

Village of Indian Hill PFAS RSSCT Summary

#200-768713-25001
October 2025

PRESENTED TO

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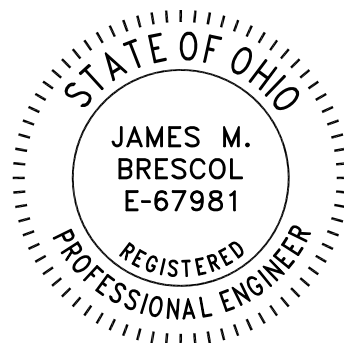


TABLE OF CONTENTS	1
1.0 BACKGROUND	1
2.0 TEST OBJECTIVES	2
3.0 RSSCT METHODOLOGY	2
3.1 Raw Water Sample Collection	2
3.2 RSSCT Design Criteria	2
3.3 RSSCT Media	4
3.4 RSSCT Setup	4
3.5 RSSCT Sampling Plan	6
4.0 RESULTS AND DISCUSSION	7
4.1 Column Operation	7
4.2 GAC RSSCT Results	8
4.2.1 General Chemistry	8
4.2.2 PFAS	10
4.2.3 Projected Full-Scale Performance	14
4.3 Ion Exchange RSSCT Results	16
4.3.1 General Chemistry	16
4.3.2 PFAS	18
4.3.3 Projected Full Scale Performance	20
5.0 CONCLUSIONS AND RECOMMENDATIONS	21
APPENDIX A. MEDIA MANUFACTURER INFORMATION	1
APPENDIX B. MEDIA PREPARATION FOR RSSCT	2
APPENDIX C. RSSCT RESULTS	3

LIST OF TABLES

Table 1-1. Village of Indian Hill PFAS Analytical Results	1
Table 3-1. RSSCT Testing Parameters	3
Table 3-2. RSSCT Testing Medias	4
Table 3-3. Water Quality Parameters and Sampling Frequency	6
Table 4-1. Column Operation: GAC Results	7
Table 4-2. Backwashing Summary	7
Table 4-3. General Water Chemistry: GAC Results ¹	9
Table 4-4. PFAS Water Quality: GAC Results ^{1,2}	14

LIST OF FIGURES

Figure 3-1. Schematic of RSSCT Setup	5
Figure 3-2. RSSCT Setup	5
Figure 4-1: pH: GAC Results	10
Figure 4-2: PFAS Breakthrough Curve: GAC 1 (Calgon Carbon F400) ¹	10
Figure 4-3: PFAS Breakthrough Curve: GAC 2 (Norit 400) ¹	12
Figure 4-4: PFAS Breakthrough Curve: GAC 3 (UltraCarb 1240LD) ¹	13
Figure 4-5: pH: IX Results	18
Figure 4-6: PFAS Breakthrough Curves: IX Results ¹	19

APPENDICES

APPENDIX A: Media Manufacturer Information
APPENDIX B: Media Preparation for RSSCT
APPENDIX C: RSSCT Results

ACRONYMS/ABBREVIATIONS

Acronyms/Abbreviations	Definition
AADD	Annual average day demand
ASTM	American Society for Testing and Materials International
CD	Constant Diffusivity
EBCT	Empty Bed Contact Time
GAC	Granular Activated Carbon
Gen X	Hexafluoropropylene Oxide Dimer Acid
gpcpd	Gallons per capita per day
HI	Hazard Index
IX	Ion Exchange
MCL	Maximum Contaminant Level
MDD	Max day demand
MG	Million gallons
MGD	Million gallons per day
mg/l	Milligrams per liter
ng/l	Nanograms per liter
OEPA	Ohio Environmental Protection Agency
PD	Proportional Diffusivity
PFAS	Per- and polyfluoroalkyl substances
PFBS	Perfluorobutane Sulfonic Acid
PFHxS	Perfluorohexane Sulfonic Acid
PFNA	Perfluorononanoic Acid
PFOA	Perfluorooctanoic Acid
PFOS	Perfluorooctanesulfonate
ppm	Parts per million
ppt	Parts per trillion
RSSCT	Rapid Small-Scale Column Test
WF	Well field
USEPA	United States Environmental Protection Agency
WSRLA	Water Supply Revolving Loan Account

1.0 BACKGROUND

The City of the Village of Indian Hill (Village) supplies water to its customers primarily from its ground water treatment plant. The Village can supplement its finished water supply from Cincinnati Water Works for emergency purposes.

In 2024, the United States Environmental Protection Agency (USEPA) promulgated a regulation that establishes maximum contaminant levels (MCLs) for certain per- and polyfluoroalkyl substances (PFAS) compounds, including: perfluorooctanoic acid (PFOA), perfluorooctanesulfonate (PFOS), Perfluorohexane sulfonic acid (PFHxS), perfluorononanoic acid (PFNA) and hexafluoropropylene oxide dimer acid (Gen X), as well as a hazard index (HI) that uses concentrations of four (4) different PFAS compounds including perfluorobutane sulfonic acid (PFBS). The MCLs and Hazard Index equation are presented in Table 1-1. The new regulation requires that all public water systems be in compliance with the MCLs by April 2029.

Initial testing was performed to ascertain the concentrations of PFAS compounds in the source water supply (raw water wells) and finished water at the Village Point of Entry (POE). The testing, summarized in Table 1-1, has shown that low levels of these compounds are present in the groundwater supply, some of which exceed the new regulatory standards. The two compounds that are present in the highest concentration are PFOA and PFOS, which are eight carbon chain compounds. The shorter chain compounds, PFHpA and PFHxS, are present in much lower concentrations. Although all these PFAS compounds are removed to varying degrees by both granular activated carbon (GAC) and ion exchange (IX) adsorptive systems, the longer chain compounds are more readily removed than the shorter chain compounds (≤ 6 carbons).

Table 1-1. Village of Indian Hill PFAS Analytical Results

Parameter	USEPA MCL	Wells – Min 09/25/2023	Wells – Avg 09/25/2023	Wells – Max 09/25/2023	POE 09/01/2022	UCMR 5
PFOA (ng/l)	4.0	2.5	4.8	9.1	2.62	BRL
PFOS (ng/l)	4.0	11.0	17.4	26.0	14.0	10.9-12.4
PFHxS (ng/l)	10 & Hazard Index	2.6	3.1	3.5	2.29	BRL
PFNA (ng/l)	10 & Hazard Index	ND	1.2	1.2	0.578	BRL
PFHP-DO (Gen X, ng/l)	10 & Hazard Index	ND	ND	ND	0.0239	BRL
PFBS (ng/l)	Hazard Index	2.6	3.8	4.8	3.58	3.6-4

1. ND = Not detected.

2. Values in red exceed the USEPA MCL.

3. **Equation 1:** $USEPA\ Hazard\ Index = \frac{PFBS\ ppt}{2,000\ ppt} + \frac{PFHxS\ ppt}{10\ ppt} + \frac{PFNA\ ppt}{10\ ppt} + \frac{HFPO-DA\ ppt}{10\ ppt}$

4. BRL = Below the minimum reporting limit

The Ohio Environmental Protection Agency (OEPA) requires a General Plan be submitted and approved for approval of changes to treatment processes at water treatment plants. An approved General Plan is also required to receive Water Supply Revolving Loan Account (WSRLA) funding. For PFAS related improvements, the OEPA General Plan guidance requires bench or pilot testing to be completed prior to plan approval.

Accordingly, an initial test plan was developed to conduct a water treatment study for the removal of PFAS from the Village's groundwater supply. In accordance with this test plan, a rapid small-scale column test (RSSCT) was conducted. This document summarizes the RSSCT that was performed to evaluate the efficacy of selected adsorptive media to treat groundwater from the Village's existing wellfield.

2.0 TEST OBJECTIVES

The objective of the RSSCT is to evaluate treatment options for the removal of PFAS from the Village's groundwater supply. Key objectives covered in the testing summary include the following.

- Determine PFAS removal by adsorptive media treatment
- Compare the performance of GAC and IX resins and evaluate various types of GAC for PFAS removal
- Determine breakthrough curves for each of the treatment media selected
- Characterize general water quality related to impact on adsorptive media treatment

3.0 RSSCT METHODOLOGY

3.1 RAW WATER SAMPLE COLLECTION

Raw water was collected prior to treatment for the performance of the RSSCT. Wells with higher concentration of PFAS were selected for operation to obtain the water for the test. Representatives of the Village and Tetra Tech collected the sample on June 11, 2025. The samples were placed in three (3) 55-gallon and one (1) 30-gallon, new, closed top, one-piece molded black HDPE containers and shipped to the Tetra Tech lab in Orlando, Florida for performance of the RSSCTs. A total sample volume of 195 gallons was delivered to the lab for testing.

3.2 RSSCT DESIGN CRITERIA

The RSSCT testing parameters are summarized in Table 3-1. The testing parameters, developed in the prior Testing Work Plan, were designed to provide similitude between the small-scale column and a larger full-scale system, allowing the results to be extrapolated accordingly. The media was prepared to the specified size, placed at the appropriate depth, and operated for the designated duration based on these parameters. The RSSCT was conducted in accordance with ASTM D6586-03, the standard practice for predicting contaminant adsorption on GAC in water using RSSCT. While the ASTM standard only covers testing of GAC media, a recent study used it for testing IX resins which appeared to provide satisfactory results (Zeng, et al., 2020).

Table 3-1. RSSCT Testing Parameters

Parameter	Units	Granular Activated Carbon				Ion Exchange Resin	
			Calgon Filtrisorb 400	Norit GAC 400	Desotec UltraCarb 1240		Cal Res 2301
		Full Scale	Small Scale	Small Scale	Small Scale	Full Scale	Small Scale
Media Mesh Size	US Standard	12 x 40	140 x 170	140 x 170	140 x 170	16 x 50	140 x 170
Media Diameter, geometric mean	mm	0.85	0.098	0.098	0.098	0.595	0.098
Diffusivity, X	X=0 for CD	--	0	0	0	--	0
Scaling Factor	$(D_{SS}/D_{FS})^2 \cdot X$	1	0.0133	0.0133	0.0133	1	0.0271
EBCT	minutes	9.5	0.13	0.13	0.13	2.1	0.057
D _{ADSORBER}	ft, cm	12	0.8	0.8	0.8	12	0.8
Area _{adsorber}	ft, cm ²	113	0.50	0.50	0.50	113	0.50
Q _{DESIGN}	gpm	1042.0	--	--	--	1389.0	--
V _{adsorber}	m/hr	22.53	7.44	7.44	7.44	--	7.83
Re, 20°C		14.89	0.76	0.76	0.76	13.89	0.80
V _{adsorber}	mL/min-cm ²	37.54	12.41	12.41	12.41	50.05	13.05
Q _{adsorber}	mL/min	4,246	6.24	6.24	6.24	5,660	6.56
Bed Volume	ft ³ , cm ³ (mL)	1,323	0.7876	0.7876	0.7876	390	0.3736
Media Depth	ft, cm	11.7	1.57	1.57	1.57	3.4	0.74
Media Mass	kg,g	1	0.37	0.37	0.37	0	0.25
Media Mass	lbs.	2	0.00082	0.00082	0.00082	1	0.00056
Operating Period _{FS}	months	22	--	--	--	30	--
Operating Period	days	669.2	8.9	8.9	8.9	912.50	24.75
BV _{treated}		3,091,943	101,432	101,432	101,432	19,073,672	625,714
V _{SAMPLE}	L	--	79.9	79.9	79.9	--	233.7
V _{SAMPLE}	gallons	--	21.1	21.1	21.1	--	61.8

3.3 RSSCT MEDIA

Four different media were tested, including three (3) types of GAC, and one (1) IX resin, which are listed in Table 3-2. Prior bench and pilot testing of various types of GAC have shown that GAC produced from bituminous coal have provided the best removal efficiencies. The Calgon Filtrasorb 400 GAC product, which is manufactured from bituminous coal was selected for the initial bench scale test. It has provided good removal of PFAS compounds and was recently bench scale tested for the City of Dayton Ottawa WTP End of Pipe PFAS treatment system, and therefore was included in the RSSCT testing. Similar offerings of bituminous GAC are available from other suppliers including the Norit Darco 400 and the Desotec UltraCarb 1240LD and were included in the testing.

Recent testing of commercially available IX resins was conducted by Tetra Tech for the City of Dayton for PFAS removal from groundwater sources from a well field that has been contaminated with PFAS compounds. Those tests demonstrated that all three PFAS removal resins tested, Calgon CalRes 2301, Dow PR2+, and Purolite PFA694E, provided good removal of PFOA, PFOS and PFHxS, which are the primary PFAS present in the Village groundwater source. Although all three resins provided similar removals, the Calgon CalRes 2301 had slightly earlier breakthrough of PFOS and PFHxS and similar breakthrough for PFOA, which makes it a conservative choice for representing IX performance. Therefore, the CalRes 2301 resin was selected for testing against the GAC media.

