March 23, 2022 East Fork Armells Creek

Synoptic Run Report

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MARCH 23, 2022 EAST FORK ARMELLS CREEK

SYNOPTIC RUN REPORT

EXECUTIVE SUMMARY

A synoptic surface water monitoring event (synoptic run) was conducted on East Fork Armells Creek (the Creek) on March 23, 2022. This was the 25th synoptic run conducted on the Creek since 1993. The 2022 synoptic run included monitoring at twelve sites on the Creek, the City of Colstrip northern sewage treatment pond (NSTP), and a tributary to the Creek known herein as the Power Road Tributary (PRT). Surface water quality samples were collected at 12 sites along the Creek and from the NSTP. No flow was observed at the PRT, and samples were not collected. Flow was measured at each of the sites where flow was observed. Survey grade GPS equipment was used to measure surface water elevations in the Creek. In addition, groundwater elevations were surveyed at 19 sites immediately adjacent to the Creek in either open boreholes or piezometers. Paired surface water/groundwater elevations were used in combination with measured flows to evaluate gaining and losing patterns along East Fork Armells Creek and to prepare a water table map.

Precipitation records indicate 0.07 inches of precipitation were recorded in Colstrip during the week prior to the 2022 synoptic run. Precipitation during water year 2021 (September 2020 through October 2021) was below average with 8.89 inches recorded. The 30-year average annual precipitation in Colstrip is 15.7 inches (based on 22 complete years). Approximately 1.4 inches of precipitation were recorded in Colstrip in 2022 prior to the synoptic run (January through March), which is below the average.

Flows measured in the Creek during the March 2022 synoptic run were below median values, ranging from 37 gallons per minute (gpm) at AR-4, to 573 gpm at AR-9. Overall flow patterns generally followed historical trends with gaining flows downstream of AR-12 to AR-6 and then a transition to losing flow downstream of AR-6.

Site specific gaining and/or losing conditions were also evaluated using the comparison of surveyed elevations of paired groundwater and surface water sites. Based on the elevation measurements, conditions in the creek and neighboring bank indicated gaining conditions at 13 sites. Conditions were inconclusive at five locations and losing conditions were present at one site (East bank at AR-6 – AR-6-E).

Total dissolved solids (TDS) concentrations and specific conductance (SC) are indicators of overall water quality. In March 2022, SC and TDS levels in East Fork Armells Creek were below the long-term averages indicating slightly improved water quality. However, concentrations of chloride and sulfate were above the long-term averages at some sites. These trends are considered a function of the Creek water quality being at, or near, natural concentrations such that concentrations of chemical constituents are expected to fluctuate near or below the historical averages.

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MARCH 23, 2022 EAST FORK ARMELLS CREEK

SYNOPTIC RUN REPORT

1.0 INTRODUCTION

1.1 BACKGROUND AND SCOPE

The synoptic run described in this report was completed on East Fork Armells Creek (the Creek) on March 23, 2022. Work was conducted in accordance with the facility Water Resources Monitoring Plan (Talen Montana, LLC Colstrip Power Plant Water Resources Monitoring Plan Rev. 7 December 8, 2020). Methods used in 2022 were consistent with previous synoptic runs.

Water quality samples were collected from 12 surface water sites in the Creek and a treated sewage holding pond, known as the North Sewage Treatment Plant (NSTP), operated by the City of Colstrip, adjacent to the Creek. Since 2008, samples have been collected when flow is present from a small tributary that enters the Creek directly north of Power Road (identified as Power Road Tributary (PRT)). Flow was measured at all of the Creek sites in 2022, except for AR-12 where frozen conditions and accumulation of tumble weed prevent accurate measurement or estimation of flow. No flow was observed at PRT. Locations for all the monitoring sites included in the 2022 synoptic run are shown on Figure 1-1. Descriptions and photographs of each site are included in Appendix 1.

Twenty-four previous synoptic runs have been conducted on the Creek. The first synoptic run was conducted in 1993. Since 2003, the synoptic runs have been conducted on an annual basis. All the synoptic runs have been conducted in the spring, except in 2015, when a second synoptic run was conducted during the fall. Synoptic runs conducted in 1993, 1994, and 1996 included sites AR-1 through AR-5. Sites AR-6 through AR-11 were added in 2000. Site AR-12, located directly upstream of the Highway 39 culvert at the south end of Colstrip, was added in 2005.

Flow was measured using a Hach FH950 handheld flow meter at sites AR-1, AR-3, AR-5, AR-6, AR-7, AR-8, AR-9, AR-10, and AR-11, a portable Montana flume (site AR-4), and a permanent Parshall flume at AR-2. Note that a Hach FH950 flow meter was used to measure flows at the North Flume (AR-1) and the PBR Weir (AR-10) in addition to stage height, since submergent conditions were observed, and accurate flows could not be calculated from the flume and weir measurements. As mentioned previously, flow was not measured or estimated at AR-12 due to poor site conditions.

Water quality samples were collected from each surface water site prior to, and upstream of the flow measurement location to eliminate the potential for disturbance and entrapment of sediment in the sample from channel disturbance. Samples were submitted to Energy Laboratories in Billings, Montana for analysis of the parameters listed in Table 1-1. Monitoring proceeded from the farthest downstream site, PBR Flume AR-10, upstream to site AR-12. Note, that when discussing water quality results, sites will typically be listed from the site farthest upstream to the site furthest downstream.

Evaluation of gaining and losing reaches of a creek can be evaluated based on changes in flow across a reach. Further evaluation of gaining and losing reaches can be conducted based on the elevation relationship between the groundwater elevations and adjacent creek elevations. This type of evaluation is more selective in that it indicates flow at given points rather than over a reach. In 2022, groundwater levels were measured in hand augured boreholes adjacent to the Creek at 19 locations (AR-5-E, AR-5-W, AR-4-E, AR-4-W, AR-3-E, AR-3-W,AR-2-W, TPlant-W, AR-1-E, AR-1-W, AR-7-E, AR-7-W, BPW, BPE, CHE, AR-6-E, AR-6-W, AR-11-E, and AR-11-W) as shown on Figure 1-1. Surface water elevations in the adjacent Creek were surveyed at the time of groundwater level measurement. Surface and groundwater elevations were measured using a survey grade GPS.

This report presents results of the spring 2022 synoptic run and a comparison of these data to results from previous synoptic runs.

1.2 SITE CONDITIONS

Precipitation records which cover the period 1927 through April 2022 were obtained from the Western Regional Climate Center, National Climatic Data Center Co-Op (Site ID 241905). Records indicate that 0.07 inches of precipitation were recorded (March 21st) in Colstrip during the week prior to the 2022 synoptic run. Precipitation during water year 2021 (October 2020 through September 2021) was below average with 8.89 inches recorded. The 30-year average annual precipitation (calendar year) in Colstrip is 15.7 inches (based on 22 complete years) and the annual average for the period of record (1927 to 2021) is 15.0 inches. Approximately 1.4 inches of precipitation were recorded in Colstrip prior to the synoptic run in 2022.

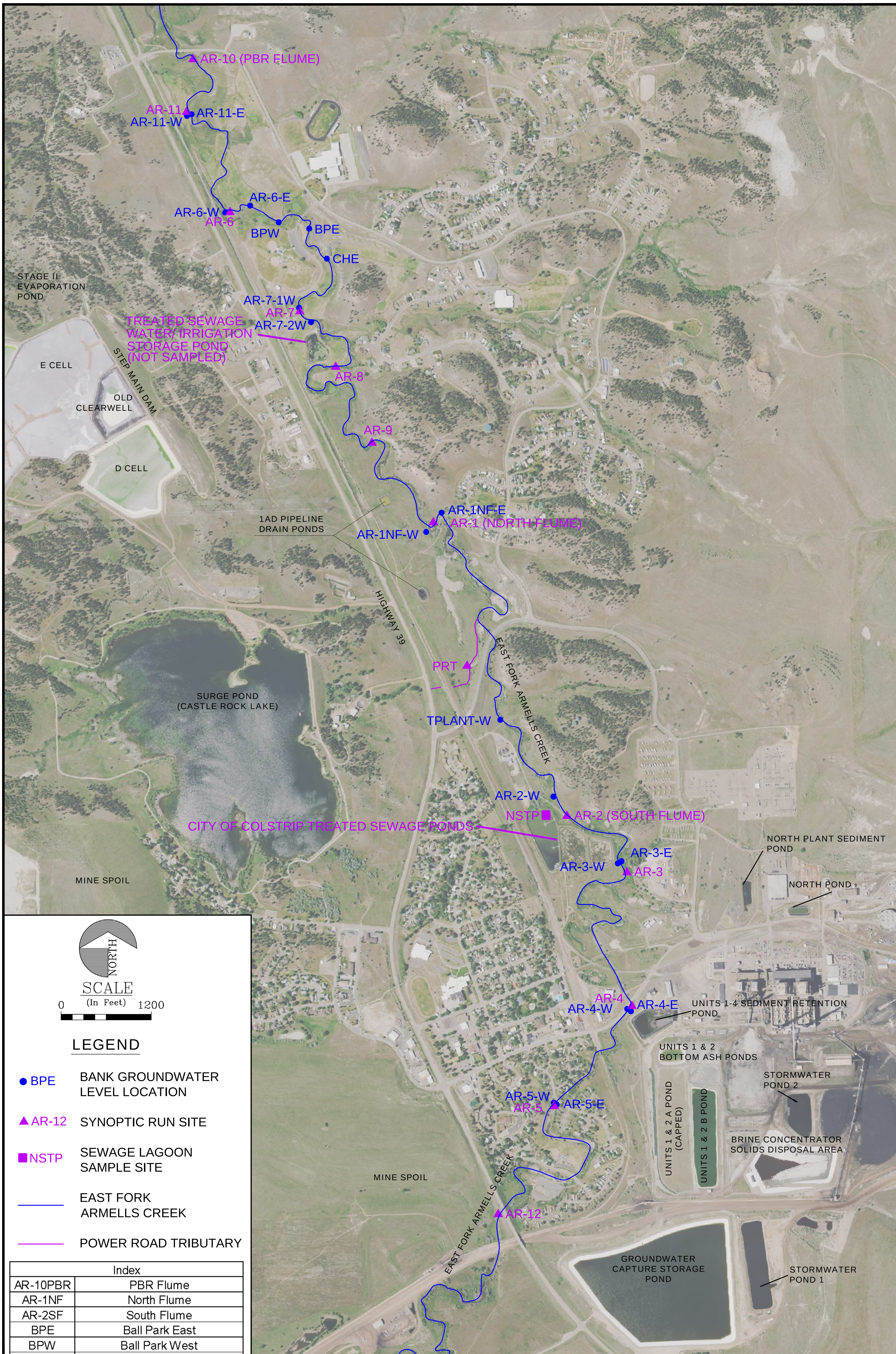
Figure 1-2 illustrates monthly precipitation totals for 2019, 2020, 2021 and 2022 and the mean monthly precipitation observed at the Colstrip Weather Station for the period of record from 1927. A plot of daily accumulation for January through April 30, 2022 is included in the figure inset to illustrate precipitation patterns preceding the synoptic run event.

Air temperatures measured during the synoptic run ranged from 32° to 63° Fahrenheit. Snow was not observed in the creek channel. However, a thin layer of ice was observed at sites AR-10 and AR-8 at the edges of ponded areas upstream of the site. Site AR-12 was completely frozen and filled with tumbleweeds. For this reason, samples were collected at the first open water about 70 feet upstream of the Highway 39 culvert. Samples are normally collected directly upstream of the Highway 39 culvert at AR-12. Flow was not estimated at AR-12 in 2022. Overland flow was not noted during the synoptic run that would affect water quality or flow. Plant growth was in the initial stages for the season. Cattails were noted at multiple sites in and near the channel. No fertilizer or water had been applied to the golf course prior to the Synoptic Run in 2022.

TABLE 1-1. 2022 SYNOPTIC RUN SURFACE WATER ANALYTICAL PARAMETERS

Constituent	USEPA Analytical Method	Requested Laboratory Reporting Limit (mg/L) Unless Noted
Dissolved Oxygen	Field	
pH		
Temperature		
Specific Conductivity @ 25° C		
ORP (Oxidation Reduction Potential)	Field	
pH	150.2/A 4500 H B	0.1 s.u.
Specific Conductivity @ 25° C	120.1/A 2510 B	1 µmhos/cm
Total Dissolved Solids, filterable	A2540 C	10
Total Alkalinity as $CaCO_3$ (Hardness)	310.1 or SM A2320B	4
Bicarbonate	SM A2320B	4
Carbonate	310.1 or SM A2320B	4
Bromide	300.0	0.5
Sulfate	300.0	1.0
Chloride	300.0	1.0
Calcium(1)	200.7/200.8	1.0
Magnesium(1)	200.7/200.8	1.0
Sodium(1)	200.7/200.8	1.0
Potassium(1)	200.7/200.8	1.0
Nitrate+Nitrite as Nitrogen	353.2	0.01
Boron(2)	200.7/200.8	0.05
Cobalt(2)	200.7/200.8	0.005
Lithium(2)	200.7/200.8	0.01
Manganese(2)	200.7/200.8	0.001
Mercury(2)	245.1	0.0001
Molybdenum(2)	200.7/200.8	0.001
Selenium(2)	200.7/200.8	0.0006

(1) Dissolved analysis only
(2) Metals will be analyzed as Total Recoverable and Dissolved



Index	
AR-10PBR	PBR Flume
AR-1NF	North Flume
AR-2SF	South Flume
BPE	Ball Park East
BPW	Ball Park West
CHE	Club House East
NSTP	North Sewage Treatment Pond
PRT	Power Road Tributary
TPLANT-W	Treatment Plant West

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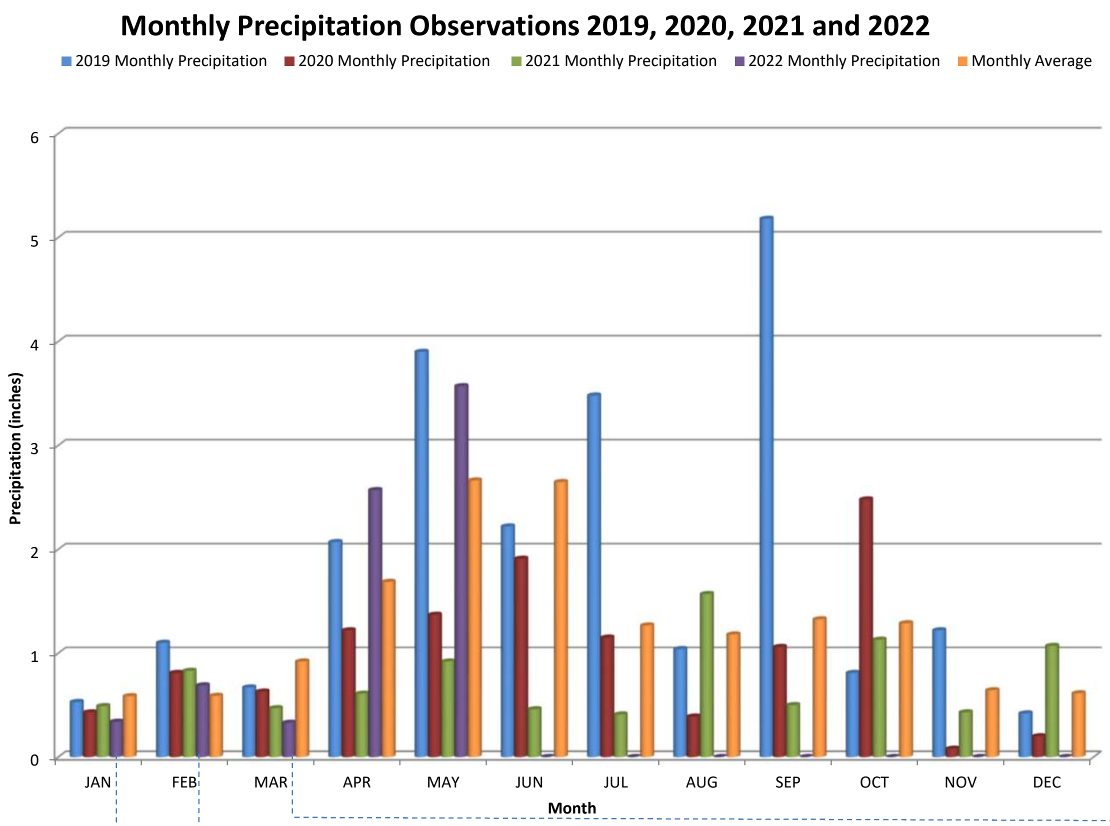
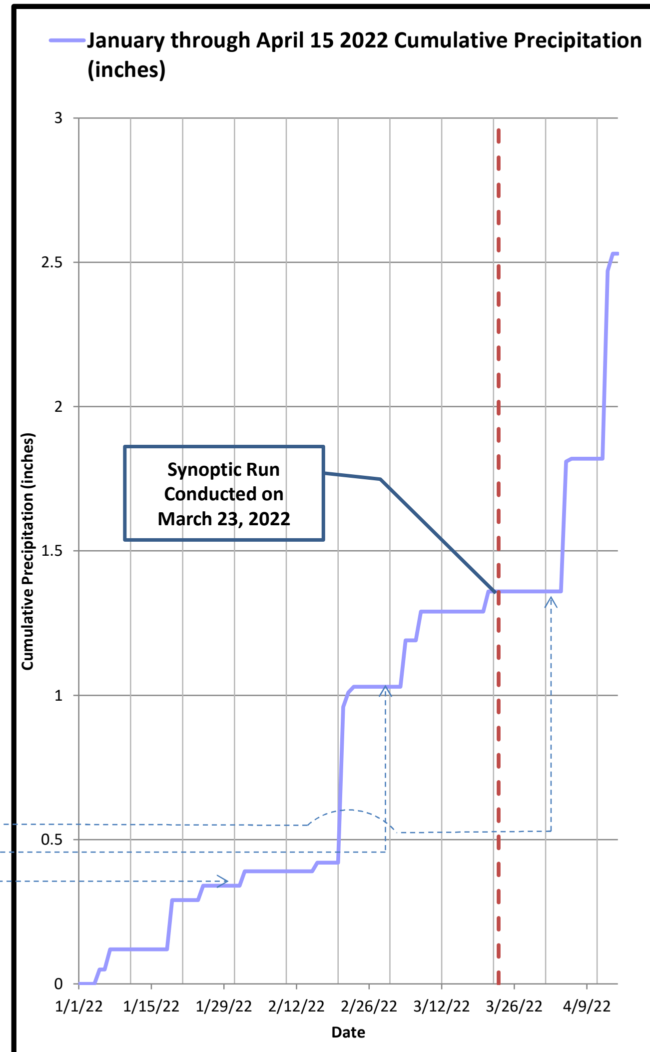
MARCH 23, 2022
EAST FORK ARMELLS CREEK
SYNOPTIC RUN REPORT

2022 SYNOPTIC RUN SITES

FIGURE
1-1





Note: Monthly averages for 2022 only shown for months leading up to Spring 2022 Synoptic Run (January, February, and March). Monthly Average is average for period of record through 2021.

