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

This report documents SWIFT Water Quality results for recharge operations from April 29 – June 30, 2019. 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 the following tables (Tables 1-4), extracted from Attachment B of the UIC-IIP. Figures 1 and 2 and Table 6 provide the data from the second quarter of operations relative to these SWIFT Water Quality Targets.

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 0.10 NTU to initiate backwash or place a filter in standby
Total Organic Carbon (TOC)[2]	4 mg/L Monthly Average 6 mg/L Maximum	Critical Operating Point (COP) Action Limit to Initiate GAC Regeneration
Total Coliform	<2 CFU/100 mL 95% of time; Not to exceed geometric mean of 3 CFU/100 mL, based on a running calculation of 20 days of daily samples for total coliforms	N/A
E.coli	Non-detect	N/A
TDS[3]	N/A	Monitor PAS Compatibility

Table 1: SWIFTRC Regulatory and Monitoring Limits for SWIFT Water

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

[3] Proposing no limit for TDS as the primary driver is aquifer compatibility. Expected range for SWIFT Water at SWIFTRC is 500-850 mg/L.

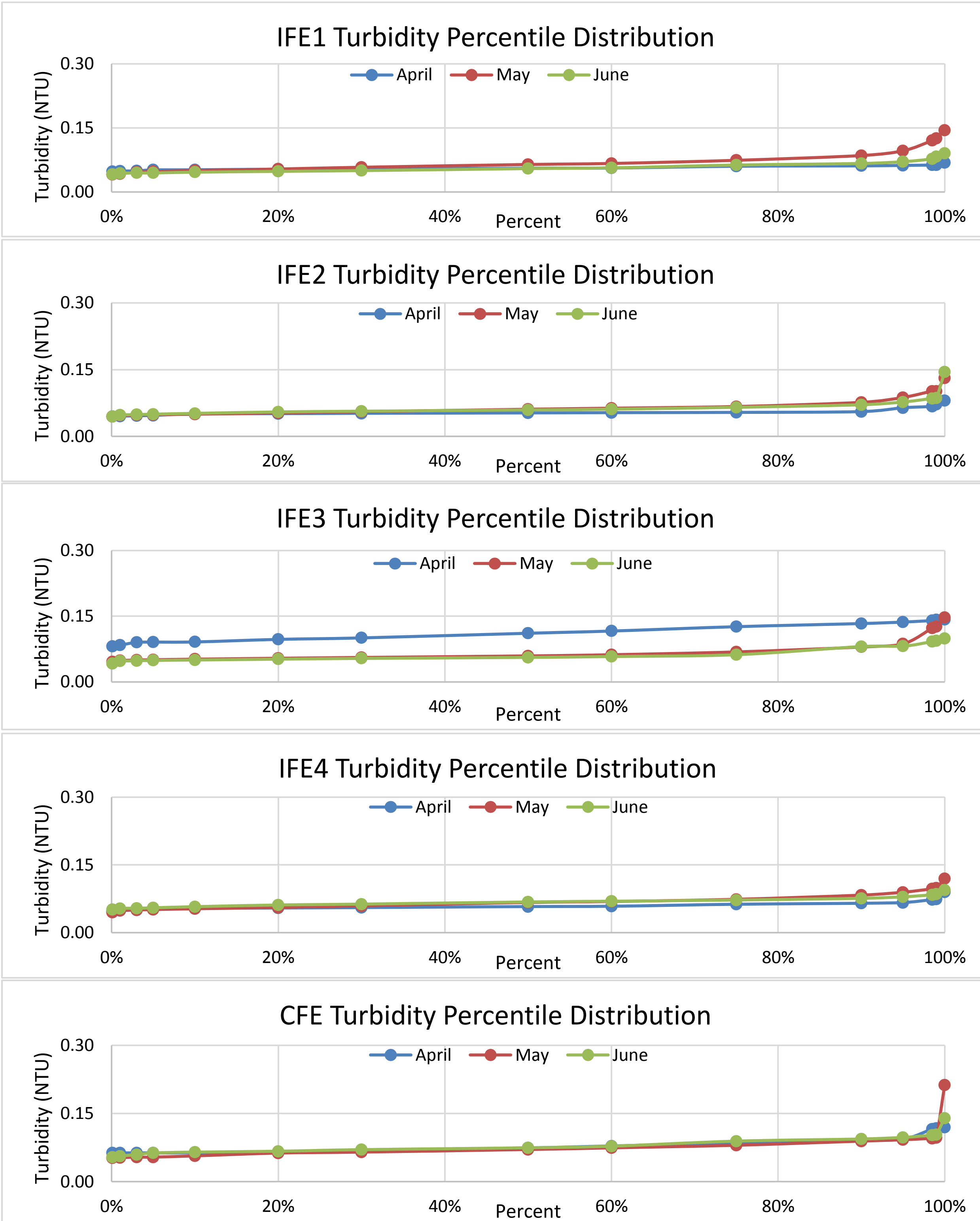

Figure 1: Percentile distribution of 15-minute average Individual Filter Effluent (IFE) Turbidities for Biofilters 1-4 (IFE1-4) and Combined Filter Effluent (CFE). There were no 15-minute periods in this quarter with biofilter effluent turbidity values greater than 0.3 NTU. The 95% measured value for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

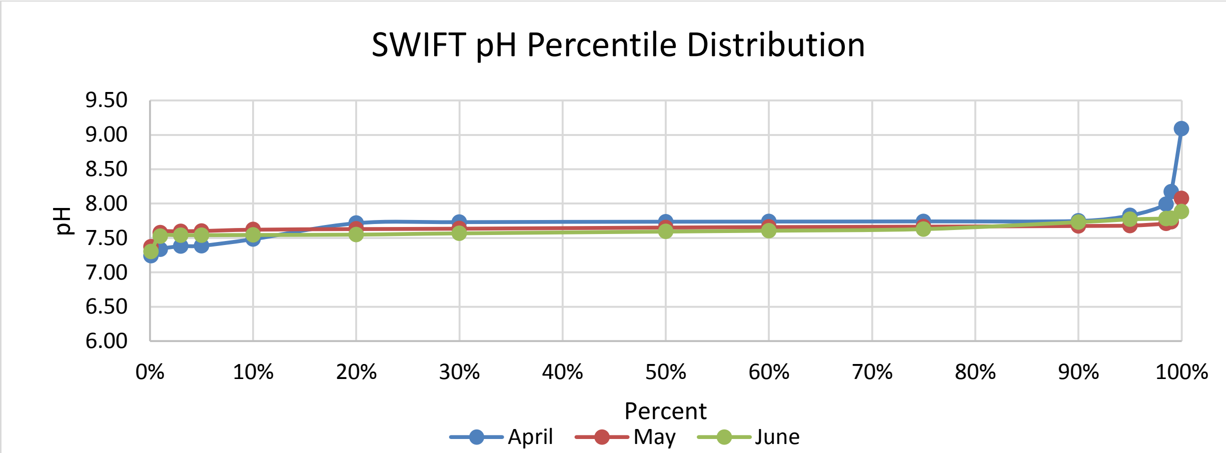

Figure 2: Distribution of Monthly SWIFT Water pH values.

