenzene	1.00	ug/L	35	ug/L	YES
8270C	2,4,6-Trichlorophenol	1.00	ug/L	1.4	ug/L	YES
8081	Aldrin	0.50	ug/L	0.000049	ug/L	NO
8081	α-BHC	0.50	ug/L	0.0026	ug/L	NO
8081	β-BHC	0.50	ug/L	0.0091	ug/L	NO
8081	γ-BHC (Lindane)	0.50	ug/L	0.98	ug/L	YES
8081	Chlordane	5.00	ug/L	0.0008	ug/L	NO
8081	4-4-DDD	0.50	ug/L	0.00031	ug/L	NO
8081	4,4-DDE	0.50	ug/L	0.00022	ug/L	NO
8081	4,4-DDT	0.50	ug/L	0.00022	ug/L	NO
8081	Dieldrin	0.50	ug/L	0.000052	ug/L	NO
8081	α-Endosulfan (Endosulfan I)	0.50	ug/L	62	ug/L	YES
8081	β-Endosulfan (Endosulfan II)	0.50	ug/L	62	ug/L	YES
8081	Endosulfan Sulfate	0.50	ug/L	62	ug/L	YES
8081	Endrin	0.50	ug/L	0.059	ug/L	NO
8081	Endrin Aldehyde	0.50	ug/L	0.29	ug/L	NO
8081	Heptachlor	0.50	ug/L	0.000079	ug/L	NO
8081	Heptachlor Epoxide	0.50	ug/L	0.000039	ug/L	NO
8081	Toxaphene	5.00	ug/L	0.00028	ug/L	NO
1613B	2,3,7,8 TCDD	1.20	pg/L	0.005	pg/L	NO
1613B	2,3,7,8-TCDF	0.60	pg/L	NA	pg/L	NA
1613B	1,2,3,7,8-PeCDF	0.83	pg/L	NA	pg/L	NA
1613B	2,3,4,7,8-PeCDF	0.59	pg/L	NA	pg/L	NA
1613B	1,2,3,4,7,8-HxCDF	0.92	pg/L	NA	pg/L	NA
1613B	1,2,3,6,7,8-HxCDF	0.96	pg/L	NA	pg/L	NA
1613B	1,2,3,7,8,9-HxCDF	1.20	pg/L	NA	pg/L	NA
1613B	2,3,4,6,7,8-HxCDF	0.93	pg/L	NA	pg/L	NA
1613B	1,2,3,4,6,7,8-HpCDF	2.10	pg/L	NA	pg/L	NA
1613B	1,2,3,4,7,8,9-HpCDF	3.30	pg/L	NA	pg/L	NA
1613B	1,2,3,7,8-PeCDD	0.83	pg/L	NA	pg/L	NA