Data from Western Regional Climate Center, National Climatic Data Center Co-Op Site ID 241905. http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?mt1905

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MARCH 23, 2022 EAST FORK ARMELLS CREEK SYNOPTIC RUN REPORT	MONTHLY PRECIPITATION OBSERVATIONS COLSTRIP, MT	FIGURE 1-2

2.0 SURFACE WATER/GROUNDWATER QUANTITY

2.1 FLOW IN EAST FORK ARMELLS CREEK

East Fork Armells Creek is categorized as an intermittent stream because surface water flow is not continuous in the Creek from its headwaters (approximately 13 miles west of Colstrip) to the confluence of West Fork Armells Creek (approximately 17 miles north of Colstrip). However, the reach through Colstrip exhibits perennial flow except during drought conditions when portions of it may be dry. Intermittent flow is attributable to limited contribution from bedrock sources or from groundwater stored in unconsolidated sediments along the Creek. In other words, flow stops when the groundwater level drops to below the Creek bed.

Flow was present throughout the entire reach (AR-12 to AR-10) during the March 2022 synoptic run. However, as noted in the previous section, AR-12 could not be accessed or measured for flow since the channel was frozen and completely covered by tumbleweeds. Synoptic runs are conducted at times when flows are not expected to be affected by runoff, prior to the onset of the growing season when evapotranspiration is minimal, prior to golf course irrigation and/or fertilization, and when groundwater discharge (bedrock or unconsolidated strata) is the primary component of surface water flow (baseflow). No snow melting or overland flow that would affect surface water flow or water quality was noted during the 2022 synoptic run.

Gaining reaches are those that show an increase in flow, typically due to groundwater issuing to the Creek. Groundwater contributions may be from inflow of a regional bedrock system, from release of water from storage near the Creek, seepage from surface water bodies, higher alluvial groundwater levels, or a combination thereof. Other factors, such as surface water inflow from tributaries, precipitation runoff, and runoff from water usage in the town could also potentially result in gaining stream reaches. Surface water was not observed to be flowing into the Creek from any tributaries in March 2022 including the PRT.

Losing reaches are those characterized as having decreases in flow due to infiltration through the Creek bottom and/or banks. Pumping groundwater from the alluvium or bedrock near the Creek may lower the water table and accentuate losses in losing reaches. The relationship between groundwater table elevations and surface water elevations is discussed later in this section. Other factors, such as evapotranspiration, diversions, or pumping directly from the Creek may also result in losing reaches. No diversions or direct pumping from the Creek were observed during the March 2022 event.

Stream flow measurements presented in Table 2-1 and on Figure 2-1 demonstrate an overall net gain in the Creek through the study area. In 2022, flow increased from about 47 gpm at AR-5 (no flow was measured or estimated at AR-12) to 388 gpm at downstream site AR-10. Paired data from stream gaging and water level measurements demonstrate that the Creek has multiple areas that either gain or lose water locally. However, various reaches showed gains or losses. A higher flow of 573 gpm was measured at AR-9. Flow at this site typically decreases slightly from those at AR-1. Lower flows were measured downstream of AR-9 and were relatively consistent between sites. See further discussion at the end of Section 2.1.

Note that there is inherent error in measurement of stream flow based on channel geometry and streambed sediments. Depending on site conditions, this error can be as high as 20%. For example, an uneven, slightly curved, non-symmetrical channel with numerous cobbles may result in high percentage of error, whereas a straight, symmetrical, sandy channel will yield more accurate flow measurement results. Open channel flow conditions encountered during the 2022 synoptic run ranged from fair to very poor, so the accuracy of the flow measurements (measured with Hach velocity meter) was estimated to vary from 8% to 20%. Flow measured with portable flumes or at stationary flumes with unsubmerged conditions (AR-2) are likely within 10% accuracy.

Permanent flume (AR-1) and weir (AR-10) measurements were affected by fully submerged conditions in 2022 caused by the flat topography, sedimentation, or vegetation near the flow devices. This resulted in no hydraulic drop across the flow measurement device. As such, no correction could be applied to estimate a flow. Because of the submerged conditions, flow at these sites was measured using a Hach flow meter. Flow at AR-1 was measured at the mouth of the flume. Flow at AR-10 was measured across the top of the weir plate. Accuracy of flow measured with the Hach at these sites is estimated to be +/- 5 to 15%. Heavy riparian vegetation was present at AR-2 but did not appear to cause irregular flow through the throat of the flume and calculated flows are accurate within 5 to 10%. Flow at AR-4 measured with a portable Parshall Flume are considered to be accurate to about 5 to 10%.

Flows measured during synoptic runs conducted along the Creek in 2018, 2019, 2020, 2021 and 2022 are presented in Figure 2-1. Also shown are the maximum, minimum, and median flows that have been measured at each site during all the synoptic runs. Flows measured during the 2022 synoptic run were generally below median values. The exceptions were AR-3 and AR-9, which had higher than median flows.

Flow patterns in 2022 generally followed the median flow pattern except for the increase noted between AR-1 and AR-9 in 2022, while the median flow between these two sites is indicative of a decrease (Figure 3). Flow has increased every event through this reach since 2014. Interestingly, flow had decreased each year though this reach prior to 2013. The cause of this change in flow pattern is not currently understood but is believed to be due to site conditions (varying submerged conditions) and differences in flow measurement methodology.

2.2 Groundwater/Surface Water Relationship

Groundwater elevations were measured at 19 piezometers and/or shallow augured boreholes adjacent to the Creek during the March 2022 synoptic run. Surface water elevations in the Creek were also measured. The purpose of the measurements was to collect data to evaluate the relationship of groundwater to surface water at each location. Groundwater and surface water elevations were measured directly using a survey grade GPS.

To obtain the data, water levels were surveyed in boreholes or piezometers located on the stream bank and the upper surface of the adjacent Creek. These data are intended to supplement streamflow evaluations for gaining and losing areas.

Measurements were taken on each side of the creek at AR-5, AR-4, AR-3, AR-1, AR-7, AR-6, AR-11, BPE, and BPW. Single measurements were taken at three sites: 1) TPLANT-W (west bank of the Creek downstream of the treated sewer ponds), 2) AR-2W, and 3) CHE (Club House East) located east of the Creek near the Ponderosa Butte Golf Course Club House. Two measurements on the west side of the Creek were taken at AR-7. Groundwater and paired surface water elevations are presented in Table 2-2.

Accuracy of GPS individual readings are about 0.03 feet. Hence, differences of greater than 0.06 feet are consider either gains (groundwater flowing into creek) or losses (Creek water recharging groundwater) as they would fall outside of the margin of error. Differences of less than 0.06 may also indicate gains and losses but with a lower degree of confidence. These measurements provide an indication of site-specific gains or losses as opposed to stream flow measurements which provide an indication in flow characteristics over an entire reach. Based on the elevation measurements, and the criteria outlined above, conditions in the creek and neighboring bank indicated gaining conditions at 13 sites. Conditions were inconclusive at five locations. And losing conditions were present at one site (East bank at AR-6 – AR-6-E).

2.3 ALLUVIAL GROUNDWATER FLOW BENEATH THE CREEK

Figure 2-2 is a potentiometric map constructed using water levels measured in March 2022 from the Creek, piezometers, augured boreholes on the creek bank and monitoring wells located near the Creek. In general, water table contours are perpendicular to the Creek or curve around the Creek with an upstream apex. As would be expected, groundwater flow is in a down drainage direction towards the north.

Exceptions to the northerly flow direction is near wells P-12 and 917A. These wells are being pumped in response to a release that occurred from the north 1 AD Pipeline Drain Pond that occurred in early December 2021. Water level contours near well P-12 indicate flow in a westward direction from the Creek to the well. There appears to be less influence from pumping at 917A although flow near the well is in a more westerly direction and the spacing between the contours is wider directly down gradient from the well reflecting capture of shallow groundwater at this location.

TABLE 2-1 EAST FORK ARMELLS CREEK SYNOPTIC RUN FLOW MEASUREMENTS AND SURFACE WATER QUALITY RESULTS - 2022

Flow Direction → Downstream →

Parameter/Site Physical Properties	AR-12	AR-5	AR-4	AR-3	NSTP	AR-2 South Flume	Power Road Tributary	AR-1 North Flume	AR-9	AR-8	AR-7	AR-6	AR-11	AR-10 PBR Flume
Flow (GPM)	NM	47	37	138	NA	65	No Sample	223	573	268	348	318	396	388
Flow (CFS)	NM	0.104	0.082	0.308	NA	0.145		0.497	1.277	0.596	0.775	0.708	0.883	0.865
Dissolved Oxygen, Field (mg/L)	1.44	4.38	6.01	5.97	3.81	5.45		5.51	5.75	6.09	5.81	6.76	7	6.32
pH, Field (standard units)	7.12	7.38	7.7	7.42	7.76	7.66		7.76	7.8	7.84	7.82	7.91	7.89	7.82
pH, Lab (standard units)	7.8	7.8	8	7.8	8.1	8.1		8.1	8.1	8.1	8.1	8.2	8.2	8.1
Specific Conductance, Lab 25^{o}C umhos/cm	4560	4030	4100	4300	1990	3560		3420	3370	3300	3300	3260	3320	3420
Specific Conductance, Field	6000	4170	4240	4469	2175	3682		3600	3548	3500	3461	3472	3508	3656
Solids,Total Dissolved TDS @ 180^{o}C (mg/L)	4470	3910	4000	4250	1390	3370		3220	3170	3080	3080	3080	3100	3220
Temperature, Field (^{o}C)	1.7	4.1	5.3	6	10	9.2		1.9	1.1	0.4	0.2	0.5	0.5	0.2
Common Ions (mg/L)														
Bicarbonate as HCO_3	679	659	681	685	508	574		587	577	554	557	544	549	560
Calcium (Ca)	358	331	345	368	106	310		294	280	272	273	268	265	270
Carbonate as CO_3	<4	<4	<4	<4	<4	<4		<4	<4	<4	<4	<4	<4	<4
Chloride (Cl)	154	116	123	139	106	102		92	81	80	78	81	83	83
Magnesium (Mg)	502	429	441	452	116	339		318	313	302	303	299	305	316
Potassium (K)	16	13	12	13	33	12		13	12	12	13	13	13	13
Sodium (Na)	273	221	226	247	165	189		195	193	188	189	187	198	207
Sulfate (SO_4)	2860	2360	2470	2870	598	2010		2110	1820	1830	1800	1900	1970	1930
Alkalinity, Total as $CaCO_3$	557	540	559	562	417	471		481	473	455	457	451	453	459
Bromide	<0.5	<0.5	<0.5	1.1	<0.5	0.7		0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Calcium/Magnesium Ratio	0.71	0.77	0.78	0.81	0.91	0.91		0.92	0.89	0.90	0.90	0.90	0.87	0.85
Nutrients (mg/L)														
Nitrogen, Nitrate+Nitrite as N (NO_3+NO_2)	0.03	0.5	0.18	0.05	0.14	0.08		0.15	0.12	0.08	0.09	0.05	0.04	0.05
Metals (mg/L)														
Boron, Dissolved (B)	0.69	1.07	1.24	1.75	0.81	1.5		1.25	1.24	1.22	1.22	1.2	1.23	1.23
Boron, Total Recoverable (B)	0.72	1.06	1.29	1.77	0.84	1.61		1.31	1.31	1.35	1.29	1.34	1.39	1.34
Cobalt, Dissolved (Co)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Cobalt, Total Recoverable (Co)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Lithium, Dissolved (Li)	0.2	<0.1	<0.1	<0.1	0.07	0.08		0.09	0.08	0.08	0.07	0.07	0.07	0.08
Lithium, Total Recoverable (Li)	0.14	0.1	0.09	0.09	0.07	0.09		0.08	0.08	0.08	0.08	0.08	0.09	0.08
Manganese, Dissolved (Mn)	2.23	0.94	0.302	0.642	0.055	0.832		0.155	0.164	0.124	0.117	0.111	0.15	0.159
Manganese, Total Recoverable (Mn)	2.22	0.928	0.316	0.66	0.069	0.848		0.171	0.187	0.13	0.128	0.119	0.151	0.161
Mercury, Dissolved (Hg)	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Mercury, Total Recoverable (Hg)	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Molybdenum, Dissolved (Mo)	0.004	0.002	0.002	0.002	0.001	0.002		0.002	0.002	0.003	0.002	0.002	0.002	0.002
Molybdenum, Total Recoverable (Mo)	0.003	0.002	0.002	0.002	0.001	0.002		0.002	0.002	0.002	0.002	0.002	0.002	0.002
Selenium, Dissolved (Se)	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006		<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006
Selenium, Total Recoverable (Se)	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006		<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006

NM - Not Measerable
NA - Not Applicable
NSTP - North Sewage Treatment Pond

TABLE 2-2
COMPARISON OF SURFACE WATER AND GROUNDWATER ELEVATIONS
EAST FORK ARMELLS CREEK SYNOPTIC RUN - 2022

Site	Groundwater	Surface Water	Difference	Stream (Gaining or Losing)
AR-5-E	3231.14	3230.71	0.43	Gaining
AR-5-W	3230.95	3230.71	0.24	Gaining
AR-4-E	3224.69	3224.51	0.18	Gaining
AR-4-W	3224.43	3224.45	0.02	No Gain or Loss
AR-3-E	3214.35	3213.92	0.43	Gaining
AR-3-W	3214.19	3213.92	0.27	Gaining
AR-2-W	3209.32	3209.16	0.16	Gaining
Tplant-W	3202.34	3201.55	0.79	Gaining
AR-1-E	3186.29	3185.47	0.82	Gaining
AR-1-W	3186.64	3184.95	1.69	Gaining
AR-7-2W	3165.97	3165.95	0.02	No Gain or Loss
AR-7-1W	3165.00	3164.94	0.06	No Gain or Loss
CHE	3162.45	3162.37	0.08	Gaining
BPE	3160.34	3160.33	0.01	No Gain or Loss
BPW	3156.76	3156.75	0.01	No Gain or Loss
AR-6-E	3153.69	3154.02	0.33	Losing
AR-6-W	3151.97	3151.86	0.11	Gaining
AR-11-E	3145.64	3145.54	0.10	Gaining
AR-11-W	3146.07	3145.54	0.53	Gaining

Difference measured with Survey Grade GPS

BPW - Ball Park West, BPE - Ball Park East, CHE - Clubhouse east, Tplant-W - Treatment plant West

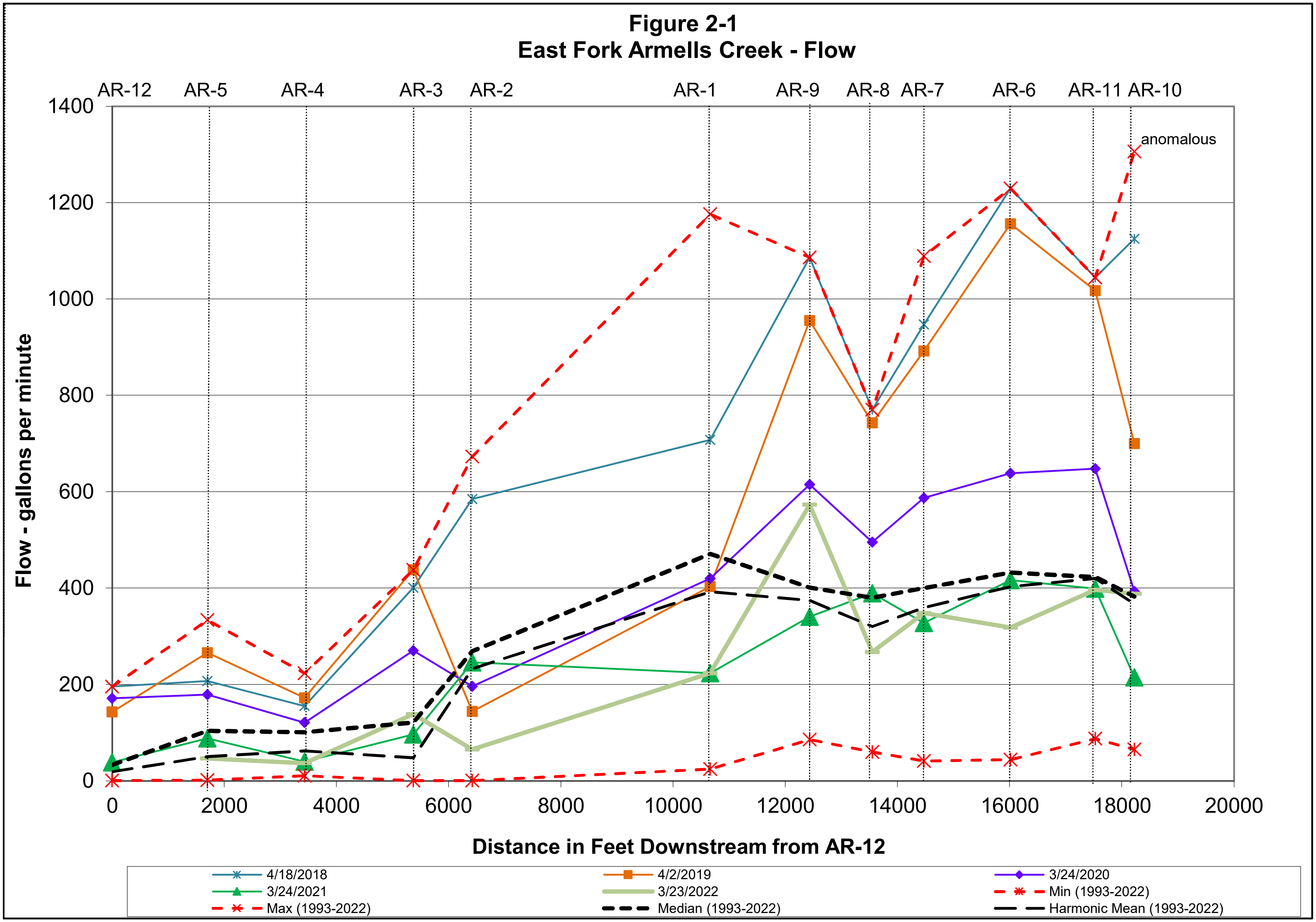
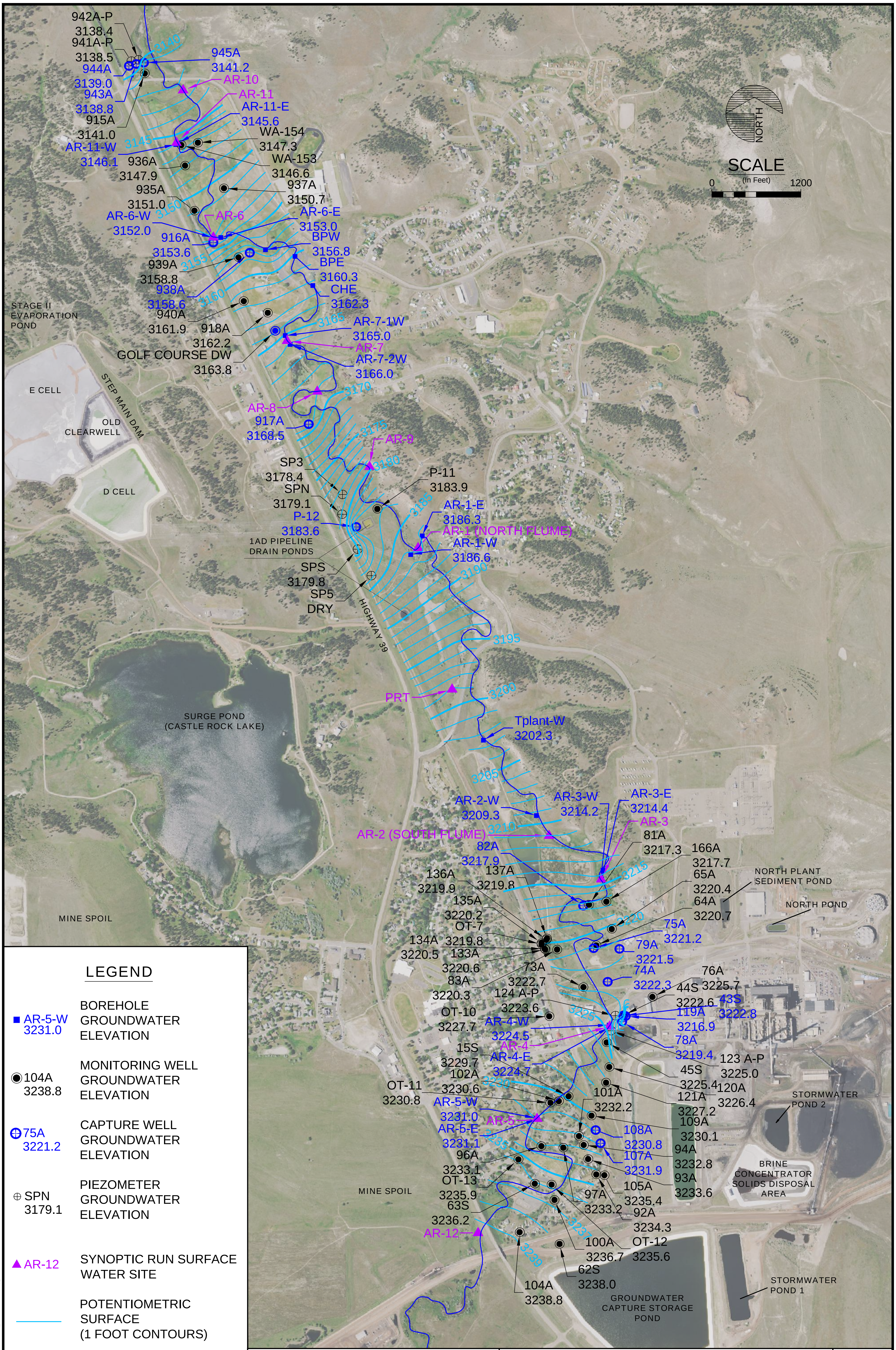


