HRSD SWIFT Research Center (SRC) Quarterly Report on SWIFT Water Quality Targets

This report documents SWIFT Water Quality results for recharge operations from October 1 – December 31, 2022. The compliance requirements are documented in HRSD's SWIFT Underground Injection Control Inventory Information Package (UIC-IIP) submitted to EPA Region III in January 2018. These requirements are noted in Tables 1-4 and reflect an update to the monitoring and compliance evaluation for Total coliform.

Figures 1 and 2 and Table 6 provide a summary of the data from the referenced quarter of operations relative to the SWIFT Water Quality Targets. Table 6 represents a summary of all analytes that were present above the laboratory reporting limit. A detailed table identifying the parameters monitored for the purpose of evaluating compliance with the SWIFT Water Quality Targets can be found as an Appendix to this report.

Parameter	Proposed Regulatory Limit	Non-Regulatory Action/Goal
EPA Drinking Water Primary Maximum Contaminant Levels (MCLs)	Meet all primary MCLs	N/A
Total Nitrogen	5 mg/L Monthly Average; 8 mg/L Max Daily	Secondary Effluent Critical Control Point (CCP) Action Limit for Total Inorganic Nitrogen (TIN) = 5 mg/L-N; CCP Action Limit for SWIFT Water Total Nitrogen (TN) = 5 mg/L-N
Turbidity	Individual Filter Effluent (IFE) < 0.15 NTU 95% of time and never >0.3 NTU in two consecutive 15 min measurements	CCP Action Limit IFE of 0.15 NTU to initiate backwash or place a filter in standby
Total Organic Carbon (TOC)[1]	4 mg/L Monthly Average; 6 mg/L Maximum Daily	Critical Operating Point (COP) Action Limit to Initiate GAC Regeneration
Total Coliform[2]	<2 CFU/100 mL for 95% of calendar month observations, applied as the 95th percentile	N/A
E.coli	Non-detect	N/A
TDS[3]	N/A	Monitor PAS Compatibility

Table 1: SRC Regulatory and Monitoring Limits for SWIFT Water

[1] Regulatory limit applies to the TOC laboratory analysis which is collected at a minimum frequency of 3 times per week.

[2] The Total Coliform (TC) monitoring and compliance evaluation reflects an update effective in January 2020 following consultation with the Virginia Department of Health and EPA Region III UIC staff.

[3] No limit for Total Dissolved Solids (TDS) proposed as the primary driver is aquifer compatibility. The concentration of TDS in SWIFT Water at the SRC generally ranges from 500-850 mg/L.

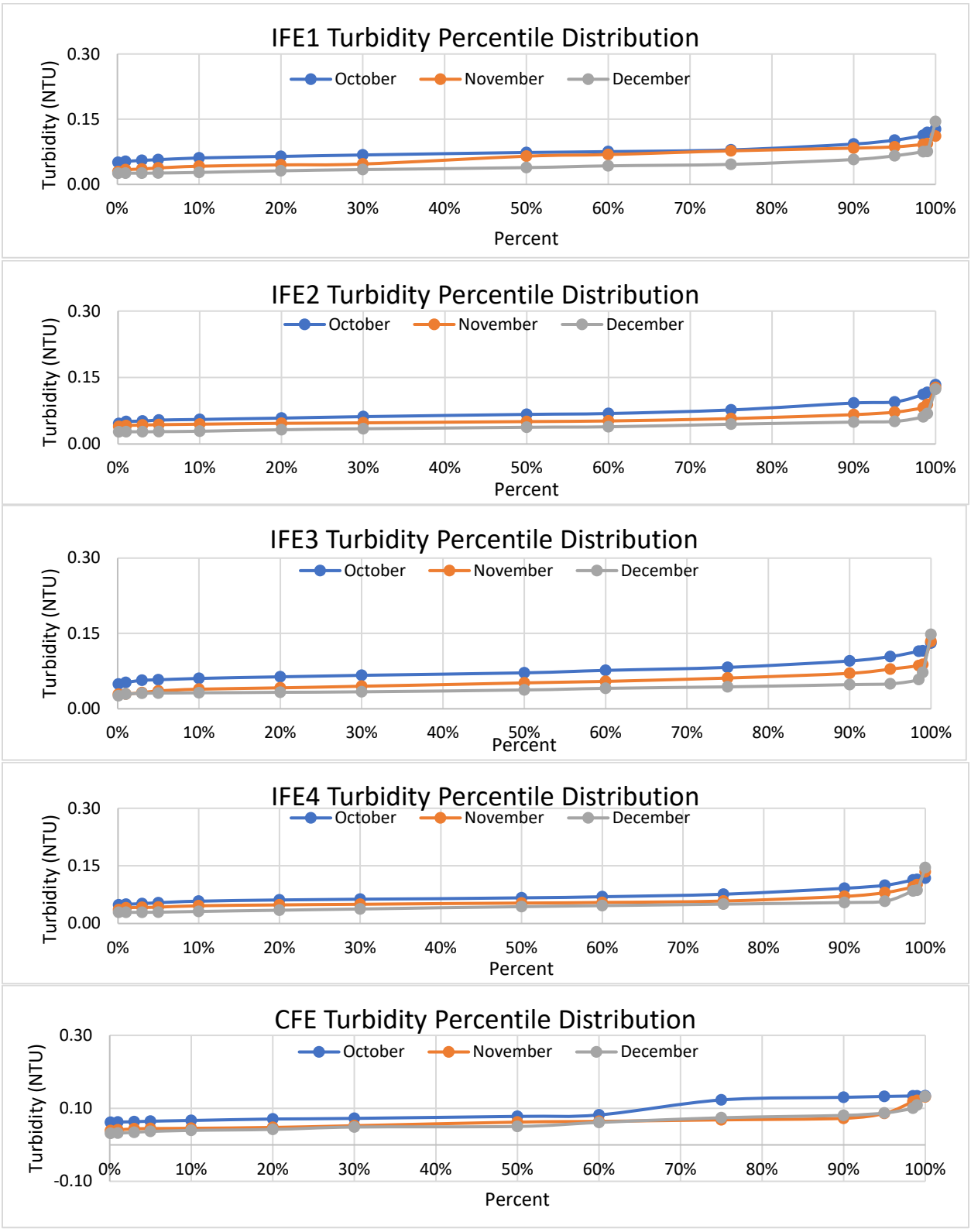

Figure 1: Percentile distribution of 15-minute average Individual Filter Effluent (IFE) Turbidities for Biofilters 1-4 (IFE1-4) and Biofilter Combined Filter Effluent (CFE). There were no 15-minute periods in this quarter with biofilter effluent turbidity values greater than 0.3 NTU. The 95% measured value for each biofilter IFE and the CFE was less than 0.15 NTU for each month in this quarter.

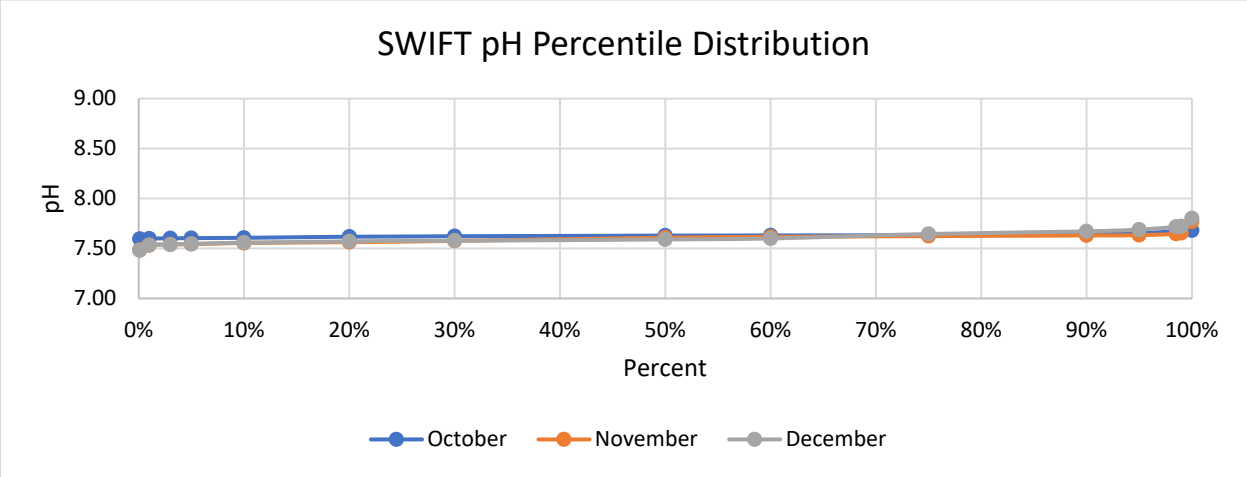

Figure 2: Distribution of Monthly SWIFT Water pH values.