Monitoring at the SWIFTRC also includes monitoring for performance indicators as documented in Table 2, extracted from Attachment B of the UIC-IIP.

Table 2. SWIFTRC Non-Regulatory Performance Indicators

Constituent	Category	Value	Unit	Notes
1,4-Dioxane	Public Health	1	µg/L	CCL4; CA Notification Limit
17-β-Estradiol	Public Health	TBD	ng/L range	CCL4
DEET	Public Health	200	µg/L	MN Health Guidance Value
Ethinyl Estradiol	Public Health	TBD	ng/L range	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	µg/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

TBD = to be determined

Table 2: SWIFTRC Non-Regulatory Performance Indicators

Pathogen Log Removal Value (LRV) is not strictly regulated but the SWIFTRC 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: SWIFTRC Pathogen LRV for Potomac Aquifer System (PAS) Recharge.

Table 4. Additional Monitoring to Support Ozone and UV LRV [1]

Ozone LRV
Ozone Influent Temperature
Ozone Influent Flow
Liquid Phase Ozone Concentration[2]
Contact Time
CT
UV LRV
UV Intensity, each reactor
UVT, GAC Combined Effluent
Reactor Flow, each
Calculated Dose, each Lamp
Status, each

1 All continuous measurements. 15 min data will be submitted.

2 The ozone liquid phase probe will be verified with lab grab samples performed at least once per week.

Table 4: Additional Monitoring to Support Ozone and UV LRV.

Critical Control Points

The SWIFTRC 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 SWIFTRC 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 SWIFTRC 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 SWIFTRC. Modifications have been made to the CCPs since startup as compared to the original design documents in order to optimize their performance. Each of these modifications from previous quarters was discussed in each of the previous reports. Additional modifications made during this period of operation are noted in the table in redline and discussed below.

- Reduced the Influent Pump Station Turbidity alarm value from 12 NTU to 3.5 and the alert value from 15 NTU to 5.0. This change will protect better the SWIFT process if Nansemond Treatment Plant experiences an upset. This was based on experience during this period.
- Tasting System critical control points were added as part of tasting system automation.
- Many actions were adjusted to place biofilters in filter to waste mode as opposed to diverting water upstream of the biofilters to the drain pump station. This change maintains biological activity in the biofilters with the hypothesis that minimizing filter shutdowns will improve the consistency and removal NDMA, Manganese and TOC.

Parameter	Alert Value	Alarm Value	Unit	Action
Critical Control Points (CCPs)				
Influent Pump Station Conductivity	1,200	1,500	microSiemens per centimeter	Place Biofilters in Filter to Waste~~Divert settled water to drain pump station~~
Influent Pump Station Total Inorganic Nitrogen	4.0	5.0	mg/L-N	Place Biofilters in Filter to Waste~~Divert settled water to drain pump station~~
Influent Pump Station Turbidity	~~15~~3.5	~~20~~5.0	NTU	Place Biofilters in Filter to Waste~~Divert settled water to drain pump station~~
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	<100% LRV Goal	%	Open Biofilter Backwash Waste Valve
Biofilter Individual Effluent Turbidity	0.1	0.15	NTU	Place That Biofilter in Filter to Waste~~Place that filter in filter-to-waste mode~~

Parameter	Alert Value	Alarm Value	Unit	Action
Biofilter Combined Filter Effluent Turbidity	0.1	0.15	NTU	Place Biofilters in Filter to WastePlace all filters in filter-to-waste mode
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
Free Chlorine CT ***(This CCP is not being used since free chlorination of the SWIFT Water is not currently being practiced)***	<120% of CT Target	<105% of CT Target	%	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	80	90	lbs/day	Place Biofilters in Filter to WastePlace all filters in filter-to-waste mode
Tasting System Free Chlorine CT	<110% of Required CT	100% of Required CT	mg-min/L	Shut Down Tasting System
Tasting System Total Ammonia	10	10	mg/L-N	Shut Down Tasting System

Table 5. Hazard Analysis and Critical Control Point: Critical Control Points

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[2]	Required Monitoring Frequency	April[1]			May			June		
					Average[3]	Maximum	Numer of Samples	Average[3]	Maximum	Numer of Samples	Average[3]	Maximum	Numer of Samples
Regulatory Parameters													
Total Nitrogen (TN)	mg/L	NA	0.50	Daily[4]	**2.11**	**2.17**	**2**	**2.90**	**3.53**	**24**	**2.90**	**3.68**	**25**
NO_3	mg/L	10	0.01	Daily[4]	**1.24**	**1.24**	**2**	**2.03**	**3.06**	**24**	**2.34**	**3.10**	**25**
NO_2	mg/L	1	0.01	Daily[4]	**<0.01**	**<0.01**	**2**	**0.26**	**0.48**	**24**	**0.12**	**0.55**	**25**
Turbidity	NTU	NA	0.01	Continuous					**Figure 1**				
Total Organic Carbon (TOC)	mg/L	NA	0.10	3x/Wk[4]	**0.32**	**0.32**	**1**	**1.23**	**2.25**	**11**	**2.73**	**3.33**	**10**
pH		NA	NA	Continuous					**Figure 2**				
TDS[5]	mg/L	Potomac Aquifer System Range: 694-8,720	2.5	Monthly					**546**	**1**		**630**	**1**
Microorganisms													
Total Coliform	MPN/100 mL	MCLG = 0	1	Daily[3]	**<1**	**<1**	**2**	**<1**	**<1**	**23**	**<1**	**<1**	**23**
E. coli	MPN/100 mL	NA	1	Weekly	**<1**	**<1**	**2**	**<1**	**<1**	**23**	**<1**	**<1**	**23**
Cryptosporidium	oocysts/L	Treatment Technique, MCLG = 0	0.091	Quarterly					**<0.091**	**1**		**<0.1**	**1**
Giardia lamblia	oocysts/L	Treatment Technique, MCLG = 0	0.091	Quarterly					**<0.091**	**1**		**<0.1**	**1**
Legionella	MPN/100 mL	Treatment Technique, MCLG = 0	10	Quarterly								**<10**	**1**
Disinfection Byproducts													
Bromate	µg/L	10	0.15	Monthly					**1.77**	**1**		**3.06**	**1**
Chlorite	mg/L	1.0	0.10	Monthly					**<0.10**	**1**		**<0.1**	**1**
Trihalomethanes													
Bromodichloromethane	µg/L		1	Monthly					**<1**	**1**		**<1**	**1**
Bromoform	µg/L		1	Monthly					**<1**	**1**		**3.16**	**1**
Chloroform	µg/L		1	Monthly					**<1**	**1**		**<1**	**1**
Dibromochloromethane	µg/L		1	Monthly					**<1**	**1**		**1.33**	**1**
Total Trihalomethanes	µg/L	80											
HAAs													
Dichloroacetic acid	µg/L		0.6	Monthly					**<0.6**	**1**		**<0.6**	**1**
Trichloroacetic acid	µg/L		0.2	Monthly					**<0.2**	**1**		**<0.2**	**1**
Monochloroacetic acid	µg/L		0.6	Monthly					**<0.6**	**1**		**<0.6**	**1**
Bromoacetic acid	µg/L		0.4	Monthly					**<0.4**	**1**		**<0.4**	**1**
Dibromoacetic acid	µg/L		0.2	Monthly					**<0.2**	**1**		**3.10**	**1**
Total Haloacetic Acids	µg/L	60											
Disinfectants													
Monochloramine (as Cl2)[6]	mg/L	4		Continuous	**0.35**	**0.61**		**0.18**	**2.14**		**0.01**	**0.05**	
Chlorine (as Cl2)	mg/L	4		Continuous	**0.30**	**0.50**		**0.31**	**2.78**		**0.65**	**2.87**	
Inorganic Chemical													
Antimony	µg/L	6	0.5	Monthly					**<0.5**	**1**		**<0.5**	**1**
Arsenic	µg/L	10	0.2	Monthly					**0.61**	**1**		**<1 (D, MQ1)**	**1**
Asbestos	MFL	7	0.2	Monthly					**<0.2**	**1**		**<0.2**	**1**

