2018 Groundwater Quality Survey and Contaminant Trends Study Report

MCD staff collects a groundwater sample from a monitoring well

Executive Summary

To analyze groundwater quality, MCD staff collected water samples from 12 monitoring wells located in the buried valley aquifer during the spring and fall of 2018. The goal of the study is to provide a better understanding of human impact on and to identify trends related to groundwater quality. The samples were analyzed for the presence of E. coli, major ions, nutrients, and volatile organic compounds.

Overall, the results show that groundwater in the sampled wells has a calcium-magnesium-bicarbonate composition. All samples collected in this study had measured water hardness in the very hard range.

The samples met all applicable primary drinking water standards and health-based screening levels in the water collected from 8 of the 12 monitoring wells.

Parameters that exceeded a primary drinking water standard or human health benchmark in at least one groundwater sample included arsenic, E. coli, manganese, and trichloroethene. Parameters that exceeded secondary drinking water standards in at least one groundwater sample included iron, manganese, and total dissolved solids.

Parameters detected in one or more groundwater samples indicative of anthropogenic sources of contamination included trichloroethene, nitrate and the ions chloride and sodium. Naturally occurring contaminants included arsenic, iron, hardness, manganese, and total dissolved solids.

Trend analysis of anthropogenic contaminants show levels of trichloroethene in one monitoring well are declining. Nitrate concentrations in groundwater samples vary widely from each well and from spring to fall. Concentrations of chloride and sodium also vary widely and show fluctuations in wells with a history of elevated concentrations. Concentrations of natural occurring contaminants such as arsenic, iron, and manganese, did not show strong evidence of increasing or decreasing trends.

The results of this study are consistent with the results of previous rounds of sampling as well as other studies which show that low levels of anthropogenic contaminants are not uncommon in sensitive, shallow sand and gravel aquifer settings. This emphasizes the need for groundwater protection to manage the quality of buried valley aquifer resources in southwest Ohio.

Introduction

MCD staff collected samples from 12 groundwater monitoring wells to survey groundwater quality in the buried valley aquifer (see Figure 1). The purpose of the study is to provide a better understanding of human impact on groundwater quality. All of the wells chosen for the study are surrounded by land uses with the potential to release contaminants into the aquifer.

The wells selected for the study are installed in unconfined sand and gravel aquifers with permeable soils at the surface. Seven of the wells are screened at shallow (< 50 feet) depths. Table 1 summarizes depths and screened intervals for all of the monitoring wells in this survey.

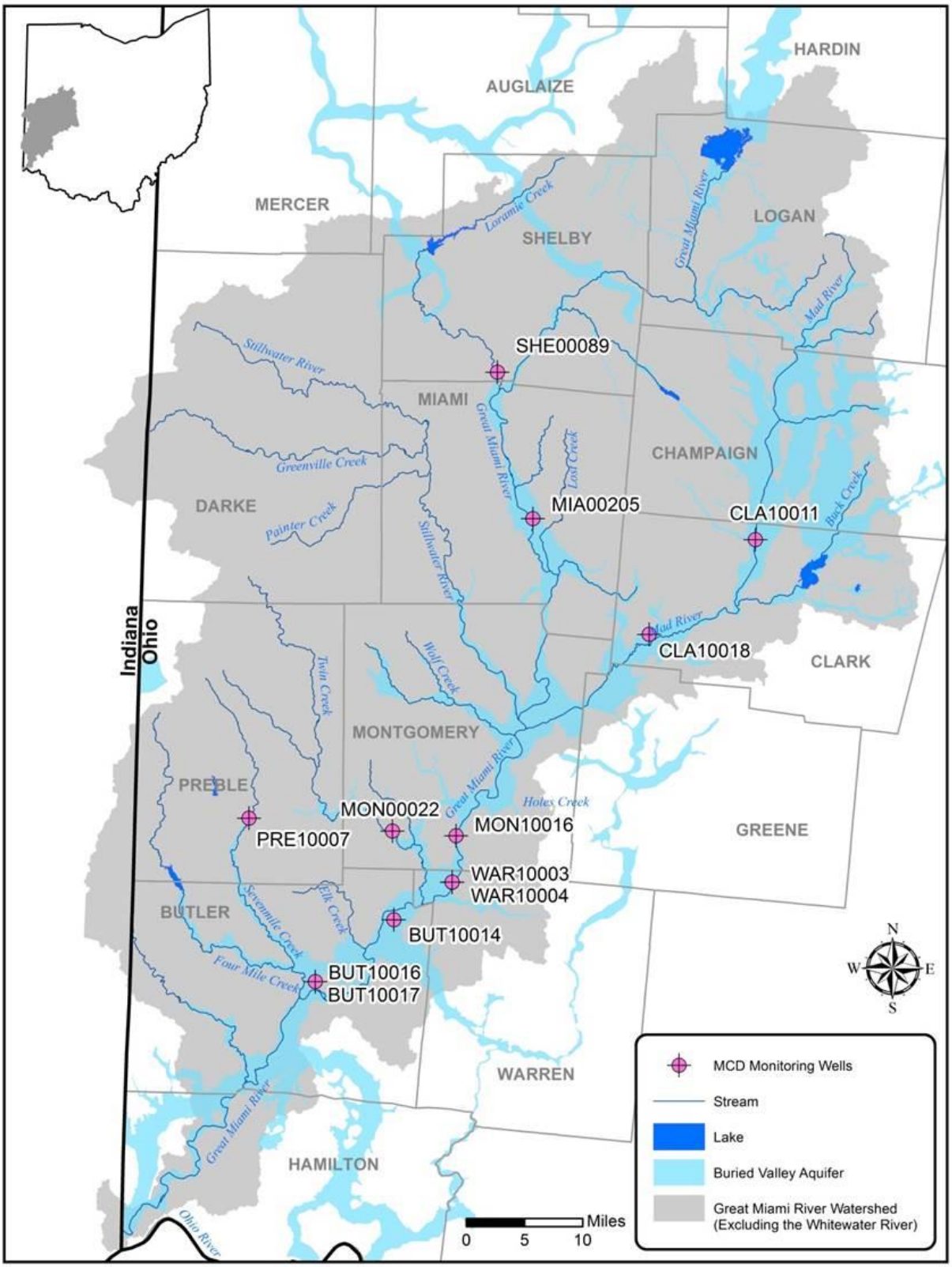
MCD equipped each monitoring well with a bladder pump installed within the screened interval of the well. The bladder pumps allow low-flow purging techniques to be used (Puls and Barcelona, 1996).

Samples were collected twice in 2018; once between May 1 and 11 (spring) and once between September 18 and October 1 (fall). The water was analyzed for a range of parameters including E. coli, major ions, metals, nutrients, and volatile organic compounds (VOCs).

Table 1 – Construction details for groundwater quality monitoring wells

Monitoring Well ID	Casing Diameter (in)	Well Depth (ft)	Screened Interval (ft)	Aquifer Screened
BUT10014	2	40	35 - 40	Sand and Gravel
BUT10016	2	65	60 - 65	Sand and Gravel
BUT10017	2	39	34 - 39	Sand and Gravel
CLA10011	2	60	55 - 60	Sand and Gravel
CLA10018	2	16	11 - 16	Sand and Gravel
MIA00205	2	24	19 - 24	Sand and Gravel
MON00022	2	15	10 - 15	Sand and Gravel
MON10016	2	108	88 - 108	Sand and Gravel
PRE10007	2	60	40 - 60	Sand and Gravel
SHE00089	2	43	38 - 43	Sand and Gravel
WAR10003	2	67	62 - 67	Sand and Gravel
WAR10004	2	32.5	27.5 – 32.5	Sand and Gravel

Figure 1 – Locations of monitoring wells



Duplicate samples were also collected from one monitoring well during each sampling event to evaluate laboratory precision. Field blanks were collected to assess potential contamination from field conditions during sampling.

The results of this study were compared with federal drinking water standards and health-based screening levels. Drinking water standards are generally more stringent than other water standards, so when groundwater meets drinking water standards it should be suitable for other uses.

National Primary Drinking Water Regulations for parameters are legally enforceable standards set by the U.S. EPA that apply to public water systems. Primary standards set maximum contaminant levels (MCLs) that help protect public health by limiting the contaminant levels in drinking water. National Secondary Drinking Water Standards are advisable guidelines addressing secondary maximum contaminant levels (SMCLs) that may cause cosmetic effects (such as skin or tooth discoloration) or aesthetic effects (such as taste, odor, or color) in drinking water. The U.S. EPA recommends, but does not require, that public water systems incorporate secondary standards. The U.S. EPA Office of Water also publishes non enforceable health-based screening levels (HBSLs) for some constituents which may pose potential human-health concerns but do not yet have an enforceable standard. HBSLs are used as a supplement for evaluating contaminants in drinking water in a human-health context.

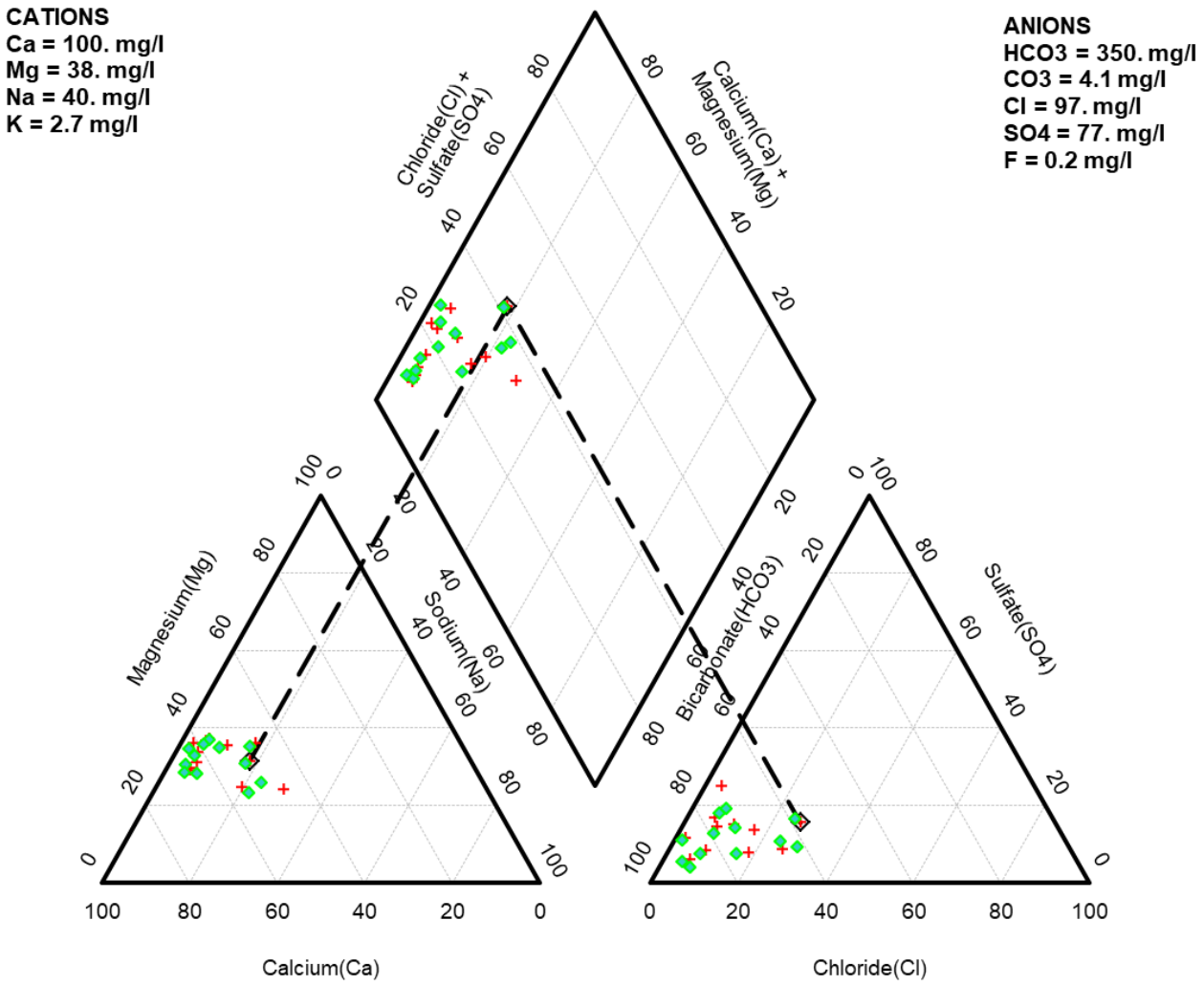
2018 Results

Analysis of major ions (cations and anions) in groundwater samples show the dominant cation is calcium with significant quantities of magnesium and sodium also present. The average calcium concentration of groundwater samples was 100 mg/L. The dominant anion was bicarbonate with lesser amounts of chloride and sulfate. The bicarbonate content was estimated using alkalinity and pH measurements for each sample. The average bicarbonate concentration in groundwater samples was 350 mg/L. A piper diagram of major cations and anions shows the groundwater is a calcium bicarbonate type of water (see Figure 2). Calcium bicarbonate groundwater tends to be present in areas where carbonate rocks comprise a significant amount of the aquifer matrix.

The samples collected at 8 of the 12 monitoring wells met all human health-based drinking water standards including MCLs and HBSLs for both sampling events (see Table 2). See Appendix A for a complete list of all analytical results.

At least one parameter in groundwater samples collected from monitoring wells BUT10014, BUT10016, CLA10011, and PRE10007 exceeded an MCL or HBSL. The groundwater sample collected in the spring from monitoring well BUT10014 exceeded the MCL for Trichloroethene (TCE). The groundwater samples collected from monitoring well BUT10016 exceeded the HBSL for manganese in both the spring and fall. The spring groundwater sample collected from monitoring well CLA10011 exceeded the MCL for E. coli. The groundwater sample collected in the fall from monitoring well PRE10007 exceeded the MCL for arsenic.

Figure 2 – Piper diagram showing dominant cations, anions, and water type of samples



Arsenic E. coli, Manganese, and TCE were the only parameters detected at concentrations exceeding human-health-based drinking water standards in this groundwater quality study.