Figure 2-1
East Fork Armells Creek - Flow
AR-12
AR-5
AR-4
AR-3
AR-2
AR-1
AR-9
AR-8
AR-7
AR-6
AR-11
AR-10
anomalous
Flow - gallons per minute
0
200
400
600
800
1000
1200
1400
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000
Distance in Feet Downstream from AR-12
4/18/2018
4/2/2019
3/24/2020
3/24/2021
3/23/2022
Min (1993-2022)
Max (1993-2022)
Median (1993-2022)
Harmonic Mean (1993-2022)



LEGEND

■ AR-5-W 3231.0	BOREHOLE GROUNDWATER ELEVATION
● 104A 3238.8	MONITORING WELL GROUNDWATER ELEVATION
⊕ 75A 3221.2	CAPTURE WELL GROUNDWATER ELEVATION
⊕ SPN 3179.1	PIEZOMETER GROUNDWATER ELEVATION
▲ AR-12	SYNOPTIC RUN SURFACE WATER SITE
(light blue line)	POTENTIOMETRIC SURFACE (1 FOOT CONTOURS)
(dark blue line)	EAST FORK ARMELLS CREEK

MARCH 23, 2022
EAST FORK ARMELLS CREEK
SYNOPTIC RUN REPORT

SURFACE WATER AND SHALLOW GROUNDWATER ELEVATIONS

FIGURE
2-2

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3.0 SURFACE WATER QUALITY

Water quality data for the surface water samples collected during the March 2022 synoptic run are presented in Table 2-1. A tri-linear Piper diagram, illustrating relative quantities of major ionic constituents present in surface water samples from each site, is included as Figure 3-1. As shown on the Piper diagram, water sampled from all the Creek locations is a magnesium-calcium sulfate type. Water from the North Treated Sewage Lagoon (NSTP) exhibited no dominant cations or anions. As demonstrated on the Piper diagram, contributions to surface water from the treated sewage effluent ponds result in a very slight shift toward a less magnesium dominant ionic composition in the Creek.

Note that most of the process water at the plant site would plot at the top of a Piper Diagram reflecting the strong magnesium-sulfate type water. Ambient water in East Fork Armells Creek is also a magnesium-sulfate type but has a higher percentage of calcium and bicarbonate than process water.

Decadal trends in SC, a general indicator of surface water quality, are presented in Figure 3-2 and show that overall water quality has improved in the Creek since beginning the synoptic run program. This improvement is indicated by the reduction in SC during subsequent decades. Only three data points (three synoptic runs) are currently available for the 2020's. However, data collected during these three events suggest values that are similar to the 2010's averages. It appears that SC may be at or near natural levels for the reach.

Additional spatiotemporal trends for individual indicator parameters (SC, sulfate, TDS, boron, chloride, and Calcium/Magnesium Ratio (Ca: Mg)) for all synoptic runs are displayed in Exhibits 1 and 2. Specifically, time series plots of SC, TDS, and sulfate observations are presented in Exhibit 1 and time series plots of boron, chloride, and Ca/Mg are shown in Exhibit 2. Graphs presented on Figures 3-2 through 3-10 illustrate results for SC, TDS, chloride, boron, sulfate, nitrate plus nitrite (N+N), and the calcium to magnesium ratio from the April 2018, April 2019, March 2020, March 2021 and March 2022 synoptic run events. These figures include the maximum, minimum, and average levels recorded during all of the synoptic runs for the specified parameters. Graphs showing data for each indicator parameter for all synoptic run events are contained in Appendix 2. A data validation and summary analysis report for the March 2022 samples are presented in Appendix 3.

3.1 EAST FORK ARMELLS CREEK

3.1.1 Specific Conductance (SC)

Overall, SC, was slightly higher in March 2022 than long-term averages at sites AR-12 to AR-3 and similar to or slightly lower than long-term averages downstream from AR-2. SC values were the highest at AR-12 than any of the previous 18 synoptic runs. These higher SC values are reflected at downstream sites AR-5, AR-4 and AR-3. Inputs of lower SC water through seepage at the NSTP generally resulted in slightly lower than average SC downstream of AR-2. Year to year fluctuations will occur when water quality varies due to community inputs, basin wide changes in precipitation, evaporation and runoff, upstream inputs, fluctuating water tables that may result in sediment loading or releases of chemical constituents. Note that SC has increased at most sites over the last two synoptic runs. This corresponds to a period of much lower-than-average precipitation. Note also, that SC values may increase in response to higher-than-normal precipitation if salts precipitated through evaporation may be remobilized.

As mentioned previously, specific conductance (SC) is an indicator of overall water quality (http://water.usgs.gov/edu/characteristics.html#). Lower SC levels typically indicate better quality water, while higher levels are typical of poorer water quality. SC measured during synoptic runs, presented by average levels per decade at each site, are used to illustrate longer term water quality trends. The average SC at each site per decade (1990's, 2000's and 2010's) is shown in Figure 3-2. Note the average SC before 2010 are not true decadal averages because none of the "decades" have ten years of observation. However, use of averages of SC measured during each decade allows for comparisons while discounting normal year to year fluctuations.

A longitudinal profile of SC from upstream to downstream is plotted in Figure 3-3. The plot includes minimum, maximum, and average SC observations for the period of record, and individual results for synoptic runs completed in April 2018, April 2019, March 2020, March 2021, and March 2022. In 2022, SC measured in the field ranged from 6,000 umhos/cm at AR-12 to 3,461 umhos/cm at AR-7 with an average of 3,492 umhos/cm. The relative percent difference (RPD) between the highest and lowest SC was about 54%. The higher SC measured at upstream site AR-12 has skewed values upward throughout the reach. This suggests an upstream source is affecting the quality.

It is important to note, however, that access to site AR-12 was encumbered by accumulation of tumbleweeds at the site. Furthermore, the site was frozen, so sampling was conducted about 75 feet upstream of the normal sampling site. Still, the value measured at AR-12 seems to be legitimate since subsequent downstream sites are higher than those measured during the previous several events.

3.1.2 Total Dissolved Solids (TDS)

Figure 3-4 is a graph of TDS concentrations for the March 2022 synoptic run. The plot also includes minimum, maximum, and average TDS concentrations for the period of record, and individual results for April 2018, April 2019, March 2020, March 2021, and March 2022 synoptic runs. In March 2022, TDS concentrations pattern generally followed the SC profile previously discussed. TDS concentrations were above average from AR-12 to AR-3 with the highest values at AR-12 (4,470 mg/L), the upstream site. From AR-2 downstream to AR-10, TDS concentrations were slightly below the historical average at all sites and mirrored average values. The lowest concentration (3,080 mg/L) was measured in water from sites AR-6, AR-7 and AR-8.

3.1.3 Chloride

Chloride concentrations observed along the Creek in March 2022 and previous 4 events are illustrated on Figure 3-5. Figure 3-5 also includes minimum, maximum, and average concentrations for all the synoptic runs. All synoptic run chloride concentrations are shown on a graph in Exhibit 2. Chloride concentrations measured in water sampled in March 2022 were the highest or near the highest measured during the past five-year period, and except for sites AR-5 and AR-12, were above the historical average. The increases in chloride concentrations over the past two to three years are believed to be normal fluctuations that would be expected with changes in flow and weather patterns. Note that both flow and precipitation have been below average for the past two years. Even though the chloride concentrations have shown an increasing trend over the past few years, they remain within ranges observed since around 2005.

3.1.4 Boron

Boron was analyzed for both total recoverable and dissolved phases. The two phases traced very closely with relative percent differences of 3.1% or less at all sites. Except for AR-5, total recoverable boron concentrations exceeded those of dissolved. Dissolved concentrations of 1.7 mg/L were reported at AR-5 and 1.6 mg/L for boron. This variation is considered within the margin of error for measurement. Note that total recoverable concentrations for metals should always be equal to or greater than dissolved concentrations for the same water.

Figure 3-6 presents the longitudinal distribution of reported concentrations of total recoverable (TR) boron for March 2022 and the previous four synoptic runs. The figure includes minimum, maximum, and average TR boron concentrations for all synoptic runs on the Creek. Total recoverable boron concentrations recorded in March 2022 were below long-term averages at all sites along the Creek. The overall pattern followed long term trends, with concentrations increasing from AR-12 to AR-3, then decreasing downstream of the Colstrip treated sewage effluent ponds. Concentrations ranged from 0.72 mg/L at AR-12 to

1.75 mg/L at AR-3. Total recoverable boron concentrations from all previous synoptic runs are also illustrated on Exhibit 2. A slight increasing trend in boron concentrations has occurred over the past two to three years. This is believed to be due to natural fluctuations in weather and streamflow patterns

3.1.5 Sulfate

Sulfate concentrations along the Creek are plotted on Figure 3-7. The plot includes sulfate concentrations for the last four synoptic runs and minimum, maximum, and average concentrations for the period of record.

Sulfate concentrations in 2022 were higher than the historical average from AR-12 downstream to AR-2. Sulfate concentrations were below the historical average at all sites downstream from AR-2 except at AR-1 where concentrations were slightly higher than the average. A maximum sulfate concentration of 2,870 mg/L was measured in water from AR-3. The minimum concentration (1,800 mg/L) was reported for site AR-7.

3.1.6 Nitrate plus Nitrite

A longitudinal profile of nitrate plus nitrite (N+N) concentrations for the period 2018 through 2022 is shown on Figure 3-8. Historical minimum, maximum and average values for the period of record are included. Values below the reporting limit were plotted as zero. N+N concentrations in water samples collected in March 2022 were near or below historical averages. Concentrations ranged from 0.03 mg/L at AR-12 to 0.18 at AR4.

Note that anomalously high N+N concentrations (typically the maximum observed) were reported at most sites during the 2012 synoptic run; specifically, N+N concentrations were 20 to 200+ times above historic concentrations at AR-5 and sites downstream of AR-2. Although these data appeared to be anomalous, the contract analytical laboratory (Energy Labs) validated the 2012 N+N results. The high concentrations recorded in 2012 skewed the data resulting in a notable increase in the long-term average at sites downstream of AR-2.

3.1.7 Calcium/Magnesium Ratio (Ca:Mg)

With a few exceptions, process water is enriched in magnesium in relation to calcium. As a result, low Ca:Mg ratios in local groundwater and/or surface water may be indicative of mixing with process water. Note, however, that calcium chloride and magnesium chloride have commonly been used for road treatment. Depending on the chemical used, runoff characteristics, precipitation, evapotranspiration, and other factors, the ratio of calcium to magnesium could vary widely in the Creek.

A longitudinal profile of Calcium/Magnesium Ratios (Ca:Mg) along the Creek for the last five synoptic runs, plus the maximum, minimum and average, is presented in Figure 3-9. In March 2022, Ca:Mg were well above average at all sites, except AR-12, for the period of record. A lower-than-average ratio of 0.71 was calculated for AR-12.

3.1.8 Bromide

Operators began adding calcium bromide ($CaBr_2$) to the wet scrubber process in 2009 to enhance mercury removal; as such, increased concentrations of bromide may be present in process water. Bromide has been included on the synoptic run parameter list since 2012 as a potential indicator of recent process water impacts. Note, however, that bromide may also be found in road treatment and other products typically used in industrial and urban areas. Detectable concentrations of bromide have been observed sparingly in the Creek (Figure 3-10). In 2022, bromide was detected at AR-3, AR-2, and AR-1. All other sites had non-detectable concentrations. The highest concentration (1.1 mg/L) was reported in water from AR-3.

3.2 POWER ROAD NORTH SIDE TRIBUTARY (SITE PRT)

Water was present in the drainage, but no flow was observed. Hence, flow was not measured, and water quality samples were not collected.

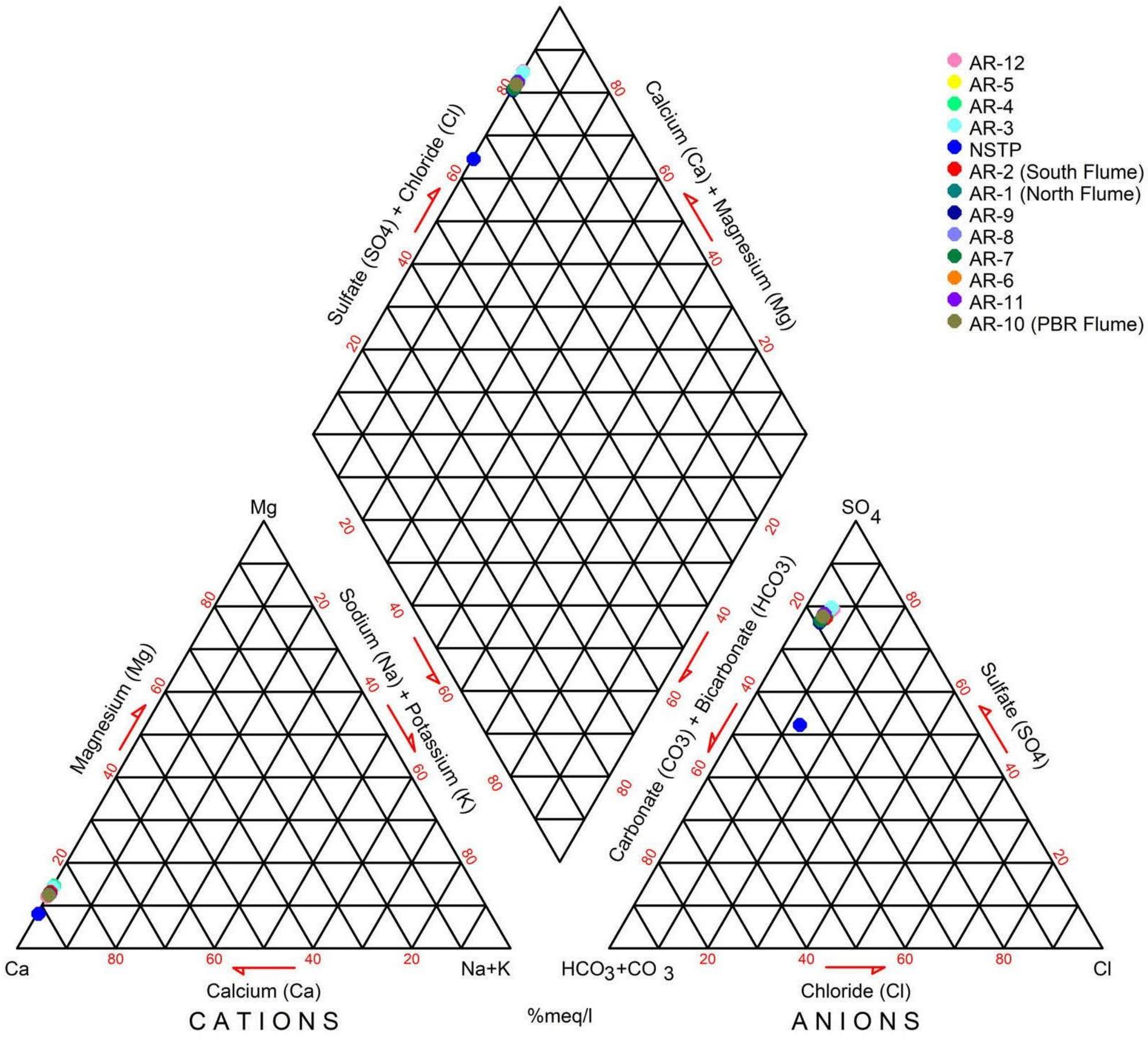
3.3 NORTH SEWAGE TREATMENT POND (NSTP)

A water quality sample was collected from the NSTP during the March 2022 synoptic run event. The water quality results from this site are included on Table 2. As in the past, water from site NSTP had lower constituent concentrations than any of the Creek sites. Concentrations of indicator parameters in the NSTP were: SC = 1,990 µmhos/cm (lab); sulfate = 598 mg/L, total recoverable boron = 0.84 mg/L, chloride = 106 mg/L, Ca: Mg = 0.91 and bromide = <0.5 mg/L. Laboratory and field pH were 8.1 and 7.8 standard units, respectively.