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[2]	Required Monitoring Frequency	April[1] Average[3]	April[1] Maximum	April[1] Numer of Samples	May Average[3]	May Maximum	May Numer of Samples	June Average[3]	June Maximum	June Numer of Samples
Barium	mg/L	2	0.005	Monthly					**0.008**	**1**		**0.005**	**1**
Beryllium	µg/L	4	0.1	Monthly					**<0.1**	**1**		**<0.1**	**1**
Cadmium	µg/L	5	0.1	Monthly					**<0.1**	**1**		**<0.1**	**1**
Chromium (total)	µg/L	100	2.5	Monthly					**<2.5**	**1**		**<2.5**	**1**
Copper	mg/L	1.3 (action level)	0.005	Monthly					**<0.005**	**1**		**<0.005**	**1**
Cyanide (total)	µg/L	200	10	Monthly					**<10**	**1**		**<10**	**1**
Fluoride	mg/L	4.0	0.100	Monthly	**0.776**	**0.879**	**2**	**0.925**	**1.06**	**24**	**0.961**	**1.16**	**25**
Lead	µg/L	15 (action level)	0.1	Monthly					**<0.1**	**1**		**<0.1**	**1**
Mercury	µg/L	2	0.1	Monthly					**<0.1**	**1**		**<0.1**	**1**
Selenium	µg/L	50	5	Monthly					**<5**	**1**		**<5**	**1**
Thallium	µg/L	2	0.1	Monthly					**<0.1**	**1**		**<0.1**	**1**
Organic Chemicals													
Acrylamide	µg/L	Treatment Technique, MCLG = 0	0.1	Monthly					**<0.1**	**1**		**<1 (D1)**	**1**
Alachlor	µg/L	2	0.05	Monthly					**<0.05**	**1**		**<0.05**	**1**
Atrazine	µg/L	3	0.05	Monthly					**<0.05**	**1**		**<0.05**	**1**
Benzo(a)pyrene (PAHs)	µg/L	0.2	0.02	Monthly					**<0.02**	**1**		**<0.02**	**1**
Di(2-ethylhexyl) adipate	µg/L	400	0.6	Monthly					**<0.6**	**1**		**<0.6**	**1**
Di(2-ethylhexyl) phthalate	µg/L	6	0.6	Monthly					**<0.6**	**1**		**<0.6**	**1**
Hexachlorocyclopentadiene	µg/L	50	0.05	Monthly					**<0.05**	**1**		**<0.05**	**1**
Hexachlorobenzene	µg/L	1	0.05	Monthly					**<0.05**	**1**		**<0.05**	**1**
Simazine	µg/L	4	0.05	Monthly					**<0.05**	**1**		**<0.05**	**1**
Carbofuran	µg/L	40	0.5	Monthly					**<0.5**	**1**		**<0.5**	**1**
Oxamyl (Vydate)	µg/L	200	0.5	Monthly					**<0.5**	**1**		**<0.5**	**1**
Chlordane	µg/L	2	0.1	Monthly					**<0.1**	**1**		**<0.1**	**1**
Endrin	µg/L	2	0.01	Monthly					**<0.01**	**1**		**<0.01**	**1**
Heptachlor	µg/L	0.4	0.01	Monthly					**<0.01**	**1**		**<0.01**	**1**
Heptachlor Epoxide	µg/L	0.2	0.01	Monthly					**<0.01**	**1**		**<0.01**	**1**
Lindane	µg/L	0.2	0.01	Monthly					**<0.01**	**1**		**<0.01**	**1**
Methoxychlor	µg/L	40	0.05	Monthly					**<0.05**	**1**		**<0.05**	**1**
Toxaphene	µg/L	3	0.5	Monthly					**<0.5**	**1**		**<0.5**	**1**
PCB Arochlor1016	µg/L		0.08	Monthly					**<0.08**	**1**		**<0.08**	**1**
PCB Arochlor1221	µg/L		0.1	Monthly					**<0.1**	**1**		**<0.1**	**1**
PCB Arochlor1232	µg/L		0.1	Monthly					**<0.1**	**1**		**<0.1**	**1**
PCB Arochlor1242	µg/L		0.1	Monthly					**<0.1**	**1**		**<0.1**	**1**
PCB Arochlor1248	µg/L		0.1	Monthly					**<0.1**	**1**		**<0.1**	**1**
PCB Arochlor1254	µg/L		0.1	Monthly					**<0.1**	**1**		**<0.1**	**1**
PCB Arochlor1260	µg/L		0.1	Monthly					**<0.1**	**1**		**<0.1**	**1**
Total Polychlorinated Biphenyls (PCBs)	µg/L	0.5											
2,4-D	µg/L	70	0.1	Monthly					**<0.1**	**1**		**<0.1**	**1**
Dalapon	µg/L	200	1	Monthly					**<1**	**1**		**<1**	**1**
Picloram	µg/L	500	0.1	Monthly					**<0.1**	**1**		**<0.1**	**1**
2,4,5-TP (Silvex)	µg/L	50	0.2	Monthly					**<0.2**	**1**		**<0.2**	**1**
Dinoseb	µg/L	7	0.2	Monthly					**<0.2**	**1**		**<0.2**	**1**