Table 3-2. RSSCT Testing Medias

Media	Raw Water
GAC 1	Calgon Carbon FILTRASORB 400
GAC 2	NORIT GAC 400
GAC 3	Evoqua UltraCarb 1240LD10
IX	Calgon Carbon CALRES 2301

3.4 RSSCT SETUP

In accordance with the RSSCT testing parameters, the media particle sizes were reduced to achieve the appropriate scaled dimensions. To size the GAC samples, the media was crushed using a mortar and pestle and then wet sieved to obtain the specified mesh size range. The wet-sieved media was dried in an oven to remove trapped moisture and volatile organics, then stored in a desiccator with a small amount of water prior to being loaded into the test columns. The IX resin was ground using an electric grinder and wet sieved. Excess water was decanted before placing the resin in the column. Water was circulated through each of the columns in the reverse direction (upflow), at a low rate to make sure any trapped air had been removed prior to starting to test. Manufacturer information for each of the media is provided in Appendix A, along with the step-by-step media preparation procedure provided in Appendix B.

A schematic of the RSSCT setup is shown in Figure 3-1, with photo images in Figure 3-2. Raw water was stored in its original shipping containers, which consisted of three (3) 55-gallon drums and one (1) 30-gallon drum. A hand-operated drum pump was used to transfer water from the 55-gallon drums to a smaller, 5-gallon tote, where a peristaltic metering pump supplied continuous feed to the columns. The raw water was then pumped to four separate 8-mm columns, each packed with one of the test media. A layer of glass wool approximately 1.5 cm tall was placed at the bottom of each column to prevent media fall out during operation. Media was then placed in each column to the height specified in the testing parameter. Additional glass wool, approximately 1.5 cm tall, was placed at the top of each column to prevent any potential larger contaminants from clogging the media.

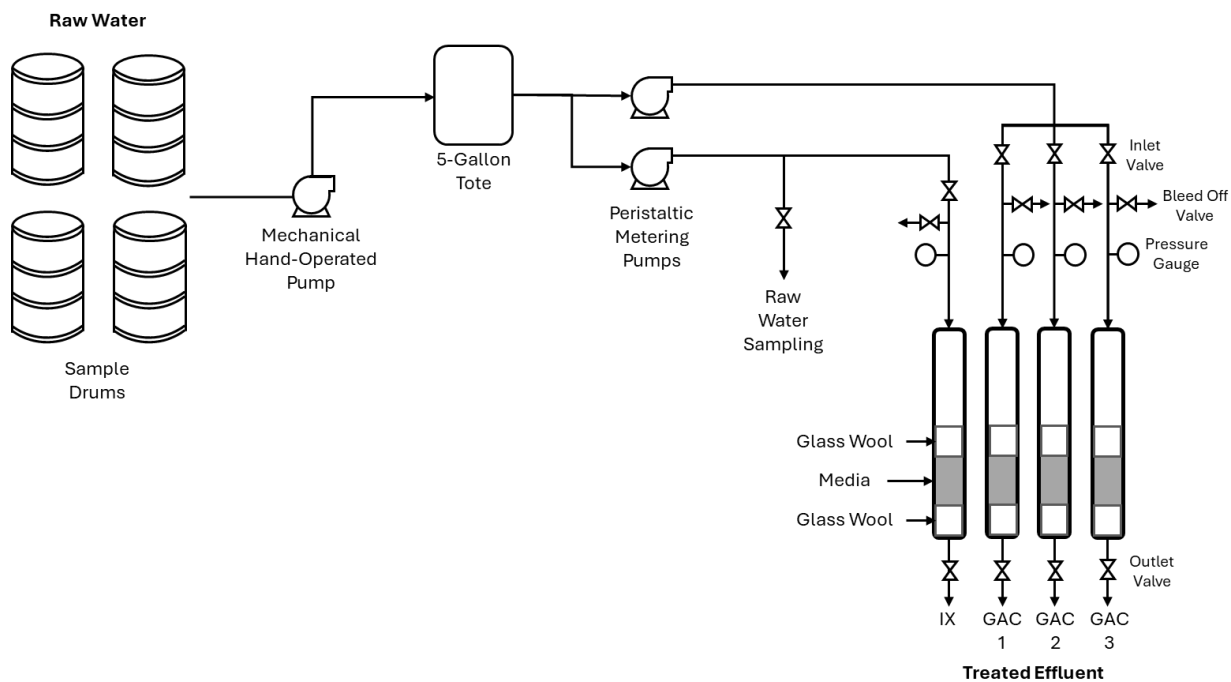


Figure 3-1. Schematic of RSSCT Setup



Figure 3-2. RSSCT Setup

3.5 RSSCT SAMPLING PLAN

The RSSCT lasted for a total of 25 days. Raw water samples were collected throughout the entire testing period. GAC-treated water was sampled for the first 10 days, while IX-treated water was tested over the full 25-day duration. The water quality parameters measured included PFAS, as well as other general water quality parameters. Table 3-3 outlines the water quality parameters and sampling frequency for each sampling point.

Table 3-3. Water Quality Parameters and Sampling Frequency

Parameter	Analysis Method	Raw Water	GAC Columns	IX Column
Frequency		Startup + 11/22 Randomly Spaced	Startup + Every 8,000 Bed Volumes	Startup + Every 25,000 Bed Volumes
Parameters		Number of Samples	Number of Samples	Number of Samples
PFAS	EPA 537.1	12	48	25
TOC	SM 5310B	12	30	25
UVA	SM 5910B	23	48	32
Frequency		Startup + Every Column Effluent Measurement	Startup + Every 6,000 Bed Volumes	Startup + Every 25,000 Bed Volumes
pH	lab	32	48	32
Frequency		Time 0 + 6 Randomly Spaced	Time 0 + 3 Randomly Spaced	Time 0 + 6 Randomly Spaced
TDS	SM 2540C	7	12	7
Total Iron	EPA 200.7	7	12	7
Arsenic	EPA 200.5	7	12	7
Calcium	EPA 200.7	7	12	7
Magnesium	EPA 200.7	7	12	7
Alkalinity	SM 2320Bc	7	12	7
Fluoride	SM 4500F	7	12	7
Chloride	EPA 300.0	7	12	7
Sulfate	EPA 300.0	7	12	7
Nitrate	EPA 300.0	7	12	7
Nitrite	EPA 300.0e	7	12	7
Orthophosphate	SM 4500 P	7	12	7
Heterotrophic Plate Count	SM 9215B	7	12	7

4.0 RESULTS AND DISCUSSION

4.1 COLUMN OPERATION

General column operational results are provided in Table 4-1. The full set of operational and water quality data for all samples that were collected throughout the duration of the RSSCT is provided in Appendix C. Each GAC column tested in the RSSCT was operated for approximately 100,000 bed volumes (BV), and approximately 600,000 BV for the IX resin column. The pressure was also measured at the influent of each operating column.

GAC 2 (Norit 400) and GAC 3 (UltraCarb 1240LD) columns did experience some pressure buildup during testing, which appeared to be caused by media clogging or swelling during operation. Backwashing was performed using deionized water at a flow rate of 3 mL/min for 5 minutes, restoring conditions to regular operating levels. A summary of the backwashing frequencies are displayed in Table 4-2.

Table 4-1. Column Operation: GAC Results

Parameter	GAC 1 (CC F400)	GAC 2 (Norit 400)	GAC 3 (UC 1240LD)	IX (CC CalRes 2301)
Operating Flow, mL/min	6.24	6.24	6.24	6.56
Totalized Flow ¹ , L	98.8	98.8	97.8	235.5
Total Bed Volumes ¹	125,447	125,447	124,177	630,366
Influent Pressure ² , psi	0.5 (0.0 – 1.5)	2.6 (0.0 – 6.0)	1.6 (0.0 – 4.0)	1.3 (0.0 – 2.5)

1. Total flow and bed volumes at completion of study.

2. The values in the table represent the average, followed by the range of minimum to maximum in parentheses.

Table 4-2. Backwashing Summary

Parameter	GAC 1 (CC F400)	GAC 2 (Norit 400)	GAC 3 (UC 1240LD)	IX (CC CalRes 2301)
Bed Volumes ¹	-	50,407	-	-
	-	61,767	-	-
	-		72,379	-

1. Backwashing occurred at the corresponding bed volumes.

4.2 GAC RSSCT RESULTS

4.2.1 General Chemistry

Table 4-3 summarizes the general water quality results for metals, anions, temperature, and other background water quality that may compete for adsorption sites with media, or impact treatability. The table includes the average and range of raw water and effluent concentrations from each GAC column, as compared to the USEPA maximum contamination level (MCL). Heterotrophic plate count (HPC) samples were also collected during the column test to provide an indication if biological activity is present which could contribute to media fouling.

The GAC effluent concentrations reported were all below the MCL limits as expected. Initial HPC results for both the raw water and GAC effluent samples were reported as Too Numerous to Count (TNTC), but a variable, downward trend was observed throughout the study across the samples. The final lab report at the end of the study indicated HPC levels below the USEPA recommended value in finished water. However, due to the duration of the RSSCT and the absence of any disinfection treatment, some biological activity was expected during the study. The data show that the GAC media did not cause a significant change in concentration for the parameters that were measured. The concentrations of TDS, chloride, sulfate and alkalinity which may impact water corrosivity were essentially unchanged by the GAC media treatment. Total organic carbon and nitrate appear to show a very slight reduction in average concentration of approximately 0.09 to 0.17 mg/L and 0.11 to 0.12 mg/L, respectively.

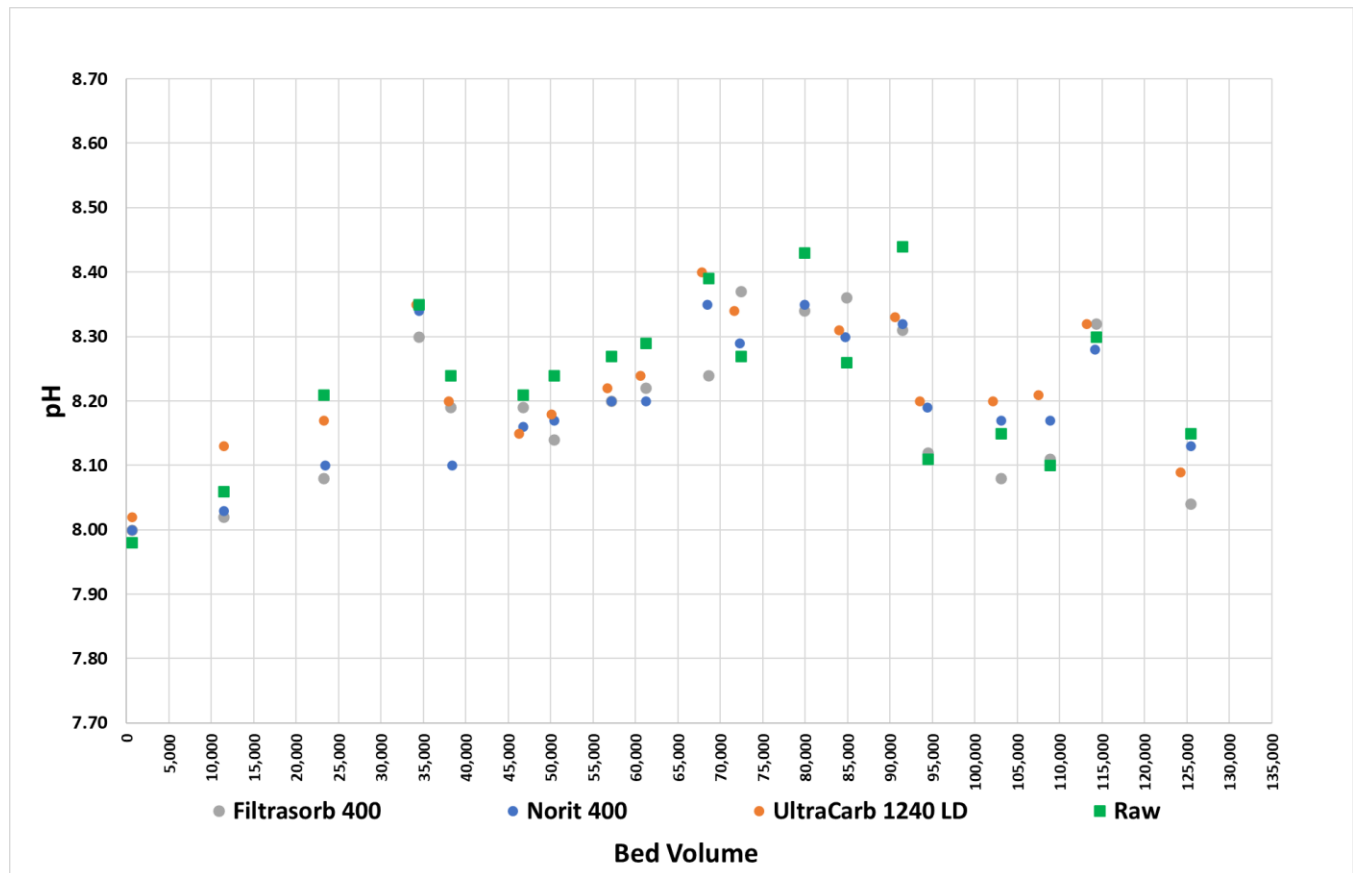
All GAC effluent values were ≤ 0.14 pH units of the raw water pH. The data do not show a consistent increase or decrease in pH over the duration of the test. The results of the RSSCT show that there was not a significant change in either pH or alkalinity and therefore, the addition of this treatment process is not anticipated to impact the existing optimum corrosion control treatment.