Monitoring at the SRC also includes monitoring for performance indicators as documented in Table 2.

Constituent	Category	Trigger Value	Unit	Notes
1,4-Dioxane	Public Health	1	µg/L	CCL4; CA Notification Limit
17-β-Estradiol	Public Health	0.9[1]	ng/L	CCL4
DEET	Public Health	200	µg/L	MN Health Guidance Value
Ethinyl Estradiol	Public Health	280[1]	ng/L	CCL4
NDMA	Public Health	10	ng/L	CCL4; CA Notification Limit
Perchlorate	Public Health	6	µg/L	CA Notification Limit
PFOA+PFOS	Public Health	70	ng/L	CCL4; EPA Health Advisory
TCEP	Public Health	5	µg/L	MN Health Guidance Value
Cotinine	Treatment Effectiveness	1	µg/L	Surrogate for low molecular weight, partially charged cyclics
Primidone	Treatment Effectiveness	10	µg/L	
Phenytoin	Treatment Effectiveness	2	µg/L	
Meprobamate	Treatment Effectiveness	200	µg/L	High occurrence in wastewater treatment plant effluent
Atenolol	Treatment Effectiveness	4	µg/L	
Carbamazepine	Treatment Effectiveness	10	µg/L	Unique structure
Estrone	Treatment Effectiveness	320	ng/L	Surrogate for steroids
Sucralose	Treatment Effectiveness	150	mg/L	Surrogate for water soluble, uncharged chemicals with moderate molecular weight
Triclosan	Treatment Effectiveness	2,100	µg/L	Chemical of interest

[1] Identified as "To Be Determined" in the UIC-IIP. Since that time, threshold values were identified in *Monitoring Strategies for Constituents of Emerging Concern (CECs) in Recycled Water, Recommendations of a Science Advisory Panel, 2018; SCCWRP Technical Report 1032.*

Table 2: SRC Non-Regulatory Performance Indicators

Pathogen Log Removal Value (LRV) is not strictly regulated but the SRC has been designed and is operated to achieve at least 12 LRV for viruses and 10 LRV for *Cryptosporidium* and *Giardia* through a combination of advanced treatment processes and soil aquifer treatment. Table 3 provides a treatment process pathogen LRV summary for recharge conditions. Table 4 provides additional monitoring that is being completed to document compliance with the LRVs for ozone and UV.

Parameter	Floc/Sed (+BAC)	Ozone	BAC+GAC	UV	Cl2	SAT	Total
Enteric Viruses	2	0-3 (TBD)	0	4	0-4	6	12-19
Cryptosporidium	4	0	0	6	0	6	16
Giardia	2.5	0-1.5 (TBD)	0	6	0	6	14.5-16

Table 3: SRC Pathogen LRV for Potomac Aquifer System (PAS) Recharge.

Ozone LRV
Ozone Influent Temperature
Ozone Influent Flow
Liquid Phase Ozone Concentration[1]
Contact Time
CT
UV LRV
UV Intensity, each reactor
UVT, GAC Combined Effluent
Reactor Flow, each
Calculated Dose, each Lamp
Status, each

[1] The ozone liquid phase probe is verified with lab grab samples performed at least once per week.

Table 4: Additional Monitoring to Support Ozone and UV LRV. All data are collected as continuous measurements. The 15-minute LRV data is submitted in Table 6.

Critical Control Points

The SRC incorporates Critical Control Points (CCP) throughout the treatment process, per Attachment G of UIC-IIP, to verify that treatment goals are being met at each of the individual processes. A violation of any CCP means that the SRC may not be producing water that meets the treatment goals and will trigger a diversion of the SWIFT Water so that it is not directed to the recharge well. In most instances, the SRC will continue to operate through the CCP violation, but the SWIFT Water will be diverted back to the Nansemond Plant chlorine contact tanks (CCT).

CCPs have alert values at which point the operator is expected to take action to correct the performance as well as the alarm values at which point an automated

response will trigger action and prevent flow from going to the recharge well. Both the alert and alarm values will be measured consistently for a specified duration before action is taken so that blips in online analyzers do not trigger action. The specific values for the alert and alarm levels will be configured as adjustable set points in the Distributed Control System (DCS) and optimized as needed to meet the water quality requirements.

Table 5 shows the current CCPs in effect at the SRC. Modifications have been made to the CCPs since startup as compared to the original design documents in order to optimize their performance. No modifications to the CCPs were made this quarter. Each of the modifications from previous quarters was discussed in the relevant quarterly report for the period.

Parameter	Alert Value	Alarm Value	Unit	Action
Critical Control Points (CCPs)				
Influent Pump Station Conductivity	1,400	1,600	microSiemens per centimeter	Place Biofilters in Filter To Waste
Influent Pump Station Total Inorganic Nitrogen	4.0	5.0	mg/L-N	Place Biofilters in Filter To Waste
Influent Pump Station Turbidity	3.5	5.0	NTU	Place Biofilters in Filter To Waste
Preformed Chloramine Failure on Injection	N/A	Failure	mg/L	Divert SWIFT Water
Total Chlorine Post Injection upstream of ozone	2.0	1.0	mg/L	Divert SWIFT Water
Chloramine injection upstream of ozone	2.0	1.0	mg/L	Divert SWIFT Water
Ozone Feed	N/A	Failure	N/A	Open Biofilter Backwash Waste Valve
Ozone Contactor Calculated LRV – Virus	<120% LRV Goal	<110% LRV Goal	%	Open Biofilter Backwash Waste Valve
Biofilter Individual Effluent Turbidity	0.1	0.15	NTU	Place That Biofilter in Filter To Waste
Biofilter Combined Filter Effluent Turbidity	0.1	0.15	NTU	Place Biofilters in Filter To Waste
GAC Combined Effluent TOC, instantaneous online analyzer	4.0	5.0	mg/L	Divert SWIFT Water
UV Reactor Dose	<120% of Dose Setpoint	<105% of Dose Setpoint	%	Divert SWIFT Water
GAC Combined Effluent Nitrite	0.25	0.50	mg/L-N	Divert SWIFT Water
SWIFT Water TN	4.5	5.0	mg/L-N	Divert SWIFT Water
Ozone dose	70	80	lbs/day	Place Biofilters in Filter To Waste
Tasting System Free Chlorine CT	<110% of Required CT	<100% of Required CT	mg-min/L	Shut Down Tasting System
Tasting System Total Ammonia	0.1	0.3	mg/L-N	Shut Down Tasting System

Table 5. Critical Control Points for the SRC

Table 6. SWIFT Water Quality Monitoring. Results of detected analytes.