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[2]	Required Monitoring Frequency	April[1] Average[3]	April[1] Maximum	April[1] Numer of Samples	May Average[3]	May Maximum	May Numer of Samples	June Average[3]	June Maximum	June Numer of Samples
Pentachlorophenol	µg/L	1	0.04	Monthly					<0.04	1		<0.04	1
Dioxin (2,3,7,8-TCDD)	pg/L	30	5	Monthly					<5	1		<5	1
Diquat	µg/L	20	0.4	Monthly					<0.4	1		<0.4	1
Endothall	µg/L	100	5	Monthly					<5	1		<5	1
Epichlorohydrin	µg/L	Treatment Technique, MCLG = 0	0.4	Monthly					<0.4	1		<0.4	1
Glycophosphate	µg/L	700	6	Monthly					<6	1		<6	1
Benzene	µg/L	5	1	Monthly					<1	1		<1	1
Carbon Tetrachloride	µg/L	5	1	Monthly					<1	1		<1	1
Chlorobenzene	µg/L	100	1	Monthly					<1	1		<1	1
,2-dibromo-3-chloropropane (DBCP)	µg/L	0.2	0.02	Monthly					<0.02	1		<0.02	1
o-Dichlororbenzene	µg/L	600	1	Monthly					<1	1		<1	1
p-Dichlorobenzene	µg/L	75	1	Monthly					<1	1		<1	1
1,2-Dichloroethane	µg/L	5	1	Monthly					<1	1		<1	1
1,1-Dichlororethylene	µg/L	7	1	Monthly					<1	1		<1	1
cis-1,2-Dichloroehtylene	µg/L	70	1	Monthly					<1	1		<1	1
trans-1,2-Dichloroethylene	µg/L	100	1	Monthly					<1	1		<1	1
Dichloromethane	µg/L	5	1	Monthly					<1	1		<1	1
1,2-Dichloropropane	µg/L	5	1	Monthly					<1	1		<1	1
Ethylbenzene	µg/L	700	1	Monthly					<1	1		<1	1
Ethylene Dibromide (EDB)	µg/L	0.05	0.02	Monthly					<0.02	1		<0.02	1
Styrene	µg/L	100	1	Monthly					<1	1		<1	1
Tetrachloroethylene	µg/L	5	1	Monthly					<1	1		<1	1
Toluene	µg/L	1,000	1	Monthly					<1	1		<1	1
1,2,4-Trichlorobenzene	µg/L	70	1	Monthly					<1	1		<1	1
1,1,1-Trichloroethane	µg/L	200	1	Monthly					<1	1		<1	1
1,1,2-Trichloroethane	µg/L	5	1	Monthly					<1	1		<1	1
Trichloroethylene	µg/L	5	1	Monthly					<1	1		<1	1
Vinyl Chloride	µg/L	2	1	Monthly					<1	1		<1	1
p/m-Xylene	µg/L		2	Monthly					<2	1		<2	1
o-Xylene	µg/L		1	Monthly					<1	1		<1	1
Total Xylene	µg/L	10,000	3	Monthly					<3	1		<3	1
Radionuclides													
Alpha particles	pCi/L	15	3	Monthly					5.0	1		<3	1
Beta particles and photon emitters	pCi/L	4 mrem/yr[7]	3	Monthly					17	1		15	1
Radium 226	pCi/L	5 (226+228)	1	Monthly					3.4	1		<1	1
Radium 228	pCi/L	5 (226+228)	1	Monthly					<1	1		<1	1
Uranium	µg/L	30	0.1	Monthly					<0.1	1		<0.1	1
Strontium-90	pCi/L	NA	0.598	Monthly					<0.565	1		<0.598	1
Tritium	pCi/L	NA	355	Monthly					<320	1		<355	1
Non-regulatory Performance Indicators													
Public Health Indicators		**Trigger Limits**											
1,4-dioxane	µg/L	1	0.06	Quarterly	0.17	0.17	1	0.61	0.67	3	0.48	0.54	4
17-β-estradiol	ug/L	TBD	0.0004	Quarterly					<0.0004	1		<0.0004	1

					April[1]			May			June		
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[2]**	**Required Monitoring Frequency**	**Average[3]**	**Maximum**	**Numer of Samples**	**Average[3]**	**Maximum**	**Numer of Samples**	**Average[3]**	**Maximum**	**Numer of Samples**
DEET	ng/L	200,000	10	Quarterly					**<10**	**1**		**<10**	**1**
Ethinyl estradiol	ng/L	TBD	5	Quarterly					**<5**	**1**		**<10**	**1**
ris(2-carboxyethyl)phosphine (TCEP)	ng/L	5,000	10	Quarterly					**<10**	**1**		**<10**	**1**
NDMA	ng/L	10	2	Quarterly	**<2**	**<2**	**1**	**1.08**	**3.23**	**3**	**1.59**	**3.93**	**4**
Perchlorate	µg/L	6	0.5	Quarterly					**<0.5**	**1**		**<0.5**	**1**
Perfluorooctanoic Acid (PFOA)	µg/L	0.070 (PFOA+PFOS)	0.002	Quarterly					**<0.002**	**1**		**<0.002**	**1**
Perfluorooctanesulfonic Acid (PFOS)	µg/L	0.070 (PFOA+PFOS)	0.002	Quarterly					**<0.002**	**1**		**<0.002**	**1**
Treatment Efficacy Indicators		**Trigger Limits**											
Cotinine	ng/L	1,000	10	Quarterly					**<10**	**1**		**<10**	**1**
Primidone	ng/L	10,000	5	Quarterly					**<5**	**1**		**<5**	**1**
Phenytoin (Dilantin)	ng/L	2,000	20	Quarterly					**<20**	**1**		**<20**	**1**
Meprobamate	ng/L	200,000	5	Quarterly					**<5**	**1**		**<5**	**1**
Atenolol	ng/L	4,000	5	Quarterly					**<5**	**1**		**<5**	**1**
Carbemazepine	ng/L	10,000	5	Quarterly					**<5**	**1**		**<5**	**1**
Estrone	ng/L	320,000	2	Quarterly					**<2**	**1**		**<2**	**1**
Sucralose	ng/L	150,000,000	100	Quarterly					**<100**	**1**		**<100**	**1**
Triclosan	ng/L	210,000	20	Quarterly					**<20**	**1**		**<20**	**1**
Additional Monitoring (Ozone & UV LRV)					**Average**	**Minimum**		**Average**	**Minimum**		**Average**	**Minimum**	
Ozone Virus LRV				Continuous	**4.51**	**4.33**		**4.54**	**3.68**		**4.51**	**3.45**	
Ozone Giardia LRV				Continuous	**2.31**	**2.21**		**2.22**	**1.78**		**2.11**	**1.61**	
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] Recharge did not begin in April until the last two days of the month. As a result, monthly samples were not collected with the exception of fluoride. Though fluoride is only required on a monthly basis as part of the routine MCL monitoring, the use of fluoride as a tracer within the upper Potomac Aquifer necessitates more frequent monitoring for tracking the migration of the recharge front.

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

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

[4] Daily samples are typically not collected on days in which there is no or limited recharge. In April, recharge occurred for two days and had a maximum daily sample count of two. In May, there was no recharge on six days and very limited recharge on one additional day (less than 25%) which impacted the collection and sample frequency for Total coliform (TC), Total Nitrogen (TN), Nitrate (NO3), Nitrite (NO2) and Total Organic Carbon (TOC). The maximum daily sample count for May was 24. In June, there was no recharge on five days which impacted the collection and sample frequency for Total coliform (TC), Total Nitrogen (TN), Nitrate (NO3), Nitrite (NO2) and TOC. TC sample collection was impacted an additional two days in June due to limited recharge during the hours of 6 am - 6 pm. The maximum number of daily samples in June was 25 for TN, NO3 and NO2 and 23 for TC.

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

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

[7] 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.

Laboratory Flags
(D) - Sample diluted at 5x.
(MQ1) - Collision cell used for drinking water.
(D1) - Sample required dilution due to matrix.