Table 4-3. General Water Chemistry: GAC Results¹

Parameter	Raw Water	GAC 1 (CC F400)	GAC 2 (Norit 400)	GAC 3 (UC 1240LD)	MCL
TOC (mg/L)	1.04 (0.98-1.12)	0.95 (0.8-1.08)	0.91 (0.69-0.98)	0.87 (0.63-0.97)	-
UVA (nm)	0.017 (0.013-0.02)	0.013 (0.001-0.02)	0.013 (0.001-0.02)	0.01 (0.0-0.02)	-
Temperature (°C)	24.9 (24.2-25.8)	24.7 (24.2-25.8)	24.6 (24-25.9)	24.5 (23.9-25.8)	-
TDS (mg/L)	431 (420-450)	440 (410-470)	428 (400-440)	425 (400-440)	500
Total Iron (mg/L)	<0.010 ² .	<0.010 ² .	<0.010 ² .	<0.010 ² .	0.3
Arsenic (µg/L)	1.01 (<1.0 ² -1.1)	<1.0 ² .	1.05 (<1.0 ² -1.1)	<1.0 ² .	10
Calcium (mg/L)	84.1 (82-86)	85 (84-86)	85 (84-86)	84.75 (84-86)	-
Magnesium (mg/L)	23.4 (23-24)	23.75 (23-24)	24	23.75 (23-24)	-
Alkalinity (mg/L)	269 (260-270)	270	270	270	-
Fluoride (mg/L)	0.19 (0.19-0.2)	0.19	0.19 (0.18-0.2)	0.193 (0.19-0.2)	2.0
Chloride (mg/L)	55.4 (53-57)	56.5 (55-57)	56.75 (56-57)	56.75 (56-57)	250
Sulfate (mg/L)	30.7 (29-32)	31.75 (31-32)	31.5 (31-32)	31.75 (31-32)	-
Nitrate (mg/L)	0.798 (0.62-0.96)	0.678 (0.6-0.81)	0.678 (0.61-0.88)	0.688 (0.63-0.82)	10
Nitrite (mg/L)	<0.040 ² .	<0.040 ² .	<0.040 ² .	<0.040 ² .	1.0
Orthophosphate (mg/L)	0.065 (0.04-0.08)	0.061 (0.04-0.07)	0.063 (0.04-0.07)	0.064 (0.05-0.07)	-
Heterotrophic Plate Count (CFU/mL)	537 (40-TNTC ³)	283 (30- TNTC ³)	803 (30- TNTC ³)	263 (50-TNTC ³)	500 ⁴

1. Raw water and resulting effluent pH values for each GAC column are shown for each testing period in Figure 4-1.
2. Not an MCL but the value EPA recommends be maintained to prevent interference with detection of other organisms such as coliforms.
3. The values in the table represent the average, followed by the range of minimum to maximum in parentheses.
4. Less than the Method Detection Limit.
5. TNTC: Too Numerous to Count.
6. Not an MCL but the value EPA recommends be maintained to prevent interference with detection of other organisms such as coliforms.

Figure 4-1: pH: GAC Results



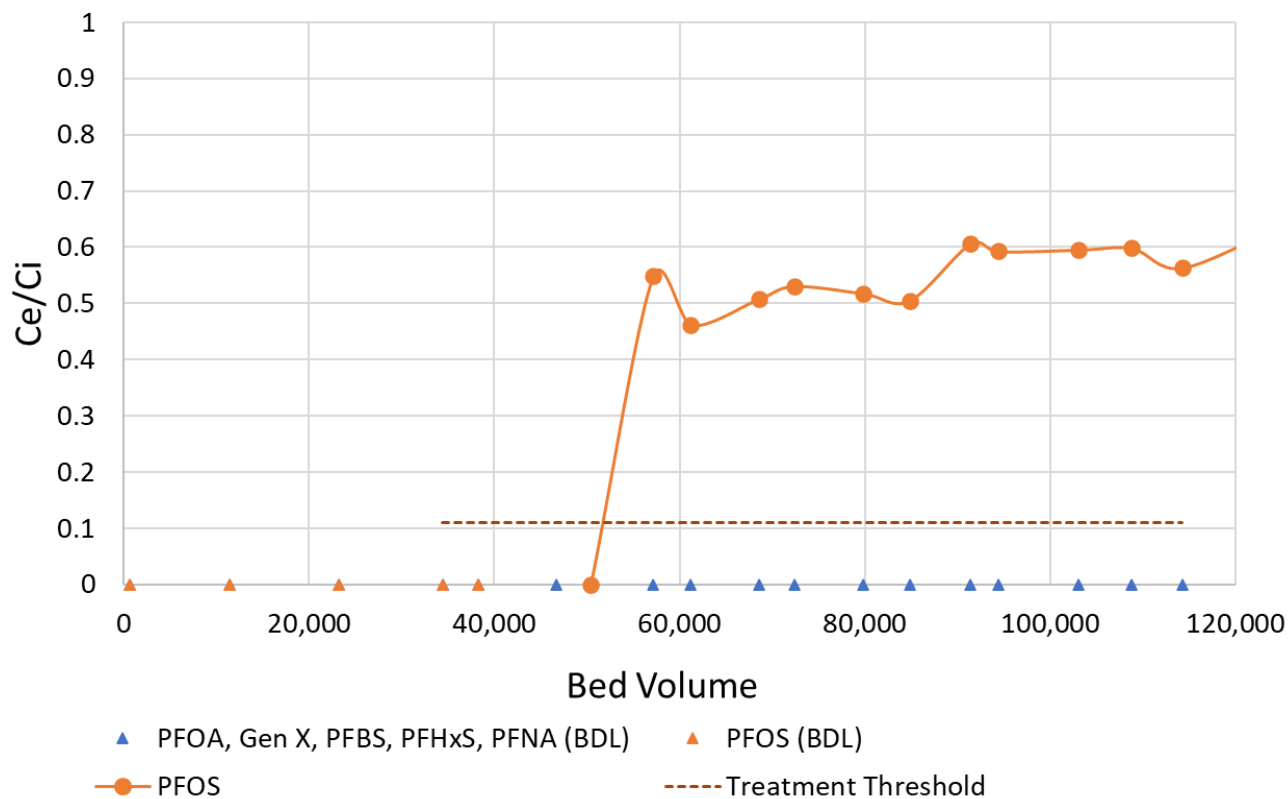
4.2.2 PFAS

As part of the RSSCT summary, concentration profiles of PFOS, PFOA, HFPO-DA, PFBS, PFHxS, and PFNA were evaluated for each GAC media. Breakthrough curves for each GAC removal media are presented in Figure 4-2, Figure 4-3, and Figure 4-4. The breakthrough threshold is defined as ratio of the treated finished water concentration (i.e., “Ce”) to the raw water concentration for each compound (i.e., “Ci”), expressed as a fraction (i.e., “Ce/Ci”). The results are also summarized in Table 4-4, which provides the range of PFAS concentrations measured in the samples.

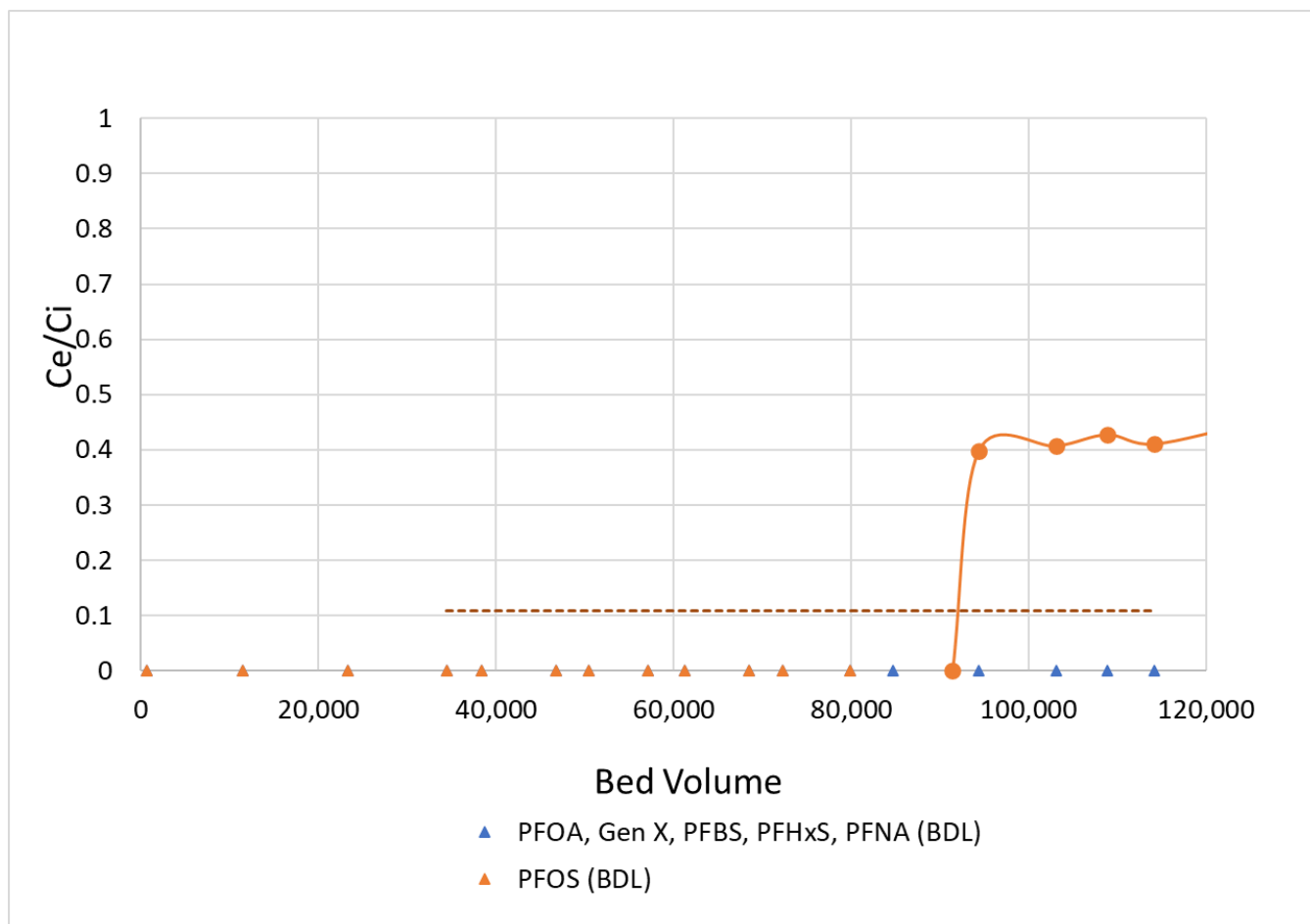
For a WTP, a running annual average hazard index below 1.0 indicates compliance with hazard index standards. All hazard index values calculated for the GAC effluent samples in this study were below the compliance threshold of 1.0.

Among all sample types, PFOS was the only compound to reach breakthrough. Due to the low concentrations of the PFAS compounds and the laboratory detection limit, breakthrough in this study is defined as an increase in PFOS concentration above the detection limit. PFOS breakthrough occurred at approximately 45,000 bed volumes for GAC 1 (Calgon Carbon F400) and approximately 90,000 bed volumes for GAC 2 (Norit 400) and 3 (UltraCarb 1240LD). While the results were similar between the GAC media, GAC 2 (Norit 400) exhibited a slightly less steep breakthrough curve and lower effluent PFOS concentrations.

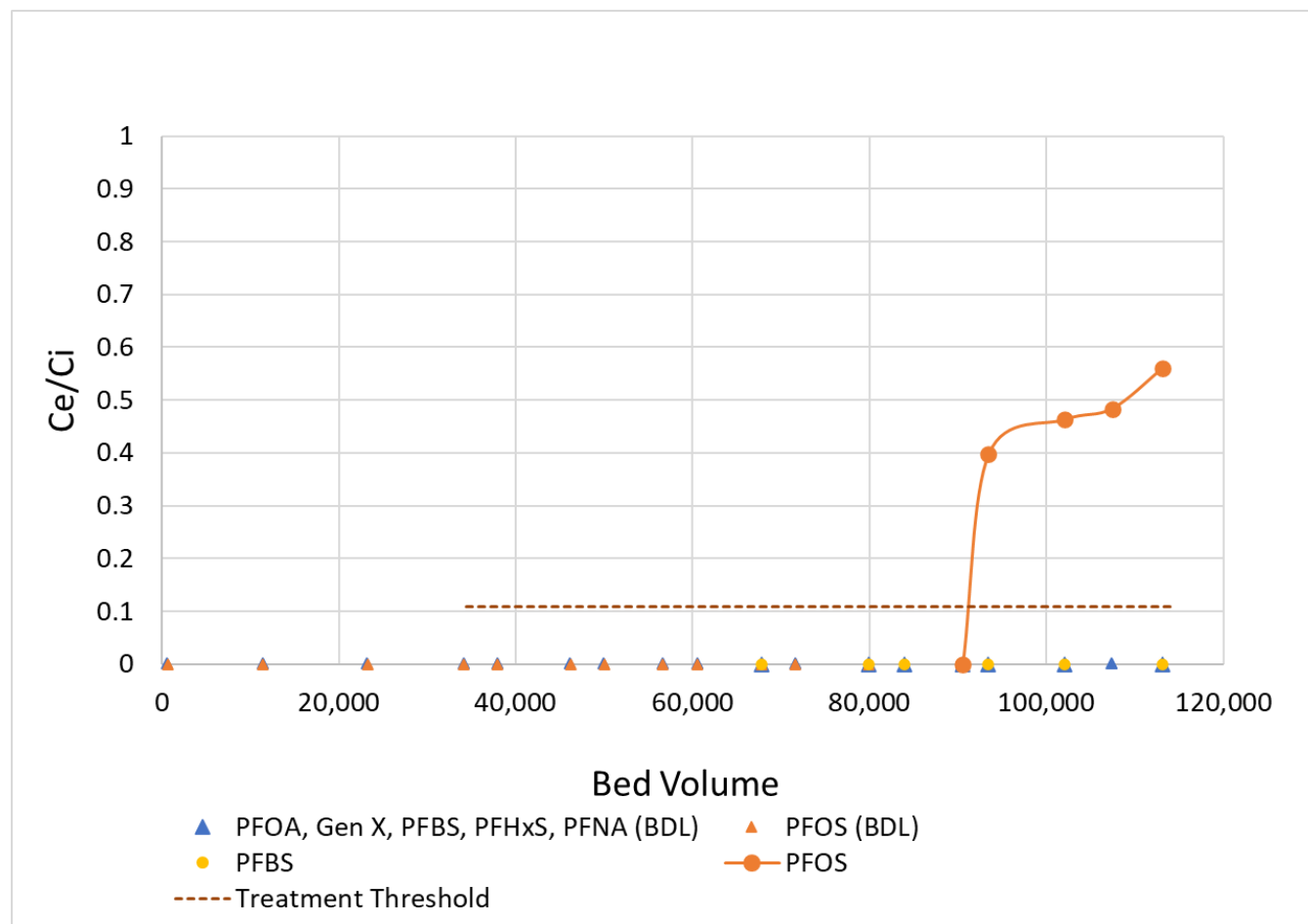
Figure 4-2: PFAS Breakthrough Curve: GAC 1 (Calgon Carbon F400)¹