3.4 SUMMARY OF SURFACE WATER QUALITY RELATED TO DRAIN POND RELEASE

A release occurred from the north 1 AD Pipeline Drain Pond on December 3, 2021. Synoptic run sites AR-9 and AR-8 are in the reach in which the release occurred. Sites AR-7 to AR-10 are further downstream. No adverse effects from the release were identified in the data from this synoptic run at any of the downstream or "in reach" sites. The location of the north drain pond is shown on Figures 1-2 and 2-2.

Synoptic Run - March 23, 2022



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MARCH 23, 2022 EAST FORK ARMELLS CREEK SYNOPTIC RUN REPORT	PIPER DIAGRAM	FIGURE 3-1

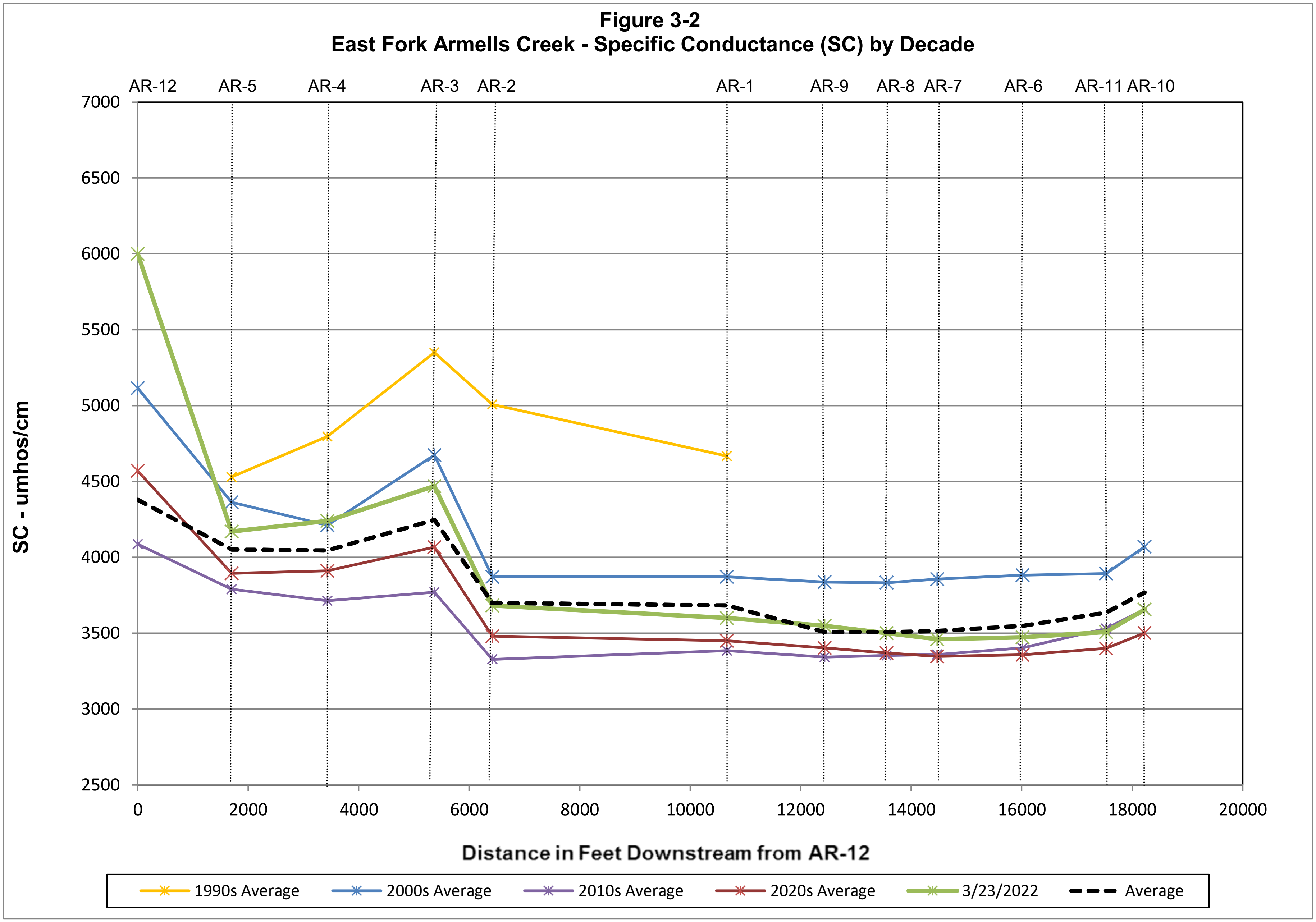
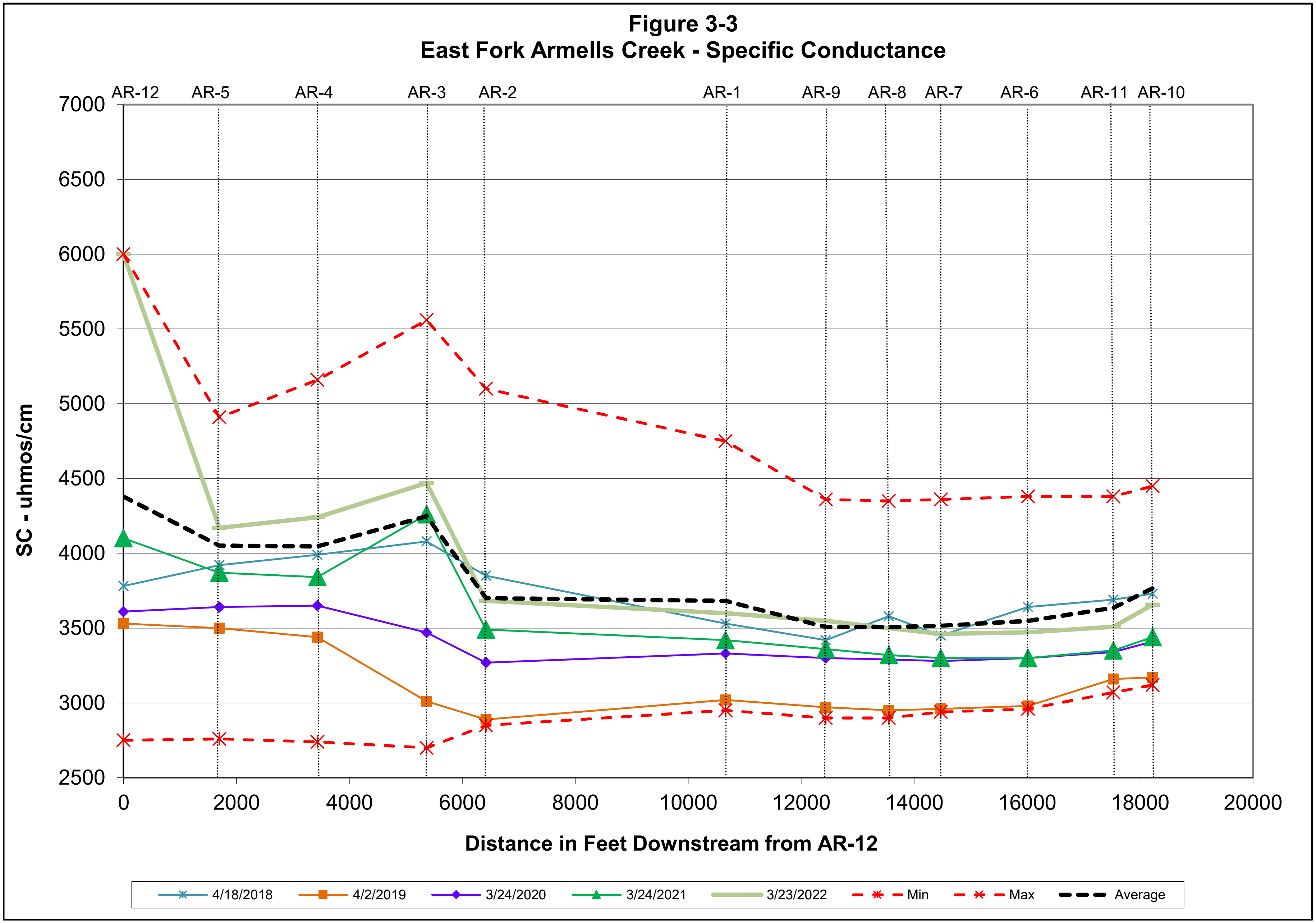


Figure 3-2
East Fork Armells Creek - Specific Conductance (SC) by Decade
AR-12
AR-5
AR-4
AR-3
AR-2
AR-1
AR-9
AR-8
AR-7
AR-6
AR-11
AR-10
SC - umhos/cm
7000
6500
6000
5500
5000
4500
4000
3500
3000
2500
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000
Distance in Feet Downstream from AR-12
1990s Average
2000s Average
2010s Average
2020s Average
3/23/2022
Average



H:\PROJECTS\TALEN\9036 Synoptic Run\2022\2022 GRAPHS Synoptic Run Graphs & DataFig3-3 SC graph

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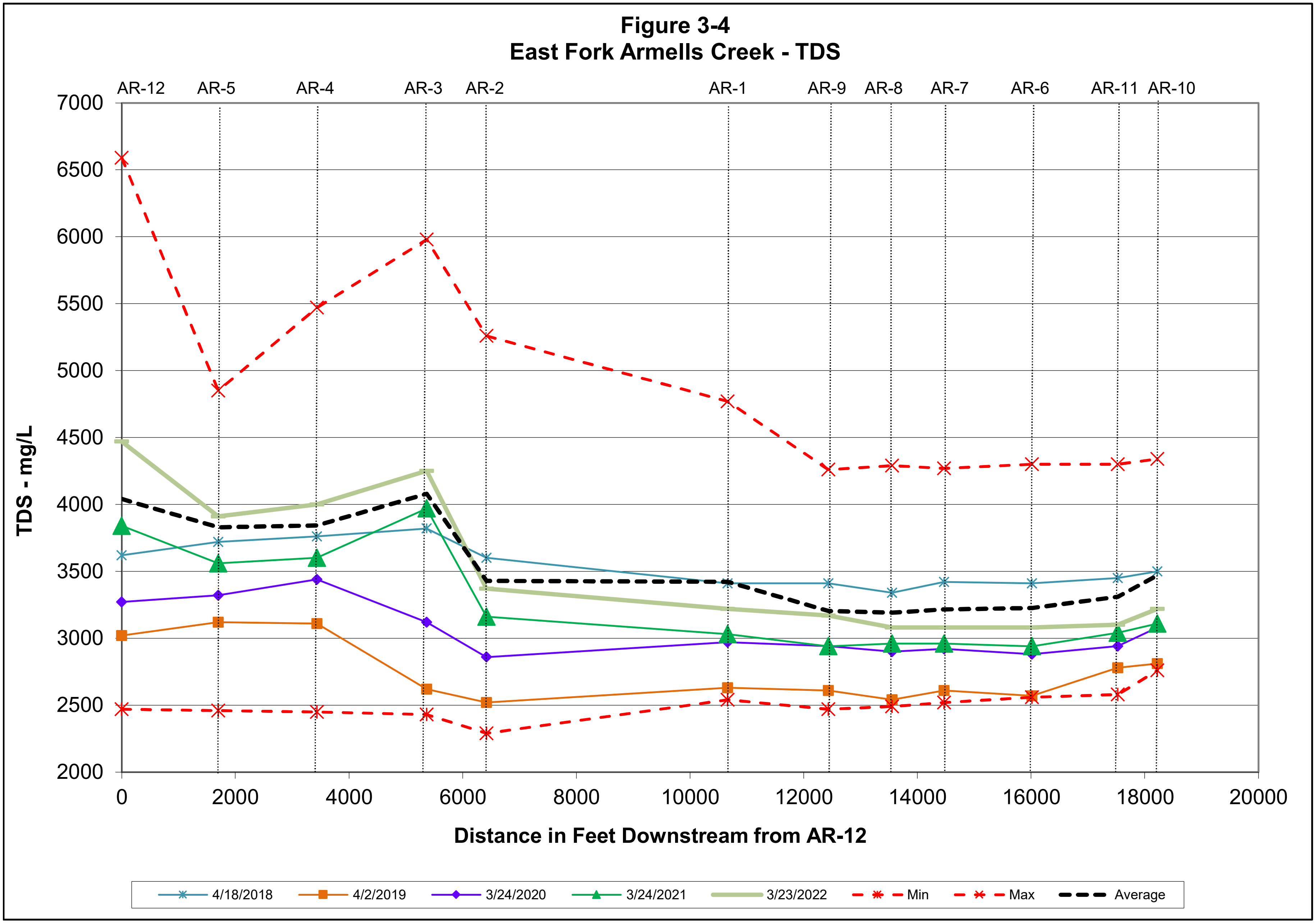


Figure 3-4
East Fork Armells Creek - TDS
AR-12
AR-5
AR-4
AR-3
AR-2
AR-1
AR-9
AR-8
AR-7
AR-6
AR-11
AR-10
7000
6500
6000
5500
5000
4500
4000
3500
3000
2500
2000
TDS - mg/L
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000
Distance in Feet Downstream from AR-12
4/18/2018
4/2/2019
3/24/2020
3/24/2021
3/23/2022
Min
Max
Average

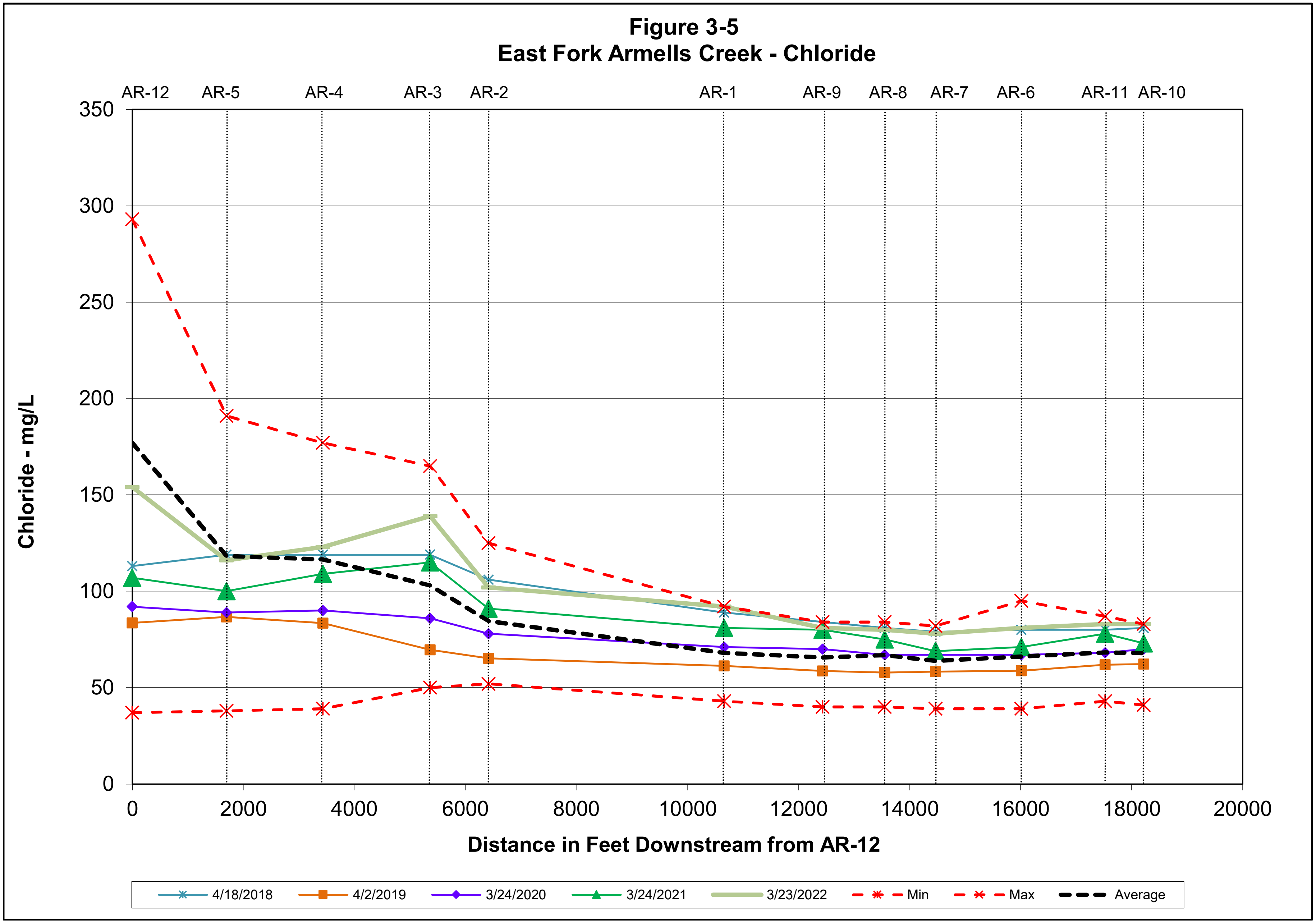


Figure 3-5
East Fork Armells Creek - Chloride
AR-12
AR-5
AR-4
AR-3
AR-2
AR-1
AR-9
AR-8
AR-7
AR-6
AR-11
AR-10
Chloride - mg/L
Distance in Feet Downstream from AR-12
4/18/2018
4/2/2019
3/24/2020
3/24/2021
3/23/2022
Min
Max
Average