Recharge Statistics

The total volume recharged during this operational period was 31.94 million gallons. 2,27 million gallons was backflushed for a net recharge of 29.67 million gallons (Figure 3). Brief backflushing periods occur as part of routine well maintenance on an approximate daily basis.

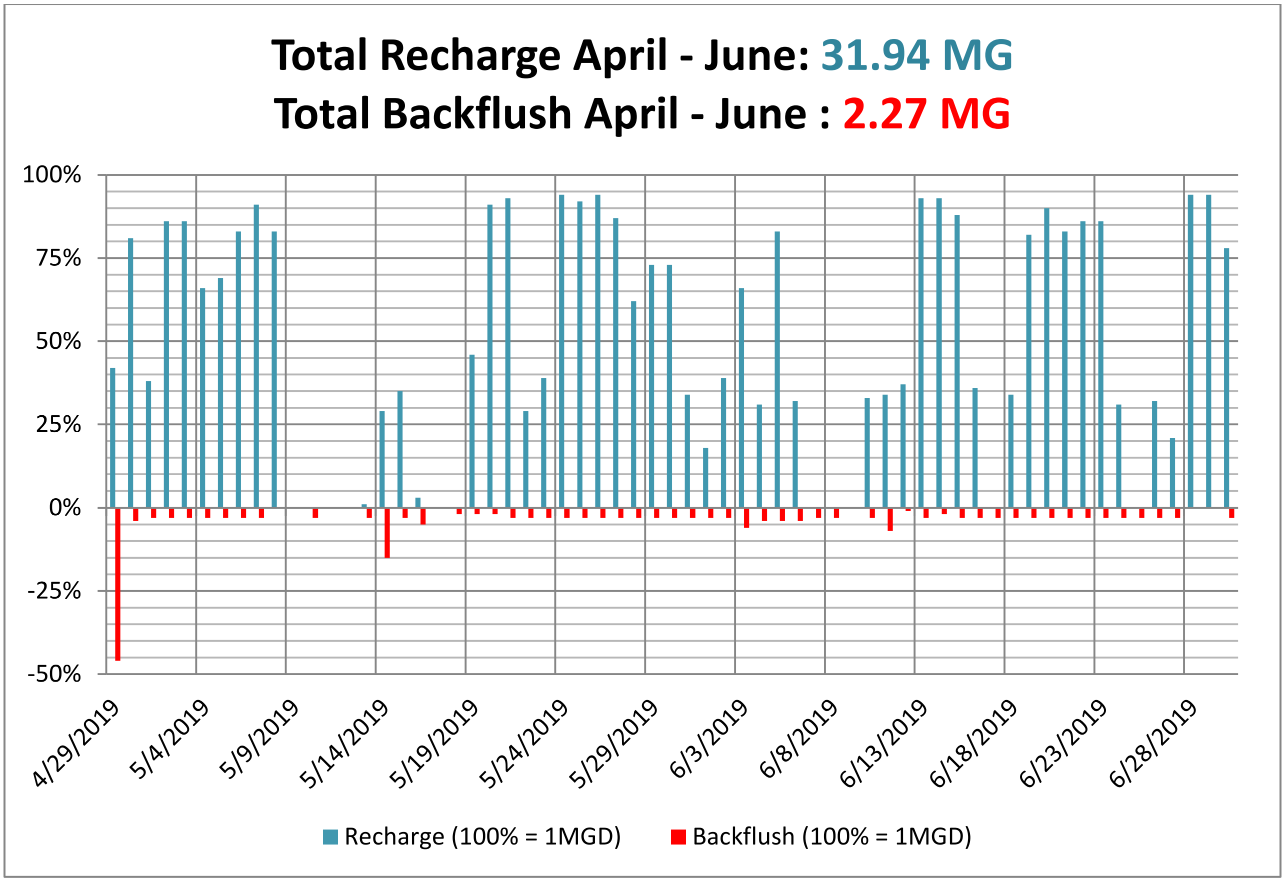

Figure 3: Recharge and Backflush Volumes, April 29 – June 30, 2019.

Recharge Well (TW-1) Rehabilitation

As described in the previous quarterly report for Recharge Operations of September 1 – November 30, 2019, corrosion in the biofilters contributed to a loss of injectivity in TW-1. In order to evaluate the condition of the well screens, a video survey was conducted in test well TW-1 on January 8, 2019. The video demonstrated that greater than 50 percent of the slots in each of the upper ten screen intervals were clogged with red brown silt or clay size deposits. Approximately 83 feet of material filled (fill) the bottom of the well from 1,327 to 1,410 feet below grade (fbg). The fill completely buried the 10-foot long sump (1,400 to 1,410 fbg), Screen 11 (1370 to 1400 fbg), the blank between Screens 10 and 11, and 8 feet of Screen 10 (1230 to 1335 fbg).

In order to regain maximum injectivity, TW-1 was rehabilitated beginning on March 5th. The following activities were performed:

- Wire brushed the well (casing/screens) while air lifting (using compressed air to move water/debris up out of the well)
- Air lifted the sand/iron debris from the bottom of the well
- Swabbed the screen zones in two passes, one using strictly mechanical swabbing and then a second, applying chemical treatment (acid/dispersant), let sit for 24hrs and then airlifted out debris and unspent chemical
- Installed test pump and conducted pumping/surging for 36 hours
- Conducted 5 hour step test
- Conducted post-rehabilitation camera survey

TW-1 well rehabilitation was completed on April 12th and was followed by installation of the backflush pump assembly, with recharge operations resuming April 29th. The static water level in the recharge well prior to resuming operations was at -91 feet below the top of the pump pedestal. Since resuming recharge operations at 1 MGD, the injection level in TW-1 has stabilized around 55 feet below the top of the pump pedestal, a drawup around 36 feet. The resulting specific injectivity is 19 gpm/ft of draw-up, slightly lower than when operations initially started-up (around 25 gpm/ft). Daily backflushing is being performed which is successfully maintaining the current capacity.

HRSD has resumed continuous monitoring of recharge and backflush water levels in TW-1, backflush specific capacity and recharge specific injectivity, and monitoring of the Bypass Filter Index (BFI) and Membrane Filter Index (MFI) 3 times a week.

Nitrite in MW-SAT Update

HRSD continues to monitor nitrite levels within MW-SAT and the conventional wells. As demonstrated in previous reports, in August 2018, nitrite levels within two of the MW-SAT intervals increased above the level of the MCL within a week of resuming recharge following the extended period of backflush performed to remove elevated nitrite in MW-SAT. This increase occurred despite low concentrations of nitrite within the SWIFT Water recharge. This is strongly believed to be a result of partial denitrification occurring within the immediate vicinity of the recharge well as nitrate is converted to nitrite under reducing conditions. Denitrification is expected to continue as the recharge front migrates, removing any remaining nitrite. Monitoring observations continue to support this hypothesis and nitrite concentrations have continued to trend down after the April 2019 resumption of recharge operations. During this period, nitrite concentrations have remained at or below one half of the MCL (Figures 4 and 5). As a result, nitrite monitoring has been reduced as of July 1 to a minimum of once every two weeks in the intervals receiving recharge. More frequent monitoring (i.e., weekly or daily) will be implemented on an as needed basis as dictated by monitoring results or trends.