Samples collected at 9 of the 12 monitoring wells exceeded an SMCL for at least one parameter at both sampling events (see Table 2). Parameters present at concentrations exceeding SMCLs included iron, manganese, and total dissolved solids.

There were also detections of parameters that reflect anthropogenic sources of contaminants but did not exceed any regulatory standards. These contaminants include chloride, sodium, and nitrate. Chloride and sodium are present in groundwater naturally, but human activities can elevate there concentration well above natural levels. Likewise, nitrogen in the form of nitrate can be present in groundwater at low concentrations naturally, but anthropogenic sources of nitrogen can elevate nitrate concentrations in groundwater above natural levels.

Contaminants Indicative of Anthropogenic Sources

Trichloroethene (TCE)
TCE is a volatile organic compound used primarily to remove grease from fabricated metal parts. The MCL for trichloroethene is 5 µg/L. TCE was detected in the spring groundwater sample collected from monitoring well BUT10014 at a concentration of 7.71 µg/L. However, TCE was not detected in the fall groundwater sample. Well BUT10014 is located at Smith Park in Middletown close to the former Aeronca Air Products site, a site which underwent environmental cleanup activities (Robinson and Richter, 2012). A TCE contaminant plume is present in the aquifer south of the site. The City of Middletown and Ohio EPA have been tracking the extent of the TCE contamination in recent years (Joe Smindak, Ohio Environmental Protection Agency, personal communication, September 8, 2017).

Nitrate
Nitrate concentrations did not exceed the MCL of 10 mg/L in any of the groundwater samples collected in 2018. According to Madison and Brunett (1985), nitrate concentrations in excess of 3.0 mg/L in groundwater are often indicative of anthropogenic sources. Nitrate concentrations measured in samples during the spring sampling event from monitoring wells BUT10017, CLA10018, and SHE00089 exceeded 3.0 mg/L. Nitrate concentrations above 3.0 mg/L occurred in samples collected during the fall sampling event from monitoring wells BUT10017, CLA10018, and MIA00205. Common sources of nitrates in groundwater include fertilizers, domestic or municipal wastewater, and animal waste.

Chloride and Sodium
Chloride has an SMCL of 250 mg/L. There are no drinking water benchmarks for sodium. Background levels of chloride in the buried valley aquifer system typically do not exceed 50 mg/L (Spieker, 1968), and (Debrewer et al, 2000). Kunz and Sroka (2004) reported mean background concentrations of chloride ranging from 13 to 23 mg/L in shallow unconsolidated aquifers in Champaign, Clark, and Pickaway counties in Ohio. Chloride concentrations above 70 mg/L and sodium concentrations above 43 mg/L in local sand and gravel aquifers likely reflect anthropogenic sources (Kunz and Sroka, 2004, Ohio EPA, 2015). These concentrations are at the high end of the typical range for sand and gravel aquifers in Ohio (Ohio EPA, 2015). Chloride concentrations measured in groundwater samples from monitoring wells BUT10014, MON10016, and WAR10003 exceeded 70 mg/L for at least one sampling event and likely reflect anthropogenic sources. Sodium concentrations in groundwater samples from monitoring wells BUT10014, MON10016, and WAR10003 exceeded 43 mg/L for at least one sampling event and also likely reflect anthropogenic sources. Anthropogenic sources of chloride and sodium include road salt applications for deicing and private and municipal wastewater from homes with water softeners.

Table 2 – Summary of significant detections of constituents in groundwater

Spring 2018		**Benchmark**		**Sample Sites**					
Parameter	**Units**	**Type**	**Value**	**BUT10014**	**BUT10016**	**BUT10017**	**CLA10011**	**CLA10018**	**MIA00205**
Chloride	mg/L	SMCL	250	85.3					
E. coli	MPN/100mL	MCL	1				**3.10**		
Nitrogen, Nitrate	mg/L	MCL	10			6.64		8.85	
Arsenic	µg/L	MCL	10		5.50		4.38		
Iron	mg/L	SMCL	0.3		**1.62**		**1.57**		
Manganese	mg/L	HBSL, SMCL	0.3, 0.05		**0.367**		**0.131**		**0.0870**
Sodium	mg/L	-	-	53.4					
Total Dissolved Solids	mg/L	SMCL	500	**579**					
Total Hardness	mg/L	-	-	430	307	336	470	389	363
Trichloroethene	µg/L	MCL	5	**7.71**					

Spring 2018		**Benchmark**		**Sample Sites**					
Parameter	**Units**	**Type**	**Value**	**MON00022**	**MON10016**	**PRE10007**	**SHE00089**	**WAR10003**	**WAR10004**
Chloride	mg/L	SMCL	250		95.4			87.4	
E. coli	MPN/100mL	MCL	1						
Nitrogen, Nitrate	mg/L	MCL	10				3.57		
Arsenic	µg/L	MCL	10			4.55			
Iron	mg/L	SMCL	0.3		**0.304**	**2.16**		**2.14**	
Manganese	mg/L	HBSL, SMCL	0.3, 0.05		**0.0819**		**0.237**	**0.0620**	
Sodium	mg/L	-	-		48.0			43.5	
Total Dissolved Solids	mg/L	SMCL	500						
Total Hardness	mg/L	-	-	395	349	359	337	462	292
Trichloroethene	µg/L	MCL	5						

Table 2 – Summary of significant detections of constituents in groundwater continued

Fall 2018		Benchmark		Sample Sites					
Parameter	**Units**	**Type**	**Value**	**BUT10014**	**BUT10016**	**BUT10017**	**CLA10011**	**CLA10018**	**MIA00205**
Chloride	mg/L	SMCL	250	52.8					
E. coli	MPN/100mL	MCL	1						
Nitrogen, Nitrate	mg/L	MCL	10			4.05		8.65	3.40
Arsenic	µg/L	MCL	10		3.45		6.42		
Iron	mg/L	SMCL	0.3		**1.51**		**2.75**		
Manganese	mg/L	HBSL, SMCL	0.3, 0.05		**0.383**		**0.0634**		**0.0819**
Sodium	mg/L	-	-	37.4					
Total Dissolved Solids	mg/L	SMCL	500						
Total Hardness	mg/L	-	-	351	293	299	425	358	351

Fall 2018		Benchmark		Sample Sites					
Parameter	**Units**	**Type**	**Value**	**MON00022**	**MON10016**	**PRE10007**	**SHE00089**	**WAR10003**	**WAR10004**
Chloride	mg/L	SMCL	250		84.5			96.6	
E. coli	MPN/100mL	MCL	1						
Nitrogen, Nitrate	mg/L	MCL	10						
Arsenic	µg/L	MCL	10			**15.5**			
Iron	mg/L	SMCL	0.3		**0.305**	**8.99**		**1.90**	
Manganese	mg/L	HBSL, SMCL	0.3, 0.05		**0.0856**		**0.263**	**0.0538**	
Sodium	mg/L	-	-		60.9			39.6	
Total Dissolved Solids	mg/L	SMCL	500	**674**				**561**	
Total Hardness	mg/L	-	-	553	323	339	351	405	258

MCL – Maximum Contaminant Level set by USPEA
SMCL – Secondary Maximum Contaminant Level set by USEPA
HBSL – Non enforceable Health Based Screening Level based on (1) latest USEPA Office of Water policies for establishing drinking water benchmarks and (2) most recent USEPA peer reviewed toxicity information
Numbers in bold exceed a benchmark

Naturally Occurring Contaminants

Arsenic

Arsenic occurs naturally in regional groundwater and concentrations of arsenic are largely controlled by redox conditions. The dominant mechanism for moving arsenic into groundwater is thought to be the release of arsenic from iron oxides in the aquifer under reducing conditions (Thomas et al, 2008). The MCL for arsenic is 10 µg/L. Spring and fall groundwater samples collected from monitoring wells BUT10016, CLA10011, and PRE10007 had detectable concentrations of arsenic. The concentration of arsenic measured in the fall groundwater sample collected from monitoring well PRE10007 exceeded the MCL. It should be noted that groundwater samples from all three of these wells had elevated levels of iron and no dissolved oxygen, which indicates reducing conditions present in the aquifer zone in which the wells were screened.

Nuisance Contaminants

Hardness, iron, manganese, and total dissolved solids are generally considered to be "nuisance" contaminants. These contaminants are present naturally in groundwater from the buried valley aquifer system. However, their presence does not typically pose a health threat. Nevertheless, they can have adverse aesthetic impacts that cause water to appear cloudy or colored. They can also adversely impact plumbing fixtures, stain laundry, and cause taste and odor issues.

Hardness is a measure of the amount of dissolved calcium and magnesium in a water sample. When the hardness value exceeds 180 mg/L the water is considered to be very hard. All groundwater samples collected in 2018 had hardness values exceeding 180 mg/L. There is no SMCL for water hardness.

The SMCL for Iron is 0.3 mg/L. Groundwater samples collected during both sampling events from wells BUT10016, CLA10011, MON10016, PRE10007, and WAR10003 exceed this standard.

The SMCL for manganese is 0.05 mg/L. Manganese concentrations in groundwater samples collected during both sampling events from wells BUT10016, CLA10011, MON10016, SHE00089, and WAR10003 exceeded this standard. Manganese also has a HBSL of 0.3 mg/L. Manganese concentrations in groundwater samples collected during both sampling events from well BUT10016 exceed this standard.

Total dissolved solids (TDS) are comprised of inorganic salts (principally calcium, magnesium, potassium, sodium, bicarbonates, chlorides, and sulfates). TDS is the sum of cations and anions in a water sample. The SMCL for TDS is 500 mg/L. Groundwater samples collected during one of the two sampling events from wells BUT10014, MON00022, and WAR10003 exceed this standard.

Contaminant Trends

Groundwater quality data collected from MCD's network of 12 monitoring wells was examined for trends in contaminant concentrations. Groundwater quality monitoring has been conducted by MCD staff twice per year since 2014 at monitoring wells BUT10014, BUT10016, CLA10018, and MON10016. The other eight monitoring wells have been sampled since 2015 or 2016. The chemical parameters TCE, nitrate, chloride, and sodium were selected for analysis as parameters indicative of anthropogenic sources. The parameters arsenic, iron, and manganese were selected to examine trends in naturally occurring contaminant concentrations.

Contaminants Indicative of Anthropogenic Sources

Trichloroethene (TCE)
TCE was detected at concentrations exceeding the drinking water MCL in groundwater samples collected at monitoring well BUT10014 at 9 of the 10 sampling events since 2014 (see figure 3). The maximum concentration of TCE (28.8 µg/L) was measured in a 2014 sample. Since 2014, concentrations of TCE collected by MCD are trending downward. The sample collected in fall 2018 was below the detection limit of 5 µg/L.

Nitrate
Nitrate concentrations measured at monitoring wells CLA10018 and BUT10017 consistently exceed 3 mg/L and likely reflect anthropogenic sources of nitrate to the aquifer screened by those wells (see figure 4). Concentrations of nitrate in groundwater samples from monitoring well CLA10018 declined in 2018 when compared with results from 2016 and 2017. Concentrations of nitrate in groundwater samples collected from monitoring well BUT10017 is also trending downward when compared with previous results. Nitrate concentrations measured in groundwater samples from monitoring wells MIA00205 and WAR10004 are often below 3 mg/L but exceeded the threshold at least once in previous sampling events.

Chloride and Sodium
Chloride concentrations measured in samples collected from monitoring wells BUT10014, MON10016, and WAR10003 are consistently higher than 70 mg/L and above the concentrations measured in samples from the other monitoring wells (see figure 5). Chloride concentrations in samples show fluctuations from sampling event to sampling event. Likewise, sodium concentrations measured in the same three wells remain above concentrations measured at other monitoring wells (see figure 6). Sodium concentrations show similar fluctuations as chloride. Seasonal fluctuations in chloride and sodium are often more pronounced in wells with the highest concentrations of those parameters. These fluctuations may reflect infiltration of saline water from snow melt and rainfall events after seasonal applications of road salt.