Parameter	Units	Maximum Contaminant Level (MCL) or MCL Goal (MCLG) where numerical MCL not expressed. Values noted for indicator compounds are non-regulatory screening values	Minimum Report Level[1]	Required Monitoring Frequency	October 2022			November 2022			December 2022		
					Average[2]	Maximum	Number of Samples	Average[2]	Maximum	Number of Samples	Average[2]	Maximum	Number of Samples
Regulatory Parameters													
Total Nitrogen (TN)	mg/L	NA	0.50	Daily[3]	2.83	3.87	16	3.08	3.93	19	3.13	4.12	16
NO_3	mg/L	10	0.20	Daily[3]	2.73	3.46	16	3.03	3.93	19	3.13	4.12	16
Turbidity	NTU	NA	0.01	Continuous	**Figure 1**								
Total Organic Carbon (TOC)	mg/L	NA	1.00	3x/Wk[3]	2.81	3.01	13	2.11	2.91	15	2.22	2.67	15
pH		NA	NA	Continuous	**Figure 2**								
TDS[4]	mg/L	Potomac Aquifer System Range: 694-8,720	2.5	Monthly		570	1		614	1		590	1
Disinfection Byproducts													
Bromate	µg/L	10	0.15	Monthly		2.27	1		2.22	1		2.79	1
Trihalomethanes													
Bromodichloromethane	µg/L		1.00	Monthly		1.66	1		<1.00	1		<1.00	1
Bromoform	µg/L		1.00	Monthly		6.96	1		5.25	1		2.70	1
Dibromochloromethane	µg/L		1.00	Monthly		5.57	1		3.32	1		1.86	1
Total Trihalomethanes	µg/L	80				14.2	1		8.57	1		4.55	1
HAAs													
Dichloroacetic acid	µg/L		0.60	Monthly		1.41	1		1.07	1		0.82	1
Trichloroacetic acid	µg/L		0.20	Monthly		0.22	1		0.23	1		<0.20	1
Monochloroacetic acid	µg/L		0.60	Monthly		<0.60	1		<0.60	1		0.86 ^	1
Bromoacetic acid	µg/L		0.40	Monthly		0.81	1		0.55	1		0.44	1
Dibromoacetic acid	µg/L		0.20	Monthly		8.04	1		9.03	1		6.05	1
Total Haloacetic Acids	µg/L	60				10.5	1		10.9	1		7.14	1
Disinfectants[5]													
Monochloramine (as Cl_2)	mg/L	4		Continuous	0.02	0.06		0.02	0.07		0.03	0.06	
Chlorine (as Cl_2)	mg/L	4		Continuous	2.43	2.98		2.34	3.26		2.28	3.53	
Inorganic Chemical													
Barium	mg/L	2	0.005	Monthly		0.007	1		0.007	1		0.007	1
Fluoride	mg/L	4.0	0.050	Monthly	0.967	1.02	17	0.984	1.11	19	0.849	0.930	16
Organic Chemicals													
Endothall	µg/L	100	5.0	Monthly		<5.0	1		5.5	1		<5.0	1
Radionuclides													
Alpha particles	pCi/L	15	2.57*	Monthly		<2.57	1		<2.22	1		PENDING	
Beta particles and photon emitters	pCi/L	4 mrem/yr[6]	2.26*	Monthly		9.62	1		17.3	1		PENDING	
Radium 228	pCi/L	5 (226+228)	0.860*	Monthly		<0.650	1		<0.860	1		PENDING	
Strontium-90	pCi/L	NA	0.577*	Monthly		0.764	1		0.573	1		<0.577	1
Tritium	pCi/L	NA	352*	Monthly		<352	1		NS	0		<341	1
Non-regulatory Performance Indicators													
Public Health Indicators		**Trigger Limits**											
1,4-dioxane	µg/L	1	0.06	Quarterly	0.17	0.19	3.00	0.15	0.19	5	0.17	0.18	4
Tris(2-carboxyethyl)phosphine (TCEP)	ng/L	5,000	10	Quarterly		17 H	1						

Table 6. SWIFT Water Quality Monitoring. Results of detected analytes.

Parameter	Units	Maximum Contaminant Level (MCL) or MCL Goal (MCLG) where numerical MCL not expressed. Values noted for indicator compounds are non-	Minimum Report Level[1]	Required Monitoring Frequency	October 2022			November 2022			December 2022		
NDMA	ng/L	10	2.00	Quarterly	<2.00	<2.00	3	<2.00	2.6	5	<2.00	<2.00	4
Perchlorate	µg/L	6	0.50	Quarterly		0.57	1						
Perfluorooctanoic Acid (PFOA)	ng/L	70 (PFOA+PFOS)	2.0	Quarterly		10	1		12	1		3.4	1
Perfluorooctanesulfonic Acid (PFOS)	ng/L	70 (PFOA+PFOS)	1.9	Quarterly		<1.9	1		2.6	1		<1.9	1
Treatment Efficacy Indicators		**Trigger Limits**											
Sucralose	ng/L	150,000,000	1000	Quarterly		26000	1		34000	1		8600	1
Additional Monitoring (Ozone & UV LRV)					**Average**	**Minimum**		**Average**	**Minimum**		**Average**	**Minimum**	
Ozone Virus LRV				Continuous	4.72	3.86		4.71	3.51		4.51	4.18	
Ozone Giardia LRV				Continuous	2.30	1.82		2.38	1.81		2.27	2.06	
UV Dose Reactor 1	mJ/cm^2			Continuous	>186	>186		>186	>186		>186	>186	
UV Virus LRV Reactor 1				Continuous	>4	>4		>4	>4		>4	>4	
UV Dose Reactor 2	mJ/cm^2			Continuous	>186	>186		>186	>186		>186	>186	
UV Virus LRV Reactor 2				Continuous	>4	>4		>4	>4		>4	>4	

[1] When minimum reporting limits varied during the quarter, the highest minumum reporting limit used is identified.

[2] Analytical results less than the reporting limit were treated as zero for the purposes of the averaging calculation.

[3] Daily samples are typically not collected on days in which there is no or limited recharge. TOC sample collection occurs routinely on Monday through Friday when recharging. Limited or inconsistent recharge impacts the collection of daily samples, particularly for the microbiological

[4] TDS of the Potomac Aquifer System is based on the averages within the upper, middle and lower Potomac Aquifer as determined during baseline montioring.

[5] The maximum residual disinfectant level (or MRDL) MCL for monochloramine and chlorine are based on annual averages.

[6] The measurement unit for beta particles and photon emitters is pCi/L while the MCL is expressed as mrem/yr. Per EPA's Implementation Guidance for Radionuclides (EPA 816-F-00-002, March 2002), the screening threshold for beta particles and photon emitters is 50 pCi/L. If sample concentrations exceed 50 pCi/L, each individual beta particle and photon emitter is converted from pCi/L to mrem using the EPA designated conversion tables, currently available in the referenced document.

* MDC - Minimum Detectable Concentration (Radiochemistry).

NS: No sample collected.

Contract Laboratory Flags:

H - Sample was prepared or analyzed beyond the specified holding time.

^ >50% difference between analytical and confirmation GC columns. Lower value was reported.

Recharge Statistics

The total volume recharged during this operational period was 25.1 million gallons. The backflushed volume was 4.5 million gallons for a net recharge of 20.6 million gallons (Figure 3.1). Total volume recharged since the start of SWIFT operations is presented in Figure 3.2. Brief backflushing periods occur as part of routine well maintenance on an approximate daily basis. From the start of operation through the end of this reporting period, the SRC has recharged a total volume of 656.2 million gallons.