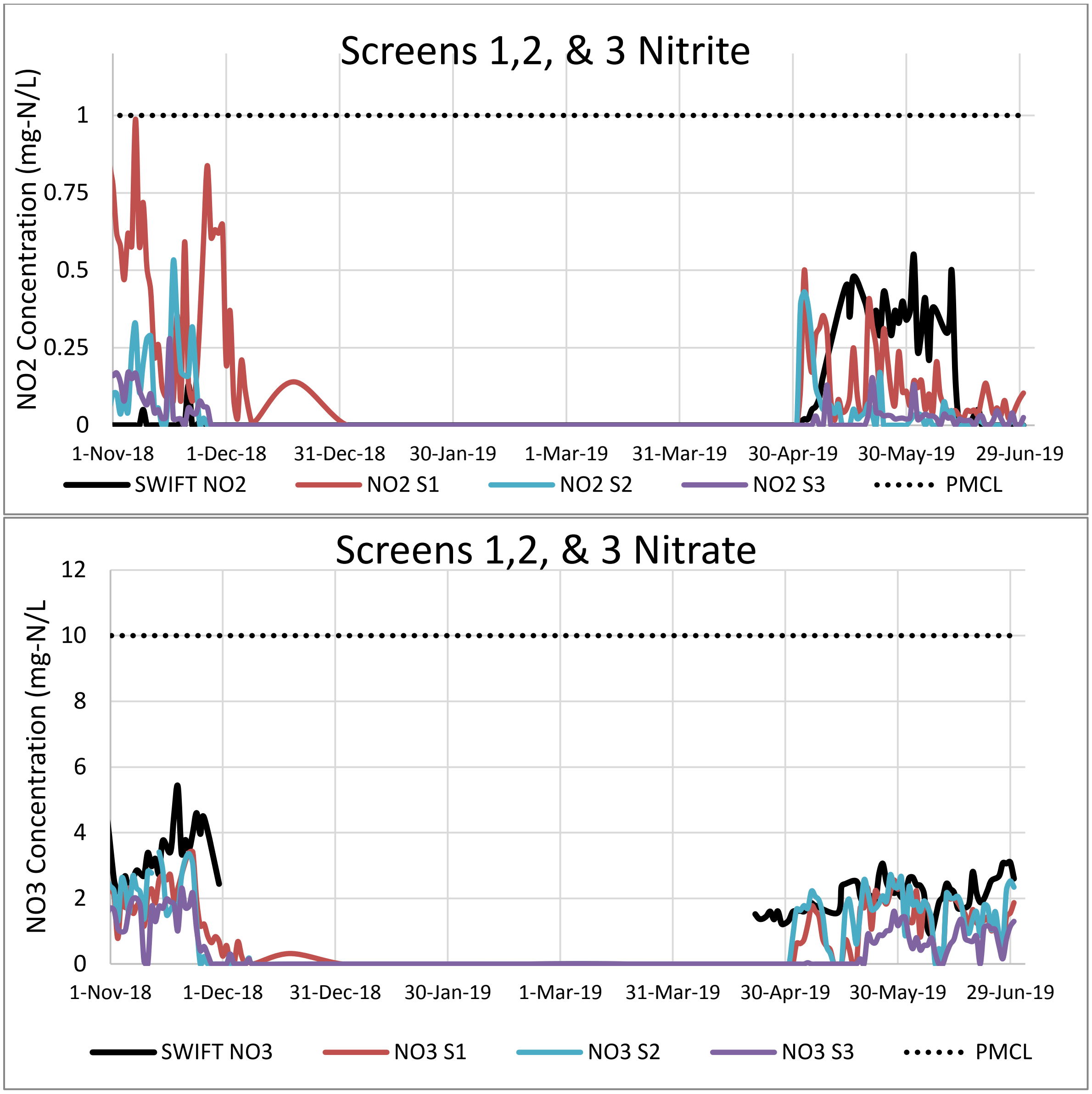

Figure 4: Average Daily Nitrite and Nitrate Concentrations in MW-SAT Screen Intervals 1 (S1), 2 (S2) and 3 (S3) relative to the nitrite PMCL and SWIFT Water concentrations (SWIFT). No recharge occurred during the period of November 22 – April 29. After the SWIFT RC resumed operations, nitrite levels in the SWIFT Water were controlled by the addition of free chlorine to maintain the nitrite concentration at or below 0.50 mg/L until the biofilters were fully acclimated.