METHOD	ANALYTE/TEST PARAMETER	LAB PQL	UNITS	PCS WQC	UNITS	MEETS PCS*
1613B	1,2,3,4,7,8-HxCDD	1.60	pg/L	NA	pg/L	NA
1613B	1,2,3,6,7,8-HxCDD	1.50	pg/L	NA	pg/L	NA
1613B	1,2,3,7,8,9-HxCDD	1.60	pg/L	NA	pg/L	NA
1613B	1,2,3,4,6,7,8-HpCDD	1.40	pg/L	NA	pg/L	NA
1613B	OCDD	4.40	pg/L	NA	pg/L	NA
1613B	OCDF	4.30	pg/L	NA	pg/L	NA
1668A	TOTAL Monochloro Biphenyls	NP	ng/L	NA	ng/L	NA
1668A	TOTAL Dichloro Biphenyls	NP	ng/L	NA	ng/L	NA
1668A	TOTAL Trichloro Biphenyls	NP	ng/L	NA	ng/L	NA
1668A	TOTAL Tetrachloro Biphenyls	NP	ng/L	NA	ng/L	NA
1668A	TOTAL Pentachloro Biphenyls	NP	ng/L	NA	ng/L	NA
1668A	TOTAL Hexachloro Biphenyls	NP	ng/L	NA	ng/L	NA
1668A	TOTAL Heptachloro Biphenyls	NP	ng/L	NA	ng/L	NA
1668A	TOTAL Octachloro Biphenyls	NP	ng/L	NA	ng/L	NA
1668A	TOTAL Nonachloro Biphenyls	NP	ng/L	NA	ng/L	NA
1668A	TOTAL Decachloro Biphenyls	NP	ng/L	NA	ng/L	NA
1668A	TOTAL PCB'S	NP	ng/L	0.064	ng/L	YES
6020A	Arsenic (Total recoverable)	2.00	ug/L	10	ug/L	YES
6020A	Arsenic (Dissolved)	2.00	ug/L	10	ug/L	YES
6020A	Silver (Total recoverable)	0.50	ug/L	0.05	mg/L	YES
6020A	Chromium III	5.00	ug/L	74.1	ug/L	YES
SM3500-CR	Hexavalent Chromium	0.0040	mg/L	0.015712	mg/L	YES
SM4500-F C11	Fluoride	0.20	mg/L	1	mg/L	YES
900	Gross Alpha	NP	pCi/L	15	pCi/L	undetermined
900	Gross Beta	NP	pCi/L	50	pCi/L	undetermined
903	Radium 226	NP	pCi/L	***	pCi/L	NA
904.1	Radium 228	NP	pCi/L	***	pCi/L	NA
903/904.1	COMBINED RADIUM 226/228	NP	pCi/L	4	pCi/L	undetermined
ASTM D5811-08	Strontium 90	NP	pCi/L	8	pCi/L	undetermined
100.2	Asbestos Fibers	<7	MFL	<7	MFL	NA
1633(DRAFT)	PFBA	varies*	ng/L	NA	ng/L	NA
1633(DRAFT)	PFPeA	varies*	ng/L	NA	ng/L	NA
1633(DRAFT)	PFHxA	varies*	ng/L	NA	ng/L	NA
1633(DRAFT)	PFHpA	varies*	ng/L	NA	ng/L	NA
1633(DRAFT)	PFOA	varies*	ng/L	NA	ng/L	NA
1633(DRAFT)	PFNA	varies*	ng/L	NA	ng/L	NA
1633(DRAFT)	PFDA	varies*	ng/L	NA	ng/L	NA
1633(DRAFT)	PFUnA	varies*	ng/L	NA	ng/L	NA
1633(DRAFT)	PFDoA	varies*	ng/L	NA	ng/L	NA
1633(DRAFT)	PFTrDA	varies*	ng/L	NA	ng/L	NA
1633(DRAFT)	PFTeDA	varies*	ng/L	NA	ng/L	NA
1633(DRAFT)	PFBS	varies*	ng/L	NA	ng/L	NA
1633(DRAFT)	PFPeS	varies*	ng/L	NA	ng/L	NA
1633(DRAFT)	PFHxS	varies*	ng/L	NA	ng/L	NA
1633(DRAFT)	PFHpS	varies*	ng/L	NA	ng/L	NA
1633(DRAFT)	PFOS	varies*	ng/L	NA	ng/L	NA
1633(DRAFT)	PFNS	varies*	ng/L	NA	ng/L	NA
1633(DRAFT)	PFDS	varies*	ng/L	NA	ng/L	NA

METHOD	ANALYTE/TEST PARAMETER	LAB PQL	UNITS	PCS WQC	UNITS	MEETS PCS*
1633(DRAFT)	PFDoS	varies*	ng/L	NA	ng/L	NA
1633(DRAFT)	4:2FTS	varies*	ng/L	NA	ng/L	NA
1633(DRAFT)	6:2FTS	varies*	ng/L	NA	ng/L	NA
1633(DRAFT)	8:2FTS	varies*	ng/L	NA	ng/L	NA
1633(DRAFT)	PFOSA	varies*	ng/L	NA	ng/L	NA
1633(DRAFT)	NMeFOSA	varies*	ng/L	NA	ng/L	NA
1633(DRAFT)	NEtFOSA	varies*	ng/L	NA	ng/L	NA
1633(DRAFT)	NMeFOSAA	varies*	ng/L	NA	ng/L	NA
1633(DRAFT)	NEtFOSAA	varies*	ng/L	NA	ng/L	NA
1633(DRAFT)	NMeFOSE	varies*	ng/L	NA	ng/L	NA
1633(DRAFT)	NEtFOSE	varies*	ng/L	NA	ng/L	NA
1633(DRAFT)	HFPO-DA	varies*	ng/L	NA	ng/L	NA
1633(DRAFT)	Adona	varies*	ng/L	NA	ng/L	NA
1633(DRAFT)	PFMPA	varies*	ng/L	NA	ng/L	NA
1633(DRAFT)	PFMBA	varies*	ng/L	NA	ng/L	NA
1633(DRAFT)	NFDHA	varies*	ng/L	NA	ng/L	NA
1633(DRAFT)	9Cl-PF3ONS	varies*	ng/L	NA	ng/L	NA
1633(DRAFT)	11Cl-PF3OUdS	varies*	ng/L	NA	ng/L	NA
1633(DRAFT)	PFEESA	varies*	ng/L	NA	ng/L	NA
1633(DRAFT)	3:3 FTCA	varies*	ng/L	NA	ng/L	NA
1633(DRAFT)	5:3 FTCA	varies*	ng/L	NA	ng/L	NA
1633(DRAFT)	7:3 FTCA	varies*	ng/L	NA	ng/L	NA