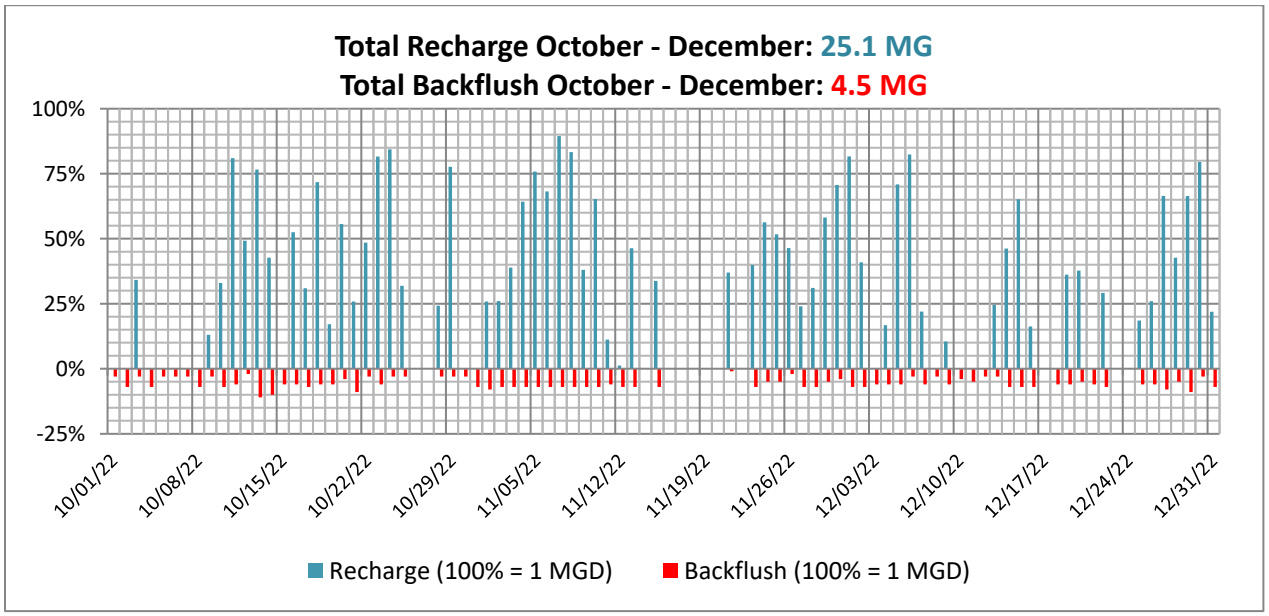

Figure 3.1: Recharge and Backflush Volumes, October 1st – December 31st, 2022

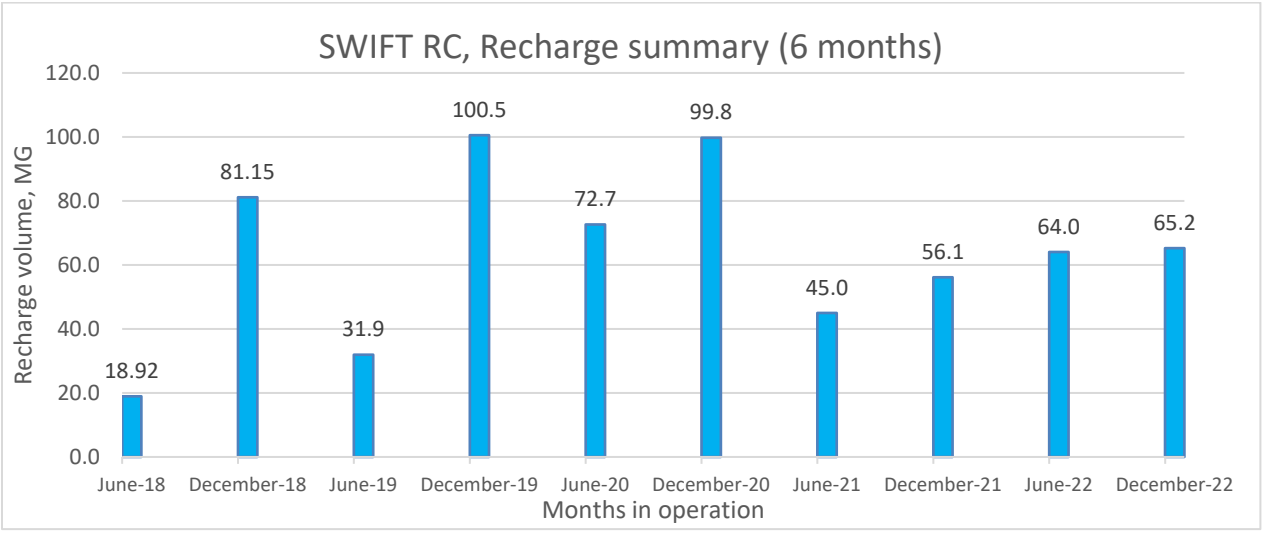

Figure 3.2: Recharge summary (6 months) since 2018 à May 18th, 2018 – December 31st, 2022. Date on x-axis represents final month of 6-month period (i.e., December-18 represents July 1 – December 31, 2018). Extended periods of shutdown for maintenance activities occurred in the first half of 2019 and 2021.

HRSD has developed an internal target to recharge 75% of a SWIFT facility's operational capacity. This is a particularly relevant planning target for full-scale operations and HRSD is striving to meet this target at the SRC. Operational redundancies will exist at full-scale facilities (e.g., multiple recharge wells) which will likely result in a higher rate of recharge at full-scale. Integration of the new well, NP_MAR_01 into the SRC system is complete and the new well has been in operation since November 1, 2022. The recharge rate for NP_MAR_01 is currently 650 gpm (0.94 MGD).

Figure 4 depicts the operational activity for this monitoring period identifying the percentage of operational time spent in recharge as well as the general factors precluding recharge.

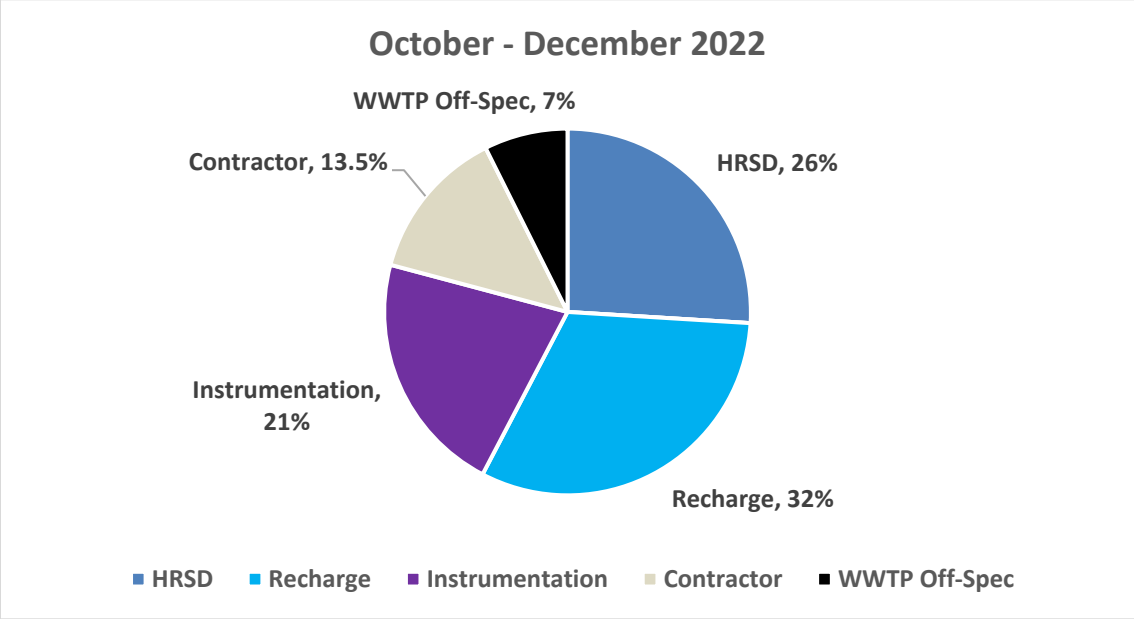

Figure 4: Operational activity for monitoring period. Notes: *Recharge*: Recharge of SWIFT Water; *WWTP Off-Spec*: Influent to the SWIFT facility (wastewater facility secondary clarifier effluent) does not meet influent quality requirements (e.g., elevated TOC or TN, or WWTP repairs; *HRSD*: Broad category covering activity within SWIFT facility that may lead to shut-down (e.g. maintenance and repairs, operational problems); *Contractor:* Recharge suspended to accommodate contractor activity at the AWT and/or recharge well; *Instrumentation*: On-line analyzer and/or instrumentation maintenance and repair.

Conventional Monitoring Wells

The conventional monitoring wells located in the upper, middle and lower zones of the Potomac Aquifer (MW-UPA, MW-MPA, and MW-LPA, respectively) are located approximately 400 – 500 ft from the recharge well and have been routinely monitored to detect the arrival of the recharge front. Based upon Total Organic Carbon (TOC) observations, the recharge front reached MW-UPA in late fall 2020 and MW-MPA in mid-late summer 2021 (Figure 5).

Travel time to MW-UPA was confirmed through a bromide tracer study initiated in July of 2020. Bromide from this tracer study was identified in MW-UPA beginning in April 2022. Travel time in days is difficult to estimate due to the frequent recharge stoppages. We can, however, relate travel time to a recharge volume equivalent. From July 2020 until the bromide appeared in MW-UPA in April 2022, approximately 230 million gallons of SWIFT Water was recharged.