1. Raw water values were interpolated for when effluent measurements were recorded but raw water measurements were not collected.
2. C_e/C_i is set to 0 for cases where both raw and GAC effluent samples were reported below the detection limit.
3. Effluent samples were reported below the detection limit. C_e was set to detection limit.

Figure 4-3: PFAS Breakthrough Curve: GAC 2 (Norit 400)¹.

1. Raw water values were interpolated for when effluent measurements were recorded but raw water measurements were not collected.
2. C_e/C_i is set to 0 for cases where both raw and GAC effluent samples were reported below the detection limit.
3. Effluent samples were reported below the detection limit. C_e was set to detection limit.

Figure 4-4: PFAS Breakthrough Curve: GAC 3 (UltraCarb 1240LD)¹.

1. Raw water values were interpolated for when effluent measurements were recorded but raw water measurements were not collected.
2. C_e/C_i is set to 0 for cases where both raw and GAC effluent samples were reported below the detection limit.
3. Effluent samples were reported below the detection limit. C_e was set to detection limit.
4. The yellow values indicate instances where the raw water was reported below the detection limit, while the effluent was reported at the detection limit. In these cases, a C_e/C_i value of 0 was also assigned.

Table 4-4. PFAS Water Quality: GAC Results^{1,2}

Parameter	Raw Water	GAC 1 (CC F400)	GAC 2 (Norit 400)	GAC 3 (UC 1240LD)	MCL
PFOS (ng/L) ¹	5.22 (4.2-6.0)	<2.52 (<1.9-3.4)	<2.03 (<1.9-2.5)	<2.18 (<1.9-3.1)	4.0
PFOA (ng/L)	<2.0	<2.0	<2.0	<2.0	4.0
PFHxS (ng/L)	<2.0	<2.0	<2.0	<2.0	10 & HI
GenX (ng/L)	<2.0	<2.0	<2.0	<2.0	10 & HI
PFNA (ng/L)	<2.0	<2.0	<2.0	<2.0	10 & HI
PFBS (ng/L)	<2.0	<2.0	<2.0	<2.0	HI
Calculated Average Hazard Index ³	-	<0.58	<0.57	<0.57	>1.0

1. The values in the table represent the average, followed by the range of minimum – maximum in parentheses.
2. Values shown as less than (“<”) were reported as below the method detection limit. For consistency and simplicity, the maximum method detection limit reported corresponds to the value provided in the table.
3. The hazard index was calculated for each sample date, and the reported value represents the average. Measurements reported below the detection limit were substituted with the detection limit value for calculation purposes.

4.2.3 Projected Full-Scale Performance

The raw water sample collected for the RSSCT only contained detectable concentrations of PFOS which was also the primary contaminant of interest from sampling previously performed which was summarized in Table 1-1. However, PFOA was also detected above the MCL in two of the well samples but at a much lower concentration than PFOS in all the samples. PFOA tends to break through faster than PFOS. However, for the purposes of analyzing the RSSCT results and scaling up to full-scale performance we are assuming that control of PFOS to non-detect will also control PFOA which was only 1/4 to 1/3 the concentration of PFOS in the raw water. The PFOS concentration in the raw water sample used for the RSSCT ranged from 4.2 to 5.4 ng/L with an average concentration of 5.22 ng/L. This concentration is lower than the average the well concentrations in Table 1-1 which was 17.4 ng/L measured in September 2023. Using that average concentration the target C_e/C_i ratio would be $(1.9 \text{ ng/L}/17.4 \text{ ng/L})$ 0.109 to maintain the PFOS effluent concentration at or below the detection limit. A C_e/C_i of 0.11 was used to interpolate the number of bed volumes treated prior to exceeding that value for each of the GAC tested as shown in Figure 4-2 through Figure 4-4. The number of bed volumes was interpolated between the last value below the detection limit and the next value that was greater than the detection limit. The bed volumes to break through determined in this manner are summarized in Table 4-5.

Table 4-5. Bed Volumes Treated to PFOS Break Through

GAC Tested	Calgon F-400	Norit 400	Ultracarb 1240 LD
BV to Break Through, CD	51,000/85,400	92,000	91,000
BV to Break Through, PD	29,700/46,600	53,600	53,000

The bed volumes treated for the Norit and Ultracarb GAC were read directly from the graph of the RSSCT results based on the scaling factor calculated for the test from the geometric mean particle diameter size range. The value in the table for the Calgon F-400 shows two values. The first value is based upon the scaling factor in the test plan based upon the geometric mean and the second value is based upon an adjusted value of the scaling factor based

upon a full scale mean particle diameter of 1.1 mm as recommended by Calgon for their F-400 product (Rodriguez, 2024). A value of 1.1 mm for the full-scale media increases the scaling factor from 75.2 to 126 which increases the number of bed volumes treated at full scale by 1.7 times from 51,000 to 85,400. Full scale mean particle diameters were not provided from the other two suppliers. If the mean particle diameters of the other two media are greater than the calculated geometric mean particle diameter used to scale the RSSCT the results in **Table 4-5** would be conservative.

The RSSCT test parameters were established using the scaling equation for constant diffusivity when diffusion does not vary with adsorption particle size.

$$SF = EBCT_{SS}/EBCT_{FS} = (d_{SS}/d_{FS})^{2-X}$$

where:

SF = Scaling Factor

FS = Pilot or Full Scale

SS = Small Scale

EBCT = Empty Bed Contact Time

d = Mean Particle Diameter

X = 0 for constant diffusivity; 1 for proportional diffusivity

This equation is considered valid for ion exchange test data but studies comparing RSSCT to pilot and full-scale performance of GAC media have shown some dependence upon particle size (Hopkins and Knappe, 2024). A modification of the scaling equation coefficient based upon modeling using the proportional diffusion model has been recommended to scale RSSCT to pilot or full-scale operation. The study looked at the value of X for various PFAS compounds and determined a value of X = 0.25 would yield a breakthrough curve that could predict full-scale performance. That adjustment is generally applicable to the range of PFAS that were examined in the study. However, a closer look at the specific data shows that a value of X = 0 for PFOS gave the best agreement between scaled RSSCT results and pilot results. Therefore, the values for constant diffusivity, CD, in Table 4-5 are considered representative for PFOS. Other compounds including PFOA would tend to follow the modified scaling factor where X = 0.25 for partial proportional diffusivity, PD, and breakthrough may occur after a shorter run time. Both values of number of bed volumes treated prior to breakthrough were used to estimate the media life and average annual cost of media replacement assuming a staggered change out operation was followed.

The new PFAS treatment system has been designed based upon the projected 2045 maximum daily demand of 5.58 MGD. The key design parameters are an empty bed contact time of 10 minutes and a surface loading rate less than 10 gpm/square foot. A set of four 12-foot diameter vessel pairs, each pair operating in series will satisfy the design requirements. The bed volume of the GAC system was utilized in combination with the bed volume treated and the average annual demand to determine the bed life for each GAC. The new PFAS treatment system is not anticipated to be online and requiring media replacement prior to 2030. Therefore, the 2030 average annual demand of 2.05 MGD was utilized to estimate the bed life and annual cost of media replacement. This information is summarized in Table 4-6.

Angela B. Rodriguez. "RSSCT Guidelines" letter, Calgon Carbon Corporation, 4 November 2024.

Zachary R. Hopkins and Detlef R. U. Knappe, (2024) "Predicting per- and polyfluoroalkyl substances removal in pilot-scale granular activated carbon adsorbers from rapid small-scale column tests." *AWWA Water Science*, 6(2), e1369. <https://doi.org/10.1002/aws2.1369>.

Table 4-6. Projected Full-Scale GAC Operating Information

GAC Media		Calgon F-400	Norit 400	Ultracarb 1240 LD
Design Flow Rate	MGD	5.95	5.95	5.95
Number of Vessel Pairs	Number	4	4	4
Vessel Diameter	Feet	12	12	12
Vessel Area	Square Feet	113	113	113
Surface Loading Rate	GPM/SF	8.6	8.6	8.6
Media Depth	Feet	11.5	11.5	11.5
Media Volume	Cubic Feet	1,301	1,301	1,301
Empty Bed Contact Time	Minutes	10	10	10
2030 Average Annual Demand	MGD	2.05	2.05	2.05
BV Treated Constant Diffusivity	BV Number	51,000/85,400 ¹	92,000	91,000
Estimated Media Life	Days	968/1621	1,747	1,728
Annual Replacement Cost	\$/Year	104,640/62,480 ¹	81,540	82,440
BV Treated Proportional Diffusivity	BV Number	29,700/46,600 ¹	53,600	53,000
Estimated Media Life	Days	564/886	1,018	1,007
Annual Replacement Cost	\$/Year	180,000/114,000 ¹	140,000	141,000

¹Calgon F-400 using the RSSCT design scaling factor and an adjusted scaling factor using a full scale mean particle diameter of 1.1 mm in place of the geometric mean.

The media life to breakthrough for the removal of PFOS is estimated to be up to a maximum of 4.5 years using the constant diffusivity scaling factor. The media life for other PFAS compounds is estimated to be up to 2.5 years using the adjustment to the scaling factor to account for the influence of the particle size on adsorption rate. After adjustment of the scaling factor for the Calgon F-400 all three GAC media provided similar removal of the primary PFAS contaminant, PFOS and very manageable replacement frequency. Even though the F-400 did not provide as long a bed life, it has the lowest operating cost because the price for regenerated media was the lowest.

4.3 ION EXCHANGE RSSCT RESULTS

4.3.1 General Chemistry

Table 4-7 presents the general water chemistry results for the raw water and the IX effluent samples. The column labeled 'concentration removed' is included to demonstrate the difference between the raw and ion-exchange effluent concentration in paired samples resulting from the IX media adsorption. The table presents the average value and range of values for each parameter. Overall, no significant differences in general water chemistry were observed between the raw water and IX effluent samples, except for HPC. For some of the samples, the IX effluent

had greater concentrations of HPC compared to the influent, however, the results were variable. It appears likely that there was some biological activity occurring in the column, but it did not appear to have a significant effect on fouling, as the column influent pressure experienced only a minimal and consistent increase throughout testing.