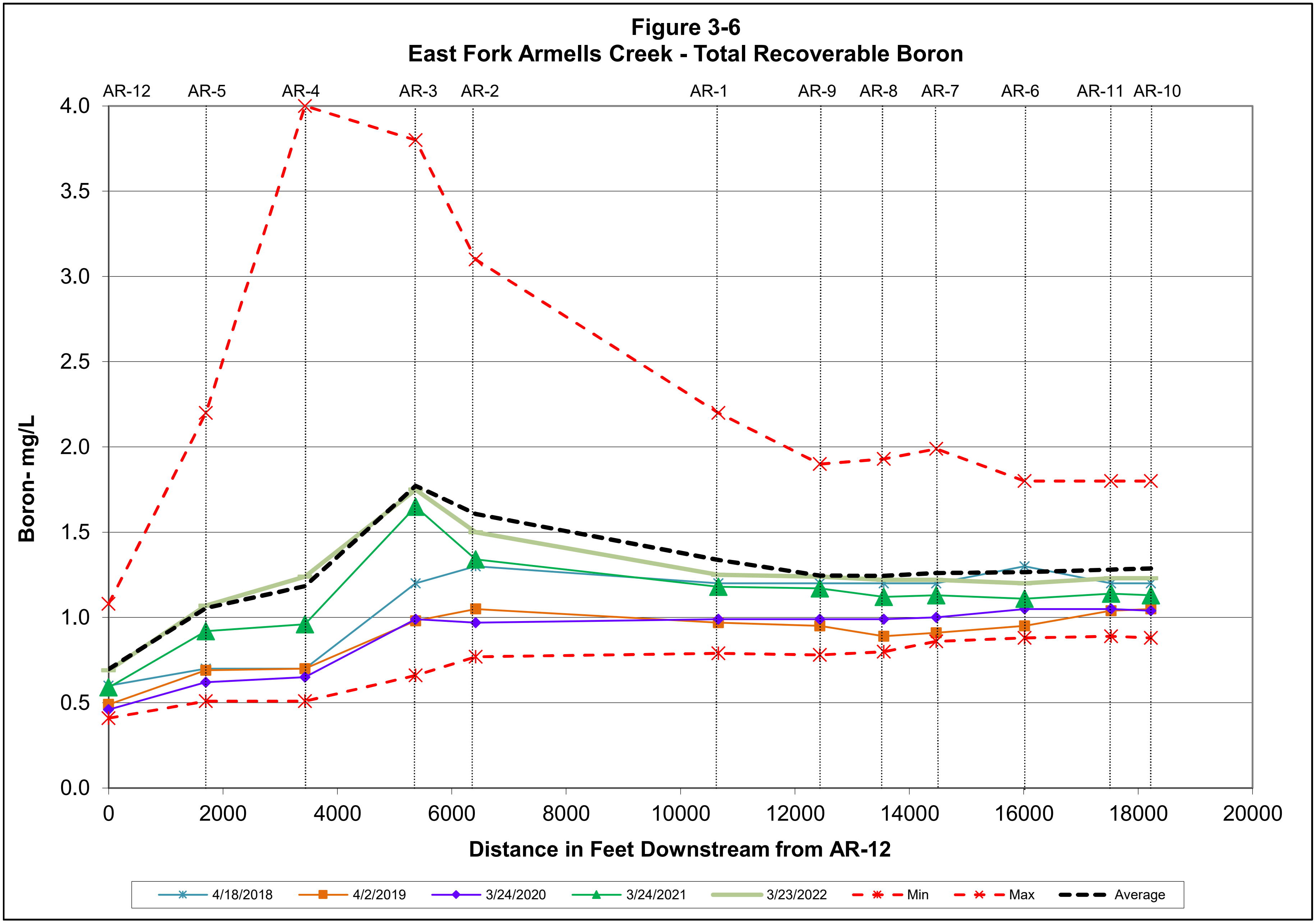


Figure 3-6
East Fork Armells Creek - Total Recoverable Boron
AR-12
AR-5
AR-4
AR-3
AR-2
AR-1
AR-9
AR-8
AR-7
AR-6
AR-11
AR-10
Boron- mg/L
Distance in Feet Downstream from AR-12
4/18/2018
4/2/2019
3/24/2020
3/24/2021
3/23/2022
Min
Max
Average

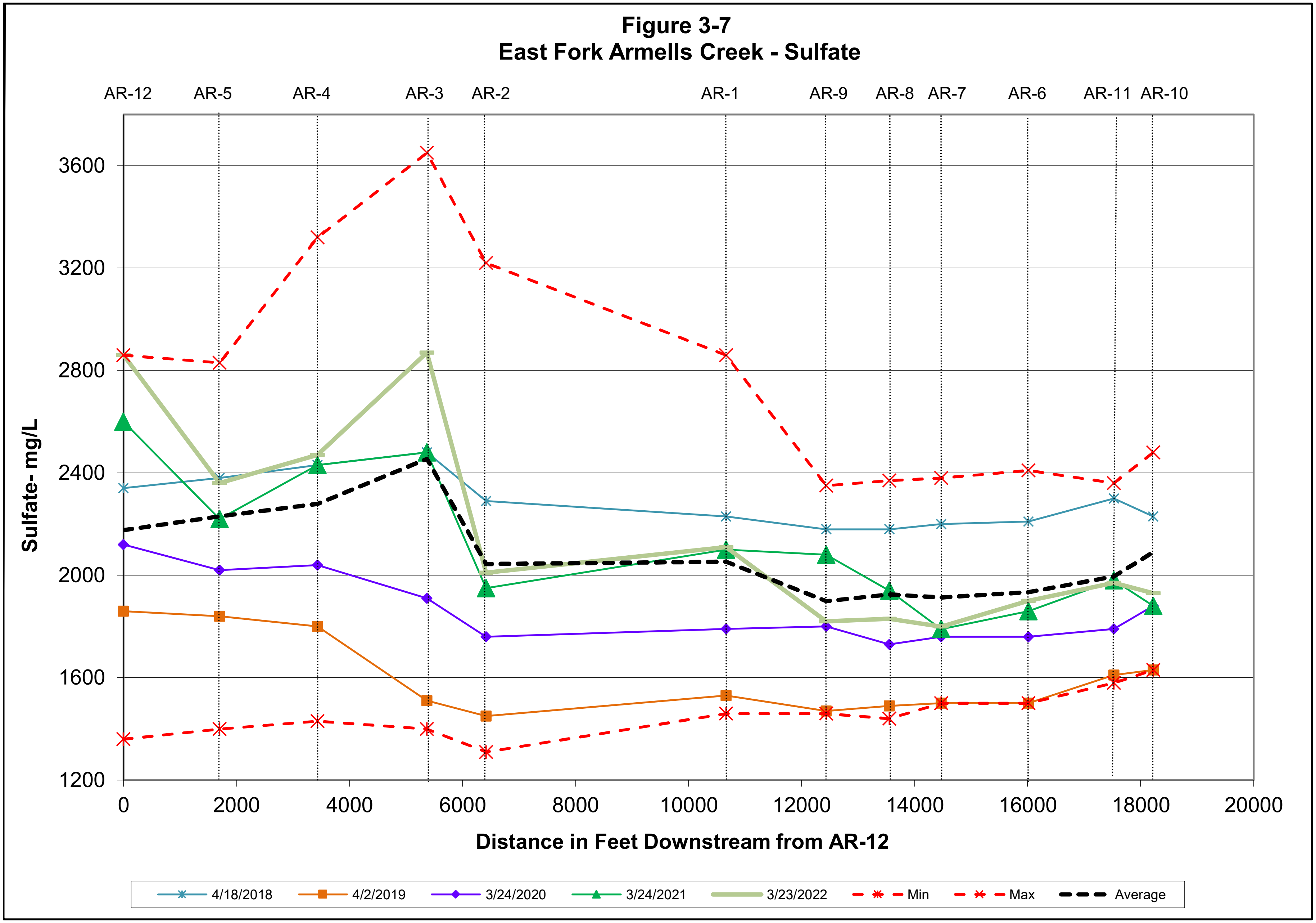


Figure 3-7
East Fork Armells Creek - Sulfate
AR-12
AR-5
AR-4
AR-3
AR-2
AR-1
AR-9
AR-8
AR-7
AR-6
AR-11
AR-10
Sulfate- mg/L
3600
3200
2800
2400
2000
1600
1200
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000
Distance in Feet Downstream from AR-12
4/18/2018
4/2/2019
3/24/2020
3/24/2021
3/23/2022
Min
Max
Average

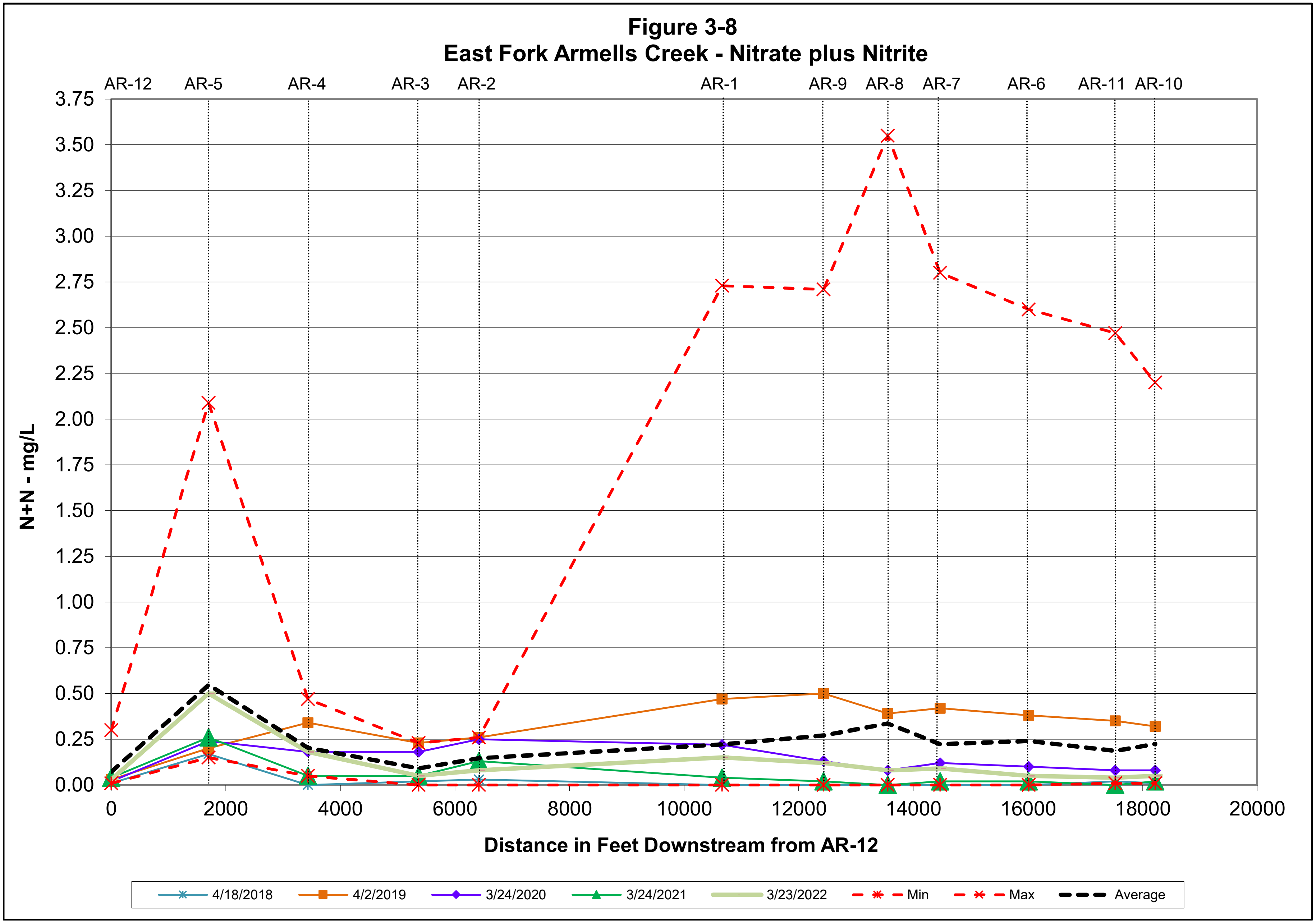


Figure 3-8
East Fork Armells Creek - Nitrate plus Nitrite
AR-12
AR-5
AR-4
AR-3
AR-2
AR-1
AR-9
AR-8
AR-7
AR-6
AR-11
AR-10
N+N - mg/L
3.75
3.50
3.25
3.00
2.75
2.50
2.25
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000
Distance in Feet Downstream from AR-12
4/18/2018
4/2/2019
3/24/2020
3/24/2021
3/23/2022
Min
Max
Average

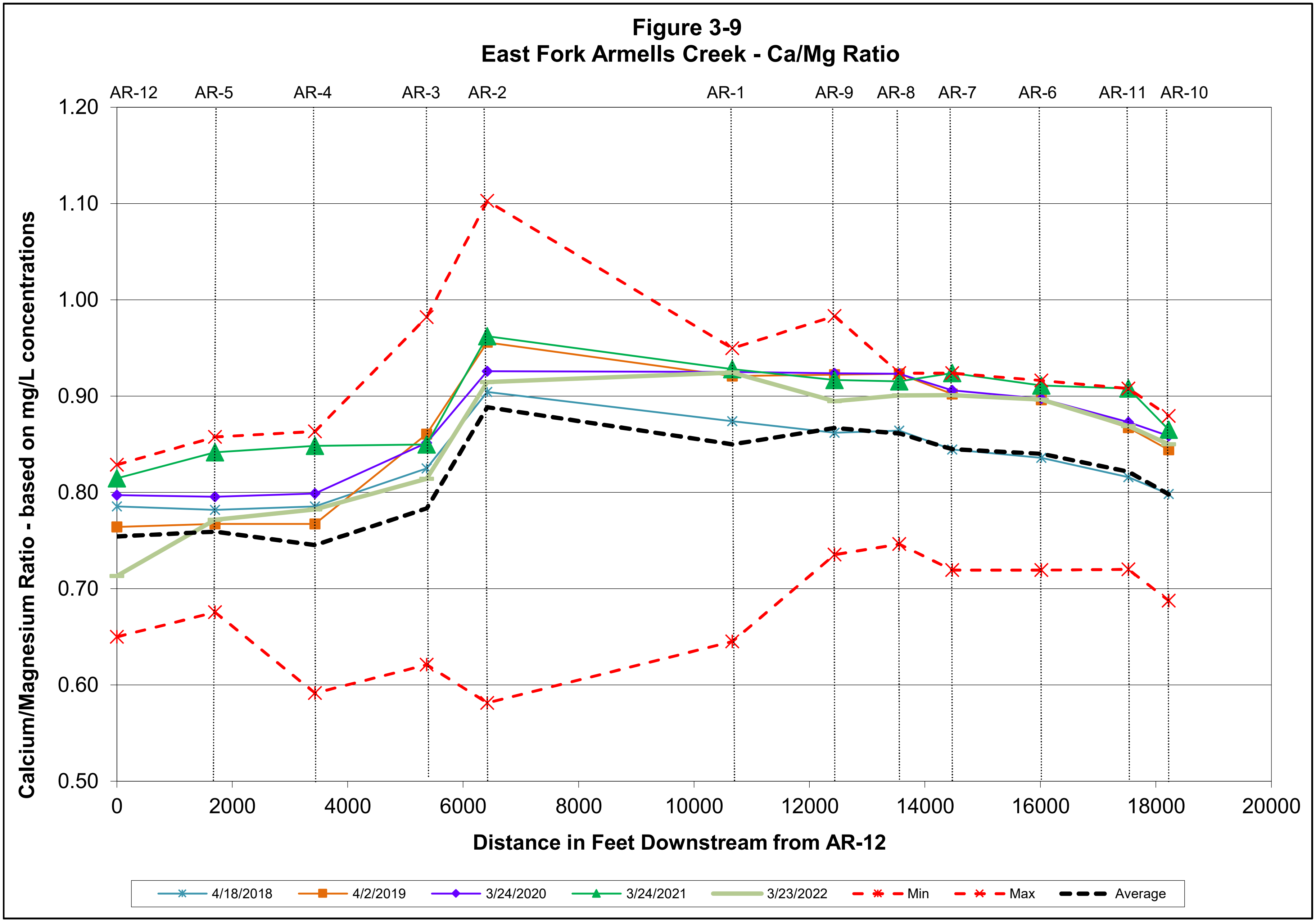


Figure 3-9
East Fork Armells Creek - Ca/Mg Ratio
AR-12
AR-5
AR-4
AR-3
AR-2
AR-1
AR-9
AR-8
AR-7
AR-6
AR-11
AR-10
Calcium/Magnesium Ratio - based on mg/L concentrations
Distance in Feet Downstream from AR-12
1.20
1.10
1.00
0.90
0.80
0.70
0.60
0.50
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000
4/18/2018
4/2/2019
3/24/2020
3/24/2021
3/23/2022
Min
Max
Average

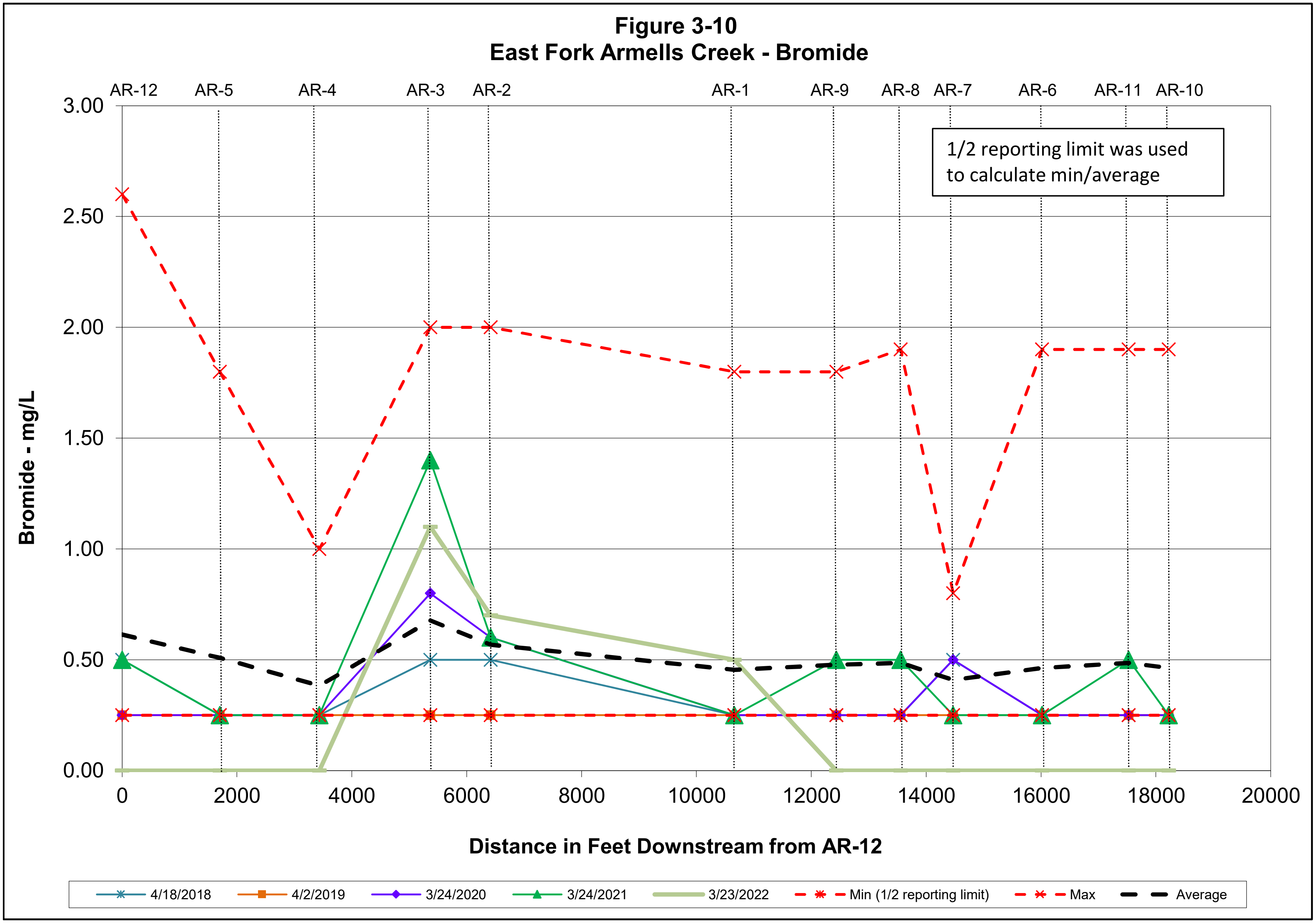


Figure 3-10
East Fork Armells Creek - Bromide
AR-12
AR-5
AR-4
AR-3
AR-2
AR-1
AR-9
AR-8
AR-7
AR-6
AR-11
AR-10
1/2 reporting limit was used to calculate min/average
Bromide - mg/L
3.00
2.50
2.00
1.50
1.00
0.50
0.00
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000
Distance in Feet Downstream from AR-12
4/18/2018
4/2/2019
3/24/2020
3/24/2021
3/23/2022
Min (1/2 reporting limit)
Max
Average

APPENDIX 1

MARCH 2022 PHOTO LOG AND SITE DESCRIPTIONS

AR-12

AR-12 is upstream of Plant Site and directly upstream of Highway 39. The Highway 39 culvert tends to cause ponding at the inlet. Furthermore, as can be seen from the photo above, dead vegetation, mostly tumbleweeds may accumulate at the inlet. The surface of the creek was frozen at the culvert inlet in 2022. Sediments at this location are typically organic rich and sometimes emit a slight sulfide odors suggesting anaerobic conditions.