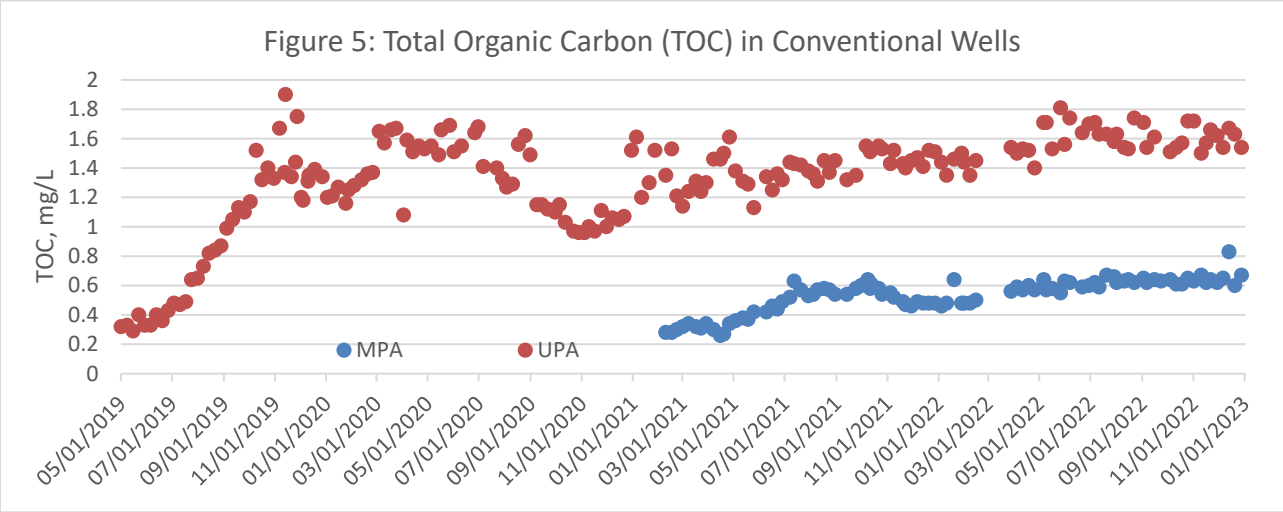

Figure 5: TOC concentration in the Upper and Middle Potomac conventional monitoring wells, MW-UPA and MW-MPA. Based on travel time studies using a conservative tracer, SWIFT Water recharged in the 4th quarter of 2020 is represented in this quarter's conventional well monitoring. The SWIFT Water average TOC concentration for October - December 2020 was 2.6 mg/L, with a maximum of 3.9 mg/L (n = 56).

In this monitoring period, three indicator compounds were observed in the conventional monitoring well, MW-UPA: 1, 4-dioxane, sucralose and PFOA. 1,4-dioxane and sucralose were also observed in MW-MPA. 1,4 dioxane and sucralose have been observed frequently in MW-UPA since November 2019 while PFOA was first observed in MW-UPA in Quarter 2 of 2022. Trend data associated with 1,4 dioxane, sucralose and PFOA is presented in Figures 6 - 8. All reported values for 1,4 dioxane, sucralose, and PFOA are less than the action thresholds ("trigger values") identified in Table 2 of this report. Results for all regulatory parameters are less than the PMCL and all regulated organics are non-detect. Arsenic observations are described in further detail in a subsequent section.

Using 230 million gallons of recharge volume as a proxy for travel time, we can estimate that the SWIFT Water appearing in MW-UPA was recharged at some point during Quarter 4 of 2020. For 1,4-dioxane, the average concentration observed in SWIFT Water during this time period was 0.32 µg/L. The decreasing trend observed in MW-UPA (Figure 6) is consistent with the reduction seen in SWIFT Water associated with early efforts to optimize 1,4-dioxane removal through the biofilters. Since that time, HRSD has further improved 1,4-dioxane removal in SWIFT Water, with results in this reporting quarter of < 0.20 µg/L (Table 6). This decreasing trend of 1,4-dioxane in MW-UPA is expected to continue, reflecting the reduction in SWIFT Water.

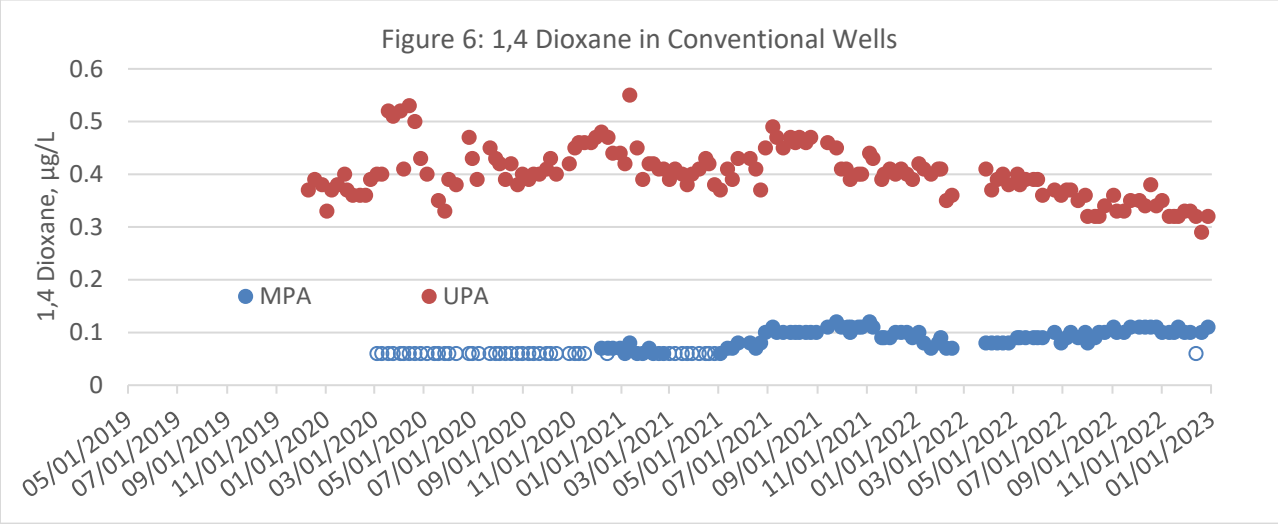

Figure 6: 1,4 dioxane trending in MW-UPA and MW-MPA. Open circles represent data that is less than the reporting limit. Based on travel time studies using a conservative tracer, SWIFT Water recharged in the 4th quarter of 2020 is represented in this quarter's conventional well monitoring. The SWIFT Water average 1,4-dioxane concentration for October - December 2020 was 0.32 µg/L, with a maximum value of 0.41 µg/L (n = 11). More recently, the SWIFT Advanced Water Treatment system has been optimized to enhance the removal of 1,4 dioxane, routinely achieving concentrations of ≤ 0.30 µg/L.

In Quarter 4 of 2020, the available data on sucralose and PFOA in SWIFT Water is much more limited, with two data points for sucralose and a single quarterly data point for PFOA. The trend for sucralose in MW-UPA and MW-MPA is presented in Figure 7. The average concentration of sucralose in SWIFT Water in Quarter 4 of 2020 was 13,000 ng/L, with a maximum value of 16,000 ng/L.

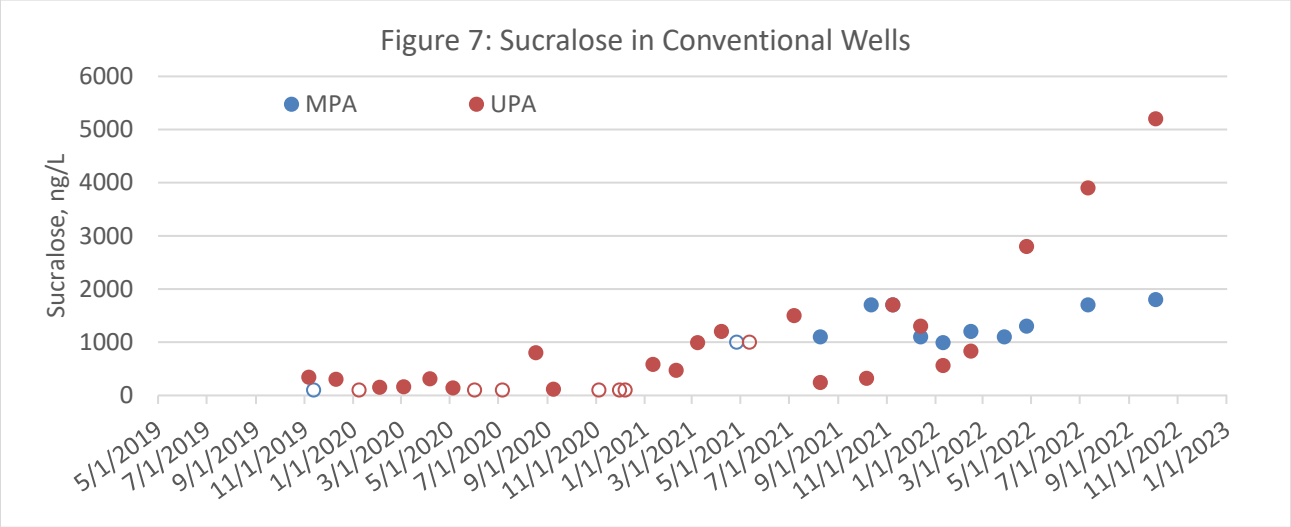

Figure 7: Sucralose trending in MW-UPA and MW-MPA. Open circles represent data that is less than the reporting limit. Based on travel time studies using a conservative tracer, SWIFT Water recharged in the 4th quarter of 2020 is represented in this quarter's conventional well monitoring. The SWIFT Water average sucralose concentration for October - December 2020 was 13,000 ng/L, with a maximum value of 16,000 ng/L (n = 2).