Figure 3 – TCE concentrations in monitoring well BUT10014

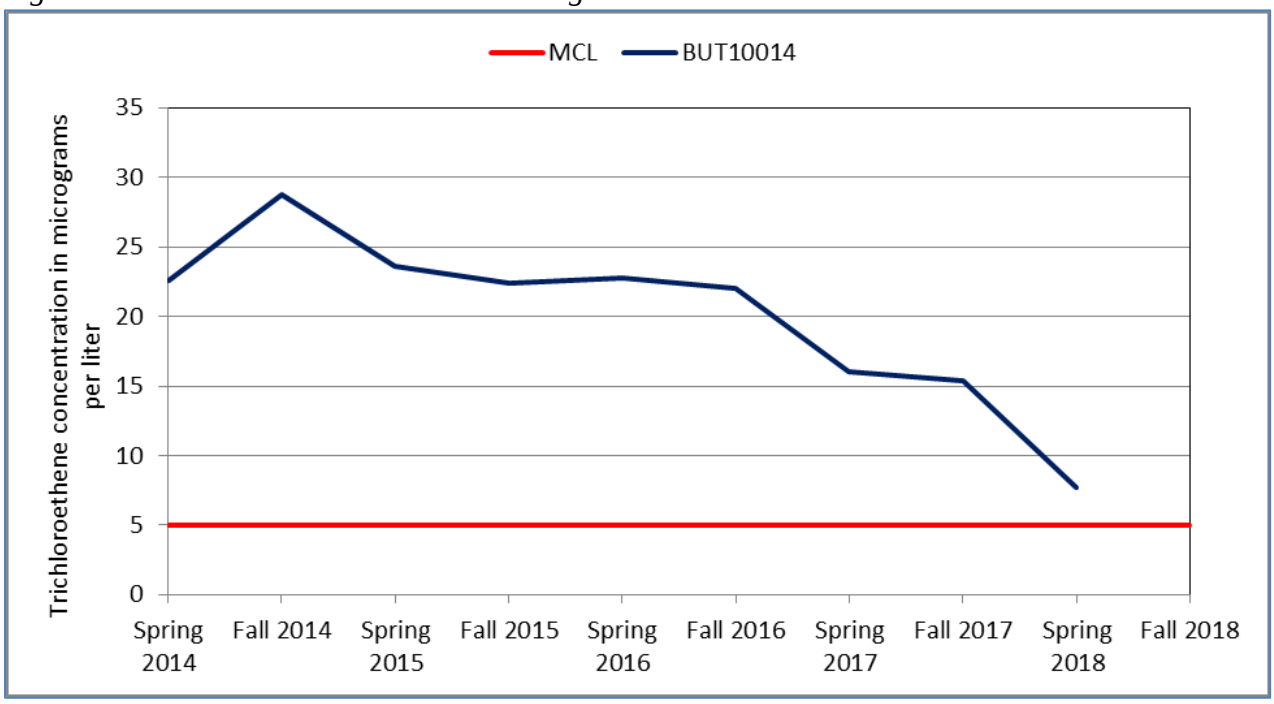
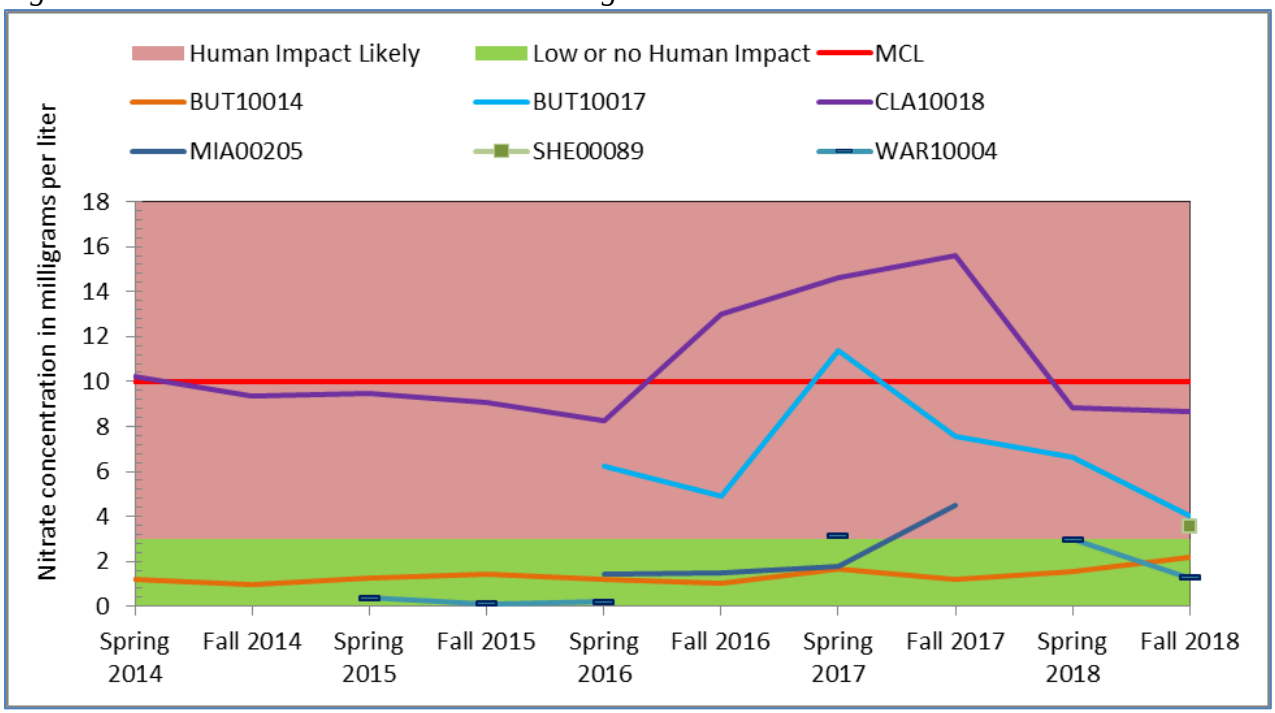


Figure 4 – Nitrate concentrations in monitoring wells



Naturally Occurring Contaminants

Arsenic

Arsenic was detected in groundwater samples collected from monitoring wells BUT10016, CLA10011, and PRE10007 (see figure 7). The measured arsenic concentration (15.5 µg/L) measured during the fall sampling event from monitoring well PRE10007 exceeded the drinking water MCL of 10 µg/L. This measurement reflects a large and sudden increase since the spring 2018 sampling event. Iron concentrations also increased markedly since the spring 2018 sampling event. Arsenic concentrations measured in monitoring wells BUT10016 and CLA10011 fluctuated between 4 and 7 µg/L but showed no overall upward or downward trends.

Iron

With the exception of monitoring well PRE10007, there is no upward or downward trend in iron concentrations in the other monitoring wells. As noted above, there was a sudden and large increase in the iron concentration collected from monitoring well PRE10007 compared to previous sampling events. The reason for this increase is not evident. Concentrations of dissolved iron greater than 0.1 mg/L in groundwater are often associated with the presence of arsenic in the glacial aquifer system of the northern United States (Thomas, 2007). When compared with previous studies, iron concentrations in groundwater samples collected from monitoring wells BUT10016, CLA10011, MON10016, PRE10007, and WAR10003 consistently exceed the drinking water SMCL of 0.3 mg/L (see figure 8). Groundwater samples from monitoring wells BUT10016, CLA10011, and PRE10007 consistently have detectable concentrations of arsenic.

Manganese

Manganese concentrations in groundwater samples collected from monitoring wells BUT10016, CLA10011, MIA00205, MON10016, SHE00089, and WAR10003 consistently exceed the SMCL of 0.05 mg/L (see figure 9). Manganese concentrations measured in groundwater samples from monitoring well BUT10016 were the highest of all the monitoring wells during all sampling events and consistently exceed the HBSL for manganese of 0.3 mg/L. There does not appear to be a strong upward or downward trend in manganese concentration for any of the monitoring wells. Manganese concentrations appear to be fairly consistent from sampling event to sampling event.