AR-5

AR-5 is directly upstream of the creek crossing on Currant Drive. This location is west of the former Units 1 & 2 A and B Ponds and northwest of Groundwater Capture Storage Pond. This site is upstream of Currant Drive culverts and downstream of a large area of riparian vegetation. A small tributary that drains a portion of the town site enters the creek from the west a short distance upstream. This drainage is typically dry although flow has been observed during past synoptic runs. H_2S odors are frequently observed along with dark brown to black soils suggesting anaerobic conditions. The AR-5 site has a significant amount of garbage, comprised mostly of plastic and paper debris, presumably blown in from the nearby residential areas.

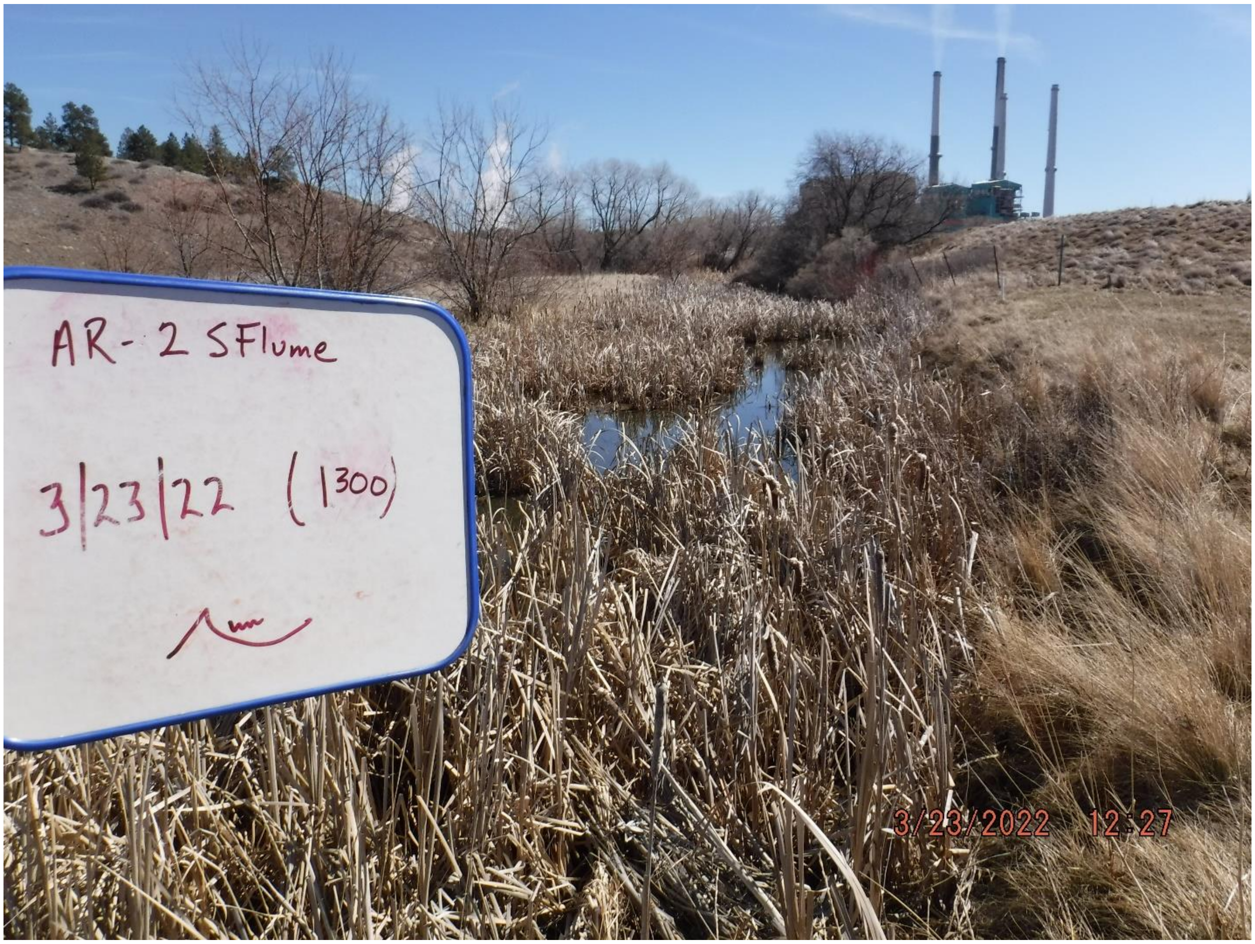
AR-4

AR-4 is located directly west of the Units 1-4 Sediment Retention Pond. This site is immediately upstream of the culvert that conveys water under Willow Avenue and downstream of a large area of riparian vegetation. Cattails are present in the channel and need to be removed for gaging. Sediment is fine grained and generally light brown in color, although some isolated black anaerobic patches exist.

AR-3

AR-3 is located upstream and up-gradient from the City of Colstrip Wastewater Treatment Plant settling ponds. This site is located in an area with Cottonwood and Russian olive trees. Clinker gravels underly the streambed at a depth of less than two inches.

AR-2SF



AR-2SF, also known as the South Flume, is located downgradient and downstream the City of Colstrip Wastewater Treatment Plant settling. This 2-foot Parshall flume is instrumented with a continuous recorder to monitor the stage height. This site is located in a large area of riparian vegetation. Cattails are present in the channel and need to be removed for gaging. Sediment upstream of the flume is black, highly organic, reduced, and exhibits an H_2S.

PRT

Power Road Tributary (PRT) is located downstream of the Power Road overpass and downstream of the Surge Pond (Castle Rock Lake) and drains portions of the northern town site. This site is located in an area of riparian vegetation. Cattails are present in the channel and need to be removed for gaging. Clinker cobbles are common along the channel bottom. No flow was observed in 2022 which is typical.

AR-1NF

AR-1NF, also known as the North Flume, is located downstream from the City of Colstrip Wastewater Treatment Plant settling ponds, Power Road, and the majority of Colstrip. This 2-foot Parshall flume is instrumented with a continuous recorder to monitor the stage height. This site is in an area of riparian vegetation, mostly Cattails. The sediment is highly organic and the black color and H2S odor suggest anaerobic conditions.

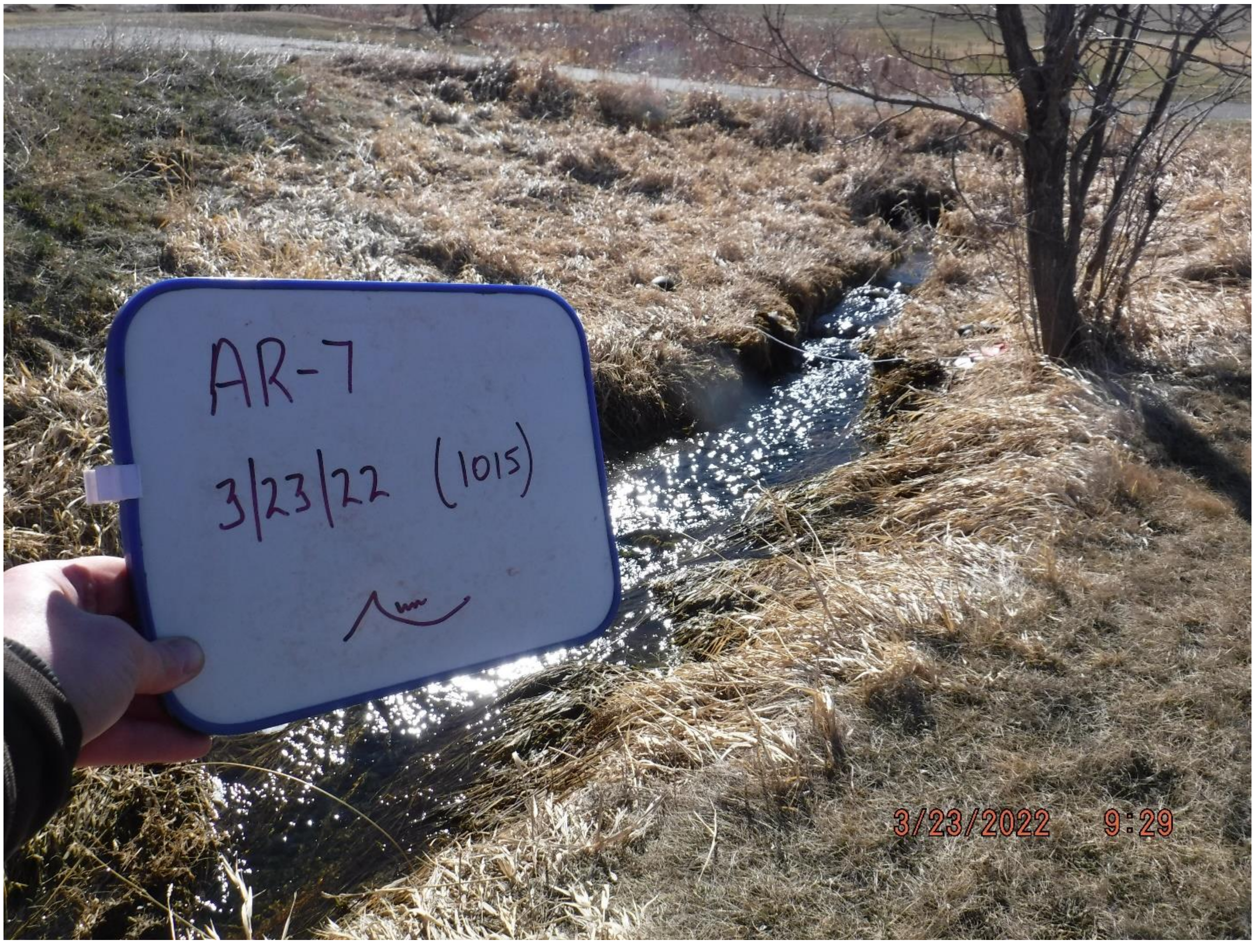
AR-9

AR-9 is located about midway between AR-1 and the Ponderosa Butte Golf Course. Over the years this site has transformed from a narrow channel, approximately 2 feet width, to a slower reach with multiple small channels. Riparian growth is abundant. The channel is eroded into the underlying claystone of the Fort Union Formation.

AR-8

AR-8 is located on Ponderosa Butte Golf Course upstream of a culvert that conveys water under a cart path. The site is also up gradient of a pond receives treated water via a pipeline from the City of Colstrip Wastewater Treatment Plant that is used for irrigation. Cattails are present on the creek banks. Sediment upstream of the culvert is black and organic rich. Cobbles line the channel directly downstream of the culvert. Aquatic insects are common on the rocks at this location.

AR-7



AR-7 is located at a culvert under a cart path at Ponderosa Butte Golf Course. The site is downstream from the irrigation holding pond and upstream from the confluence of the tributary that holds the Units 1 and 2 Stage one and two evaporation ponds. Sediment at the site appear minimal.

AR-6

AR-6 is located on Ponderosa Butte Golf Course downstream from the City of Colstrip sports fields (baseball, softball, soccer, etc.) and downstream from the confluence of the tributary that holds Units 1 and 2 Stage one and two evaporation ponds. The site is located at a culvert that conveys water under a golf cart path. This site is mainly grass vegetation with cattails on the edge of the stream. Rounded cobbles dominate the streambed.

AR-11

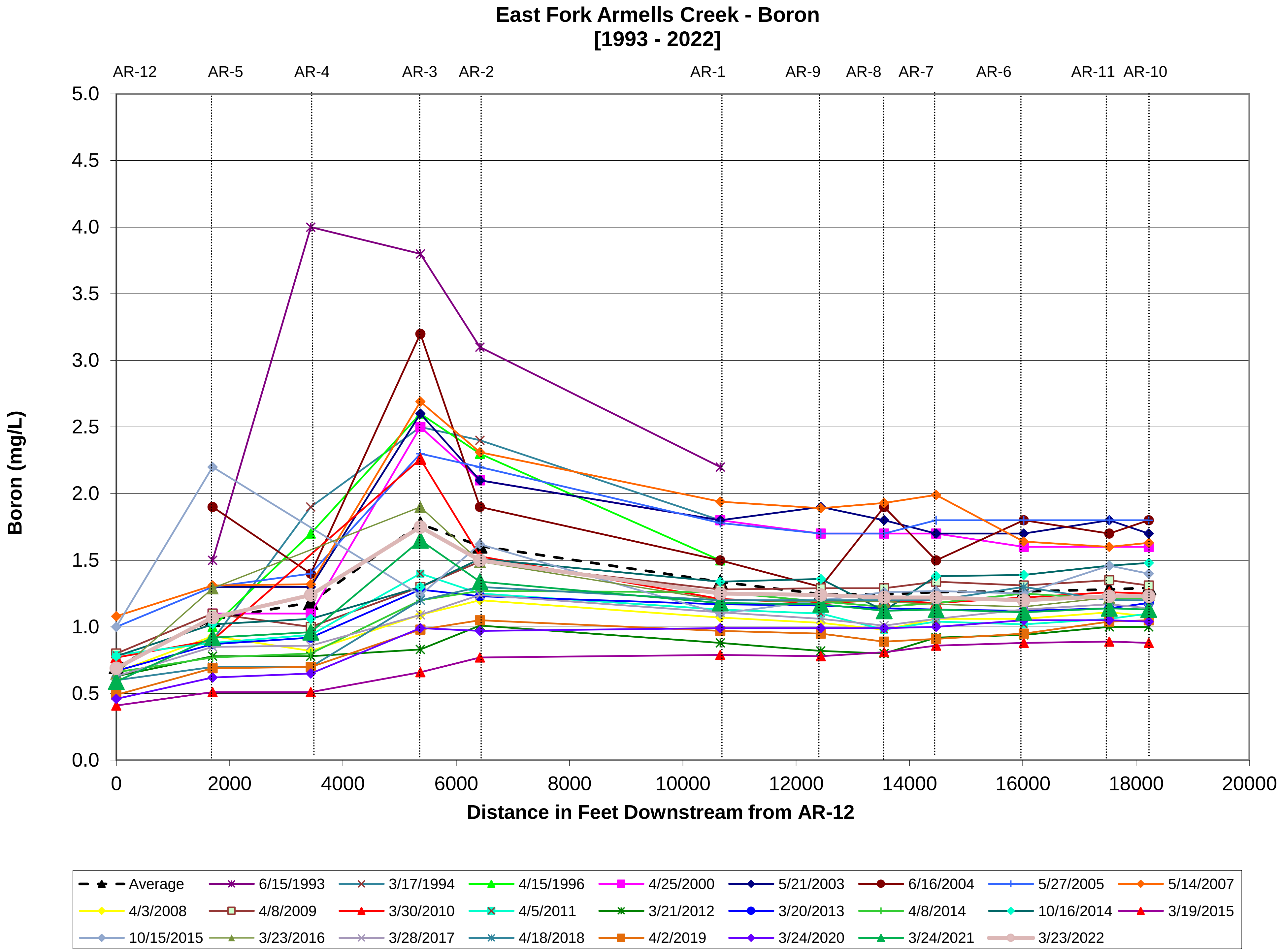
AR-11 is on the Ponderosa Butte Golf Course between sites AR-6 and AR-10. Flow is measured at a foot bridge on the right side of the third hole fairway. Cattails and other riparian vegetation are present on both banks. However, the streambed is mostly coarse sand to pebble and granular gravel with little small grained sediment.