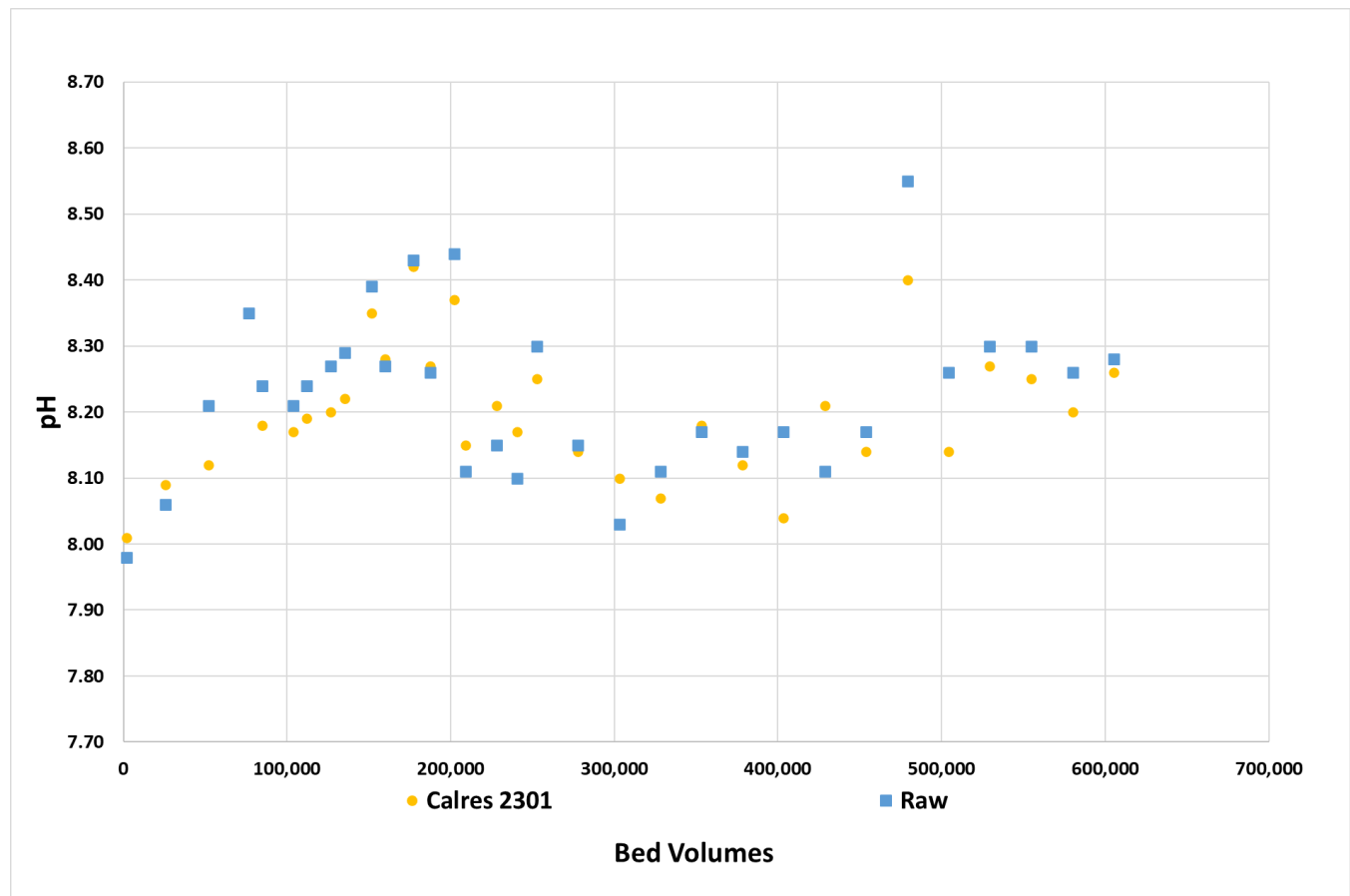
In Figure 4-5, the pH measured in both the IX column and raw water is reported over the testing period. The pH values of the raw water and IX effluent samples remained similar throughout the study. The maximum change in pH was a single measurement where the IX effluent was 0.15 pH units below the raw water. The rest of the measurements were within 0.05 pH units which is not a significant change.

Table 4-7. General Water Chemistry: IX Results^{1,2}

Parameter	Raw Water	IX	MCL	Concentration Removed ³
TOC (mg/L)	1.04 (0.98 - 1.12)	0.98 (0.79 - 1.19)	-	0.02 (-0.07 – 0.33)
UVA (nm)	0.017 (0.013 - 0.02)	0.013 (0.005 - 0.02)	-	--
Temperature (°C)	24.9 (24.2 - 25.8)	24.6 (23.7 - 25.8)	-	--
TDS (mg/L)	431 (420 - 450)	417 (400 - 430)	500	2.78(0 - 40)
Total Iron (mg/L)	<0.010	<0.010	0.3	0
Arsenic (ug/L)	1.01 (<1.0-1.1)	<1.01 (<1.0-1.1)	10	0
Calcium (mg/L)	84.1 (82 - 86)	84.3 (82 - 86)	-	-0.03 (-1 - 0)
Magnesium (mg/L)	23.4 (23 - 24)	23.4 (23 - 24)	-	0
Alkalinity (mg/L)	269 (260 - 270)	270	-	-0.28(-10 - 0)
Fluoride (mg/L)	0.19 (0.19 - 0.2)	0.19 (0.19 - 0.2)	2.0	0
Chloride (mg/L)	55.4 (53 - 57)	55.4 (52 - 59)	250	0(-2 - 2)
Sulfate (mg/L)	30.7 (29 - 32)	30.14 (29 - 31)	-	0.11(0 - 2)
Nitrate (mg/L)	0.798 (0.62 - 0.96)	0.766 (0.33 - 0.96)	10	0.01 (-0.06 - 0.31)
Nitrite (mg/L)	<0.040	<0.040	1.0	0
Orthophosphate (mg/L)	0.065 (0.04 - 0.08)	0.063 (0.04 - 0.08)	-	0 (0 - 0.01)
Heterotrophic Plate Count (CFU/mL)	537 (40 – TNTC ⁴)	802 (30 - 2100)	500 ⁵	-51.44 (-890 - 440)

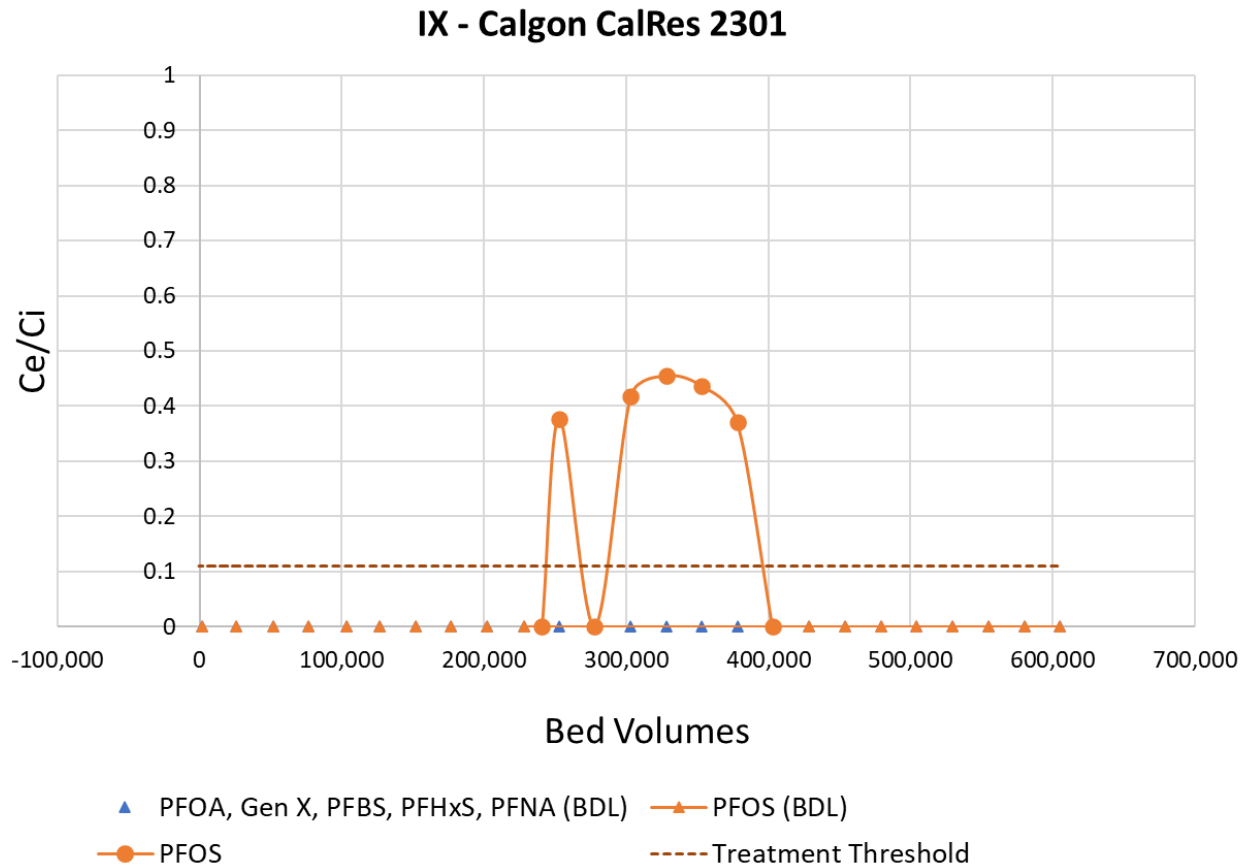
1. The values in the table represent the average, followed by the range of minimum – maximum in parentheses.
2. Values shown as less than (“<”) were reported as below the method detection limit.
3. Concentration removed is calculated as the difference between IX effluent and raw water samples for each sample pair collected on the same day, and the range of concentrations removed are the values that are shown.
4. TNTC: Too Numerous to Count
5. Not an MCL but the value EPA recommends be maintained to prevent interference with detection of other organisms such as coliforms.

Figure 4-5: pH: IX Results



4.3.2 PFAS

The level of breakthrough is portrayed in Figure 4-6 for the IX removal media. Of the measured PFAS compounds, PFOS was the only compound to be detected above the detection limit in the effluent samples. A spike was observed in the results and breakthrough curve mid-study (~250-300,000 bed volumes). However, values subsequently returned at 400,000 bed volumes to the range observed at the beginning of the study, all less than the detection limit. The influent concentration to the column was not spiked and the values measured during the spike up to 2.5 ng/L were still very close to the method detection limit of 1.9 ng/L. For the purpose of estimating the media life, breakthrough was assumed to have occurred at around 284,000 bed volumes. A second RSSCT with a PFAS spike or a pilot test would be required to determine if the spike was an anomaly, and breakthrough would occur up to 600,000 bed volumes as indicated by the end of the RSSCT results. The results are also reported in Table 4-8, demonstrating the performance of PFAS removal media compared to the raw water samples and the respective MCLs. Similarly to the GAC media, IX achieved effective PFAS removal, yielding effluent concentrations below the influent concentrations and MCLs. The average of hazard index values calculated for the IX effluent samples in this study was below the compliance threshold of 1.0.

Figure 4-6: PFAS Breakthrough Curves: IX Results¹

1. Raw water values were interpolated for when effluent measurements were recorded but raw water measurements were not collected.
2. Ce/Ci is set to 0 for cases where both raw and IX effluent samples were reported below the detection limit.
3. Effluent samples were reported below the detection limit. Ce was set to detection limit.

Table 4-8. Performance Comparison of PFAS Removal Media: IX Results^{1,2}

Parameter	Raw Water	IX	MCL
PFOS (ng/L)	5.22 (4.2 - 6.0)	1.98 (<1.9 - 2.5)	4.0
PFOA (ng/L)	<2.0	<2.0	4.0
PFHxS (ng/L)	<2.0	<2.0	10 & HI
GenX (ng/L)	<2.0	<2.0	10 & HI
PFNA (ng/L)	<2.0	<2.0	10 & HI
PFBS (ng/L)	<2.0	<2.0	HI
Calculated average Hazard Index ³	-	<0.58	>1.0

1. The values in the table represent the average, followed by the range of minimum – maximum in parentheses.
2. Values shown as less than (“<”) were reported as below the method detection limit. For consistency and simplicity, the maximum method detection limit reported corresponds to the value provided in the table.
3. The hazard index was calculated for each sample date, and the reported value represents the average. Measurements reported below the detection limit were substituted with the detection limit value for calculation purposes.

4.3.3 Projected Full Scale Performance

The raw water sample collected for the RSSCT only contained detectable concentrations of PFOS which was also the primary contaminant of interest from sampling previously performed which was summarized in Table 1-1. However, PFOA was also detected above the MCL in two (2) of the well samples but at a much lower concentration than PFOS in all the samples. PFOA tends to break through faster than PFOS. However, for the purposes of analyzing the RSSCT results and scaling up to full-scale performance we are assuming that control of PFOS to non-detect will also control PFOA which was only 1/4 to 1/3 the concentration of PFOS in the raw water. The PFOS concentration in the raw water sample used for the RSSCT ranged from 4.2 to 5.4 ng/L with an average concentration of 5.0 ng/L. This concentration is lower than the average the well concentration in Table 1-1 which was 17.4 ng/ measured in September 2023. Using that average concentration the target C_e/C_i ratio would be $(1.9 \text{ ng/L} / 17.4 \text{ ng/L}) 0.109$ to maintain the PFOS effluent concentration at or below the detection limit. A C_e/C_i of 0.11 was used to interpolate the number of bed volumes treated prior to exceeding that value for the IX resin tested as shown in Figure 4-6. Interpolating the bed volumes treated between the last non-detect value and the first C_e/C_i value indicates that 284,000 bed volumes were treated when C_e/C_i reached 0.11.

The new PFAS treatment system will be designed based upon the projected 2045 maximum daily demand of 5.58 MGD. The key design parameters are an empty bed contact time of 2.1 minutes and a surface loading rate less than 18 gpm/square foot. A set of three 12-foot diameter vessel pairs, each pair operating in series will satisfy the design requirements. The bed volume of the IX system was utilized in combination with the bed volume treated and the average annual demand to determine the bed life for each IX media. The new PFAS treatment system is not anticipated to be online and requiring media replacement prior to 2030. Therefore, the 2030 average annual demand of 2.05 MGD was utilized to estimate the bed life and annual cost of media replacement. This information is summarized in Table 4-9.