Figure 5 – Chloride concentrations in monitoring wells

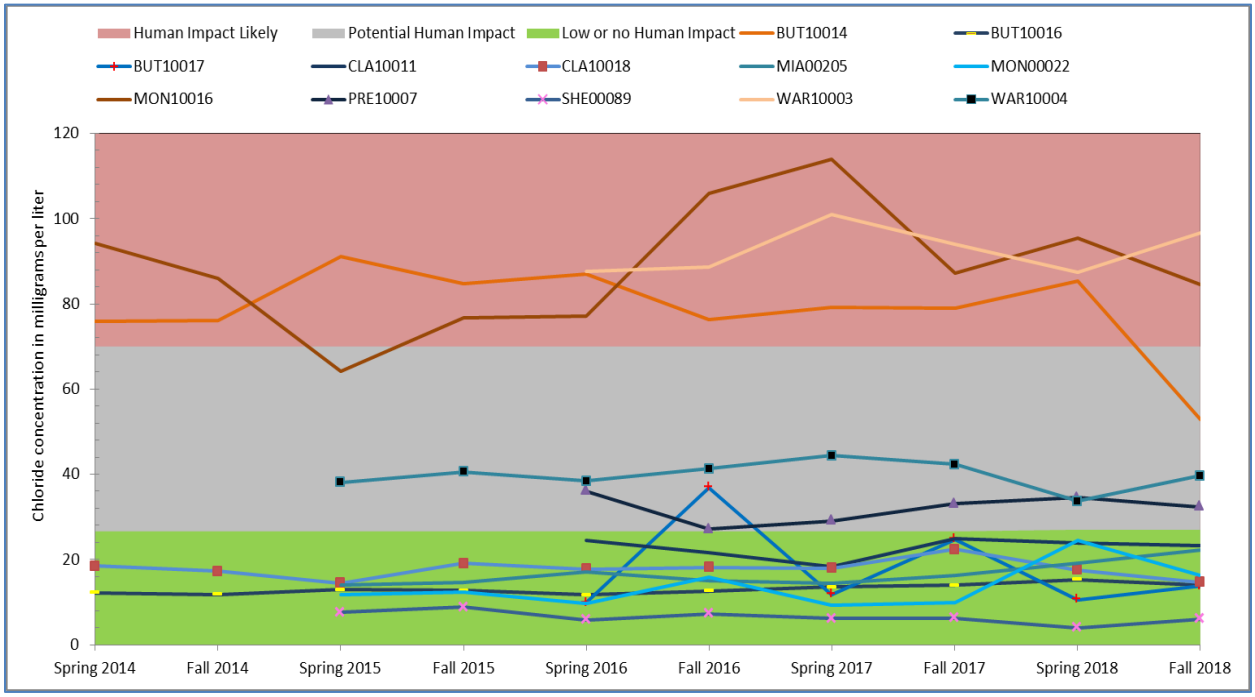


Figure 6 – Sodium concentrations in monitoring wells

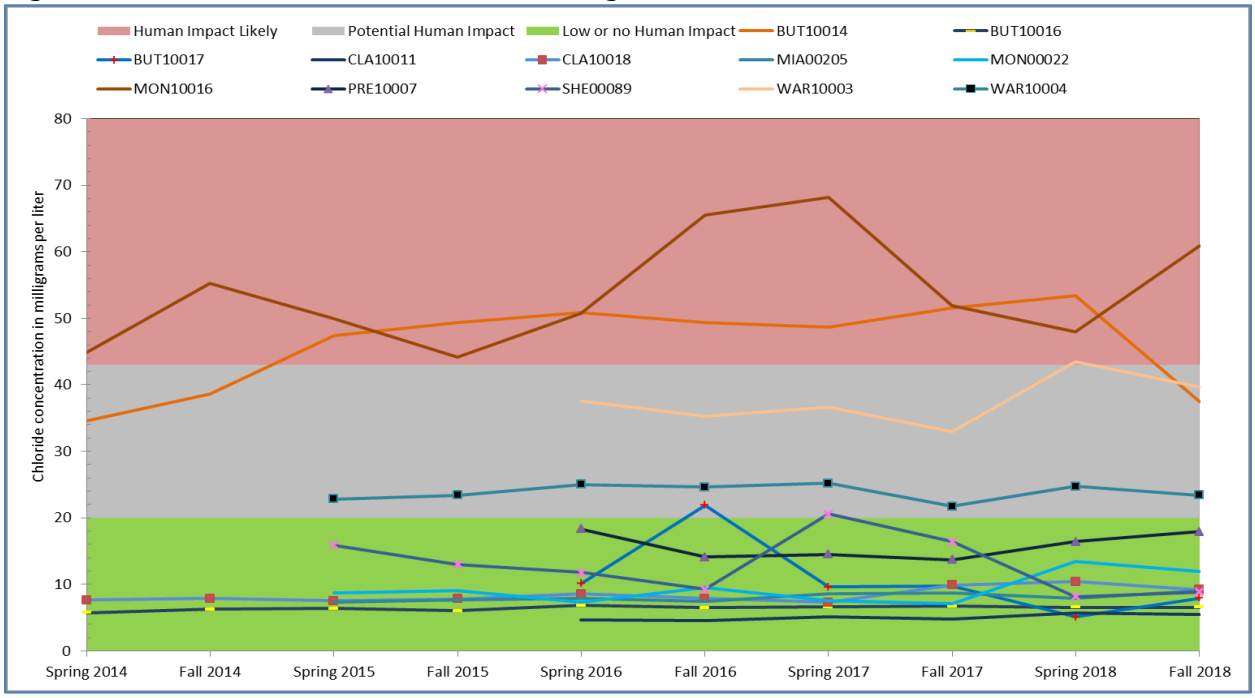


Figure 7 – Arsenic concentrations in monitoring wells

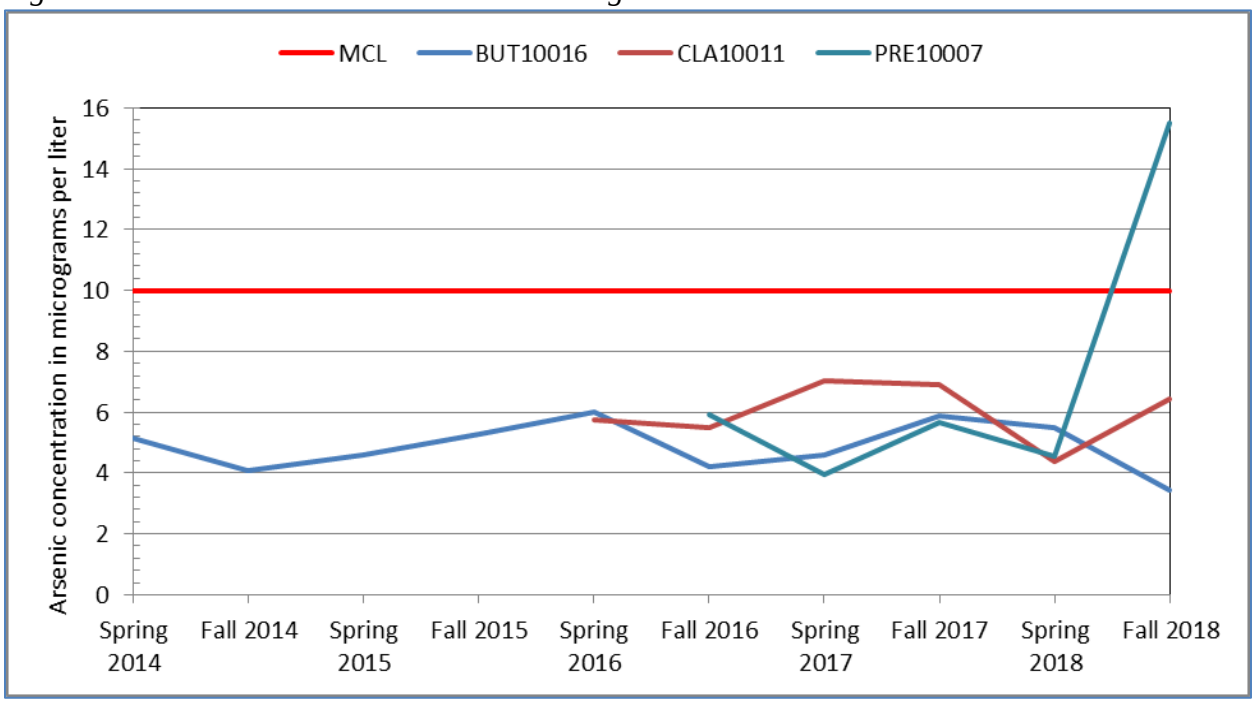


Figure 8 – Iron concentrations in monitoring wells

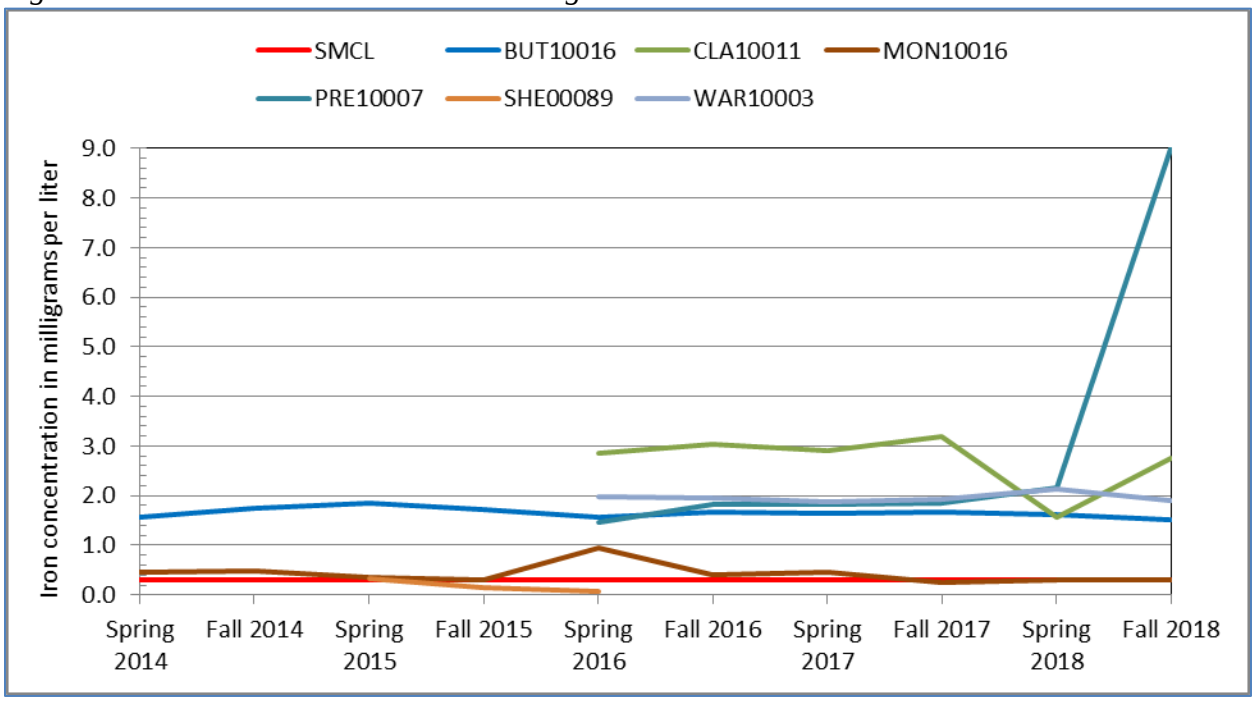
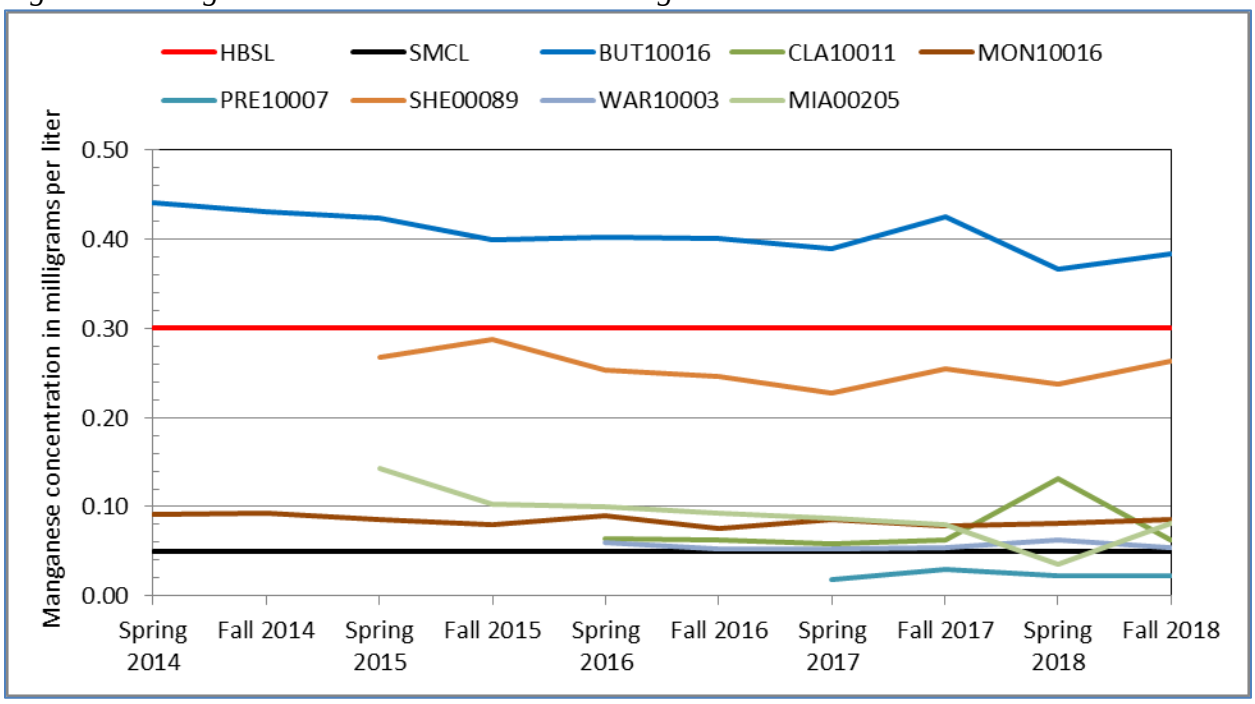


Figure 9 – Manganese concentrations in monitoring wells



Conclusions for 2018

While the sample set of this study was small and the results cannot be used to generalize about the health of the entire buried valley aquifer system, the results can be used to better understand which contaminants may impact groundwater quality in the buried valley aquifer in southwest Ohio. When the 2018 results are compared with previous rounds of sampling and other studies, trends of groundwater quality in the aquifer begin to emerge.

Anthropogenic contaminants such as nitrate, chloride and sodium, and VOCs are present in groundwater samples from sensitive aquifer settings such as shallow unconfined sand and gravel aquifers (Ohio Environmental Protection Agency, 2015), (Rowe et al, 2004), and (Stuck, 2016).

Naturally occurring contaminants including arsenic and nuisance contaminants are also present in groundwater samples collected from the buried valley aquifer system. Arsenic is a naturally occurring contaminant and may be present in groundwater at concentrations exceeding the MCL. Nuisance contaminants such as hardness, iron, and manganese are present in groundwater at concentrations exceeding secondary drinking water standards in some of the monitoring wells. Water softening as well as iron and manganese removal may be necessary to deliver the desired water quality.

These findings emphasize the importance of managing land use over the buried valley aquifer so as to preserve the quality of the water. Proactive groundwater protection is critical to ensure the quality of groundwater in our region.

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Appendix A

Spring 2018					Benchmark		Sample Sites					
Parameter	**Units**	**Method**	**PQL**	**MDL**	**Type**	**Value**	**BUT10014**	**BUT10016**	**BUT10017**	**CLA10011**	**CLA10018**	**MIA00205**
Dissolved Oxygen	mg/L	Field Measured			—	—	4.87	0.02	9.74	-0.01	4.05	-0.10
pH	S.U.	Field Measured			SMCL	6.5 - 8.5	6.86	7.26	7.04	6.95	7.02	7.03
Specific Conductance	mS/cm	Field Measured			—	—	1034	599	654	794	704	690
Temperature	°C	Field Measured			—	—	13.0	12.8	12.9	12.0	9.6	10.6
Ammonia	mg/L	EPA 350.1	0.200	0.0732	—	—	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200
Chloride	mg/L	SM 4500-CL-E	2.00	0.806	SMCL	250	85.3	15.3	10.6	23.9	17.5	19.2
Fluoride	mg/L	SM 4500 F-C	0.200	0.0174	MCL	4	< 0.200	0.254	< 0.200	0.238	0.201	< 0.200
Nitrite Nitrogen as NO2-N	mg/L	SM 4500 NO3-F	0.100	0.0210	MCL	1	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100
Nitrogen, Nitrate-Nitrite	mg/L	SM 4500 NO3-F	0.100	0.0157	MCL	10	1.56	< 0.100	6.64	< 0.100	8.85	< 0.100
Nitrogen, Total Kjeldahl	mg/L	EPA 351.2	0.500	0.165	—	—	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500
Phosphorus	mg/L	SW 6010B	0.100	0.00452	—	—	< 0.100	0.108	< 0.100	< 0.100	< 0.100	< 0.100
Silica	mg/L	EPA 200.7/SW 6010	0.107	0.00296	—	—	11.4	13.4	10.2	14.4	7.78	8.35
Sulfate	mg/L	EPA 375.4 Modified	10.0	3.80	SMCL	250	51.0	55.4	16.9	79.2	13.2	24.9
Total Hardness	mg/L	EPA 200.7	0.662	0.0850	—	—	430	307	336	470	389	363
Total Orthophosphate, as P	mg/L	SM 4500 P-F	0.100	0.0218	—	—	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100
Aluminum	mg/L	SW 6010B	0.100	0.00561	HBSL, SMCL	6, 0.2	< 0.100	0.112	< 0.100	< 0.100	< 0.100	< 0.100
Antimony	ug/L	SW 7041	0.00300	0.00110	MCL	6	<3.00	<3.00	<3.00	<3.00	<3.00	<3.00
Arsenic	ug/L	SW 7060A	0.00300	0.000763	MCL	10	< 3.00	5.50	< 3.00	4.38	< 3.00	< 3.00
Barium	mg/L	SW 6010B	0.00500	0.000747	MCL	2	0.227	0.217	0.0416	0.0564	0.0732	0.105
Beryllium	mg/L	SW 6010B	0.000500	0.0000236	MCL	0.004	< 0.000500	< 0.000500	< 0.000500	< 0.000500	< 0.000500	< 0.000500
Boron	mg/L	SW 6010B	0.100	0.00328	HBSL	5	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100
Cadmium	ug/L	SW 7131A	0.000200	0.0000702	MCL	0.005	< 0.000200	< 0.000200	< 0.000200	< 0.000200	< 0.000200	< 0.000200
Calcium	mg/L	SW 6010B	0.100	0.0174	—	—	121	80.3	91.9	121	94.3	102
Chromium, Hexavalent	mg/L	SM 3500 Cr B	0.0100	0.00480	HBSL	0.02	< 0.00400	< 0.00400	< 0.00400	< 0.00400	< 0.00400	< 0.00400
Cobalt	mg/L	SW 6010B	0.00500	0.000815	HBSL	0.002	< 0.00500	< 0.00500	< 0.00500	< 0.00500	< 0.00500	< 0.00500
Copper	mg/L	SW 6010B	0.00500	0.000566	MCL	1.3	< 0.00500	< 0.00500	< 0.00500	< 0.00500	< 0.00500	< 0.00500
Iron	mg/L	SW 6010B	0.0500	0.00534	SMCL	0.3	< 0.0500	**1.62**	< 0.0500	**1.57**	< 0.0500	< 0.0500
Lead	ug/L	SW 7421	0.00200	0.000738	MCL	15	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00
Lithium	mg/L	SW 6010B	0.00500	0.0000315	HBSL	0.01	< 0.00500	< 0.00500	< 0.00500	< 0.00500	< 0.00500	< 0.00500
Magnesium	mg/L	SW 6010B	0.100	0.0101	—	—	31.1	25.8	25.9	40.5	37.2	26.3
Manganese	mg/L	SW 6010B	0.00500	0.00153	HBSL, SMCL	0.3, 0.05	< 0.00500	**0.367**	< 0.00500	**0.131**	< 0.00500	0.0357
Molybdenum	mg/L	SW 6010B	0.0100	0.00207	HBSL	0.03	< 0.0100	< 0.0100	< 0.0100	< 0.0100	< 0.0100	< 0.0100
Nickel	mg/L	SW 6010B	0.00500	0.00118	HBSL	0.1	< 0.00500	< 0.00500	< 0.00500	< 0.00500	< 0.00500	< 0.00500
Potassium	mg/L	SW 6010B	1.00	0.0397	—	—	4.78	1.24	2.11	1.25	2.10	1.19
Silver	mg/L	SW 6010B	0.00200	0.000384	HBSL	0.1	< 0.00200	< 0.00200	< 0.00200	< 0.00200	< 0.00200	< 0.00200
Sodium	mg/L	SW 6010B	1.00	0.0631	—	—	53.4	6.56	5.12	5.69	10.4	7.92
Strontium	mg/L	SW 6010B	0.00500	0.000527	HBSL	4	0.683	0.406	0.147	0.330	2.30	0.344
Thallium	ug/L	SW 7841/EPA 279.2	0.00100	0.000407	MCL	2	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Vanadium	mg/L	SW 6010B	0.00500	0.000517	HBSL	0.0004	< 0.00500	< 0.00500	< 0.00500	< 0.00500	< 0.00500	< 0.00500
Zinc	mg/L	SW 6010B	0.0100	0.00138	HBSL	2	< 0.0100	< 0.0100	< 0.0100	< 0.0100	< 0.0100	< 0.0100
Alkalinity, Total (As CaCO3)	mg/L	SM 2320B	25.0	25.0	—	—	319	238	289	314	304	292
Biochemical Oxygen Demand	mg/L	SM 5210B	2.00	2.00	—	—	< 2.00	< 2.00	< 2.00	< 2.00	< 2.00	12.0
Carbonaceous Biological Oxyg	mg/L	EPA 405.1/SM 5210	2.00	2.00	—	—	6.06	< 2.00	< 2.00	< 2.00	< 2.00	< 4.00
Chemical Oxygen Demand	mg/L	HACH 8000	5.00	4.68	—	—	< 5.00	< 5.00	< 5.00	< 5.00	< 5.00	< 5.00
Cyanide, Total	mg/L	EPA 335.4	0.0100	0.00195	MCL	0.2	< 0.0100	< 0.0100	< 0.0100	< 0.0100	< 0.0100	< 0.0100
Phenolics, Total Recoverable	mg/L	EPA 420.4	0.0100	0.00336	—	—	< 0.0100	< 0.0100	< 0.0100	< 0.0100	< 0.0100	< 0.0100
Total Dissolved Solids (Residu	mg/L	SM 2540C	5.00	1.67	SMCL	500	**579**	354	348	494	392	393
Total Organic Carbon	mg/L	SM 5310C	1.00	0.142	—	—	1.08	< 1.00	1.00	1.06	< 1.00	< 1.00