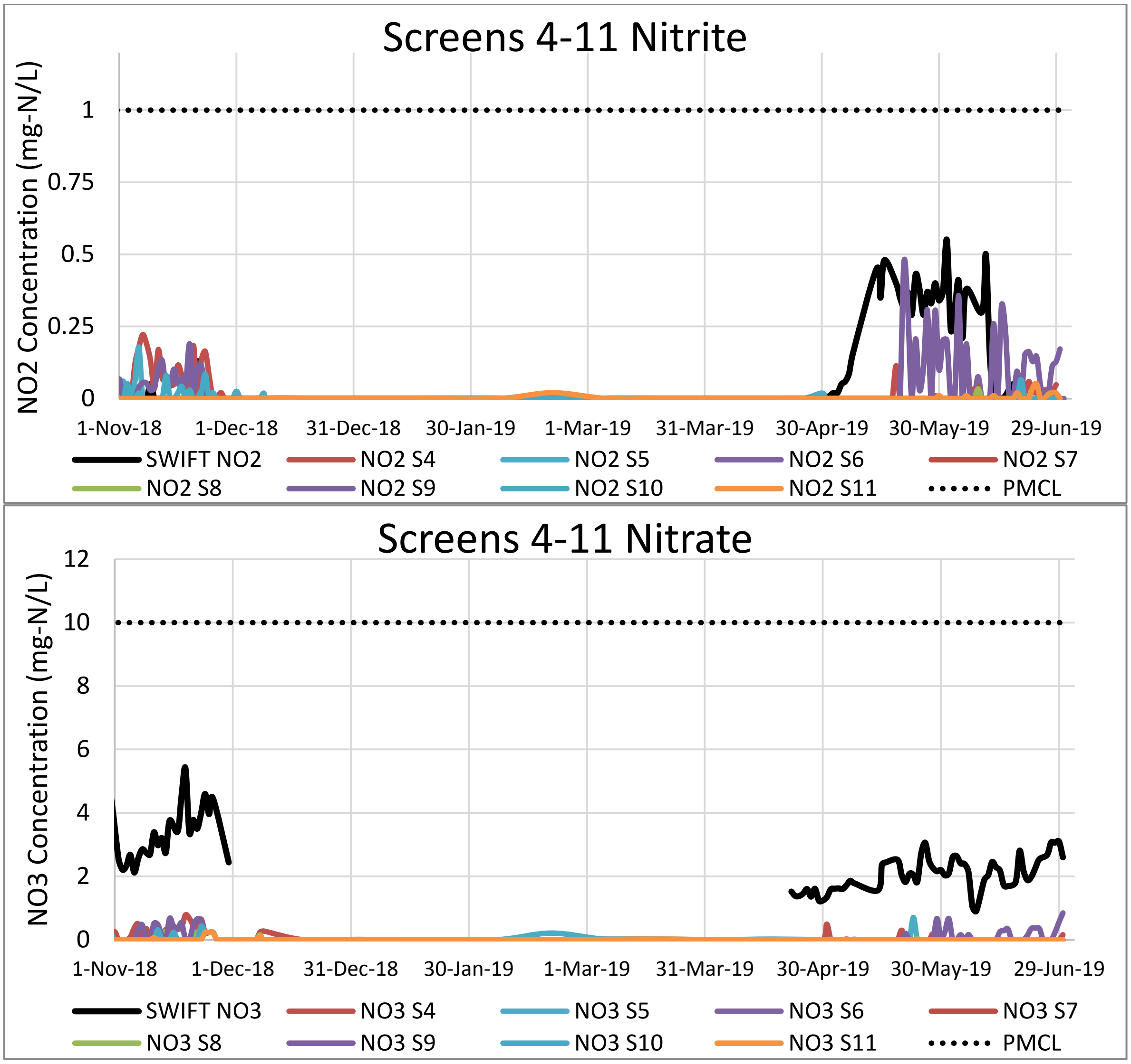

Figure 5: Average Daily Nitrite Concentration in MW-SAT Screen Intervals 4 - 11 (S4-S11) relative to the nitrite PMCL and SWIFT Water concentrations (SWIFT). No recharge occurred during the period of November 22 – April 29.

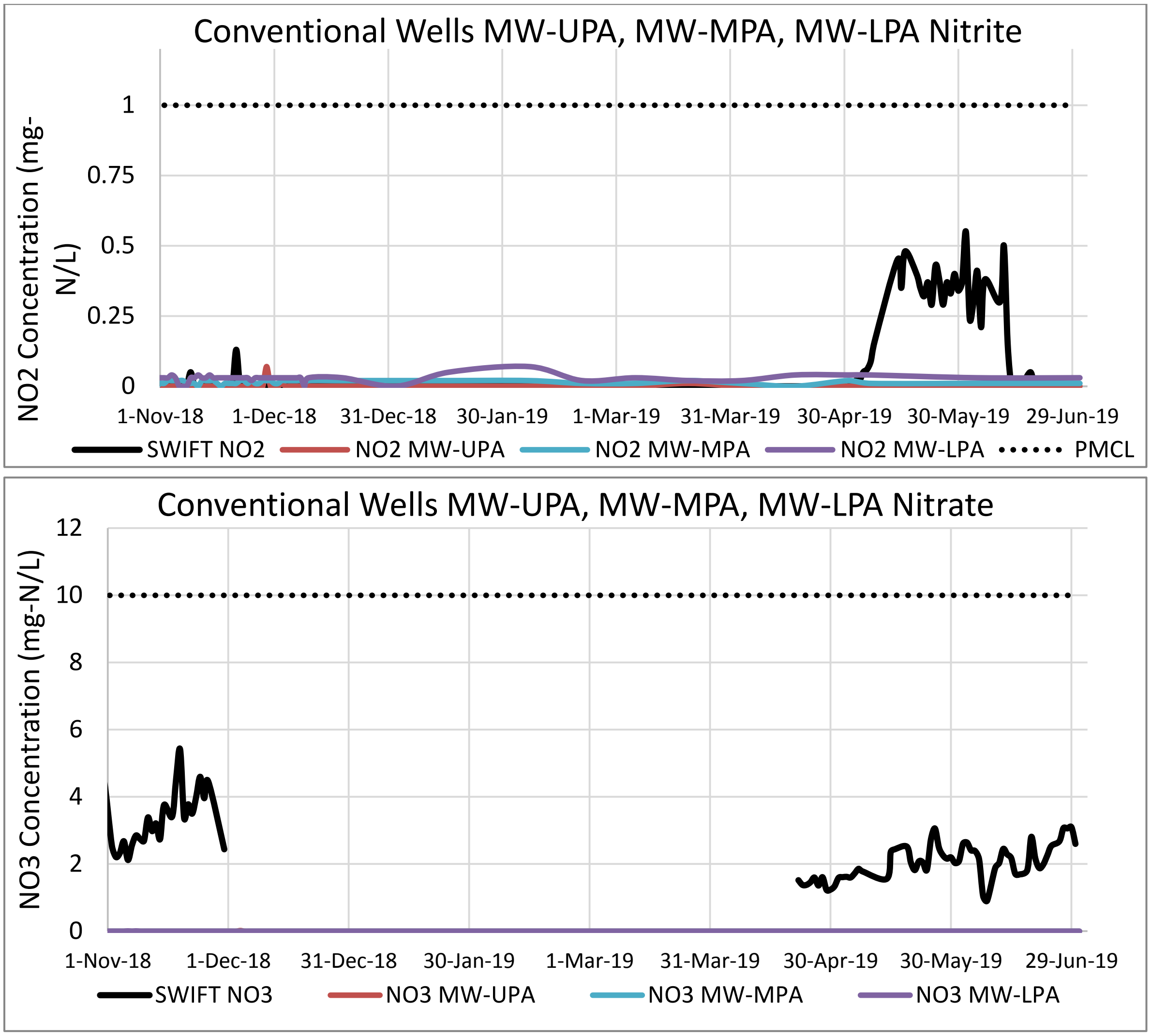

Figure 6: Average Daily Nitrite Concentration in the conventional monitoring wells (MW-UPA, MW-MPA, MW-LPA). No recharge occurred during the period of November 22 – April 29.

Arsenic in MW-SAT Update

As described in a brief report issued on May 16, 2019, the concentration of arsenic in MW-SAT screen interval 9 increased above the MCL of 10 µg/L in a sample collected on May 6, eight days after resuming recharge. Analysis of both total and dissolved arsenic indicated that the arsenic was present primarily as dissolved. For the remainder of May and early June, the concentration of arsenic fluctuated around the MCL (Figure 7), decreasing during periods in which recharge was temporarily halted and increasing when recharge resumed. For the latter half of June, the concentration of arsenic in interval 9 exhibited a decreasing trend during periods of consistent recharge.

The arsenic concentration in the remaining intervals of MW-SAT remained less than one half of the MCL and the arsenic concentration in the conventional wells of the lower, middle and upper Potomac Aquifer remained less than 1 µg/L (Figure 8) during this period.