PCB Congener groups

Individual dibenzofurans (DBF)

Analysis for informational purposes

NP=not provided in lab report

NA=not available

PCS DATA based on lowest concentration for acute or chronic Water Quality Criteria

Appx B:
PCB Results

PCB CONGENER GROUP	SITE LOCATION ID									
	0192 ng/L	QAQC	0192 DUP ng/L	QAQC	0633 ng/L		0633 DUP ng/L	QAQC	0912 ng/L	QAQC
Total Monochloro Biphenyls										
Round 1	0.0074				NS	*	0.0034		0.0020	***
Round 2	0.0134		0.0145		NS	*			ND	
Total Dichloro Biphenyls										
Round 1	0.0403	**			NS	*	0.0628		0.0708	***
Round 2	0.0835		0.0696		NS	*			0.4980	J***
Total Trichloro Biphenyls										
Round 1	0.1020	**			NS	*	0.1050		0.0911	***
Round 2	0.0936		0.0905		NS	*			0.4080	J***
Total Tetrachloro Biphenyls										
Round 1	0.2070	**			NS	*	0.1940		0.1740	***
Round 2	0.2030	**	0.214		NS	*			0.0850	J***
Total Pentachloro Biphenyls										
Round 1	0.1890	**			NS	*	0.1040		0.1520	***
Round 2	0.1500	**	0.166		NS	*			0.0854	J***
Total Hexachloro Biphenyls										
Round 1	0.1360	**			NS	*	0.0737		0.0741	***
Round 2	0.0974	**	0.0989		NS	*			0.0686	J***
Total Heptachloro Biphenyls										
Round 1	0.0449	**			NS	*	0.0294		0.0222	
Round 2	0.0573		0.0514		NS	*			0.0213	J***
Total Octachloro Biphenyls										
Round 1	0.0038				NS	*	0.0038		0.0104	
Round 2	0.0211		0.0232		NS	*			0.0045	
Total Nonachloro Biphenyls										
Round 1	0.00396				NS	*	ND		0.0348	
Round 2	0.0034		0.0031		NS	*			ND	
Total Decachloro Biphenyls										
Round 1	ND				NS	*	ND		ND	
Round 2	0.0120		ND		NS	*			ND	
TOTAL PCBS										
Round 1	0.7360	**			NS	*	0.5750		0.6000	***
Round 2	0.7340	**	0.7310		NS	*			0.3360	J***

J= Estimated concentration, Reporting level>Result>Detection Limit. Qualified data do not enter into Total PCB concentration values.

*** Sample was evaporated to dryness/sample dropped, resulting in loss of sample-no results**

**** Field blank showed traces of PCB present in both rounds; <sample value and < WQ std of (0.064 ng/L) RD1. RD2 FB (0.0857) > WQ std.**

***** Equipment blank showed traces of PCB present in both rounds, <sample value but >WQ std in both rounds. (0.717 ng/L & 0.0857(J) ng/L respectively).**