Appendix A

Spring 2018					Benchmark		Sample Sites					
Parameter	**Units**	**Method**	**PQL**	**MDL**	**Type**	**Value**	**BUT10014**	**BUT10016**	**BUT10017**	**CLA10011**	**CLA10018**	**MIA00205**
E. coli	MPN/100 ml	Colilert	1.00		MCL	0	< 1.00	< 1.00	< 1.00	**3.10**	< 1.00	< 1.00
1,1,1,2-Tetrachloroethane	ug/L	SW 8260B	1.00	0.220	HBSL	0.1	< 5.00					
1,1,1-Trichloroethane	ug/L	SW 8260B	1.00	0.283	MCL	200	< 5.00					
1,1,2,2-Tetrachloroethane	ug/L	SW 8260B	1.00	0.230	HBSL	0.0002	< 5.00					
1,1,2-Trichloroethane	ug/L	SW 8260B	1.00	0.337	MCL	5	< 5.00					
1,1-Dichloroethane	ug/L	SW 8260B	1.00	0.274	HBSL	1	< 5.00					
1,1-Dichloroethene	ug/L	SW 8260B	1.00	0.224	MCL	7	< 5.00					
1,1-Dichloropropene	ug/L	SW 8260B	1.00	0.213	—	—	< 5.00					
1,2,3-Trichlorobenzene	ug/L	SW 8260B	1.00	0.228	—	—	< 5.00					
1,2,3-Trichloropropane	ug/L	SW 8260B	1.00	0.271	HBSL	30	< 5.00					
1,2,4-Trichlorobenzene	ug/L	SW 8260B	1.00	0.214	MCL	70	< 5.00					
1,2,4-Trimethylbenzene	ug/L	SW 8260B	1.00	0.194	HBSL	60	< 5.00					
1,2-Dibromo-3-chloropropane	ug/L	SW 8260B	5.00	0.869	MCL	0.2	< 10.0					
1,2-Dibromoethane	ug/L	SW 8260B	1.00	0.192	MCL	0.05	< 5.00					
1,2-Dichlorobenzene	ug/L	SW 8260B	1.00	0.570	MCL	600	< 5.00					
1,2-Dichloroethane	ug/L	SW 8260B	1.00	0.300	MCL	5	< 5.00					
1,2-Dichloropropane	ug/L	SW 8260B	1.00	0.230	MCL	5	< 5.00					
1,3,5-Trimethylbenzene	ug/L	SW 8260B	1.00	0.199	HBSL	60	< 5.00					
1,3-Dichlorobenzene	ug/L	SW 8260B	1.00	0.197	HBSL	600	< 5.00					
1,3-Dichloropropane	ug/L	SW 8260B	1.00	0.237	HBSL	100	< 5.00					
1,4-Dichlorobenzene	ug/L	SW 8260B	1.00	0.214	MCL	75	< 5.00					
2,2-Dichloropropane	ug/L	SW 8260B	1.00	0.262	—	—	< 5.00					
2-Butanone	ug/L	SW 8260B	10.0	2.75	—	—	< 20.0					
2-Chlorotoluene	ug/L	SW 8260B	1.00	0.217	—	—	< 5.00					
2-Hexanone	ug/L	SW 8260B	10.0	0.0779	HBSL	30	< 20.0					
4-Chlorotoluene	ug/L	SW 8260B	1.00	0.241	HBSL	100	< 5.00					
4-Isopropyltoluene	ug/L	SW 8260B	1.00	0.182	—	—	< 5.00					
4-Methyl-2-pentanone	ug/L	SW 8260B	10.0	1.91	—	—	< 20.0					
Acetone	ug/L	SW 8260B	20.0	3.76	HBSL	6000	< 20.0					
Acetonitrile	ug/L	SW 8260B	20.0	2.41	—	—	< 40.0					
Acrolein	ug/L	SW 8260B	10.0	1.49	HBSL	4	< 20.0					
Acrylonitrile	ug/L	SW 8260B	10.0	0.388	HBSL	0.06	< 20.0					
Allyl chloride	ug/L	SW 8260B	1.00	0.250	—	—	< 5.00					
Benzene	ug/L	SW 8260B	1.00	0.269	MCL	5	< 5.00					
Bromobenzene	ug/L	SW 8260B	1.00	0.221	HBSL	50	< 5.00					
Bromochloromethane	ug/L	SW 8260B	1.00	0.293	HBSL	60	< 5.00					
Bromodichloromethane	ug/L	SW 8260B	1.00	0.232	MCL	80	< 5.00					
Bromoform	ug/L	SW 8260B	1.00	0.231	MCL	80	< 5.00					
Bromomethane	ug/L	SW 8260B	1.00	0.494	HHBP	140	< 5.00					
Carbon Disulfide	ug/L	SW 8260B	10.0	0.242	HBSL	600	< 20.0					
Carbon Tetrachloride	ug/L	SW 8260B	1.00	0.241	MCL	5	< 5.00					
Chlorobenzene	ug/L	SW 8260B	1.00	0.265	MCL	100	< 5.00					
Chloroethane	ug/L	SW 8260B	1.00	0.261	—	—	< 5.00					
Chloroform	ug/L	SW 8260B	1.00	0.269	MCL	80	< 5.00					
Chloromethane	ug/L	SW 8260B	1.00	0.318	—	—	< 5.00					
cis-1,2-Dichloroethene	ug/L	SW 8260B	1.00	0.296	MCL	70	< 5.00					
cis-1,3-Dichloropropene	ug/L	SW 8260B	1.00	0.234	HBSL	0.3	< 5.00					
Dibromochloromethane	ug/L	SW 8260B	1.00	0.645	MCL	80	< 5.00					

Appendix A

Spring 2018					Benchmark		Sample Sites					
Parameter	**Units**	**Method**	**PQL**	**MDL**	**Type**	**Value**	**BUT10014**	**BUT10016**	**BUT10017**	**CLA10011**	**CLA10018**	**MIA00205**
Dibromomethane	ug/L	SW 8260B	1.00	0.299	—	—	< 5.00					
Dichlorodifluoromethane	ug/L	SW 8260B	1.00	0.242	HBSL	1000	< 5.00					
Ethylbenzene	ug/L	SW 8260B	1.00	0.168	MCL	700	< 5.00					
Hexachlorobutadiene	ug/L	SW 8260B	1.00	0.277	HBSL	0.8	< 5.00					
Iodomethane	ug/L	SW 8260B	10.0	1.10	—	—	< 10.0					
Isopropylbenzene	ug/L	SW 8260B	1.00	0.204	HBSL	600	< 5.00					
m,p-Xylene	ug/L	SW 8260B	5.00	0.410	MCL	10000	< 10.0					
Methyl tert-Butyl Ether	ug/L	SW 8260B	5.00	0.239	—	—	< 10.0					
Methylene Chloride	ug/L	SW 8260B	1.00	0.164	MCL	5	< 5.00					
Naphthalene	ug/L	SW 8260B	5.00	0.212	HBSL	100	< 5.00					
n-Butylbenzene	ug/L	SW 8260B	1.00	0.167	HBSL	300	< 5.00					
n-Hexane	ug/L	SW 8260B	5.00	0.225	—	—	< 5.00					
n-Propylbenzene	ug/L	SW 8260B	1.00	0.204	—	—	< 5.00					
o-Xylene	ug/L	SW 8260B	1.00	0.220	MCL	10000	< 5.00					
sec-Butylbenzene	ug/L	SW 8260B	1.00	0.193	—	—	< 5.00					
Styrene	ug/L	SW 8260B	1.00	0.210	MCL	100	< 5.00					
tert_Butylbenzene	ug/L	SW 8260B	1.00	0.193	—	—	< 5.00					
Tetrachloroethene	ug/L	SW 8260B	1.00	0.230	MCL	5	< 5.00					
Toluene	ug/L	SW 8260B	1.00	0.231	MCL	1000	< 5.00					
trans-1,2-Dichloroethene	ug/L	SW 8260B	1.00	0.225	MCL	100	< 5.00					
trans-1,3-Dichloropropene	ug/L	SW 8260B	1.00	0.203	HBSL	0.3	< 5.00					
Trichloroethene	ug/L	SW 8260B	1.00	0.295	MCL	5	**7.71**					
Trichlorofluoromethane	ug/L	SW 8260B	1.00	0.250	HBSL	2000	< 5.00					
Vinyl acetate	ug/L	SW 8260B	1.00	0.282	—	—	< 10.0					
Vinyl Chloride	ug/L	SW 8260B	1.00	0.224	MCL	2	< 1.00					

MCL - Maximum Contaminant Level set by USEPA

SMCL - Secondary Maximum Contaminant Level set by USEPA

AMCL - Alternative Maximum Contaminant Level set by USEPA

HBSL - Non enforceable Health Based Screening Level based on (1) latest USEPA Office of Water policies for

HHBP - Human Health Benchmark for Pesticides set by USEPA

— No drinking water benchmark set for the compound

Numbers in bold exceed a benchmark

Appendix A

Spring 2018					Benchmark		Sample Sites					
Parameter	**Units**	**Method**	**PQL**	**MDL**	**Type**	**Value**	**MON00022**	**MON10016**	**PRE10007**	**SHE00089**	**WAR10003**	**WAR10004**
Dissolved Oxygen	mg/L	Field Measured			—	—	0.93	-0.05	-0.01	-0.03	0.06	3.92
pH	S.U.	Field Measured			SMCL	6.5 - 8.5	6.90	7.09	7.14	7.04	7.23	7.35
Specific Conductance	mS/cm	Field Measured			—	—	764	910	738	672	995	605
Temperature	°C	Field Measured			—	—	9.4	12.7	12.7	12.1	14.3	14.3
Ammonia	mg/L	EPA 350.1	0.200	0.0732	—	—	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200
Chloride	mg/L	SM 4500-CL-E	2.00	0.806	SMCL	250	24.4	95.4	34.5	3.99	87.4	33.7
Fluoride	mg/L	SM 4500 F-C	0.200	0.0174	MCL	4	< 0.200	< 0.200	< 0.200	0.456	0.220	0.223
Nitrite Nitrogen as NO2-N	mg/L	SM 4500 NO3-F	0.100	0.0210	MCL	1	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100
Nitrogen, Nitrate-Nitrite	mg/L	SM 4500 NO3-F	0.100	0.0157	MCL	10	< 0.100	< 0.100	< 0.100	3.57	< 0.100	2.99
Nitrogen, Total Kjeldahl	mg/L	EPA 351.2	0.500	0.165	—	—	< 0.500	0.571	< 0.500	< 0.500	< 0.500	< 0.500
Phosphorus	mg/L	SW 6010B	0.100	0.00452	—	—	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100
Silica	mg/L	EPA 200.7/SW 6010	0.107	0.00296	—	—	11.0	8.96	11.2	12.6	13.3	8.03
Sulfate	mg/L	EPA 375.4 Modified	10.0	3.80	SMCL	250	49.8	40.7	54.5	39.7	78.6	22.0
Total Hardness	mg/L	EPA 200.7	0.662	0.0850	—	—	395	349	359	337	462	292
Total Orthophosphate, as P	mg/L	SM 4500 P-F	0.100	0.0218	—	—	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100
Aluminum	mg/L	SW 6010B	0.100	0.00561	HBSL, SMCL	6, 0.2	< 0.100	0.129	< 0.100	< 0.100	< 0.100	< 0.100
Antimony	ug/L	SW 7041	0.00300	0.00110	MCL	6	<3.00	<3.00	<3.00	<3.00	<3.00	<3.00
Arsenic	ug/L	SW 7060A	0.00300	0.000763	MCL	10	< 3.00	< 3.00	4.55	< 3.00	< 3.00	< 3.00
Barium	mg/L	SW 6010B	0.00500	0.000747	MCL	2	0.0597	0.113	0.225	0.131	0.206	0.0632
Beryllium	mg/L	SW 6010B	0.000500	0.0000236	MCL	0.004	< 0.000500	< 0.000500	< 0.000500	< 0.000500	< 0.000500	< 0.000500
Boron	mg/L	SW 6010B	0.100	0.00328	HBSL	5	< 0.100	< 0.100	< 0.100	< 0.100	0.224	< 0.100
Cadmium	ug/L	SW 7131A	0.000200	0.0000702	MCL	0.005	< 0.000200	< 0.000200	< 0.000200	< 0.000200	< 0.000200	< 0.000200
Calcium	mg/L	SW 6010B	0.100	0.0174	—	—	110	92.7	88.5	83.8	116	67.7
Chromium, Hexavalent	mg/L	SM 3500 Cr B	0.0100	0.00480	HBSL	0.02	< 0.00400	< 0.00400	< 0.00400	< 0.00400	< 0.00400	< 0.00400
Cobalt	mg/L	SW 6010B	0.00500	0.000815	HBSL	0.002	< 0.00500	< 0.00500	< 0.00500	< 0.00500	< 0.00500	< 0.00500
Copper	mg/L	SW 6010B	0.00500	0.000566	MCL	1.3	< 0.00500	< 0.00500	< 0.00500	< 0.00500	< 0.00500	< 0.00500
Iron	mg/L	SW 6010B	0.0500	0.00534	SMCL	0.3	< 0.0500	**0.304**	**2.16**	< 0.0500	**2.14**	< 0.0500
Lead	ug/L	SW 7421	0.00200	0.000738	MCL	15	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00
Lithium	mg/L	SW 6010B	0.00500	0.0000315	HBSL	0.01	0.00506	< 0.00500	< 0.00500	< 0.00500	0.00684	< 0.00500
Magnesium	mg/L	SW 6010B	0.100	0.0101	—	—	29.4	28.6	33.5	30.9	41.9	30.0
Manganese	mg/L	SW 6010B	0.00500	0.00153	HBSL, SMCL	0.3, 0.05	< 0.00500	**0.0819**	0.0223	**0.237**	**0.0620**	< 0.00500
Molybdenum	mg/L	SW 6010B	0.0100	0.00207	HBSL	0.03	< 0.0100	< 0.0100	< 0.0100	0.0101	< 0.0100	< 0.0100
Nickel	mg/L	SW 6010B	0.00500	0.00118	HBSL	0.1	< 0.00500	< 0.00500	< 0.00500	< 0.00500	< 0.00500	< 0.00500
Potassium	mg/L	SW 6010B	1.00	0.0397	—	—	3.00	2.64	2.01	1.29	2.92	2.75
Silver	mg/L	SW 6010B	0.00200	0.000384	HBSL	0.1	< 0.00200	< 0.00200	< 0.00200	< 0.00200	< 0.00200	< 0.00200
Sodium	mg/L	SW 6010B	1.00	0.0631	—	—	13.5	48.0	16.4	8.18	43.5	24.7
Strontium	mg/L	SW 6010B	0.00500	0.000527	HBSL	4	0.291	0.404	1.08	0.627	1.11	0.460
Thallium	ug/L	SW 7841/EPA 279.2	0.00100	0.000407	MCL	2	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Vanadium	mg/L	SW 6010B	0.00500	0.000517	HBSL	0.0004	< 0.00500	< 0.00500	< 0.00500	< 0.00500	< 0.00500	< 0.00500
Zinc	mg/L	SW 6010B	0.0100	0.00138	HBSL	2	< 0.0100	< 0.0100	< 0.0100	< 0.0100	< 0.0100	< 0.0100
Alkalinity, Total (As CaCO3)	mg/L	SM 2320B	25.0	25.0	—	—	324	284	289	324	289	228
Biochemical Oxygen Demand	mg/L	SM 5210B	2.00	2.00	—	—	< 2.00	< 2.00	< 4.00	< 4.00	< 2.00	< 2.00
Carbonaceous Biological Oxyg	mg/L	EPA 405.1/SM 5210	2.00	2.00	—	—	< 2.00	7.77	< 4.00	< 4.00	< 2.00	< 2.00
Chemical Oxygen Demand	mg/L	HACH 8000	5.00	4.68	—	—	< 5.00	< 5.00	< 5.00	< 5.00	< 5.00	< 5.00
Cyanide, Total	mg/L	EPA 335.4	0.0100	0.00195	MCL	0.2	< 0.0100	< 0.0100	< 0.0100	< 0.0100	< 0.0100	< 0.0100
Phenolics, Total Recoverable	mg/L	EPA 420.4	0.0100	0.00336	—	—	< 0.0100	< 0.0100	< 0.0100	< 0.0100	< 0.0100	< 0.0100
Total Dissolved Solids (Residu	mg/L	SM 2540C	5.00	1.67	SMCL	500	438	486	440	368	436	328
Total Organic Carbon	mg/L	SM 5310C	1.00	0.142	—	—	1.65	1.05	< 1.00	< 1.00	< 1.00	< 1.00