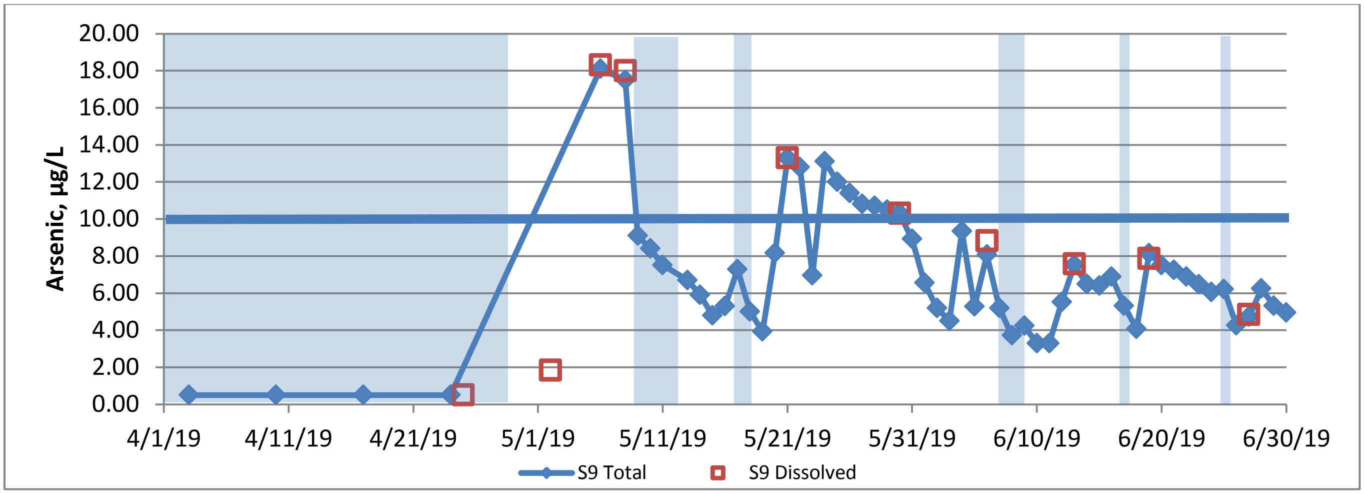

Figure 7: Total and dissolved arsenic concentrations in Screen Interval 9. The MCL of 10 µg/L is noted by the blue horizontal bar. Periods in which recharge did not occur are noted in shaded areas.

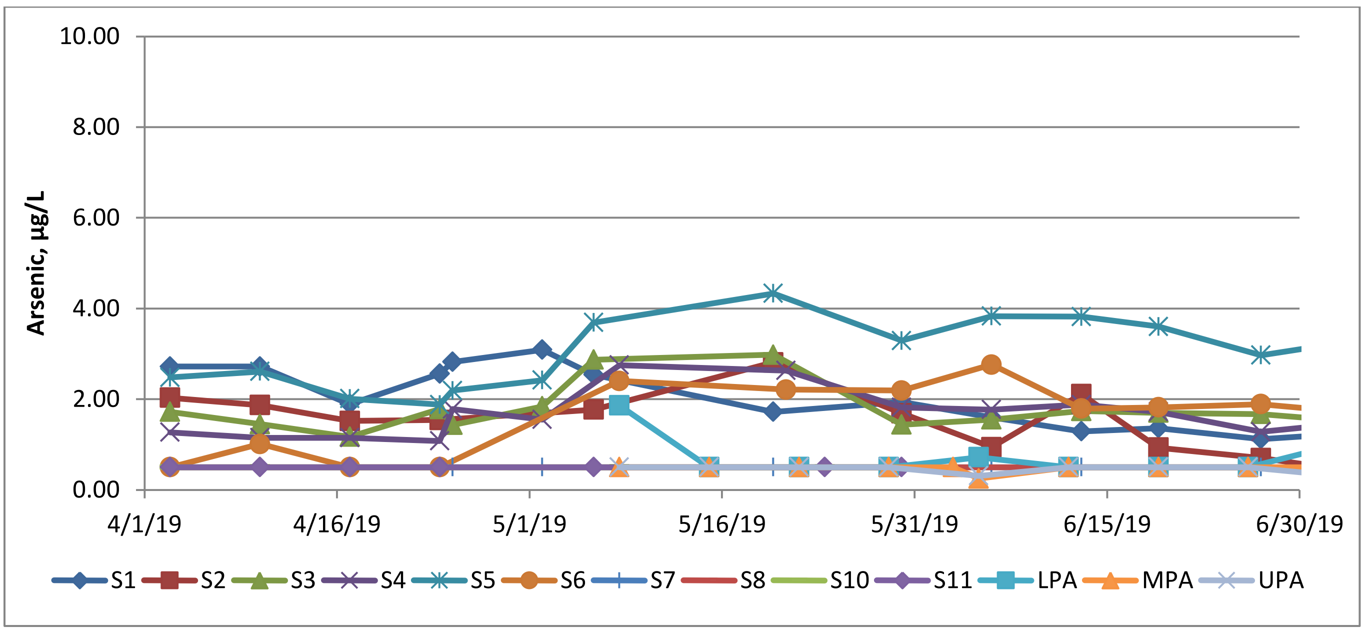

Figure 8: Arsenic concentration in MW-SAT intervals (excluding interval 9) and the conventional wells (Lower Potomac Aquifer - LPA, Middle Potomac Aquifer - MPA, and Upper Potomac Aquifer - UPA). The concentration of arsenic remained less than one half of the MCL in each of the depicted intervals of MW-SAT and remained less than 1 µg/L in each of the conventional monitoring wells.

On May 8, a sample was collected to determine arsenic speciation within interval 9. The results of the speciation analysis indicated that all of the arsenic present within interval 9 was present as arsenic (V) (Table 7).

Date	Total Arsenic (µg/L)	Arsenic (V) (µg/L)	Arsenic (III) (µg/L)
May 8, 2019	20	19	Non-detect

Table 7. Results of arsenic speciation from MW-SAT, screen interval 9.

Though no definitive conclusions can be drawn as to the cause of the temporary increase in arsenic above the MCL in interval 9, the presence of arsenic (V) in interval 9 supports the hypothesis that the temporary spike in arsenic concentration is related to the well rehabilitation that was necessitated by the corrosion event within the biofilters of the SWIFT advanced water treatment system. During the rehabilitation work, sulfamic acid and surfactants were used to restore the well screens and likely interfered with the hydrous ferric oxide (HFO) surface, allowing for the release of arsenic (V). The soil columns, which were built to quantify the additional benefits of soil aquifer treatment, are being utilized to better understand the potential for arsenic mobilization within the Potomac Aquifer System (PAS). In addition to quantifying the concentration of arsenic entering and exiting the columns, the washed PAS sediment cuttings retrieved from well installation which were used to build the columns are undergoing further analysis to determine if significant arsenic bearing minerals or surfaces that adsorb arsenic are present that may not have been observed in the original evaluation of these materials. Weekly monitoring of total and dissolved arsenic is occurring in each of the screened intervals of MW-SAT which are receiving recharge and in the conventional monitoring wells. Additional data continues to be collected as part of our routine monitoring including conductivity, iron, orthophosphate, pH and dissolved oxygen. Periodic arsenic speciation is also being included for interval 9 and any other intervals that exhibit consistent arsenic concentrations above 3 µg/L (e.g., screen interval 5).

The close proximity of MW-SAT to the recharge well has proven invaluable to understanding these types of geochemical reactions at a highly granular level of detail. Continued observation of arsenic concentration in the outer lying conventional monitoring wells as the recharge front approaches coupled with the planned soil column study will provide a better understanding of the potential for arsenic mobilization further afield. Updates on this issue will continue to be presented in the quarterly regulatory reports.