The single PFOA data point in SWIFT Water for Quarter 4 of 2020 was 4.5 ng/L. While it appears that the concentration of PFOA in MW-UPA is greater than what was observed in SWIFT Water (Figure 8), the single data point is not sufficient to characterize SWIFT Water concentration in that quarter. We do know, however, that the removal efficiency of the granular activated carbon was beginning to decrease during that time. Following a shutdown of recharge from December 2021 through April 2021, PFOA concentration in SWIFT Water continued to increase, reaching as high as 9.3 ng/L in April 2021. The frequency of monitoring for sucralose, PFOA and PFOS in SWIFT Water increased more recently from quarterly to monthly. This increase will benefit future evaluations of the fate of these contaminants in the Potomac Aquifer and provide greater understanding of the potential benefit of additional soil aquifer treatment.

It is important to note that until July of 2022 when EPA released interim Health Advisory Limits (HAL) for PFOA and PFOS, HRSD's operational controls for these compounds were based upon the previous HAL of 70 ng/L PFOA+PFOS. HRSD is working to optimize GAC performance to maintain PFOA and PFOS below 4 ng/L, each (refer to Potomac Aquifer Recharge Oversight Committee Meeting Minutes December 2022 for additional information).

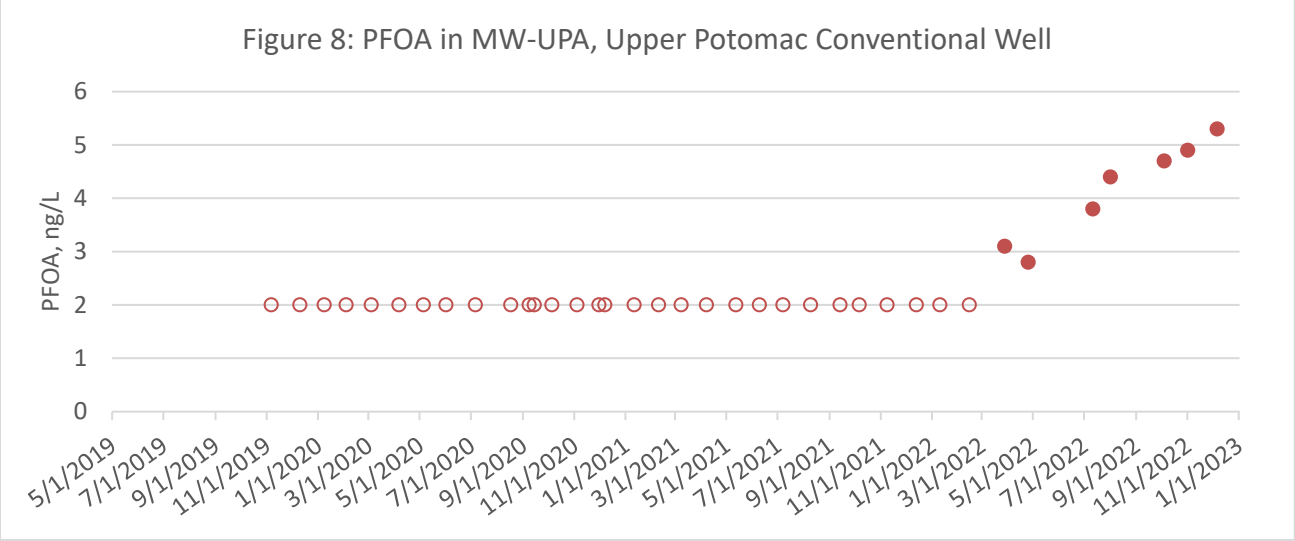

Figure 8: PFOA trending in MW-UPA. Open circles represent data that is less than the reporting limit. Based on travel time studies using a conservative tracer, SWIFT Water recharged in the 4th quarter of 2020 is represented in this quarter's conventional well monitoring. The SWIFT Water PFOA concentration for October - December 2020 was 4.5 ng/L (n = 1).

Arsenic in MW-SAT Update

HRSD continues to monitor arsenic (As) concentrations in MW-SAT on a monthly frequency, focusing on representative screen intervals 1, 2, 4, 9, 10 and 11. The highest observable arsenic concentration continues to occur in screen interval 9, but remains below the MCL of 10 µg/L. Concentrations in screen interval 9 remain relatively stable between 1.8 µg/L and 2.7 µg/L, representing typical conditions for screen interval 9.

Other than screen interval 9, arsenic concentration in the remaining monitored screens was < 1.4 µg/L.

HRSD will continue monitoring and evaluating As during recharge in the most transmissive screens of MW-SAT and in the conventional wells as well as DO in the SWIFT Water. Arsenic discussions in the quarterly reporting will be suspended and will resume as needed, if conditions warrant.

Appendix
SRC Monitoring Data for SWIFT Water Quality Regulatory Targets

Parameter	Units	Maximum Contaminant Level (MCL) or MCL Goal (MCLG) where numerical MCL not expressed. Values noted for indicator compounds are non-regulatory screening values	Minimum Report Level[1]	Required Monitoring Frequency	October 2022			November 2022			December 2022		
					Average[2]	Maximum	Number of Samples	Average[2]	Maximum	Number of Samples	Average[2]	Maximum	Number of Samples
Regulatory Parameters													
Total Nitrogen (TN)	mg/L	NA	0.50	Daily[3]	2.83	3.87	16	3.08	3.93	19	3.13	4.12	16
NO_3	mg/L	10	0.20	Daily[3]	2.73	3.46	16	3.03	3.93	19	3.13	4.12	16
NO_2	mg/L	1	0.01	Daily[3]	<0.01	<0.01	17	<0.01	<0.01	19	<0.01	<0.01	16
Turbidity	NTU	NA	0.01	Continuous	**Figure 1**								
Total Organic Carbon (TOC)	mg/L	NA	1.00	3x/Wk[3]	2.81	3.01	13	2.11	2.91	15	2.22	2.67	15
pH		NA	NA	Continuous	**Figure 2**								
TDS[4]	mg/L	Potomac Aquifer System Range: 694-8,720	2.5	Monthly		570	1		614	1		590	1
Microorganisms													
Total Coliform	MPN/100 mL	MCLG = 0	1	Daily[3]	<1	<1	17	<1	<1	19	<1	<1	16
E. coli	MPN/100 mL	NA	1	Weekly	<1	<1	17	<1	<1	19	<1	<1	16
Cryptosporidium	oocysts/L	Treatment Technique, MCLG = 0	0.0909	Quarterly		<0.0909	1						
Giardia lamblia	oocysts/L	Treatment Technique, MCLG = 0	0.0909	Quarterly		<0.0909	1						
Legionella	MPN/100 mL	Treatment Technique, MCLG = 0	1	Quarterly		<1	1						
Disinfection Byproducts													
Bromate	µg/L	10	0.15	Monthly		2.27	1		2.22	1		2.79	1
Chlorite	mg/L	1.0	0.100	Monthly		<0.100	1		<0.100	1		<0.100	1
Trihalomethanes													
Bromodichloromethane	µg/L		1.00	Monthly		1.66	1		<1.00	1		<1.00	1
Bromoform	µg/L		1.00	Monthly		6.96	1		5.25	1		2.70	1
Chloroform	µg/L		1.00	Monthly		<1.00	1		<1.00	1		<1.00	1
Dibromochloromethane	µg/L		1.00	Monthly		5.57	1		3.32	1		1.86	1
Total Trihalomethanes	µg/L	80				14.2	1		8.57	1		4.55	1