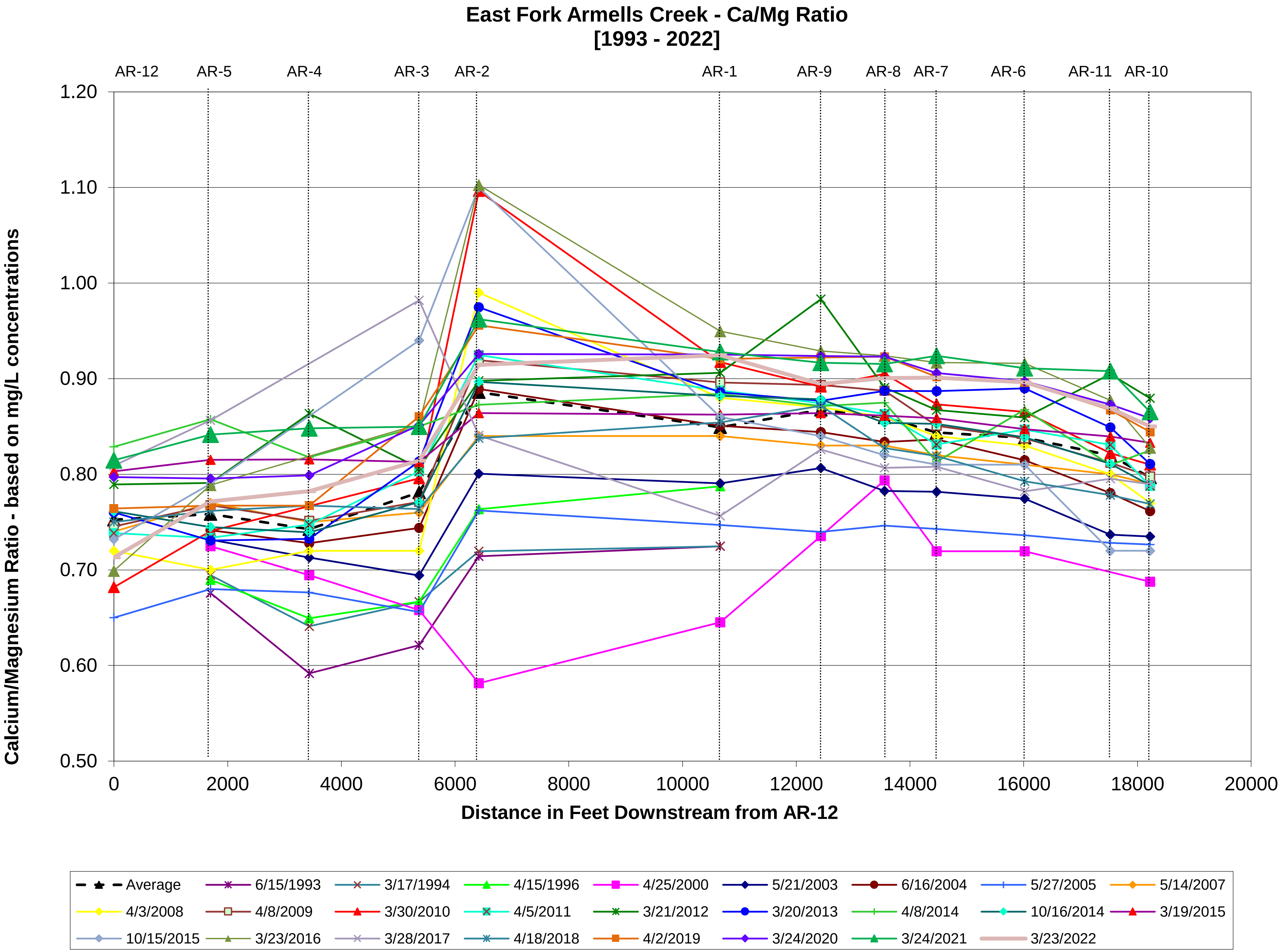
AR-10PBR

AR-10PBR, also known as the Pine Butte Road (PBR) Flume, is at the northern edge of the Ponderosa Butte Golf Course and upstream of Pine Butte Road. Flow is gaged using a compound weir (90-degree v-notch bottom with rectangular upper portion). Cattails are present on both banks and in the channel. The creek is backed up by the weir and the flat topography creates ponding downstream and submergent conditions. Streambed sediments both up and downstream of the site are black, exhibit an H_2S odor, and contain substantial organic matter.

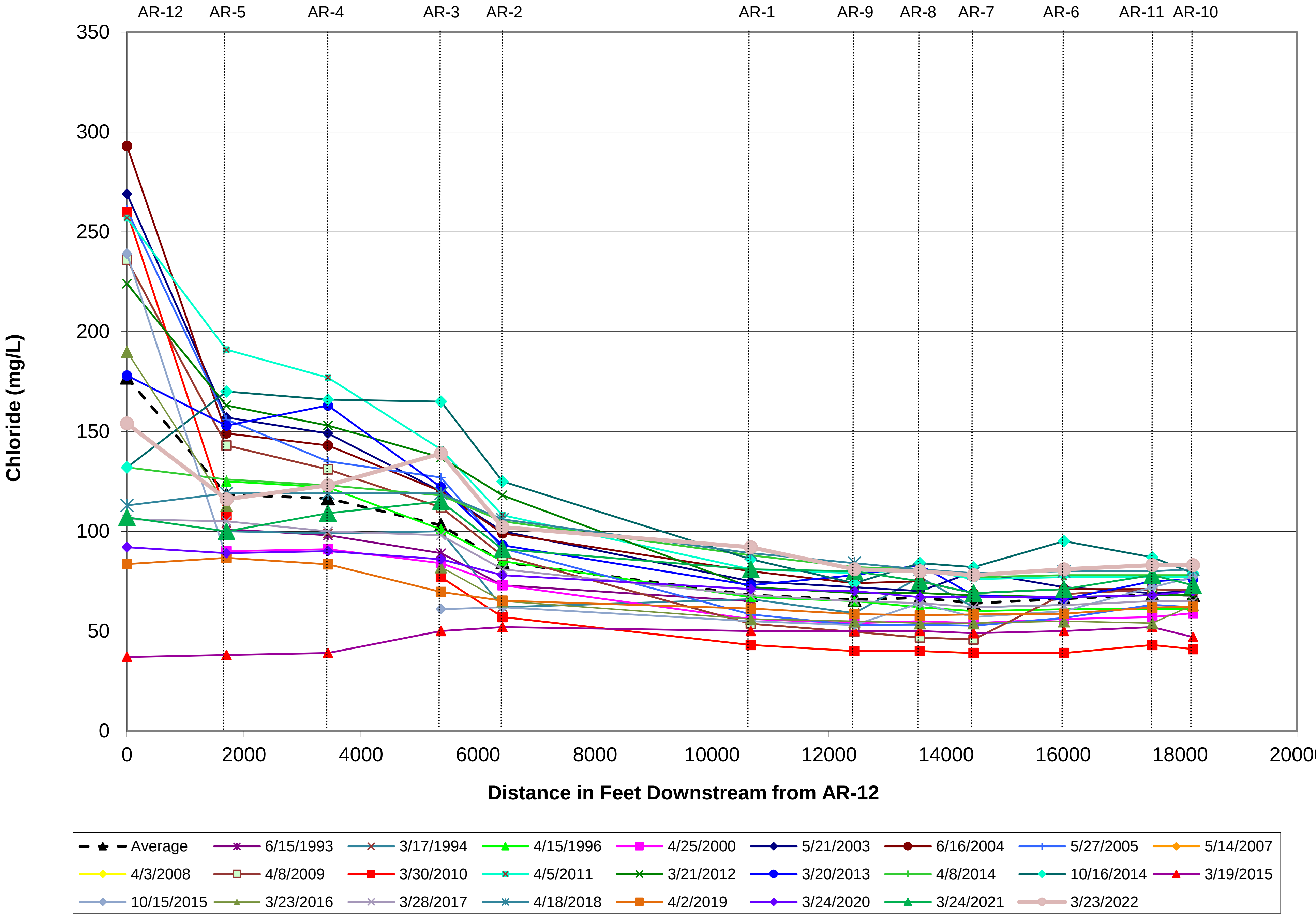
APPENDIX 2

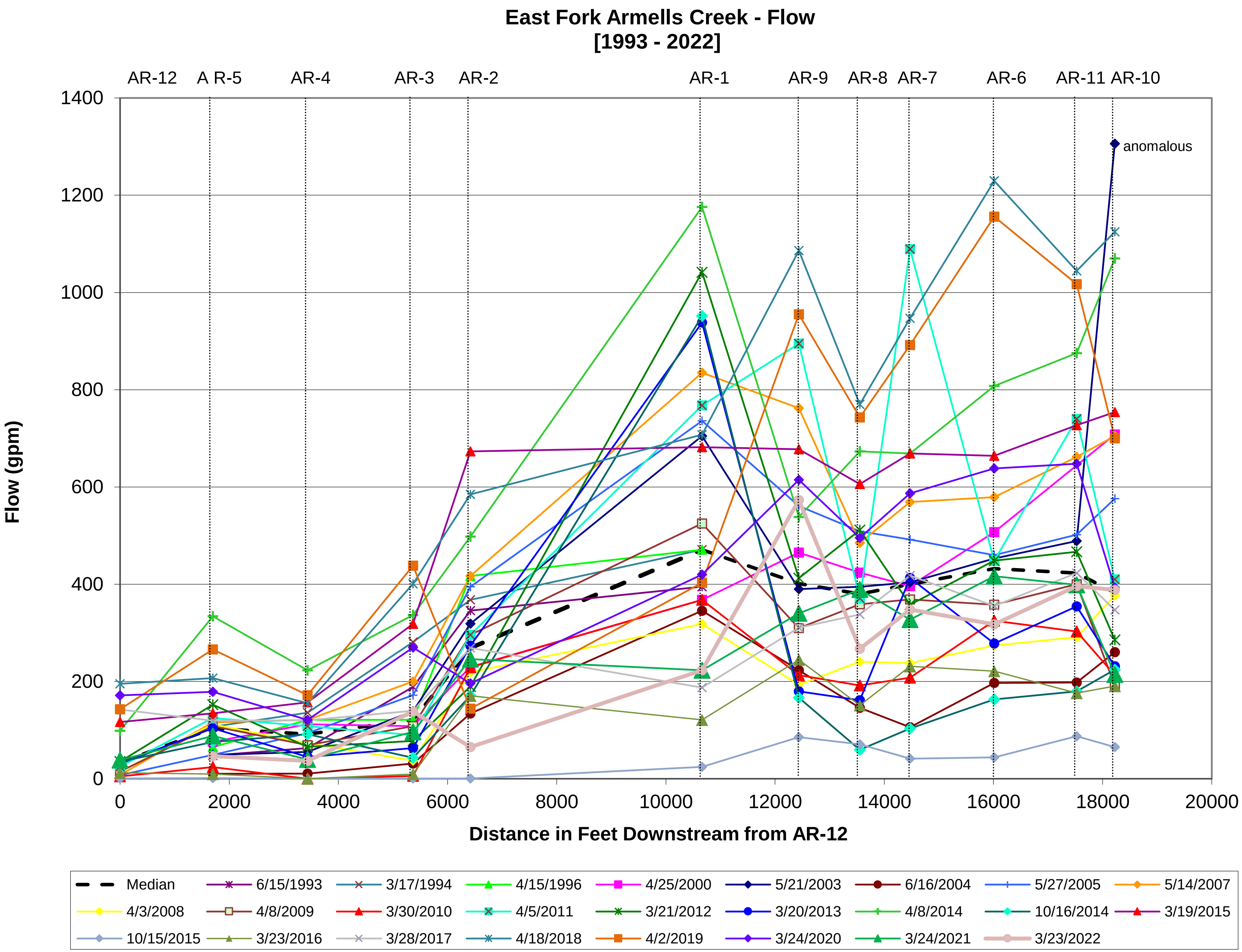
WATER QUALITY AND FLOW GRAPHS THROUGH MARCH 2021

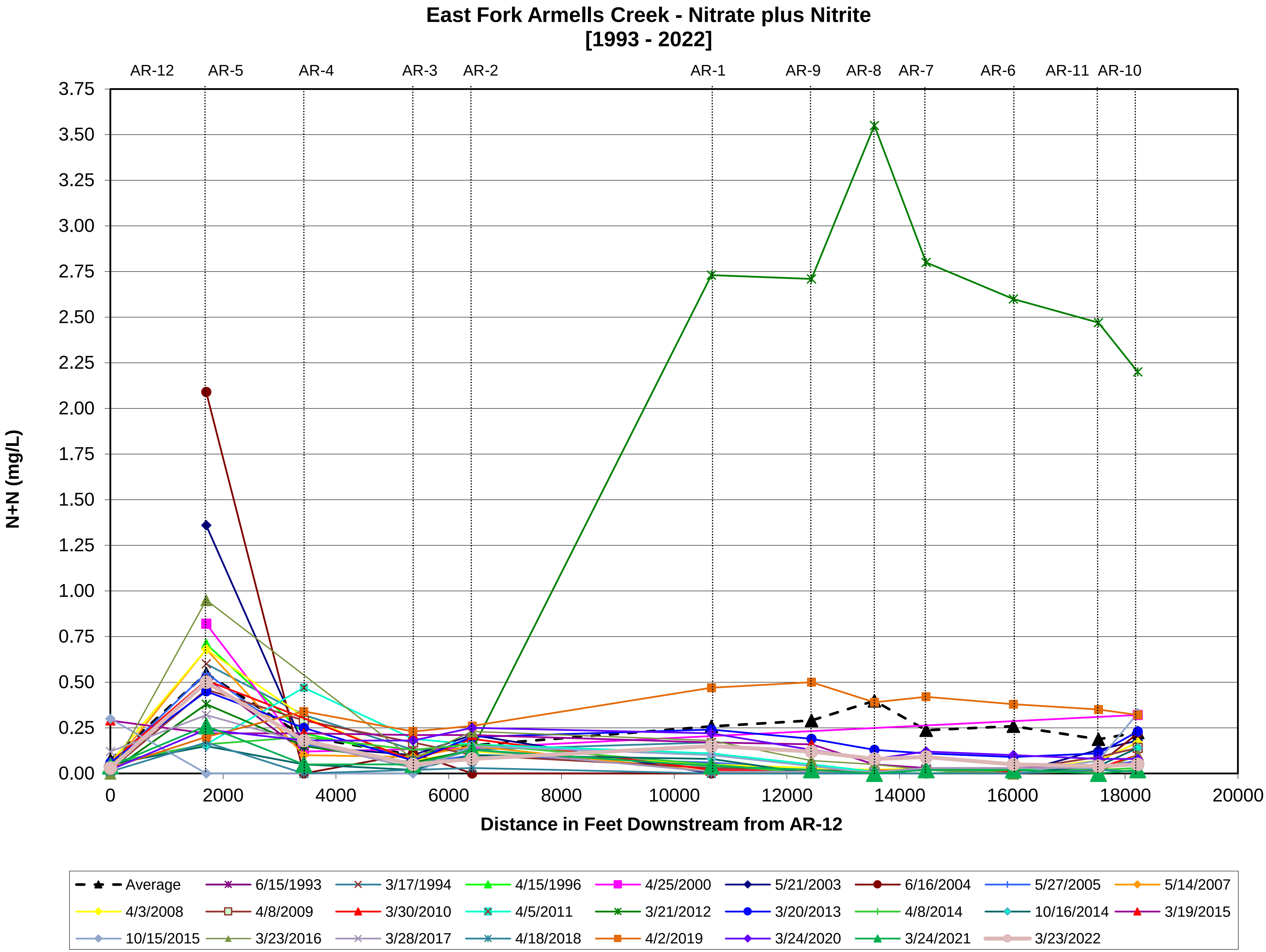

East Fork Armells Creek - Boron
[1993 - 2022]
AR-12
AR-5
AR-4
AR-3
AR-2
AR-1
AR-9
AR-8
AR-7
AR-6
AR-11
AR-10
Boron (mg/L)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000
Distance in Feet Downstream from AR-12
Average
6/15/1993
3/17/1994
4/15/1996
4/25/2000
5/21/2003
6/16/2004
5/27/2005
5/14/2007
4/3/2008
4/8/2009
3/30/2010
4/5/2011
3/21/2012
3/20/2013
4/8/2014
10/16/2014
3/19/2015
10/15/2015
3/23/2016
3/28/2017
4/18/2018
4/2/2019
3/24/2020
3/24/2021
3/23/2022


East Fork Armells Creek - Ca/Mg Ratio
[1993 - 2022]
AR-12
AR-5
AR-4
AR-3
AR-2
AR-1
AR-9
AR-8
AR-7
AR-6
AR-11
AR-10
Calcium/Magnesium Ratio - based on mg/L concentrations
Distance in Feet Downstream from AR-12
Average
6/15/1993
3/17/1994
4/15/1996
4/25/2000
5/21/2003
6/16/2004
5/27/2005
5/14/2007
4/3/2008
4/8/2009
3/30/2010
4/5/2011
3/21/2012
3/20/2013
4/8/2014
10/16/2014
3/19/2015
10/15/2015
3/23/2016
3/28/2017
4/18/2018
4/2/2019
3/24/2020
3/24/2021
3/23/2022

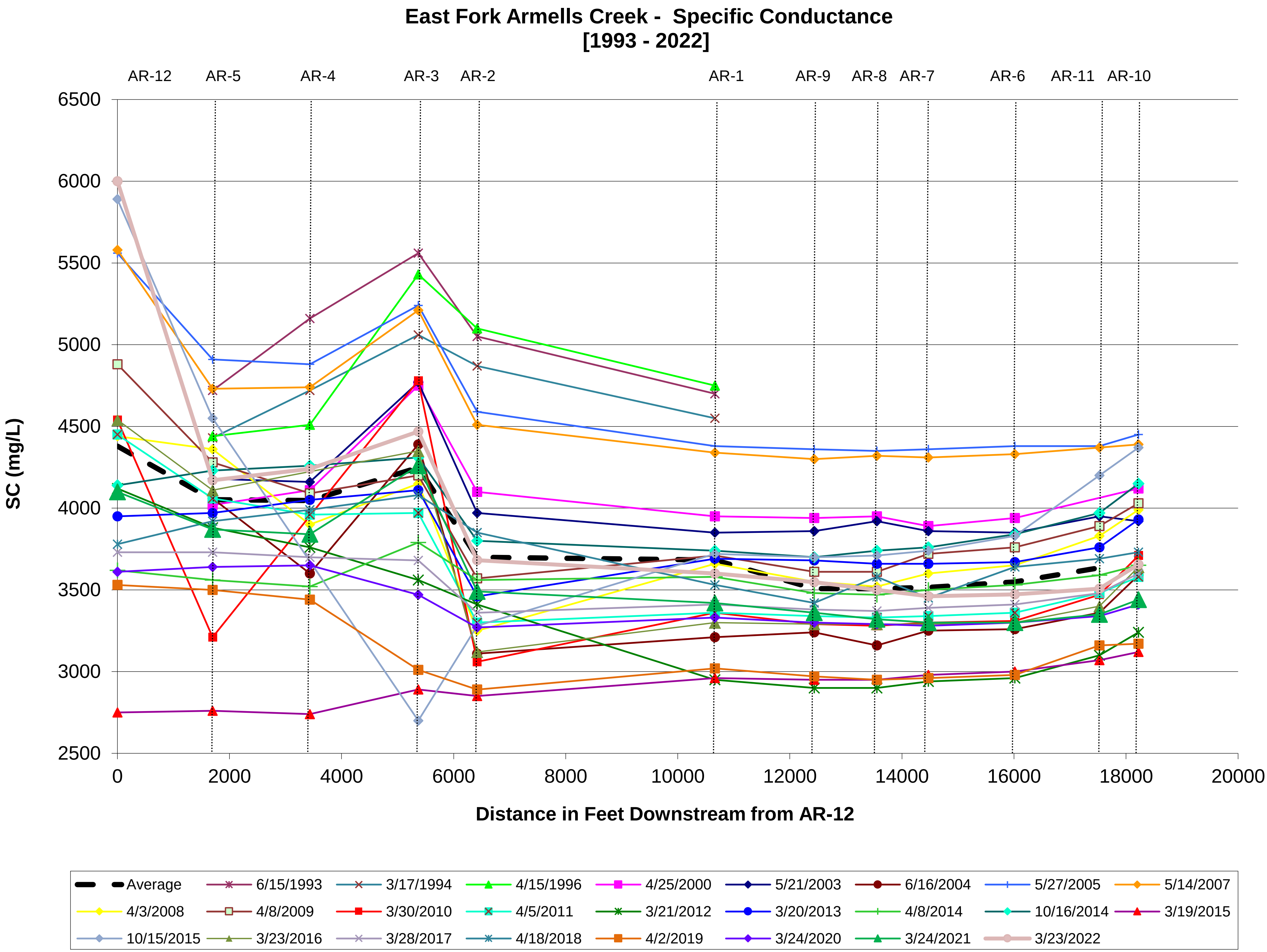
East Fork Armells Creek - Chloride
[1993 - 2022]