RED values indicate > PCS WQC level of 0.064 ng/L

Appx C:
DBF Results

	SITE LOCATION ID									
	0192 pg/L	QAQC FLAG	0192 DUP pg/L	QAQC FLAG	0633 pg/L	QAQC FLAG	0633 DUP pg/L	QAQC FLAG	0912 pg/L	QAQC FLAG
2,3,7,8 TCDD										
Round 1	ND				ND		ND		ND	
Round 2	ND		ND		ND				ND	
2,3,7,8 TCDF										
Round 1	ND				ND		ND		ND	
Round 2	ND		0.55	J	0.55	J			ND	
1,2,3,7,8 PeCDF										
Round 1	ND				ND		ND		ND	
Round 2	ND		1.1	IJ EMPC	1.1	IJ EMPC			3.4	IJ EMPC
2,3,4,7,8 PeCDF										
Round 1	ND				ND		ND		ND	
Round 2	ND		ND		ND				ND	
1,2,3,4,7,8 HxCDF										
Round 1	ND				ND		ND		ND	
Round 2	ND		ND		ND				ND	
1,2,3,6,7,8 HxCDF										
Round 1	ND				ND		ND		ND	
Round 2	ND		ND		ND				ND	
1,2,3,7,8,9 HxCDF										
Round 1	ND				ND		ND		ND	
Round 2	0.68	IJ EMPC	ND		1.3	BJ			ND	
2,3,4,6,7,8 HxCDF										
Round 1	ND				ND		ND		ND	
Round 2	ND		ND		ND				1.0	IJ
1,2,3,4,6,7,8 HpCDF										
Round 1	ND				ND		ND		ND	
Round 2	ND		2.5	IJ	2.9	J			2.7	IJ
1,2,3,4,7,8,9 HpCDF										
Round 1	ND				ND		ND		ND	
Round 2	ND		ND		ND				ND	
1,2,3,7,8 PeCDD										
Round 1	ND				ND		ND		ND	
Round 2	ND		ND		ND				ND	

J= Estimated value, Reporting level>Result>Detection Limit
B= <10x Blank level
I= isotope ratio out of speciation
EMPC=Estimated maximum possible concentration (treated as "positives" in TEQ calc) unless J flagged, then EMPC is not included in TEQ calculation.

EDL=Estimated Detection Limit, based on signal to noise measurements

RED values indicate pollutant value that exceeded 2019 WQ standard of 0.005 pg/L. This is a frequency and duration values for acute, chronic, human health (carcinogen & non-carcinogen) and fish consumption criteria

Appx C: DBF Results

	SITE LOCATION ID									
	0192 pg/L	QAQC FLAG	0192 DUP pg/L	QAQC FLAG	0633 pg/L	QAQC FLAG	0633 DUP pg/L	QAQC FLAG	0912 pg/L	QAQC FLAG
1,2,3,4,7,8 HxCDD										
Round 1	2.5	EMPC			2.4	J	2.5	EMPC IJ	ND	
Round 2	2.2	IJ	1.9	IJ	2.1	J			2.2	BJ
1,2,3,6,7,8 HxCDD										
Round 1	ND				ND		ND		ND	
Round 2	ND		ND		ND				ND	
1,2,3,7,8,9 HxCDD										
Round 1	ND				ND		ND		ND	
Round 2	ND		ND		ND				ND	
1,2,3,4,6,7,8 HpCDD										
Round 1	ND				ND		2.2	J	4.2	EMPC
Round 2	ND		ND		3.8	BJ			7.7	BJ
OCDD										
Round 1	45	J			42	J	31	J	170	
Round 2	31	J	25	IJ	67	BJ			110	B
OCDF										
Round 1	ND				ND		ND		ND	
Round 2	ND		4.5	IJ	6.8	J			18	J
TOTAL DBF TCDD TEQ										
Round 1	0.00				0.00		0.00		0.051	
Round 2	0.00		0.00		0.00				0.033	

J= Estimated value, Reporting level>Result>Detection Limit

B= <10x Blank level

I= isotope ratio out of speciation

EMPC=Estimated maximum possible concentration (treated as "positives" in TEQ calc) unless J flagged, then EMPC is not included in TEQ calculation.

EDL=Estimated Detection Limit, based on signal to noise measurements

RED values indicate pollutant value that exceeded 2019 WQ standard of 0.005 pg/L. This are frequency and duration values for acute, chronic, human health (carcinogen & non-carcinogen) and fish consumption criteria