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					Average[2]	Maximum	Number of Samples	Average[2]	Maximum	Number of Samples	Average[2]	Maximum	Number of Samples
HAAs													
Dichloroacetic acid	µg/L		0.60	Monthly		1.41	1		1.07	1		0.82	1
Trichloroacetic acid	µg/L		0.20	Monthly		0.22	1		0.23	1		<0.20	1
Monochloroacetic acid	µg/L		0.60	Monthly		<0.60	1		<0.60	1		0.86 ^	1
Bromoacetic acid	µg/L		0.40	Monthly		0.81	1		0.55	1		0.44	1
Dibromoacetic acid	µg/L		0.20	Monthly		8.04	1		9.03	1		6.05	1
Total Haloacetic Acids	µg/L	60				10.5	1		10.9	1		7.14	1
Disinfectants[5]													
Monochloramine (as Cl_2)	mg/L	4		Continuous	0.02	0.06		0.02	0.07		0.03	0.06	
Chlorine (as Cl_2)	mg/L	4		Continuous	2.43	2.98		2.34	3.26		2.28	3.53	
Inorganic Chemical													
Antimony	µg/L	6	2.00	Monthly	<2.00	<2.00	2		<2.00	1		<2.00	1
Arsenic	µg/L	10	0.50	Monthly	<0.50	<0.50	2		<0.50	1		<0.50	1
Asbestos	MFL	7	0.20	Monthly		<0.20	1		<0.20	1		<0.20	1
Barium	mg/L	2	0.005	Monthly		0.007	1		0.007	1		0.007	1
Beryllium	µg/L	4	0.10	Monthly	<0.10	<0.10	2		<0.10	1		<0.10	1
Cadmium	µg/L	5	0.10	Monthly	<0.10	<0.10	2		<0.10	1		<0.10	1
Chromium (total)	µg/L	100	1.00	Monthly	<1.00	<1.00	2		<1.00	1		<1.00	1
Copper	mg/L	1.3 (action level)	0.005	Monthly		<0.005	1		<0.005	1		<0.005	1
Cyanide (total)	µg/L	200	5	Monthly		<5	1		<5	1		<5	1
Fluoride	mg/L	4.0	0.050	Monthly	0.967	1.02	17	0.984	1.11	19	0.849	0.930	16
Lead	µg/L	15 (action level)	0.10	Monthly		<0.10	2		<0.10	1		<0.10	1
Mercury	µg/L	2	0.10	Monthly		<0.10	1		<0.10	1		<0.10	1
Selenium	µg/L	50	5.00	Monthly	<5.00	<5.00	2		<5.00	1		<5.00	1
Thallium	µg/L	2	0.20	Monthly	<0.20	<0.20	2		<0.20	1		<0.20	1
Organic Chemicals													
Acrylamide	µg/L	Treatment Technique, MCLG = 0	0.10	Monthly		<0.10	1		<0.10	1		<0.10	1
Alachlor	µg/L	2	0.10	Monthly		<0.097	1		<0.096	1		<0.10	1
Atrazine	µg/L	3	0.10	Monthly		<0.097	1		<0.096	1		<0.10	1
Benzo(a)pyrene (PAHs)	µg/L	0.2	0.021	Monthly		<0.019	1		<0.019	1		<0.021	1
Di(2-ethylhexyl) adipate	µg/L	400	0.62	Monthly		<0.58	1		<0.58	1		<0.62 *+	1
Di(2-ethylhexyl) phthalate	µg/L	6	0.62	Monthly		<0.58	1		<0.58	1		<0.62	1

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					Average[2]	Maximum	Number of Samples	Average[2]	Maximum	Number of Samples	Average[2]	Maximum	Number of Samples
Hexachlorocyclopentadiene	µg/L	50	0.10	Monthly		<0.097	1		<0.096	1		<0.10	1
Hexachlorobenzene	µg/L	1	0.10	Monthly		<0.097	1		<0.096	1		<0.10	1
Simazine	µg/L	4	0.072	Monthly		<0.068	1		<0.067	1		<0.072	1
Carbofuran	µg/L	40	0.90	Monthly		<0.90	1		<0.90	1		<0.90	1
Oxamyl (Vydate)	µg/L	200	1.0	Monthly		<1.0	1		<1.0	1		<1.0	1
Chlordane	µg/L	2	0.10	Monthly		<0.10	1		<0.10	1		<0.10	1
Endrin	µg/L	2	0.010	Monthly		<0.0097	1		<0.0096	1		<0.010	1
Heptachlor	µg/L	0.4	0.041	Monthly		<0.039	1		<0.039	1		<0.041*+	1
Heptachlor Epoxide	µg/L	0.2	0.021	Monthly		<0.019	1		<0.019	1		<0.021	1
Lindane	µg/L	0.2	0.021	Monthly		<0.019	1		<0.019	1		<0.021 *+	1
Methoxychlor	µg/L	40	0.10	Monthly		<0.097	1		<0.096	1		<0.10	1
Toxaphene	µg/L	3	0.50	Monthly		<0.50	1		<0.50	1		<0.50	1
PCB Arochlor1016	µg/L		0.080	Monthly		<0.080	1		<0.080	1		<0.080	1
PCB Arochlor1221	µg/L		0.10	Monthly		<0.10	1		<0.10	1		<0.10	1
PCB Arochlor1232	µg/L		0.10	Monthly		<0.10	1		<0.10	1		<0.10	1
PCB Arochlor1242	µg/L		0.10	Monthly		<0.10	1		<0.10	1		<0.10	1
PCB Arochlor1248	µg/L		0.10	Monthly		<0.10	1		<0.10	1		<0.10	1
PCB Arochlor1254	µg/L		0.10	Monthly		<0.10	1		<0.10	1		<0.10	1
PCB Arochlor1260	µg/L		0.10	Monthly		<0.10	1		<0.10	1		<0.10	1
Total Polychlorinated Biphenyls (PCBs)	µg/L	0.5				<0.10	1		<0.10	1		<0.10	1
2,4-D	µg/L	70	0.10	Monthly		<0.10	1		<0.10	1		<0.10	1
Dalapon	µg/L	200	1.0	Monthly		<1.0	1		<1.0	1		<1.0	1
Picloram	µg/L	500	0.10	Monthly		<0.10	1		<0.10	1		<0.10	1
2,4,5-TP (Silvex)	µg/L	50	0.10	Monthly		<0.10	1		<0.10	1		<0.10	1
Dinoseb	µg/L	7	0.10	Monthly		<0.10	1		<0.10	1		<0.10	1
Pentachlorophenol	µg/L	1	0.040	Monthly		<0.040	1		<0.040	1		<0.040	1
Dioxin (2,3,7,8-TCDD)	pg/L	30	4.0	Monthly		<3.9	1		<3.8	1		<4.0	1
Diquat	µg/L	20	0.40	Monthly		<0.40	1		<0.40	1		<0.40	1
Endothall	µg/L	100	5.0	Monthly		<5.0	1		5.5	1		<5.0	1
Epichlorohydrin	µg/L	Treatment Technique, MCLG = 0	5.0	Monthly		<5.0	1		<5.0	1		<5.0	1
Glycophosphate	µg/L	700	6.0	Monthly		<6.0	1		<6.0	1		<6.0	1
Benzene	µg/L	5	1.00	Monthly		<1.00	1		<1.00	1		<1.00	1
Carbon Tetrachloride	µg/L	5	1.00	Monthly		<1.00	1		<1.00	1		<1.00	1