Table 4-9. Projected Full-Scale IX Operating Information

IX Media		Calgon CalRes 2301
Design Flow Rate	MGD	5.95
Number of Vessel Pairs	Number	3
Vessel Diameter	Feet	12
Vessel Area	Square Feet	113
Surface Loading Rate	GPM/SF	11.4
Media Depth	Feet	3.2
Media Volume	Cubic Feet	362
Empty Bed Contact Time	Minutes	2.1
2030 Average Annual Demand	MGD	2.05
BV Treated (Constant Diffusivity)	BV Number	284,000
Estimated Media Life	Days	1125
Annual Replacement Cost	\$/Year	156,000

The IX media tested provided good removal of the target PFAS compound, PFOS, and has an estimated media life of at least 2.6 years. Media life could be much more than that if the spike in concentration that occurred in the middle of the test was an anomaly. The spike that was measured was less than 1 ng/L above the method detection

limit and may be related to the precision of the analytical method at this low concentration. However, this can only be confirmed by additional testing with a higher raw water concentration in a new RSSCT or by pilot testing which would be more accurate and representative of full-scale operation. It is still a viable method of removing PFAS, especially PFOS, from this raw water although at 3 years media life the annual media replacement cost is somewhat greater than the GAC media tested.

5.0 CONCLUSIONS AND RECOMMENDATIONS

PFOS was the only compound detected above the method detection limit in the raw water samples collected for this test, with an average concentration of 5.22 ppt and a maximum of 6.0 ppt, exceeding the EPA maximum contaminant level (MCL) of 4.0 ppt. All three GAC media and the IX media evaluated in this RSSCT effectively reduced PFOS concentrations to levels below the EPA MCL and the detection limit. Earlier sampling of the wells summarized in Table 1-1 showed concentrations of PFOA exceeding the regulatory MCL which was not detected in the raw water sample used for this testing. PFAS other than PFOS have been shown to not exactly follow the constant diffusion model for scale up of the RSSCT results. Therefore, a correction factor was applied to the scaling factor to account for some dependence upon particle size or proportional diffusion in the results. Using this approach yields a GAC media life of approximately 2.5 years which is recommended for planning purposes. If only PFOS is present in the raw water this represents a very conservative estimate of media life that can be adjusted based upon full-scale operating results.

The raw data from the GAC show that the Norit and Evoqua media had significantly longer life to break through than the Calgon media. The scaling factor used to design the RSSCT was calculated by the geometric mean to estimate the mean particle diameter of the full-scale media. Calgon guidelines for RSSCT indicate that a mean particle diameter of 1.1 mm should be used for the full-scale F-400 media. Making that adjustment to the RSSCT results increased the Calgon F-400 to approximately 85,000 bed volumes which is very close to the life of the other media. Use of any of the three media tested can produce finished water with PFAS concentrations below the detection limit with a small advantage given to the Norit and Evoqua media in terms of bed life based upon this specific test.

The IX media tested was able to remove PFOS concentration to below the detection limit for at least the first 284,000 bed volumes and possibly up to 600,000 bed volumes. The spike in concentration detected in the middle of the test period was only 0.6 ng/L above the detection limit and could have more to do with the precision of the test method than an actual breakthrough. The operating cost projected at the lower bed life was slightly higher than the projected GAC media replacement cost. Another RSSCT with a spike added to the raw water or a pilot test would be required to confirm that the extended bed life could be achieved. Since the media depth for IX media is significantly less than the GAC media depth the GAC media could be replaced in the future with IX media with a modification to the vessel inlet. Therefore, it is recommended that the City proceed with implementation of a GAC treatment system unless additional testing is performed to verify the life of the IX media.

APPENDIX A. MEDIA MANUFACTURER INFORMATION

NORIT® GAC 400

Granular Activated Carbon

WHY NORIT

Since 1918, we have been helping our customers to make pure products, reach environmental compliance, and create catalytic performance. As one of the largest activated carbon manufacturers globally, we provide quality and stability. We offer a very diverse set of NORIT activated carbon products, many of them yielding truly unique performance benefits. Our experienced staff, including dedicated application specialists, can help you find a best fitting solution for your specific situation.



NORIT GAC 400 granular activated carbon is produced by steam activation of select grades of coal. As a result of a unique patented activation process and stringent quality control, NORIT GAC 400 granular activated carbon offers excellent adsorption properties and is recommended for removal of impurities from water and industrial process applications.

NORIT GAC 400 granular activated carbon meets all AWWA B604 standard for potable water use and meets NSF/ANSI Standard 61. PRODUCTNAME] is Halal and Kosher certified and meets the requirements of the latest version of the U.S. Food and Chemicals Codex.

SPECIFICATIONS

Iodine number	min. 1000	-
Abrasion number (AWWA)	min. 75	-
Particle size > 12 mesh (1.70 mm)	max. 5	%
Particle size < 40 mesh (0.425 mm)	max. 4	%
Moisture (as packed)	max. 2	%

GENERAL CHARACTERISTICS

Apparent density, vibrating feed	0.48	g/ml
	30	lb/ft³
Density, backwashed and drained	26	lb/ft³
Effective size	0.65	mm
Uniformity coefficient	1.7	-

NORIT® GAC 400

Granular Activated Carbon

NOTES

1. For important product safety, health, environmental and regulatory information, please refer to the Safety Data Sheet (SDS) which is available upon request.
2. General characteristics reflect representative values of product parameters and are not to be used as purchase specifications.
3. All analyses based on standard test methods and specifications are guaranteed values based on lot-to-lot quality control, as covered by Norit Activated Carbon's ISO 9001 certification.

PACKAGING

This product is available in:

- 55 lb bag, 45 bags per pallet for a net pallet weight of 2475 lb
- Woven polypropylene bulk bag, 1000 lb net
- Bulk trailer

Product availabilities depend on the type of packaging.



norit.com

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Westates® Coal Based Granular Activated Carbon - UltraCarb® 1240LD10 Carbon

UltraCarb 1240LD is a virgin granular activated carbon produced from select grades of coal by a high temperature, steam activation process under strict quality control. These materials have a large surface area, very good mechanical hardness, unique pore size distribution, low density, chemical stability and are well suited for liquid phase adsorption applications.

Applications

Cost-effective 1240LD carbon developed by Evoqua has been demonstrated to provide superior performance in an extensive array of liquid phase treatment applications. UltraCarb 1240LD carbon is suitable for:

- Removal of organic contaminants
- Decolorization
- Amine purification
- Glycol purification
- Chemical purification
- Perfluorinated Compounds (PFCs) treatment for drinking water

Typical Properties:	
Parameter	UC1240LD10
Material	Sub-bituminous coal
Mesh Size, U.S. Sieve	12x40
	>12 mesh, 5%
	<40 mesh, 4%
Iodine Number, mg/g	1000 min.
Abrasion Number, min	70
Effective Size, mm	0.55 – 0.75
Uniformity Coefficient	<1.9
Moisture (as packed)	2% max.
Apparent Density, g/cc	0.36 - 0.42
Total Ash, max	15%

Features and Benefits

- ANSI/NSF Standard 61 approved
- Conforms to requirements established by the current ANSI/AWWA B604
- A detailed quality assurance program guarantees consistent quality from lot to lot and shipment to shipment

Quality Control

UltraCarb activated carbons are extensively quality checked at our State of California certified environmental and carbon testing laboratory located in Los Angeles, CA. Evoqua's laboratory is fully equipped to provide complete quality control analyses using ASTM standard test methods in order to assure the consistent quality of all Westates® carbons. Our technical staff offers hands-on guidance in selecting the most appropriate system, operating conditions and carbon to meet your needs. For more information, contact your nearest Evoqua representative

210 Sixth Avenue, Pittsburgh, PA 15222
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environmentalsolutions@evoqua.com
www.evoqua.com

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FILTRASORB® 400

Granular Activated Carbon



FILTRASORB 400 activated carbon can be used in a variety of liquid phase applications for the removal of dissolved organic compounds. FILTRASORB 400 has been successfully applied for over 40 years in applications such as drinking and process water purification, wastewater treatment, and food, pharmaceutical, and industrial purification.

APPLICATIONS

- Municipal Drinking Water
- Industrial Wastewater
- Pond/Aquarium
- Pharmaceuticals
- Environmental Water Processing
- Water Reuse
- Surface Water
- Groundwater
- Food & Beverage
- Bottling & Brewing

DESCRIPTION

FILTRASORB 400 is a granular activated carbon (GAC) for the removal of dissolved organic compounds from water and wastewater as well as industrial and food processing streams. These contaminants include taste and odor compounds, organic color, total organic carbon (TOC), and industrial organic compounds such as TCE, PCE, and PFAS.

Filtrisorb 400 is made from select grades of bituminous coal through a process known as reagglomeration to produce a high activity, durable, granular product capable of withstanding the abrasion associated with repeated backwashing, hydraulic transport, and reactivation for reuse. The raw coal is mined and subsequently manufactured into GAC in the United States to ensure the highest quality and consistency in the finished product. Activation is carefully controlled to produce a significant volume of both low and high energy pores for effective adsorption of a broad range of high and low molecular weight organic contaminants.

FILTRASORB 400 is formulated to comply with all the applicable provisions of the AWWA Standard for Granular Activated Carbon (B604) and Food Chemicals Codex. FILTRASORB 400 is also certified to the requirements of NSF/ANSI 61 for use in municipal water treatment facilities. Only products bearing the NSF Mark are certified to the NSF/ANSI 61 - Drinking Water System Components - Health Effects standard. Certified Products will bear the NSF Mark on packaging or documentation shipped with the product.

Specifications

Iodine Number, mg/g	1,000 (min)
Moisture by Weight	2% (max)
Effective Size	0.55–0.75 mm
Uniformity Coefficient	1.9 (max)
Abrasion Number	75 (min)
Screen Size by Weight, US Sieve Series	
On 12 mesh	5% (max)
Through 40 mesh	4% (max)

Typical Properties

Apparent Density (tamped)	0.57 g/cc
Water Extractables	<1%
Non-Wettables	<1%

FEATURES & BENEFITS

- Produced in the United States from a pulverized blend of high quality, domestically mined bituminous coals resulting in a consistent, high quality product.
- Carbon granules are uniformly activated through the whole granule, not just the outside, resulting in excellent adsorption properties and consistent adsorption kinetics.
- The reagglomerated structure ensures proper wetting and minimal floating material.
- High mechanical strength relative to other raw materials, thereby reducing the generation of fines during backwashing and hydraulic transport.
- Carbon bed segregation is retained after repeated backwashing, ensuring the adsorption profile remains unchanged and therefore maximizing the bed life.
- Reagglomerated with a high abrasion resistance, which provides excellent reactivation performance.
- High density carbon resulting in a greater adsorption capacity per unit volume.
- Carbon is preconditioned to reduce the release of soluble inorganics and thus reduce the volume of rinse water needed during the start-up and conditioning.

SAFETY MESSAGE

Wet, activated carbon can deplete oxygen from air in enclosed spaces. If use in an enclosed space is required, procedures for work in an oxygen deficient environment should be followed.

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BACKWASH AND CONDITIONING

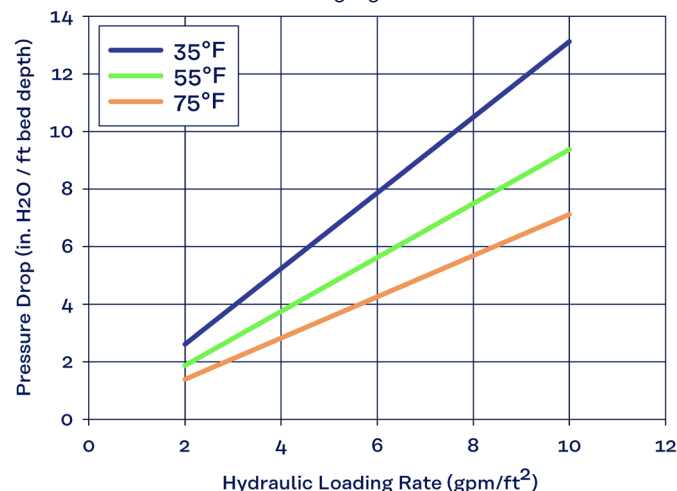
Prior to placing a recently filled granular activated carbon (GAC) vessel online, adequate media backwash and media conditioning are required. The following steps are intended to serve as guidelines to condition GAC media prior to placing the system in service. These steps may be able to be tailored to accommodate site specific constraints. For more information, please contact your Calgon Carbon sales or technical representative.

INITIAL BACKWASH

Following GAC media exchange, slowly fill the vessel with potable water in the up-flow direction until the vessel is full. Fill using flow rates that provide less than 5% bed expansion. Soak the new GAC media overnight (approx. 16 hours) to degas the media bed. Once the soaking period is complete, conduct a start-up backwash (up-flow operation) per the steps outlined below:

TYPICAL CLEAN-BED PRESSURE DROP

Based on a backwashed and segregated bed



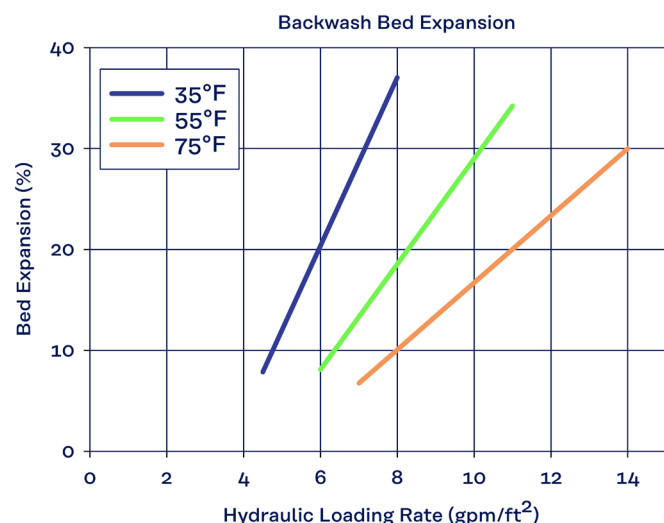
Startup Backwash

1. Flow @ 5% expansion for 2 minutes
2. Flow @ 10% expansion for 2 minutes
3. Flow @ 15% expansion for 2 minutes
4. Flow @ 30% expansion for 30 minutes
5. Flow @ 15% expansion for 2 minutes
6. Flow @ 10% expansion for 2 minutes
7. Flow @ 5% expansion for 2 minutes

Refer to the bed expansion curve to determine the flowrates needed at each step.
Please note, an identical backwash procedure is recommended when a media vessel is restarted after an extended shutdown or restarted after the bed has been drained.