Appendix A

Spring 2018					Benchmark		Sample Sites					
Parameter	**Units**	**Method**	**PQL**	**MDL**	**Type**	**Value**	**MON00022**	**MON10016**	**PRE10007**	**SHE00089**	**WAR10003**	**WAR10004**
E. coli	MPN/100 ml	Colilert	1.00		MCL	0	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00
1,1,1,2-Tetrachloroethane	ug/L	SW 8260B	1.00	0.220	HBSL	0.1						
1,1,1-Trichloroethane	ug/L	SW 8260B	1.00	0.283	MCL	200						
1,1,2,2-Tetrachloroethane	ug/L	SW 8260B	1.00	0.230	HBSL	0.0002						
1,1,2-Trichloroethane	ug/L	SW 8260B	1.00	0.337	MCL	5						
1,1-Dichloroethane	ug/L	SW 8260B	1.00	0.274	HBSL	1						
1,1-Dichloroethene	ug/L	SW 8260B	1.00	0.224	MCL	7						
1,1-Dichloropropene	ug/L	SW 8260B	1.00	0.213	—	—						
1,2,3-Trichlorobenzene	ug/L	SW 8260B	1.00	0.228	—	—						
1,2,3-Trichloropropane	ug/L	SW 8260B	1.00	0.271	HBSL	30						
1,2,4-Trichlorobenzene	ug/L	SW 8260B	1.00	0.214	MCL	70						
1,2,4-Trimethylbenzene	ug/L	SW 8260B	1.00	0.194	HBSL	60						
1,2-Dibromo-3-chloropropane	ug/L	SW 8260B	5.00	0.869	MCL	0.2						
1,2-Dibromoethane	ug/L	SW 8260B	1.00	0.192	MCL	0.05						
1,2-Dichlorobenzene	ug/L	SW 8260B	1.00	0.570	MCL	600						
1,2-Dichloroethane	ug/L	SW 8260B	1.00	0.300	MCL	5						
1,2-Dichloropropane	ug/L	SW 8260B	1.00	0.230	MCL	5						
1,3,5-Trimethylbenzene	ug/L	SW 8260B	1.00	0.199	HBSL	60						
1,3-Dichlorobenzene	ug/L	SW 8260B	1.00	0.197	HBSL	600						
1,3-Dichloropropane	ug/L	SW 8260B	1.00	0.237	HBSL	100						
1,4-Dichlorobenzene	ug/L	SW 8260B	1.00	0.214	MCL	75						
2,2-Dichloropropane	ug/L	SW 8260B	1.00	0.262	—	—						
2-Butanone	ug/L	SW 8260B	10.0	2.75	—	—						
2-Chlorotoluene	ug/L	SW 8260B	1.00	0.217	—	—						
2-Hexanone	ug/L	SW 8260B	10.0	0.0779	HBSL	30						
4-Chlorotoluene	ug/L	SW 8260B	1.00	0.241	HBSL	100						
4-Isopropyltoluene	ug/L	SW 8260B	1.00	0.182	—	—						
4-Methyl-2-pentanone	ug/L	SW 8260B	10.0	1.91	—	—						
Acetone	ug/L	SW 8260B	20.0	3.76	HBSL	6000						
Acetonitrile	ug/L	SW 8260B	20.0	2.41	—	—						
Acrolein	ug/L	SW 8260B	10.0	1.49	HBSL	4						
Acrylonitrile	ug/L	SW 8260B	10.0	0.388	HBSL	0.06						
Allyl chloride	ug/L	SW 8260B	1.00	0.250	—	—						
Benzene	ug/L	SW 8260B	1.00	0.269	MCL	5						
Bromobenzene	ug/L	SW 8260B	1.00	0.221	HBSL	50						
Bromochloromethane	ug/L	SW 8260B	1.00	0.293	HBSL	60						
Bromodichloromethane	ug/L	SW 8260B	1.00	0.232	MCL	80						
Bromoform	ug/L	SW 8260B	1.00	0.231	MCL	80						
Bromomethane	ug/L	SW 8260B	1.00	0.494	HHBP	140						
Carbon Disulfide	ug/L	SW 8260B	10.0	0.242	HBSL	600						
Carbon Tetrachloride	ug/L	SW 8260B	1.00	0.241	MCL	5						
Chlorobenzene	ug/L	SW 8260B	1.00	0.265	MCL	100						
Chloroethane	ug/L	SW 8260B	1.00	0.261	—	—						
Chloroform	ug/L	SW 8260B	1.00	0.269	MCL	80						
Chloromethane	ug/L	SW 8260B	1.00	0.318	—	—						
cis-1,2-Dichloroethene	ug/L	SW 8260B	1.00	0.296	MCL	70						
cis-1,3-Dichloropropene	ug/L	SW 8260B	1.00	0.234	HBSL	0.3						
Dibromochloromethane	ug/L	SW 8260B	1.00	0.645	MCL	80						

Appendix A

Spring 2018					Benchmark		Sample Sites					
Parameter	**Units**	**Method**	**PQL**	**MDL**	**Type**	**Value**	**MON00022**	**MON10016**	**PRE10007**	**SHE00089**	**WAR10003**	**WAR10004**
Dibromomethane	ug/L	SW 8260B	1.00	0.299	—	—						
Dichlorodifluoromethane	ug/L	SW 8260B	1.00	0.242	HBSL	1000						
Ethylbenzene	ug/L	SW 8260B	1.00	0.168	MCL	700						
Hexachlorobutadiene	ug/L	SW 8260B	1.00	0.277	HBSL	0.8						
Iodomethane	ug/L	SW 8260B	10.0	1.10	—	—						
Isopropylbenzene	ug/L	SW 8260B	1.00	0.204	HBSL	600						
m,p-Xylene	ug/L	SW 8260B	5.00	0.410	MCL	10000						
Methyl tert-Butyl Ether	ug/L	SW 8260B	5.00	0.239	—	—						
Methylene Chloride	ug/L	SW 8260B	1.00	0.164	MCL	5						
Naphthalene	ug/L	SW 8260B	5.00	0.212	HBSL	100						
n-Butylbenzene	ug/L	SW 8260B	1.00	0.167	HBSL	300						
n-Hexane	ug/L	SW 8260B	5.00	0.225	—	—						
n-Propylbenzene	ug/L	SW 8260B	1.00	0.204	—	—						
o-Xylene	ug/L	SW 8260B	1.00	0.220	MCL	10000						
sec-Butylbenzene	ug/L	SW 8260B	1.00	0.193	—	—						
Styrene	ug/L	SW 8260B	1.00	0.210	MCL	100						
tert_Butylbenzene	ug/L	SW 8260B	1.00	0.193	—	—						
Tetrachloroethene	ug/L	SW 8260B	1.00	0.230	MCL	5						
Toluene	ug/L	SW 8260B	1.00	0.231	MCL	1000						
trans-1,2-Dichloroethene	ug/L	SW 8260B	1.00	0.225	MCL	100						
trans-1,3-Dichloropropene	ug/L	SW 8260B	1.00	0.203	HBSL	0.3						
Trichloroethene	ug/L	SW 8260B	1.00	0.295	MCL	5						
Trichlorofluoromethane	ug/L	SW 8260B	1.00	0.250	HBSL	2000						
Vinyl acetate	ug/L	SW 8260B	1.00	0.282	—	—						
Vinyl Chloride	ug/L	SW 8260B	1.00	0.224	MCL	2						

MCL - Maximum Contaminant Level set by USEPA

SMCL - Secondary Maximum Contaminant Level set by USEPA

AMCL - Alternative Maximum Contaminant Level set by USEPA

HBSL - Non enforceable Health Based Screening Level based on (1) latest USEPA Office of Water policies for