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					Average[2]	Maximum	Number of Samples	Average[2]	Maximum	Number of Samples	Average[2]	Maximum	Number of Samples
Chlorobenzene	µg/L	100	1.00	Monthly		<1.00	1		<1.00	1		<1.00	1
1,2-dibromo-3-chloropropane (DBCP)	µg/L	0.2	0.02	Monthly		<0.02	1		<0.02	1		<0.02	1
o-Dichlororbenzene	µg/L	600	1.00	Monthly		<1.00	1		<1.00	1		<1.00	1
p-Dichlorobenzene	µg/L	75	1.00	Monthly		<1.00	1		<1.00	1		<1.00	1
1,2-Dichloroethane	µg/L	5	1.00	Monthly		<1.00	1		<1.00	1		<1.00	1
1,1-Dichlororethylene	µg/L	7	1.00	Monthly		<1.00	1		<1.00	1		<1.00	1
cis-1,2-Dichloroethylene	µg/L	70	1.00	Monthly		<1.00	1		<1.00	1		<1.00	1
trans-1,2-Dichloroethylene	µg/L	100	1.00	Monthly		<1.00	1		<1.00	1		<1.00	1
Dichloromethane	µg/L	5	1.00	Monthly		<1.00	1		<1.00	1		<1.00	1
1,2-Dichloropropane	µg/L	5	1.00	Monthly		<1.00	1		<1.00	1		<1.00	1
Ethylbenzene	µg/L	700	1.00	Monthly		<1.00	1		<1.00	1		<1.00	1
Ethylene Dibromide (EDB)	µg/L	0.05	0.02	Monthly		<0.02	1		<0.02	1		<0.02	1
Styrene	µg/L	100	1.00	Monthly		<1.00	1		<1.00	1		<1.00	1
Tetrachloroethylene	µg/L	5	1.00	Monthly		<1.00	1		<1.00	1		<1.00	1
Toluene	µg/L	1,000	1.00	Monthly		<1.00	1		<1.00	1		<1.00	1
1,2,4-Trichlorobenzene	µg/L	70	1.00	Monthly		<1.00	1		<1.00	1		<1.00	1
1,1,1-Trichloroethane	µg/L	200	1.00	Monthly		<1.00	1		<1.00	1		<1.00	1
1,1,2-Trichloroethane	µg/L	5	1.00	Monthly		<1.00	1		<1.00	1		<1.00	1
Trichloroethylene	µg/L	5	1.00	Monthly		<1.00	1		<1.00	1		<1.00	1
Vinyl Chloride	µg/L	2	1.00	Monthly		<1.00	1		<1.00	1		<1.00	1
Total Xylene	µg/L	10,000	3.00	Monthly		<3.00	1		<3.00	1		<3.00	1
Radionuclides													
Alpha particles	pCi/L	15	2.57*	Monthly		<2.57	1		<2.22	1		PENDING	
Beta particles and photon emitters	pCi/L	4 mrem/yr[6]	2.26*	Monthly		9.62	1		17.3	1		PENDING	
Radium 226	pCi/L	5 (226+228)	0.650*	Monthly		<0.650	1		<0.200	1		<0.240	1
Radium 228	pCi/L	5 (226+228)	0.860*	Monthly		<0.650	1		<0.860	1		PENDING	
Uranium	µg/L	30	0.10	Monthly		<0.10	2		<0.10	1		<0.10	1
Strontium-90	pCi/L	NA	0.577*	Monthly		0.764	1		0.573	1		<0.577	1
Tritium	pCi/L	NA	352*	Monthly		<352	1		NS	0		<341	1

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					Average[2]	Maximum	Number of Samples	Average[2]	Maximum	Number of Samples	Average[2]	Maximum	Number of Samples
Non-regulatory Performance Indicators													
Public Health Indicators		**Trigger Limits**											
1,4-dioxane	µg/L	1	0.06	Quarterly	0.17	0.19	3.00	0.15	0.19	5	0.17	0.18	4
17-β-estradiol	ng/L	0.9	0.42	Quarterly		<0.42	1						
DEET	ng/L	200,000	10	Quarterly		<10 H	1						
Ethinyl estradiol	ng/L	280	0.95	Quarterly		<0.95	1						
Tris(2-carboxyethyl)phosphine (TCEP)	ng/L	5,000	10	Quarterly		17 H	1						
NDMA	ng/L	10	2.00	Quarterly	<2.00	<2.00	3	<2.00	2.6	5	<2.00	<2.00	4
Perchlorate	µg/L	6	0.50	Quarterly		0.57	1						
Perfluorooctanoic Acid (PFOA)	ng/L	70 (PFOA+PFOS)	2.0	Quarterly		10	1		12	1		3.4	1
Perfluorooctanesulfonic Acid (PFOS)	ng/L	70 (PFOA+PFOS)	1.9	Quarterly		<1.9	1		2.6	1		<1.9	1
Treatment Efficacy Indicators		**Trigger Limits**											
Cotinine	ng/L	1,000	10	Quarterly		<10 H	1						
Primidone	ng/L	10,000	5.0	Quarterly		<5.0 H	1						
Phenytoin (Dilantin)	ng/L	2,000	20	Quarterly		<20 H	1						
Meprobamate	ng/L	200,000	5.0	Quarterly		11 H	1						
Atenolol	ng/L	4,000	5.0	Quarterly		<5.0 H	1						
Carbamazepine	ng/L	10,000	5.0	Quarterly		<5.0 H	1						
Estrone	ng/L	320,000	2.1	Quarterly		<2.1	1						
Sucralose	ng/L	150,000,000	1000	Quarterly		26000	1		34000	1		8600	1
Triclosan	ng/L	210,000	50	Quarterly		<50	1		<50	1		<50	1
Additional Monitoring (Ozone & UV LRV)					**Average**	**Minimum**		**Average**	**Minimum**		**Average**	**Minimum**	
Ozone Virus LRV				Continuous	4.72	3.86		4.71	3.51		4.51	4.18	
Ozone Giardia LRV				Continuous	2.30	1.82		2.38	1.81		2.27	2.06	
UV Dose Reactor 1	mJ/cm^2			Continuous	>186	>186		>186	>186		>186	>186	
UV Virus LRV Reactor 1				Continuous	>4	>4		>4	>4		>4	>4	
UV Dose Reactor 2	mJ/cm^2			Continuous	>186	>186		>186	>186		>186	>186	
UV Virus LRV Reactor 2				Continuous	>4	>4		>4	>4		>4	>4	

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					Average[2]	Maximum	Number of Samples	Average[2]	Maximum	Number of Samples	Average[2]	Maximum	Number of Samples

[1] When minimum reporting limits varied during the quarter, the highest minumum reporting limit used is identified.

[2] Analytical results less than the reporting limit were treated as zero for the purposes of the averaging calculation.

[3] Daily samples are typically not collected on days in which there is no or limited recharge. TOC sample collection occurs routinely on Monday through Friday when recharging. Limited or inconsistent recharge impacts the collection of daily samples, particularly for the microbiological samples collected for total coliform and E coli which have limited holding time requirements. In October, limited or no recharge impacted 14 days of sampling. On one additional day in October, microbiological, total nitrogen and nitrate samples were not collected due to miscommunication. In November, limited or no recharge impacted 11 days of sampling. In December, limited or no recharge impacted 15 days of sampling.

[4] TDS of the Potomac Aquifer System is based on the averages within the upper, middle and lower Potomac Aquifer as determined during baseline montioring.

[5] The maximum residual disinfectant level (or MRDL) MCL for monochloramine and chlorine are based on annual averages.

[6] The measurement unit for beta particles and photon emitters is pCi/L while the MCL is expressed as mrem/yr. Per EPA's Implementation Guidance for Radionuclides (EPA 816-F-00-002, March 2002), the screening threshold for beta particles and photon emitters is 50 pCi/L. If sample concentrations exceed 50 pCi/L, each individual beta particle and photon emitter is converted from pCi/L to mrem using the EPA designated conversion tables, currently available in the referenced document.

* MDC - Minimum Detectable Concentration (Radiochemistry).

NS: No sample collected.

Contract Laboratory Flags:

*+ - LCS and/or LCSD is outside acceptance limits, high biased.

H - Sample was prepared or analyzed beyond the specified holding time.

* MDC - Minimum Detectable Concentration (Radiochemistry).

January 26, 2023

Dr. Li Zhang
Hampton Roads Sanitation District
1432 Air Rail Ave
Virginia Beach, VA 23455-3330

Dear Dr. Zhang:

Per you request, I am providing a letter in regards to the radiological data for 810-46452.

Currently, job 810-46452 is waiting on results for Gross Alpha/Beta and Radium 228. The lab is behind on processing these samples and there have been some matrix issues that have led to re-counting the sample for SRC_SWIFT. The lab is still working on the samples and it could still be a few weeks. I am currently targeting February 10th for completion of this report but will send it as soon as it's ready to report.

If you have any questions, please let me know.

Sincerely,

Nathan Trowbridge
Client Services Manager