TYPICAL BED EXPANSION DURING BACKWASH

Based on a backwashed and segregated bed



DESIGN CONSIDERATIONS

FILTRASORB 400 activated carbon is typically applied in down-flow packed-bed operations using either pressure or gravity systems. Design considerations for a treatment system is based on the user's operating conditions, the treatment objectives desired, and the chemical nature of the compound(s) being adsorbed.

SAFETY MESSAGE

Wet, activated carbon can deplete oxygen from air in enclosed spaces. If use in an enclosed space is required, procedures for work in an oxygen deficient environment should be followed.

CALRES™ 2301

Strong Base Anion Exchange Resin



Calgon Carbon offers a range of proprietary, high quality products under the CalRes brand, including CalRes 2301. This product was designed specifically to remove PFAS (poly-and perfluoroalkyl substances). CalRes 2301 is a selective strong base anion resin that possesses distinctive functionality provided in the chloride form.

APPLICATIONS

- PFAS
 - Groundwater
 - Surface Water
- Industrial/environmental water remediation

DESCRIPTION

CalRes 2301 is a styrene-based polymer resin with tributylamine functional groups which makes it highly selective for PFAS. CalRes 2301 is formulated to be certified to the requirements of NSF/ANSI/CAN 61 for use in municipal water treatment facilities. Only products bearing the NSF Mark are certified to the NSF/ANSI/CAN 61 - Drinking Water System Components - Health Effects standard. Certified Products will bear the NSF/WQA Gold Seal on packaging or documentation shipped with the product.

FEATURES & BENEFITS

- CalRes 2301 has a macroporous structure that allows for increased diffusion rates into the bead enhancing its performance.
- Consistent record of PFAS removal performance
- CalRes 2301 is the only PFAS resin recommended for surface water treatment because it can be disinfected with low levels of chlorine. Alternatively, gel resins will not withstand a chlorine disinfection.
- Calgon Carbon offers large equipment systems and related turnkey field services. Services include resin delivery and installation, as well as spent resin removal and disposal.
- Calgon Carbon has extensive technical support along with ISO 9001 certified quality control.

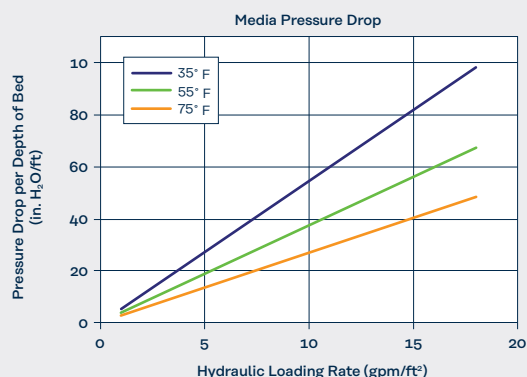
Physical and Chemical Properties

Type	Strong Base Anion (SBA)
Base Structure Polymer	Styrene
Matrix	Macro
Physical Form	Spherical Beads
Ionic Form	Chloride
Total Exchange Capacity	Min: 0.51 eq/L
Water Retention Capacity	48-60 wt%
Particle Size (Typical)	580 µm +/- 50 µm (16 x 50 US MESH)
Shipping Weight	40-47 lbs/cf

SAFETY

Before handling or using this product, please consult the current Safety Data Sheet.

Warning: Before using strong oxidizing agent, please consult knowledgeable sources for handling such material as these agents, such as nitric acid, can attack these organic resins under certain conditions and result in a slightly degraded resin up to an explosive reaction. Preferred storage is to be between 0-50C in a dry place.



MEDIA CONDITIONING

Virgin CalRes 2301 resin must be conditioned prior to use to remove any residues from the manufacturing process. Calgon Carbon suggests a conditioning step of up to 40 bed volumes prior to startup. A pre-installation conditioning can be performed by Calgon Carbon at our facilities at the customer's request. Please contact Calgon Carbon for more information about this process or backwashing of the resin.

APPENDIX B. MEDIA PREPARATION FOR RSSCT

Media Preparation for RSSCT

GAC Media Preparation

1. In a clean mortar and pestle grind the GAC sample to a size that can pass through the 140 mesh screen. Continue grinding the carbon sample and sieving through the 140 mesh sieve to obtain about 50 mL of the ground GAC.
2. Sieve that 50 mL sample with the smaller 170 mesh sieve to pass through any particles less than the screen size. Weigh a clean 50 mL beaker and record the weight to the nearest 0.1 mg. Retain the portion of media remaining on the screen and place about 25 mL of it in the 50 mL beaker.
3. Wet sieve the 25 mL sample with deionized water until the water runs clear and the fines have been removed. Record volume of water used to rinse the GAC.
4. Place the sample back in the beaker and then place the beaker in the oven at 105°C for 24 hours to remove the remaining water.
5. Place the beaker with the media in the dessicator to cool. After the beaker and media have cooled to room temperature weigh the beaker and media recording the weight to the nearest 0.1 mg.
6. After weighing add approximately 20 mL of deionized water to the beaker and place it back in the dessicator under vacuum. The water and vacuum applied are to remove any air from the carbon pores. This will be the slurry that will be added to the test column. The sample should remain under vacuum for at least 24 hours.
1. After placing the media in the column, deionized water should be circulated through the column in the reverse direction (upflow) at a low rate to make sure any trapped air has been removed. Continue this step for up to two hours checking to see that there are no air bubbles in the water after it has passed through the column.

IX Media Preparation

2. Grind the resin to a size that can pass through the 140 mesh screen. Continue grinding the carbon sample and sieving through the 140 mesh sieve to obtain about 50 mL of the ground GAC.
3. Sieve that 50 mL sample with the smaller 170 mesh sieve to pass through any particles less than the screen size. Weigh a clean 50 mL beaker and record the weight to the nearest 0.1 mg. Retain the portion of resin remaining on the screen and place about 25 mL of it in the 50 mL beaker.
4. Wet sieve the 25 mL sample with deionized water until the water runs clear and the fines have been removed. Record volume of water used to rinse the IX.
5. Let the sample sit for 24 hours to allow for swelling prior to placing in the column.
6. Deionized water should be circulated through the column in the reverse direction (upflow) at a low rate to make sure any trapped air has been removed. Continue this step for up to two hours checking to see that there are no air bubbles in the water after it has passed through the column.

Test Column Setup

1. Install the stopper in the bottom of the glass column. Attach the tubing and valve and close the valve. Place glass wool into the column and gently pack it down to create a layer of glass wool approximately 1.5 cm tall with a flat surface on top.
2. Pour the mixture of ground GAC or IX and water from the beaker into the column to obtain a media depth per the developed testing parameters. Rinse the sides of the column to make sure all the media is at the bottom and none is adhering to the sides.
3. Loosely place approximately 1.5 cm of glass wool on top of the media layer. Fill the column to the top with deionized water.
4. Place the beakers with remaining GAC and any liquid back in the drying oven to evaporate the remaining water. Remove the beaker from the drying oven and place it in the dessicator. After the beaker and contents have cooled to room temperature weigh the beaker and remaining media and record the weight to the nearest 0.1 mg.
5. Retain the IX media that has been prepared for the column but not placed into the column. Measure a volume in a graduated cylinder that is greater than 10 mL and record volume. Transfer that to a clean, weighed 50 mL beaker and decan any excess water. Place the beaker and media in the vacuum dessicator to dry. Leave in the dessicator for 5 to 7 days and remove for weighing. Place the beaker back in the dessicator and weigh again the following day. Continue weighing each day until a consistent weight is obtained.

APPENDIX C. RSSCT RESULTS

Indian Hill PFAS RSSCT

Field Sample Data Collection Log

Raw Water									PFAS					
Date	Time	Sampler/Operator	Temp. (°C)	pH	Conductivity (µs/cm)	UV-254 (nm)	Pressure (psi)	Totalized Flow (L)	PFOA (ng/L)	PFOS (ng/L)	Gen X (HFPO-DA) (ng/L)	PFBS (ng/L)	PFHxS (ng/L)	PFNA (ng/L)
7/3/2025	9:00 AM	PE	24.30	7.98	714	0.018		0.50	<1.9	5.4	<1.9	<1.9	<1.9	<1.9
7/3/2025														
7/4/2025	8:10 AM	ZSP	25.20	8.06	707	0.015								
7/4/2025														
7/5/2025	8:33 AM	ZSP	25.40	8.21	737	0.014			<1.9	4.7	<1.9	<1.9	<1.9	<1.9
7/5/2025														
7/6/2025	8:20 AM	MR	25.30	8.35	730	0.019								
7/6/2025	5:04 PM	AP	25.80	8.24	759	0.017								
7/7/2025	10:00 AM	PE	25.00	8.21	716	0.017			<2.0	4.2	<2.0	<2.0	<2.0	<2.0
7/7/2025	5:11 PM	ZSP		8.24		0.016								
7/8/2025	8:20 AM	PE	24.60	8.27	750	0.017								
7/8/2025	5:10 PM	ZSP		8.29		0.017								
7/9/2025	8:14 AM	MR	24.60	8.39	732	0.017			<1.9	4.9	<1.9	<1.9	<1.9	<1.9
7/9/2025	4:00 PM	PE	24.20	8.27	759	0.015								
7/10/2025	10:01 AM	MR	24.60	8.43	739	0.016								
7/10/2025	5:07 PM	ZSP		8.26		0.018								
7/11/2025	8:20 AM	ZSP	24.50	8.44	739	0.018			<1.9	5.4	<1.9	<1.9	<1.9	<1.9
7/11/2025	2:30 PM	PE	24.50	8.11	728	0.017								
7/12/2025	8:11 AM	ZSP	24.50	8.15	762	0.018								
7/12/2025	5:17 PM	ZSP	24.40	8.10		0.018								
7/13/2025	8:00 AM	PE	25.10	8.30	750	0.013			<1.9	5.3	<1.9	<1.9	<1.9	<1.9
7/14/2025	8:52 AM	AP	24.60	8.15	753	0.019								
7/15/2025	8:10 AM	MR	24.80	8.03	759	0.018			<1.9	5.5	<1.9	<1.9	<1.9	<1.9
7/16/2025	8:15 AM	JT	25.20	8.11	755	0.019								
7/17/2025	8:03 AM	MR	24.70	8.17	744	0.019			<1.9	5.5	<1.9	<1.9	<1.9	<1.9
7/18/2025	8:15 AM	AP	24.80	8.14	747	0.017								
7/19/2025	8:00 AM	AP	25.10	8.17	755	0.016			<2.1	5.3	<2.1	<2.1	<2.1	<2.1
7/20/2025	8:47 AM	MR	25.50	8.11	757	0.018								
7/21/2025	8:03 AM	MR	24.50	8.17	747	0.015			<1.9	5.1	<1.9	<1.9	<1.9	<1.9
7/22/2025	8:20 AM	PE	24.50	8.55	737	0.017								
7/23/2025	8:03 AM	MR	24.70	8.26	749	0.018			<1.9	6	<1.9	<1.9	<1.9	<1.9
7/24/2025	8:30 AM	PE	24.60	8.30	752	0.016								
7/25/2025	8:00 AM	JT	25.10	8.30	751	0.018			<2.0	5.3	<2.0	<2.0	<2.0	<2.0
7/26/2025	8:30 AM	JT	25.00	8.26										
7/27/2025	8:30 AM	JT	25.80	8.28										
7/28/2025	8:05 AM	JT	24.80	8.38										