HHBP - Human Health Benchmark for Pesticides set by USEPA

— No drinking water benchmark set for the compound

Numbers in bold exceed a benchmark

Appendix A

Fall 2018					Benchmark		Sample Sites					
Parameter	**Units**	**Method**	**PQL**	**MDL**	**Type**	**Value**	**BUT10014**	**BUT10016**	**BUT10017**	**CLA10011**	**CLA10018**	**MIA00205**
Dissolved Oxygen	mg/L	Field Measured			—	—	5.08	0.14	8.96	0.03	4.13	0.16
pH	S.U.	Field Measured			SMCL	6.5 - 8.5	7.21	7.51	7.34	7.05	7.00	7.25
Specific Conductance	mS/cm	Field Measured			—	—	846	599	610	797	711	705
Temperature	°C	Field Measured			—	—	14.4	12.7	12.4	13.1	17.3	12.9
Ammonia	mg/L	EPA 350.1	0.200	0.0732	—	—	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200
Chloride	mg/L	SM 4500-CL-E	2.00	0.806	SMCL	250	52.8	14.0	13.7	23.3	14.7	22.2
Fluoride	mg/L	SM 4500 F-C	0.200	0.0174	MCL	4	< 0.200	0.251	< 0.200	0.264	0.267	< 0.200
Nitrite Nitrogen as NO2-N	mg/L	SM 4500 NO3-F	0.100	0.0210	MCL	1	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100
Nitrogen, Nitrate-Nitrite	mg/L	SM 4500 NO3-F	0.100	0.0157	MCL	10	2.20	< 0.100	4.05	< 0.100	8.65	3.40
Nitrogen, Total Kjeldahl	mg/L	EPA 351.2	0.500	0.165	—	—	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500
Phosphorus	mg/L	SW 6010B	0.100	0.00452	—	—	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100
Silica	mg/L	EPA 200.7/SW 6010	0.107	0.00296	—	—	10.1	13.2	9.70	15.0	10.1	9.64
Sulfate	mg/L	EPA 375.4 Modified	10.0	3.80	SMCL	250	56.8	51.7	12.1	56.6	< 20.0	29.2
Total Hardness	mg/L	EPA 200.7	0.662	0.0850	—	—	351	293	299	425	358	351
Total Orthophosphate, as P	mg/L	SM 4500 P-F	0.100	0.0218	—	—	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100
Aluminum	mg/L	SW 6010B	0.100	0.00561	HBSL, SMCL	6, 0.2	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100
Antimony	ug/L	SW 7041	0.00300	0.00110	MCL	6	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500
Arsenic	ug/L	SW 7060A	0.00300	0.000763	MCL	10	< 3.00	3.45	< 3.00	6.42	< 3.00	< 3.00
Barium	mg/L	SW 6010B	0.00500	0.000747	MCL	2	0.202	0.229	0.0404	0.0601	0.0922	0.122
Beryllium	mg/L	SW 6010B	0.000500	0.0000236	MCL	0.004	< 0.000500	< 0.000500	< 0.000500	< 0.000500	< 0.000500	< 0.000500
Boron	mg/L	SW 6010B	0.100	0.00328	HBSL	5	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100
Cadmium	ug/L	SW 7131A	0.000200	0.0000702	MCL	5	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200
Calcium	mg/L	SW 6010B	0.100	0.0174	—	—	97.3	75.5	80.1	107	86.5	97.5
Chromium, Hexavalent	mg/L	SM 3500 Cr B	0.0100	0.00480	HBSL	0.02	< 0.00400	< 0.00400	< 0.00400	< 0.00400	< 0.00400	< 0.00400
Cobalt	mg/L	SW 6010B	0.00500	0.000815	HBSL	0.002	< 0.00500	< 0.00500	< 0.00500	< 0.00500	< 0.00500	< 0.00500
Copper	mg/L	SW 6010B	0.00500	0.000566	MCL	1.3	< 0.00500	< 0.00500	< 0.00500	< 0.00500	< 0.00500	< 0.00500
Iron	mg/L	SW 6010B	0.0500	0.00534	SMCL	0.3	< 0.0500	**1.51**	< 0.0500	**2.75**	< 0.0500	< 0.0500
Lead	ug/L	SW 7421	0.00200	0.000738	MCL	15	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500
Lithium	mg/L	SW 6010B	0.00500	0.0000315	HBSL	0.01	< 0.00500	< 0.00500	< 0.00500	< 0.00500	< 0.00500	< 0.00500
Magnesium	mg/L	SW 6010B	0.100	0.0101	—	—	26.1	25.3	24.1	38.3	34.4	26.2
Manganese	mg/L	SW 6010B	0.00500	0.00153	HBSL, SMCL	0.3, 0.05	< 0.00500	**0.383**	< 0.00500	**0.0634**	< 0.00500	**0.0819**
Molybdenum	mg/L	SW 6010B	0.0100	0.00207	HBSL	0.03	< 0.0100	< 0.0100	< 0.0100	< 0.0100	< 0.0100	< 0.0100
Nickel	mg/L	SW 6010B	0.00500	0.00118	HBSL	0.1	< 0.00500	< 0.00500	< 0.00500	< 0.00500	< 0.00500	< 0.00500
Potassium	mg/L	SW 6010B	1.00	0.0397	—	—	4.09	1.28	2.16	< 1.00	2.43	1.34
Silver	mg/L	SW 6010B	0.00200	0.000384	HBSL	0.1	< 0.00200	< 0.00200	< 0.00200	< 0.00200	< 0.00200	< 0.00200
Sodium	mg/L	SW 6010B	1.00	0.0631	—	—	37.4	6.53	7.91	5.48	9.20	9.04
Strontium	mg/L	SW 6010B	0.00500	0.000527	HBSL	4	0.583	0.393	0.128	0.302	2.42	0.339
Thallium	ug/L	SW 7841/EPA 279.2	0.00100	0.000407	MCL	0.002	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500
Vanadium	mg/L	SW 6010B	0.00500	0.000517	HBSL	0.0004	< 0.00500	< 0.00500	< 0.00500	< 0.00500	< 0.00500	< 0.00500
Zinc	mg/L	SW 6010B	0.0100	0.00138	HBSL	2	< 0.0100	< 0.0100	< 0.0100	< 0.0100	< 0.0100	< 0.0100
Alkalinity, Total (As CaCO3)	mg/L	SM 2320B	25.0	25.0	—	—	298	240	267	314	300	297
Biochemical Oxygen Demand	mg/L	SM 5210B	2.00	2.00	—	—	< 2.00	< 2.00	< 2.00	< 2.00	< 2.00	< 2.00
Carbonaceous Biological Oxyg	mg/L	EPA 405.1/SM 5210	2.00	2.00	—	—	< 2.00	< 2.00	< 2.00	< 2.00	< 2.00	< 2.00
Chemical Oxygen Demand	mg/L	HACH 8000	5.00	4.68	—	—	< 5.00	< 5.00	< 5.00	< 5.00	< 5.00	< 5.00
Cyanide, Total	mg/L	EPA 335.4	0.0100	0.00195	MCL	0.2	< 0.0100	< 0.0100	< 0.0100	< 0.0100	< 0.0100	< 0.0100
Phenolics, Total Recoverable	mg/L	EPA 420.4	0.0100	0.00336	—	—	< 0.0100	< 0.0100	< 0.0100	< 0.0100	< 0.0100	< 0.0100
Total Dissolved Solids (Residu	mg/L	SM 2540C	5.00	1.67	SMCL	500	499	349	333	465	389	409
Total Organic Carbon	mg/L	SM 5310C	1.00	0.142	—	—	< 1.00	< 1.00	< 1.00	1.47	1.18	< 1.00

Appendix A

Fall 2018					Benchmark		Sample Sites					
Parameter	**Units**	**Method**	**PQL**	**MDL**	**Type**	**Value**	**BUT10014**	**BUT10016**	**BUT10017**	**CLA10011**	**CLA10018**	**MIA00205**
E. coli	MPN/100 ml	Colilert	1.00		MCL	0	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00
1,1,1,2-Tetrachloroethane	ug/L	SW 8260B	1.00	0.220	HBSL	0.1	< 5.00					
1,1,1-Trichloroethane	ug/L	SW 8260B	1.00	0.283	MCL	200	< 5.00					
1,1,2,2-Tetrachloroethane	ug/L	SW 8260B	1.00	0.230	HBSL	0.0002	< 5.00					
1,1,2-Trichloroethane	ug/L	SW 8260B	1.00	0.337	MCL	5	< 5.00					
1,1-Dichloroethane	ug/L	SW 8260B	1.00	0.274	HBSL	1	< 5.00					
1,1-Dichloroethene	ug/L	SW 8260B	1.00	0.224	MCL	7	< 5.00					
1,1-Dichloropropene	ug/L	SW 8260B	1.00	0.213	—	—	< 5.00					
1,2,3-Trichlorobenzene	ug/L	SW 8260B	1.00	0.228	—	—	< 5.00					
1,2,3-Trichloropropane	ug/L	SW 8260B	1.00	0.271	HBSL	30	< 5.00					
1,2,4-Trichlorobenzene	ug/L	SW 8260B	1.00	0.214	MCL	70	< 5.00					
1,2,4-Trimethylbenzene	ug/L	SW 8260B	1.00	0.194	HBSL	60	< 5.00					
1,2-Dibromo-3-chloropropane	ug/L	SW 8260B	5.00	0.869	MCL	0.2	< 10.0					
1,2-Dibromoethane	ug/L	SW 8260B	1.00	0.192	MCL	0.05	< 5.00					
1,2-Dichlorobenzene	ug/L	SW 8260B	1.00	0.570	MCL	600	< 5.00					
1,2-Dichloroethane	ug/L	SW 8260B	1.00	0.300	MCL	5	< 5.00					
1,2-Dichloropropane	ug/L	SW 8260B	1.00	0.230	MCL	5	< 5.00					
1,3,5-Trimethylbenzene	ug/L	SW 8260B	1.00	0.199	HBSL	60	< 5.00					
1,3-Dichlorobenzene	ug/L	SW 8260B	1.00	0.197	HBSL	600	< 5.00					
1,3-Dichloropropane	ug/L	SW 8260B	1.00	0.237	HBSL	100	< 5.00					
1,4-Dichlorobenzene	ug/L	SW 8260B	1.00	0.214	MCL	75	< 5.00					
2,2-Dichloropropane	ug/L	SW 8260B	1.00	0.262	—	—	< 5.00					
2-Butanone	ug/L	SW 8260B	10.0	2.75	—	—	< 20.0					
2-Chlorotoluene	ug/L	SW 8260B	1.00	0.217	—	—	< 5.00					
2-Hexanone	ug/L	SW 8260B	10.0	0.0779	HBSL	30	< 20.0					
4-Chlorotoluene	ug/L	SW 8260B	1.00	0.241	HBSL	100	< 5.00					
4-Isopropyltoluene	ug/L	SW 8260B	1.00	0.182	—	—	< 5.00					
4-Methyl-2-pentanone	ug/L	SW 8260B	10.0	1.91	—	—	< 20.0					
Acetone	ug/L	SW 8260B	20.0	3.76	HBSL	6000	< 20.0					
Acetonitrile	ug/L	SW 8260B	20.0	2.41	—	—	< 40.0					
Acrolein	ug/L	SW 8260B	10.0	1.49	HBSL	4	< 20.0					
Acrylonitrile	ug/L	SW 8260B	10.0	0.388	HBSL	0.06	< 20.0					
Allyl chloride	ug/L	SW 8260B	1.00	0.250	—	—	< 5.00					
Benzene	ug/L	SW 8260B	1.00	0.269	MCL	5	< 5.00					
Bromobenzene	ug/L	SW 8260B	1.00	0.221	HBSL	50	< 5.00					
Bromochloromethane	ug/L	SW 8260B	1.00	0.293	HBSL	60	< 5.00					
Bromodichloromethane	ug/L	SW 8260B	1.00	0.232	MCL	80	< 5.00					
Bromoform	ug/L	SW 8260B	1.00	0.231	MCL	80	< 5.00					
Bromomethane	ug/L	SW 8260B	1.00	0.494	HHBP	140	< 5.00					
Carbon Disulfide	ug/L	SW 8260B	10.0	0.242	HBSL	600	< 20.0					
Carbon Tetrachloride	ug/L	SW 8260B	1.00	0.241	MCL	5	< 5.00					
Chlorobenzene	ug/L	SW 8260B	1.00	0.265	MCL	100	< 5.00					
Chloroethane	ug/L	SW 8260B	1.00	0.261	—	—	< 5.00					
Chloroform	ug/L	SW 8260B	1.00	0.269	MCL	80	< 5.00					
Chloromethane	ug/L	SW 8260B	1.00	0.318	—	—	< 5.00					
cis-1,2-Dichloroethene	ug/L	SW 8260B	1.00	0.296	MCL	70	< 5.00					
cis-1,3-Dichloropropene	ug/L	SW 8260B	1.00	0.234	HBSL	0.3	< 5.00					
Dibromochloromethane	ug/L	SW 8260B	1.00	0.645	MCL	80	< 5.00					

Appendix A

Fall 2018					Benchmark		Sample Sites					
Parameter	**Units**	**Method**	**PQL**	**MDL**	**Type**	**Value**	**BUT10014**	**BUT10016**	**BUT10017**	**CLA10011**	**CLA10018**	**MIA00205**
Dibromomethane	ug/L	SW 8260B	1.00	0.299	—	—	< 5.00					
Dichlorodifluoromethane	ug/L	SW 8260B	1.00	0.242	HBSL	1000	< 5.00					
Ethylbenzene	ug/L	SW 8260B	1.00	0.168	MCL	700	< 5.00					
Hexachlorobutadiene	ug/L	SW 8260B	1.00	0.277	HBSL	0.8	< 5.00					
Iodomethane	ug/L	SW 8260B	10.0	1.10	—	—	< 10.0					
Isopropylbenzene	ug/L	SW 8260B	1.00	0.204	HBSL	600	< 5.00					
m,p-Xylene	ug/L	SW 8260B	5.00	0.410	MCL	10000	< 10.0					
Methyl tert-Butyl Ether	ug/L	SW 8260B	5.00	0.239	—	—	< 10.0					
Methylene Chloride	ug/L	SW 8260B	1.00	0.164	MCL	5	< 5.00					
Naphthalene	ug/L	SW 8260B	5.00	0.212	HBSL	100	< 5.00					
n-Butylbenzene	ug/L	SW 8260B	1.00	0.167	HBSL	300	< 5.00					
n-Hexane	ug/L	SW 8260B	5.00	0.225	—	—	< 5.00					
n-Propylbenzene	ug/L	SW 8260B	1.00	0.204	—	—	< 5.00					
o-Xylene	ug/L	SW 8260B	1.00	0.220	MCL	10000	< 5.00					
sec-Butylbenzene	ug/L	SW 8260B	1.00	0.193	—	—	< 5.00					
Styrene	ug/L	SW 8260B	1.00	0.210	MCL	100	< 5.00					
tert_Butylbenzene	ug/L	SW 8260B	1.00	0.193	—	—	< 5.00					
Tetrachloroethene	ug/L	SW 8260B	1.00	0.230	MCL	5	< 5.00					
Toluene	ug/L	SW 8260B	1.00	0.231	MCL	1000	< 5.00					
trans-1,2-Dichloroethene	ug/L	SW 8260B	1.00	0.225	MCL	100	< 5.00					
trans-1,3-Dichloropropene	ug/L	SW 8260B	1.00	0.203	HBSL	0.3	< 5.00					
Trichloroethene	ug/L	SW 8260B	1.00	0.295	MCL	5	< 5.00					
Trichlorofluoromethane	ug/L	SW 8260B	1.00	0.250	HBSL	2000	< 5.00					
Vinyl acetate	ug/L	SW 8260B	1.00	0.282	—	—	< 10.0					
Vinyl Chloride	ug/L	SW 8260B	1.00	0.224	MCL	2	< 1.00					

MCL - Maximum Contaminant Level set by USEPA

SMCL - Secondary Maximum Contaminant Level set by USEPA

AMCL - Alternative Maximum Contaminant Level set by USEPA

HBSL - Non enforceable Health Based Screening Level based on (1) latest USEPA Office of Water policies for