Indian Hill PFAS RSSCT

Field Sample Data Collection Log

Raw Water														
			Anions		Metals									
Date	TOC (mg/L)	TDS (mg/L)	Chloride (mg/L)	Sulfate (mg/L)	Calcium (mg/L)	Iron (mg/L)	Magnesium (mg/L)	Arsenic (ug/L)	Total Alkalinity (mg/L)	Fluoride (mg/L)	NO2 (mg/L)	NO3 (mg/L)	Orthophosphate (mg/L)	HPC (CFU/mL)
7/3/2025	1.12	440	57	32	84	<0.010	24	<1.0	270	0.19	<0.040	0.64	0.046	TNTC
7/3/2025														
7/4/2025														
7/4/2025														
7/5/2025	1.05													
7/5/2025														
7/6/2025														
7/6/2025		440	57	32	84	<0.010	23	1.1	270	0.19	<0.040	0.62	0.068	290
7/7/2025	1.10													
7/7/2025														
7/8/2025		450	56	31	85	<0.010	24	<1.0	270	0.19	<0.040	0.64	0.072	290
7/8/2025														
7/9/2025	1.05													
7/9/2025														
7/10/2025		430	55	31	86	<0.010	24	<1.0	270	0.19	<0.040	0.77	0.066	510
7/10/2025														
7/11/2025	1.04													
7/11/2025														
7/12/2025											<0.040	0.96	0.073	1210
7/12/2025														
7/13/2025	0.99													
7/14/2025		420	53	29	85	<0.010	23	<1.0	270	0.19	<0.040	0.96	0.073	1210
7/15/2025	0.98													
7/16/2025														
7/17/2025	1.09													
7/18/2025														
7/19/2025	1.01													
7/20/2025														
7/21/2025	1.12	420	54	30	83	<0.010	23	<1.0	270	0.2	<0.040	0.96	0.044	40
7/22/2025														
7/23/2025	0.99													
7/24/2025														
7/25/2025	1.00													
7/26/2025														
7/27/2025														
7/28/2025		420	56	30	82	<0.010	23	<1.0	260	0.19	<0.040	0.83	0.078	210

Wild Sample Data Collection Log

[illegible]

Field Sample Data Collection Log

GAC 2 Effluent									PFAS					
Date	Time	Sampler/Operator	Temp. (°C)	pH	Conductivity (µs/cm)	UV-254 (nm)	Pressure (psi)	Totalized Flow (L)	PFOA (ng/L)	PFOS (ng/L)	Gen X (HPFO-DA) (ng/L)	PFBS (ng/L)	PFHxS (ng/L)	PFNA (ng/L)
7/3/2025	8:45 AM	PE	24.20	8.00	696	0.001	0.00	0.50	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9
7/3/2025														
7/4/2025	8:02 AM	ZSP	24.90	8.03	749	0.004	1.00	9.00	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9
7/4/2025														
7/5/2025	8:36 AM	ZSP	25.00	8.10	756	0.005	1.00	18.40	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9
7/5/2025														
7/6/2025	8:34 AM	MR	25.10	8.34	757	0.010	6.00	27.10	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9
7/6/2025	4:58 PM	AP	25.90	8.10	763	0.013	5.50	30.20	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9
7/7/2025	10:20 AM	PE	24.40	8.16	742	0.010	0.00	36.80	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9
7/7/2025	5:03 PM	ZSP		8.17		0.012	0.00	39.70	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9
7/8/2025	8:20 AM	PE	24.80	8.20	748	0.014	2.10	45.00	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9
7/8/2025	5:03 PM	ZSP		8.20		0.015	3.50	48.20	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9
7/9/2025	8:32 AM	MR	24.40	8.35	743	0.012	0.00	53.90	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9
7/9/2025	4:00 PM	PE	24.00	8.29	746	0.013	0.50	56.90	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
7/10/2025	9:45 AM	MR	24.40	8.35	734	0.014	1.50	62.90	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9
7/10/2025	5:03 PM	ZSP		8.30		0.014	2.00	66.70	<1.9	2.10	<1.9	<1.9	<1.9	<1.9
7/11/2025	8:04 AM	ZSP	24.40	8.32	735	0.015	3.00	72.00	<1.9	2.20	<1.9	<1.9	<1.9	<1.9
7/11/2025	2:30 PM	PE	24.30	8.19	735	0.014	3.50	74.30	<2.0	2.30	<2.0	<2.0	<2.0	<2.0
7/12/2025	8:06 AM	ZSP	24.40	8.17	735	0.014	4.50	81.20	<1.9	2.20	<1.9	<1.9	<1.9	<1.9
7/12/2025	5:10 PM	ZSP	24.40	8.17		0.015	4.50	85.70	<1.9	2.40	<1.9	<1.9	<1.9	<1.9
7/13/2025	8:00 AM	PE	25.00	8.28	734	0.011	5.00	89.90	<1.9	2.50	<1.9	<1.9	<1.9	<1.9
7/14/2025	8:30 AM	AP	24.50	8.13	752	0.016	5.50	98.80						

[illegible]

Field Sample Data Collection Log

GAC 3 Effluent									PFAS					
Date	Time	Sampler/Operator	Temp. (°C)	pH	Conductivity (µS/cm)	UV-254 (nm)	Pressure (psi)	Totalized Flow (L)	PFOA (ng/L)	PFOS (ng/L)	Gen X (HFPO-DA) (ng/L)	PFBS (ng/L)	PFHxS (ng/L)	PFNA (ng/L)
7/3/2025	8:50 AM	PE	24.10	8.02	725	0.000	0.00	0.50	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9
7/3/2025														
7/4/2025	8:04 AM	ZSP	24.90	8.13	750	0.002	1.00	9.00	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9
7/4/2025														
7/5/2025	8:39 AM	ZSP	24.90	8.17	756	0.003	1.50	18.30	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9
7/5/2025														
7/6/2025	8:44 AM	MR	25.20	8.35	742	0.011	1.50	26.90	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9
7/6/2025	4:35 PM	AP	25.80	8.20	754	0.009	1.50	29.90	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9
7/7/2025	10:25 AM	PE	24.10	8.15	708	0.006	2.00	36.40	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9
7/7/2025	5:07 PM	ZSP		8.18		0.010	4.00	39.40	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9
7/8/2025	8:20 AM	PE	24.50	8.22	738	0.012	2.00	44.60	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9
7/8/2025	5:05 PM	ZSP		8.24		0.013	3.00	47.70	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9
7/9/2025	8:38 AM	MR	23.90	8.40	740	0.012	0.00	53.40	<1.9	<1.9	<1.9	1.90	<1.9	<1.9
7/9/2025	4:00 PM	PE	23.90	8.34	732	0.011	1.00	56.40	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
7/10/2025	9:50 AM	MR	24.60	8.43	744	0.011	1.00	62.90	<1.9	<1.9	<1.9	1.90	<1.9	<1.9
7/10/2025	5:05 PM	ZSP		8.31		0.012	1.50	66.10	<1.9	2.10	<1.9	1.90	<1.9	<1.9
7/11/2025	8:07 AM	ZSP	24.30	8.33	745	0.014	1.50	71.30	<1.9	2.50	<1.9	2.00	<1.9	<1.9
7/11/2025	2:30 PM	PE	24.30	8.20	715	0.013	1.75	73.60	<1.9	2.60	<1.9	1.90	<1.9	<1.9
7/12/2025	8:08 AM	ZSP	24.40	8.20	769	0.014	1.50	80.40	<1.9	3.00	<1.9	1.90	<1.9	<1.9
7/12/2025	5:12 PM	ZSP	24.40	8.21		0.014	1.50	84.60	<1.9	3.00	<1.9	<1.9	<1.9	<1.9
7/13/2025	8:00 AM	PE	24.90	8.32	725	0.008	1.75	89.10	<1.9	3.10	<1.9	1.90	<1.9	<1.9
7/14/2025	8:36 AM	AP	24.40	8.09	740	0.016	2.00	97.80						

[illegible]

Indian Hill PFAS RSSCT

Field Sample Data Collection Log

Ion Exchange Effluent									PFAS					
Date	Time	Sampler/Operator	Temp. (°C)	pH	Conductivity (µs/cm)	UV-254 (nm)	Pressure (psi)	Totalized Flow (L)	PFOA (ng/L)	PFOS (ng/L)	Gen X (HFPO-DA) (ng/L)	PFBS (ng/L)	PFHxS (ng/L)	PFNA (ng/L)
7/3/2025	8:55 AM	PE	24.20	8.01	733	0.005	0.50	0.70	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9
7/3/2025														
7/4/2025	8:07 AM	ZSP	25.00	8.09	747	0.005	0.50	9.60	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9
7/4/2025														
7/5/2025	8:42 AM	ZSP	24.90	8.12	758	0.005	0.00	19.40	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9
7/5/2025														
7/6/2025	8:50 AM	MR	24.80	8.35	754	0.013	0.00	28.60	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9
7/6/2025	4:53 PM	AP	25.50	8.18	760	0.012	0.50	31.70						
7/7/2025	10:30 AM	PE	24.20	8.17	726	0.010	0.00	38.70	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9
7/7/2025	5:10 PM	ZSP		8.19		0.011	0.50	41.90						
7/8/2025	8:20 AM	PE	24.50	8.20	714	0.012	0.50	47.30	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9
7/8/2025	5:07 PM	ZSP		8.22		0.012	0.50	50.60						
7/9/2025	8:41 AM	MR	23.70	8.35	749	0.012	0.50	56.70	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9
7/9/2025	4:00 PM	PE	23.90	8.28	692	0.011	1.00	59.80						
7/10/2025	9:55 AM	MR	24.50	8.42	744	0.013	1.00	66.10	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9
7/10/2025	5:06 PM	ZSP		8.27		0.014	1.00	70.10						
7/11/2025	8:10 AM	ZSP	24.50	8.37	745	0.014	1.00	75.60	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9
7/11/2025	2:30 PM	PE	24.30	8.15	719	0.012	1.50	78.10						
7/12/2025	8:10 AM	ZSP	24.30	8.21	760	0.012	1.50	85.20	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9
7/12/2025	5:15 PM	ZSP	24.50	8.17		0.012	1.50	89.90						
7/13/2025	8:00 AM	PE	25.00	8.25	736	0.010	1.75	94.40	<2.0	2.00	<2.0	<2.0	<2.0	<2.0
7/14/2025	8:45 AM	AP	24.40	8.14	749	0.017	2.00	103.70	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
7/15/2025	8:15 AM	MR	24.60	8.10	754	0.016	2.00	113.30	<1.9	2.30	<1.9	<1.9	<1.9	<1.9
7/16/2025	9:46 AM	JT	25.10	8.07	753	0.016	2.00	122.60	<1.9	2.50	<1.9	<1.9	<1.9	<1.9
7/17/2025	8:10 AM	MR	24.50	8.18	752	0.018	2.00	131.90	<1.9	2.40	<1.9	<1.9	<1.9	<1.9
7/18/2025	8:20 AM	AP	24.70	8.12	744	0.016	2.00	141.30	<2.0	2.00	<2.0	<2.0	<2.0	<2.0
7/19/2025	7:55 AM	AP	24.90	8.04	748	0.016	2.00	150.60	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
7/20/2025	9:35 AM	MR	25.30	8.21	755	0.016	1.50	160.20	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
7/21/2025	8:03 AM	MR	24.40	8.14	753	0.015	1.50	169.50	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9
7/22/2025	8:20 AM	PE	24.40	8.40	745	0.016	2.00	179.10	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
7/23/2025	8:20 AM	MR	24.30	8.14	750	0.015	2.00	188.40	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9
7/24/2025	8:30 AM	PE	24.40	8.27	741	0.015	2.00	197.70	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9
7/25/2025	8:00 AM	JT	25.10	8.25	754	0.015	2.00	207.20	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9
7/26/2025	8:30 AM	JT	25.00	8.20	745	0.016	2.00	216.80	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9
7/27/2025	8:30 AM	JT	25.80	8.26	750	0.016	2.25	226.10	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9
7/28/2025	8:05 AM	JT					2.50	235.50						

Indian Hill PFAS RSSCT

Field Sample Data Collection Log

Ion Exchange Effluent														
			Anions		Metals									
Date	TOC (mg/L)	TDS (mg/L)	Chloride (mg/L)	Sulfate (mg/L)	Calcium (mg/L)	Iron (mg/L)	Magnesium (mg/L)	Arsenic (ug/L)	Total Alkalinity (mg/L)	Fluoride (mg/L)	NO2 (mg/L)	NO3 (mg/L)	Orthophosphate (mg/L)	HPC (CFU/mL)
7/3/2025	0.786	400	59	30	84	<0.010	24	<1.0	270	0.19	<0.040	0.33	0.038	TNTC
7/3/2025														
7/4/2025	0.788													
7/4/2025														
7/5/2025	0.869													
7/5/2025														
7/6/2025	0.964													
7/6/2025		400	57	31	84	<0.010	23	1.10	270	0.19	<0.040	0.61	0.066	640
7/7/2025	0.964													
7/7/2025														
7/8/2025	0.903	430	56	31	86	<0.010	24	<1.0	270	0.19	<0.040	0.65	0.07	640
7/8/2025														
7/9/2025	0.962													
7/9/2025														
7/10/2025	1.01	430	57	31	86	<0.010	24	<1.0	270	0.19	<0.040	0.83	0.066	70
7/10/2025														
7/11/2025	0.987													
7/11/2025														
7/12/2025	0.961										<0.040	0.96	0.071	2100
7/12/2025														
7/13/2025	0.968													
7/14/2025	1.02		52	29	85	<0.010	23	<1.0	270	0.19	<0.040	0.96	0.071	2100
7/15/2025	1.01													
7/16/2025	0.985													
7/17/2025	1.03													
7/18/2025	0.965													
7/19/2025	0.972													
7/20/2025	0.978													
7/21/2025	1.190	420	53	29	83	<0.010	23	<1.0	270	0.2	<0.040	0.95	0.046	30
7/22/2025	1.03													
7/23/2025	0.995													
7/24/2025	0.993													
7/25/2025	1.04													
7/26/2025	1.06													
7/27/2025	0.99													
7/28/2025		420	54	30	82	<0.010	23	<1.0	270	0.19	<0.040	0.84	0.078	32