HHBP - Human Health Benchmark for Pesticides set by USEPA

— No drinking water benchmark set for the compound

Numbers in bold exceed a benchmark

Appendix A

Fall 2018					Benchmark		Sample Sites					
Parameter	**Units**	**Method**	**PQL**	**MDL**	**Type**	**Value**	**MON00022**	**MON10016**	**PRE10007**	**SHE00089**	**WAR10003**	**WAR10004**
Dissolved Oxygen	mg/L	Field Measured			—	—	0.20	0.04	0.00	0.08	0.06	2.02
pH	S.U.	Field Measured			SMCL	6.5 - 8.5	6.72	7.19	7.14	7.25	7.4	7.47
Specific Conductance	mS/cm	Field Measured			—	—	1057	895	738	678	996	600
Temperature	°C	Field Measured			—	—	17.8	13.9	12.7	12.4	14.9	14.6
Ammonia	mg/L	EPA 350.1	0.200	0.0732	—	—	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200
Chloride	mg/L	SM 4500-CL-E	2.00	0.806	SMCL	250	16.2	84.5	32.3	6.02	96.6	39.7
Fluoride	mg/L	SM 4500 F-C	0.200	0.0174	MCL	4	< 0.200	< 0.200	0.217	0.478	0.220	0.236
Nitrite Nitrogen as NO2-N	mg/L	SM 4500 NO3-F	0.100	0.0210	MCL	1	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100
Nitrogen, Nitrate-Nitrite	mg/L	SM 4500 NO3-F	0.100	0.0157	MCL	10	0.367	< 0.100	< 0.100	< 0.100	< 0.100	1.27
Nitrogen, Total Kjeldahl	mg/L	EPA 351.2	0.500	0.165	—	—	0.580	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500
Phosphorus	mg/L	SW 6010B	0.100	0.00452	—	—	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100
Silica	mg/L	EPA 200.7/SW 6010	0.107	0.00296	—	—	9.17	9.42	11.6	11.1	13.4	8.31
Sulfate	mg/L	EPA 375.4 Modified	10.0	3.80	SMCL	250	142	37.9	55.6	41.0	76.6	23.0
Total Hardness	mg/L	EPA 200.7	0.662	0.0850	—	—	553	323	339	351	405	258
Total Orthophosphate, as P	mg/L	SM 4500 P-F	0.100	0.0218	—	—	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100
Aluminum	mg/L	SW 6010B	0.100	0.00561	HBSL, SMCL	6, 0.2	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100
Antimony	ug/L	SW 7041	0.00300	0.00110	MCL	6	< 0.500	< 0.500		0.970	< 0.500	< 0.500
Arsenic	ug/L	SW 7060A	0.00300	0.000763	MCL	10	< 3.00	< 3.00	**15.5**	< 3.00	< 3.00	< 3.00
Barium	mg/L	SW 6010B	0.00500	0.000747	MCL	2	0.112	0.122	0.293	0.157	0.210	0.0635
Beryllium	mg/L	SW 6010B	0.000500	0.0000236	MCL	0.004	< 0.000500	< 0.000500	< 0.000500	< 0.000500	< 0.000500	< 0.000500
Boron	mg/L	SW 6010B	0.100	0.00328	HBSL	5	< 0.100	< 0.100	< 0.100	< 0.100	0.224	< 0.100
Cadmium	ug/L	SW 7131A	0.000200	0.0000702	MCL	5	< 0.200	< 0.200	< 0.200	0.920	< 0.200	< 0.200
Calcium	mg/L	SW 6010B	0.100	0.0174	—	—	152	85.1	81.5	85.9	99.7	58.4
Chromium, Hexavalent	mg/L	SM 3500 Cr B	0.0100	0.00480	HBSL	0.02	< 0.00400	< 0.00400	< 0.00400	< 0.00400	< 0.00400	< 0.00400
Cobalt	mg/L	SW 6010B	0.00500	0.000815	HBSL	0.002	< 0.00500	< 0.00500	< 0.00500	< 0.00500	< 0.00500	< 0.00500
Copper	mg/L	SW 6010B	0.00500	0.000566	MCL	1.3	< 0.00500	< 0.00500	< 0.00500	< 0.00500	< 0.00500	< 0.00500
Iron	mg/L	SW 6010B	0.0500	0.00534	SMCL	0.3	< 0.0500	**0.305**	**8.99**	< 0.0500	**1.90**	< 0.0500
Lead	ug/L	SW 7421	0.00200	0.000738	MCL	15	< 0.500	< 0.500	< 0.500	0.950	< 0.500	< 0.500
Lithium	mg/L	SW 6010B	0.00500	0.0000315	HBSL	0.01	0.0114	< 0.00500	< 0.00500	< 0.00500	0.00583	< 0.00500
Magnesium	mg/L	SW 6010B	0.100	0.0101	—	—	42.2	26.9	32.8	33.2	37.8	27.2
Manganese	mg/L	SW 6010B	0.00500	0.00153	HBSL, SMCL	0.3, 0.05	< 0.00500	**0.0856**	0.0229	**0.263**	**0.0538**	< 0.00500
Molybdenum	mg/L	SW 6010B	0.0100	0.00207	HBSL	0.03	< 0.0100	< 0.0100	< 0.0100	< 0.0100	< 0.0100	< 0.0100
Nickel	mg/L	SW 6010B	0.00500	0.00118	HBSL	0.1	< 0.00500	< 0.00500	< 0.00500	< 0.00500	< 0.00500	< 0.00500
Potassium	mg/L	SW 6010B	1.00	0.0397	—	—	4.45	3.12	2.10	1.41	2.69	2.53
Silver	mg/L	SW 6010B	0.00200	0.000384	HBSL	0.1	< 0.00200	< 0.00200	< 0.00200	< 0.00200	< 0.00200	< 0.00200
Sodium	mg/L	SW 6010B	1.00	0.0631	—	—	11.9	60.9	17.9	8.88	39.6	23.4
Strontium	mg/L	SW 6010B	0.00500	0.000527	HBSL	4	0.451	0.427	0.963	0.750	0.992	0.408
Thallium	ug/L	SW 7841/EPA 279.2	0.00100	0.000407	MCL	0.002	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500
Vanadium	mg/L	SW 6010B	0.00500	0.000517	HBSL	0.0004	< 0.00500	< 0.00500	< 0.00500	< 0.00500	< 0.00500	< 0.00500
Zinc	mg/L	SW 6010B	0.0100	0.00138	HBSL	2	< 0.0100	< 0.0100	< 0.0100	< 0.0100	< 0.0100	< 0.0100
Alkalinity, Total (As CaCO3)	mg/L	SM 2320B	25.0	25.0	—	—	420	299	281	318	291	219
Biochemical Oxygen Demand	mg/L	SM 5210B	2.00	2.00	—	—	< 2.00	< 2.00	< 2.00	< 2.00	< 2.00	< 2.00
Carbonaceous Biological Oxyg	mg/L	EPA 405.1/SM 5210	2.00	2.00	—	—	< 2.00	< 2.00	< 2.00	< 2.00	< 2.00	< 2.00
Chemical Oxygen Demand	mg/L	HACH 8000	5.00	4.68	—	—	< 5.00	< 5.00	< 5.00	< 5.00	7.30	< 5.00
Cyanide, Total	mg/L	EPA 335.4	0.0100	0.00195	MCL	0.2	< 0.0100	< 0.0100	< 0.0100	< 0.0100	< 0.0100	< 0.0100
Phenolics, Total Recoverable	mg/L	EPA 420.4	0.0100	0.00336	—	—	< 0.0100	< 0.0100	< 0.0100	< 0.0100	< 0.0100	< 0.0100
Total Dissolved Solids (Residu	mg/L	SM 2540C	5.00	1.67	SMCL	500	**674**	487	399	371	**561**	331
Total Organic Carbon	mg/L	SM 5310C	1.00	0.142	—	—	1.50	1.13	< 1.00	< 1.00	< 1.00	< 1.00

Appendix A

Fall 2018					Benchmark							
Parameter	**Units**	**Method**	**PQL**	**MDL**	**Type**	**Value**	**MON00022**	**MON10016**	**PRE10007**	**SHE00089**	**WAR10003**	**WAR10004**
E. coli	MPN/100 ml	Colilert	1.00		MCL	0	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00
1,1,1,2-Tetrachloroethane	ug/L	SW 8260B	1.00	0.220	HBSL	0.1						
1,1,1-Trichloroethane	ug/L	SW 8260B	1.00	0.283	MCL	200						
1,1,2,2-Tetrachloroethane	ug/L	SW 8260B	1.00	0.230	HBSL	0.0002						
1,1,2-Trichloroethane	ug/L	SW 8260B	1.00	0.337	MCL	5						
1,1-Dichloroethane	ug/L	SW 8260B	1.00	0.274	HBSL	1						
1,1-Dichloroethene	ug/L	SW 8260B	1.00	0.224	MCL	7						
1,1-Dichloropropene	ug/L	SW 8260B	1.00	0.213	—	—						
1,2,3-Trichlorobenzene	ug/L	SW 8260B	1.00	0.228	—	—						
1,2,3-Trichloropropane	ug/L	SW 8260B	1.00	0.271	HBSL	30						
1,2,4-Trichlorobenzene	ug/L	SW 8260B	1.00	0.214	MCL	70						
1,2,4-Trimethylbenzene	ug/L	SW 8260B	1.00	0.194	HBSL	60						
1,2-Dibromo-3-chloropropane	ug/L	SW 8260B	5.00	0.869	MCL	0.2						
1,2-Dibromoethane	ug/L	SW 8260B	1.00	0.192	MCL	0.05						
1,2-Dichlorobenzene	ug/L	SW 8260B	1.00	0.570	MCL	600						
1,2-Dichloroethane	ug/L	SW 8260B	1.00	0.300	MCL	5						
1,2-Dichloropropane	ug/L	SW 8260B	1.00	0.230	MCL	5						
1,3,5-Trimethylbenzene	ug/L	SW 8260B	1.00	0.199	HBSL	60						
1,3-Dichlorobenzene	ug/L	SW 8260B	1.00	0.197	HBSL	600						
1,3-Dichloropropane	ug/L	SW 8260B	1.00	0.237	HBSL	100						
1,4-Dichlorobenzene	ug/L	SW 8260B	1.00	0.214	MCL	75						
2,2-Dichloropropane	ug/L	SW 8260B	1.00	0.262	—	—						
2-Butanone	ug/L	SW 8260B	10.0	2.75	—	—						
2-Chlorotoluene	ug/L	SW 8260B	1.00	0.217	—	—						
2-Hexanone	ug/L	SW 8260B	10.0	0.0779	HBSL	30						
4-Chlorotoluene	ug/L	SW 8260B	1.00	0.241	HBSL	100						
4-Isopropyltoluene	ug/L	SW 8260B	1.00	0.182	—	—						
4-Methyl-2-pentanone	ug/L	SW 8260B	10.0	1.91	—	—						
Acetone	ug/L	SW 8260B	20.0	3.76	HBSL	6000						
Acetonitrile	ug/L	SW 8260B	20.0	2.41	—	—						
Acrolein	ug/L	SW 8260B	10.0	1.49	HBSL	4						
Acrylonitrile	ug/L	SW 8260B	10.0	0.388	HBSL	0.06						
Allyl chloride	ug/L	SW 8260B	1.00	0.250	—	—						
Benzene	ug/L	SW 8260B	1.00	0.269	MCL	5						
Bromobenzene	ug/L	SW 8260B	1.00	0.221	HBSL	50						
Bromochloromethane	ug/L	SW 8260B	1.00	0.293	HBSL	60						
Bromodichloromethane	ug/L	SW 8260B	1.00	0.232	MCL	80						
Bromoform	ug/L	SW 8260B	1.00	0.231	MCL	80						
Bromomethane	ug/L	SW 8260B	1.00	0.494	HHBP	140						
Carbon Disulfide	ug/L	SW 8260B	10.0	0.242	HBSL	600						
Carbon Tetrachloride	ug/L	SW 8260B	1.00	0.241	MCL	5						
Chlorobenzene	ug/L	SW 8260B	1.00	0.265	MCL	100						
Chloroethane	ug/L	SW 8260B	1.00	0.261	—	—						
Chloroform	ug/L	SW 8260B	1.00	0.269	MCL	80						
Chloromethane	ug/L	SW 8260B	1.00	0.318	—	—						
cis-1,2-Dichloroethene	ug/L	SW 8260B	1.00	0.296	MCL	70						
cis-1,3-Dichloropropene	ug/L	SW 8260B	1.00	0.234	HBSL	0.3						
Dibromochloromethane	ug/L	SW 8260B	1.00	0.645	MCL	80						

Appendix A

Fall 2018					Benchmark		Sample Sites					
Parameter	**Units**	**Method**	**PQL**	**MDL**	**Type**	**Value**	**MON00022**	**MON10016**	**PRE10007**	**SHE00089**	**WAR10003**	**WAR10004**
Dibromomethane	ug/L	SW 8260B	1.00	0.299	—	—						
Dichlorodifluoromethane	ug/L	SW 8260B	1.00	0.242	HBSL	1000						
Ethylbenzene	ug/L	SW 8260B	1.00	0.168	MCL	700						
Hexachlorobutadiene	ug/L	SW 8260B	1.00	0.277	HBSL	0.8						
Iodomethane	ug/L	SW 8260B	10.0	1.10	—	—						
Isopropylbenzene	ug/L	SW 8260B	1.00	0.204	HBSL	600						
m,p-Xylene	ug/L	SW 8260B	5.00	0.410	MCL	10000						
Methyl tert-Butyl Ether	ug/L	SW 8260B	5.00	0.239	—	—						
Methylene Chloride	ug/L	SW 8260B	1.00	0.164	MCL	5						
Naphthalene	ug/L	SW 8260B	5.00	0.212	HBSL	100						
n-Butylbenzene	ug/L	SW 8260B	1.00	0.167	HBSL	300						
n-Hexane	ug/L	SW 8260B	5.00	0.225	—	—						
n-Propylbenzene	ug/L	SW 8260B	1.00	0.204	—	—						
o-Xylene	ug/L	SW 8260B	1.00	0.220	MCL	10000						
sec-Butylbenzene	ug/L	SW 8260B	1.00	0.193	—	—						
Styrene	ug/L	SW 8260B	1.00	0.210	MCL	100						
tert_Butylbenzene	ug/L	SW 8260B	1.00	0.193	—	—						
Tetrachloroethene	ug/L	SW 8260B	1.00	0.230	MCL	5						
Toluene	ug/L	SW 8260B	1.00	0.231	MCL	1000						
trans-1,2-Dichloroethene	ug/L	SW 8260B	1.00	0.225	MCL	100						
trans-1,3-Dichloropropene	ug/L	SW 8260B	1.00	0.203	HBSL	0.3						
Trichloroethene	ug/L	SW 8260B	1.00	0.295	MCL	5						
Trichlorofluoromethane	ug/L	SW 8260B	1.00	0.250	HBSL	2000						
Vinyl acetate	ug/L	SW 8260B	1.00	0.282	—	—						
Vinyl Chloride	ug/L	SW 8260B	1.00	0.224	MCL	2						

MCL - Maximum Contaminant Level set by USEPA

SMCL - Secondary Maximum Contaminant Level set by USEPA

AMCL - Alternative Maximum Contaminant Level set by USEPA

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HHBP - Human Health Benchmark for Pesticides set by USEPA

— No drinking water benchmark set for the compound

Numbers in bold exceed a benchmark

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