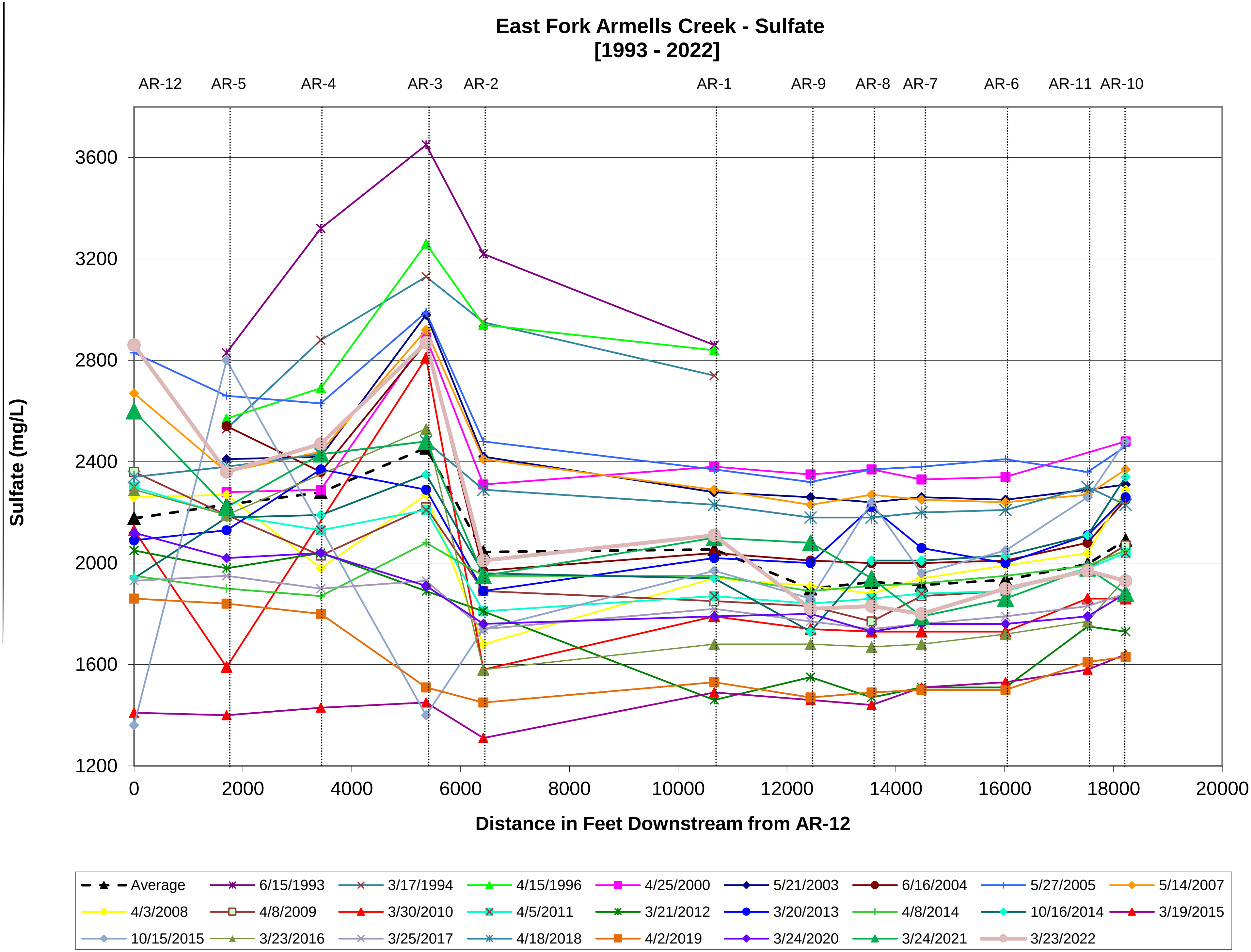


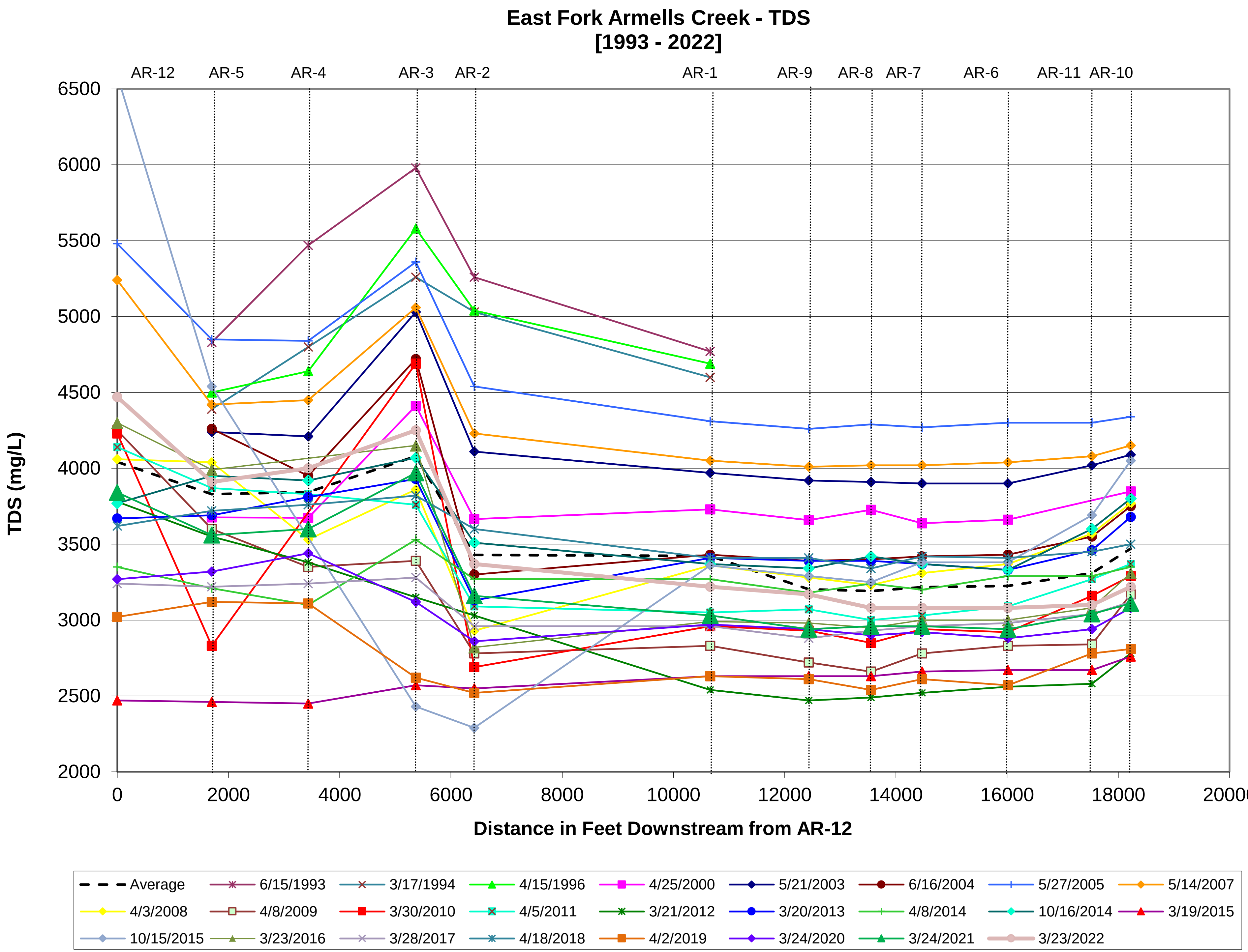

East Fork Armells Creek - Flow
[1993 - 2022]
AR-12
A R-5
AR-4
AR-3
AR-2
AR-1
AR-9
AR-8
AR-7
AR-6
AR-11
AR-10
anomalous
Flow (gpm)
Distance in Feet Downstream from AR-12
Median
6/15/1993
3/17/1994
4/15/1996
4/25/2000
5/21/2003
6/16/2004
5/27/2005
5/14/2007
4/3/2008
4/8/2009
3/30/2010
4/5/2011
3/21/2012
3/20/2013
4/8/2014
10/16/2014
3/19/2015
10/15/2015
3/23/2016
3/28/2017
4/18/2018
4/2/2019
3/24/2020
3/24/2021
3/23/2022



East Fork Armells Creek - Nitrate plus Nitrite
[1993 - 2022]
AR-12
AR-5
AR-4
AR-3
AR-2
AR-1
AR-9
AR-8
AR-7
AR-6
AR-11
AR-10
3.75
3.50
3.25
3.00
2.75
2.50
2.25
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
N+N (mg/L)
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000
Distance in Feet Downstream from AR-12
Average
6/15/1993
3/17/1994
4/15/1996
4/25/2000
5/21/2003
6/16/2004
5/27/2005
5/14/2007
4/3/2008
4/8/2009
3/30/2010
4/5/2011
3/21/2012
3/20/2013
4/8/2014
10/16/2014
3/19/2015
10/15/2015
3/23/2016
3/28/2017
4/18/2018
4/2/2019
3/24/2020
3/24/2021
3/23/2022


East Fork Armells Creek - Specific Conductance
[1993 - 2022]
AR-12
AR-5
AR-4
AR-3
AR-2
AR-1
AR-9
AR-8
AR-7
AR-6
AR-11
AR-10
6500
6000
5500
5000
4500
4000
3500
3000
2500
SC (mg/L)
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000
Distance in Feet Downstream from AR-12
Average
6/15/1993
3/17/1994
4/15/1996
4/25/2000
5/21/2003
6/16/2004
5/27/2005
5/14/2007
4/3/2008
4/8/2009
3/30/2010
4/5/2011
3/21/2012
3/20/2013
4/8/2014
10/16/2014
3/19/2015
10/15/2015
3/23/2016
3/28/2017
4/18/2018
4/2/2019
3/24/2020
3/24/2021
3/23/2022


East Fork Armells Creek - Sulfate
[1993 - 2022]
AR-12
AR-5
AR-4
AR-3
AR-2
AR-1
AR-9
AR-8
AR-7
AR-6
AR-11
AR-10
Sulfate (mg/L)
3600
3200
2800
2400
2000
1600
1200
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000
Distance in Feet Downstream from AR-12
Average
6/15/1993
3/17/1994
4/15/1996
4/25/2000
5/21/2003
6/16/2004
5/27/2005
5/14/2007
4/3/2008
4/8/2009
3/30/2010
4/5/2011
3/21/2012
3/20/2013
4/8/2014
10/16/2014
3/19/2015
10/15/2015
3/23/2016
3/25/2017
4/18/2018
4/2/2019
3/24/2020
3/24/2021
3/23/2022


East Fork Armells Creek - TDS
[1993 - 2022]
AR-12
AR-5
AR-4
AR-3
AR-2
AR-1
AR-9
AR-8
AR-7
AR-6
AR-11
AR-10
TDS (mg/L)
Distance in Feet Downstream from AR-12
Average
6/15/1993
3/17/1994
4/15/1996
4/25/2000
5/21/2003
6/16/2004
5/27/2005
5/14/2007
4/3/2008
4/8/2009
3/30/2010
4/5/2011
3/21/2012
3/20/2013
4/8/2014
10/16/2014
3/19/2015
10/15/2015
3/23/2016
3/28/2017
4/18/2018
4/2/2019
3/24/2020
3/24/2021
3/23/2022

APPENDIX 3

DATA VALIDATION SUMMARY 2022

Hydrometrics, Inc.
Consulting Scientists and Engineers

TALEN MONTANA, LLC
EAST FORK ARMELLS CREEK
SPRING SYNOPTIC RUN
DATA VALIDATION SUMMARY 2022

GENERAL INFORMATION:

Site/Facility Name	Talen Montana, LLC
Project Name	Talen East Fork Armell's Creek Spring 2022 Synoptic Run
Name of DEQ Approved Sampling Plan	Talen Montana Colstrip Steam Electric Station 2022 East Fork Armells Creek
	Synoptric Run Work Plan
Date of DEQ Approved Sampling Plan	March 2022
Name of Data Validator	Jennifer Vanek
Phone	(406) 656-1172 Extension (304)
Date Validated	April 2022

FIELD COLLECTION INFORMATION:

Sample Matrix	Water
Sample Collection Start Date	March 23, 2022
Sample Collection End Date	March 23, 2022
Analytical Methods Used	See Table 1. Summary of Laboratory Methods and Detection Limits

GENERAL LABORATORY INFORMATION:

Laboratory Names and Locations	Energy Laboratories, Billings, MT
Laboratory Project IDs - Batch Numbers	See Table 2. Summary of Samples Evaluated

All Data Conforms to Analytical Methods and Data Quality Objectives Specified for this Project?			**Comments**
	Yes	X	
	No		

Reported methods and data quality objectives were in compliance with those requested in the Talen Montana Colstrip Steam Electric Station 2022 East Fork Armells Creek Synoptic Run Work Plan.

Samples Received in Good Condition and at Appropriate Temperature? (4° C+/-2°)			**Comments**
	Yes	X	
	No		

Comments

All samples were received in good condition and at the appropriate temperature.

Chain-of-Custody Forms Complete?			**Comments**
	Yes	X	
	No		

Comments

COC records from field to laboratory were complete, and custody was maintained as evidenced by personnel signatures, dates, and times of receipt.

All Samples Analyzed Within Method Specified or Technical Holding Times?			**Comments**
	Yes	X	
	No		

**Holding times were exceeded for laboratory pH. However, as a rule, holding times for laboratory pH measurements are frequently exceeded because measurements are typically not conducted "immediately", but rather as soon as practicable. Therefore, no validation qualifiers are placed on the data. All pH measurements have been qualified by the laboratories to indicate that the recommended holding times were exceeded.*

Comments

All analysis were within the specified holding time with the exception of the above mentioned pH.

LABORATORY QUALITY CONTROL EVALUATION:

Laboratory Complied With Quality Control Procedures. Data is Validated With Qualifiers?			**Comments**
	Yes	X	
	No		

Comments

All Laboratory Quality Control procedures were followed. All of the data has been validated and assigned appropriate data validation qualifiers, if necessary.

Were All Laboratory Quality Control Samples of the Same Matrix as Samples and Prepared the Same?			**Comments**
	Yes	X	
	No		

Comments

All laboratory quality control samples were of the same matrix and prepared the same as all samples analyzed.

Were All Calibration Verification Results Within Acceptable Limits?			**Comments**
	Yes	X	
	No		

Comments

All instrument calibrations were within method or data validation control limits and were performed in accordance with published procedures.

Were All Laboratory Blank Samples Free of Contamination?		Comments	
	Yes	X	
	No		

Comments
Reported laboratory blanks were free of target analyte contamination.

Are All Matrix Spike and Matrix Spike Duplicate Relative Percent Difference (RPDs) Within Quality Control Limits?		Comments	
	Yes	X	
	No		

Comments
All laboratory Matrix Spike and Matrix Spike duplicates were within control limits.

Were All Laboratory Duplicate Relative Percent Differences (RPDs) Within Quality Control Limits?		Comments	
	Yes	X	
	No		

Comments
All laboratory duplicate RPDs were within control limits.

Was the Total Number of Laboratory Method Blanks at Least 5% of the Total Number of Samples Analyzed or as Required by the Method?		Comments	
	Yes	X	
	No		

Comments
All laboratory blank samples met the above suggested frequency as recommended in the Montana Department of Environmental Quality Data Validation Guidelines for Evaluating Analytical Data, January 26, 2018.

Was the Total Number of Laboratory Matrix Spike Samples at Least 5% of the Total Number of Samples Analyzed or as Required by the Method?		Comments	
	Yes	X	
	No		

Comments
All laboratory matrix spike samples met the above suggested frequency as recommended in the Montana Department of Environmental Quality Data Validation Guidelines for Evaluating Analytical Data, January 26, 2018.

Was the Total Number of Laboratory Control Samples at Least 5% of the Total Samples Analyzed?	Comments		
	Yes	X	
	No		

Comments

The total number of laboratory control samples met the above suggested frequency as recommended in the Montana Department of Environmental Quality, 2018. Montana Department of Environmental Quality Data Validation Guidelines for Evaluating Analytical Data, January 26, 2018.

Please List Any Project Samples Used For Matrix Spike (MS)/Matrix Spike Duplicate(MSD)

Lab ID	Project Sample ID	Comments

VALIDATOR SUMMARY INFORMATION:

Are the Detection Limits Appropriate for the Project (i.e. at or below screening levels)?	Comments		
	Yes	X	
	No		

Comments

Reported detection limits were in compliance with those requested in the Talen Montana Colstrip Steam Electric Station 2022 East Fork Armells Creek Synoptic Run Work Plan.

Are the Reported Units Appropriate for the Matrix? (i.e. mg/L water, ug/L soil)	Comments		
	Yes	X	
	No		

Comments

Correct and appropriate concentration units were reported for all water samples evaluated in this report.

Do the Laboratory Reports Include all Constituents Requested to be Analyzed on the Chain-Of-Custody or Under the Sampling Plan or Other Applicable Document?	Comments		
	Yes	X	
	No		

Comments

All requested analyses as documented on original COCs were completed by the laboratory.

Was the Number of Sample Collection Blanks (i.e. Field Blanks, Rinsate, DI) Equal to at Least 10% of the Total Samples Collected or as Otherwise Required?			**Comments**
		X	
	No		

Comments
The total number of sample collection blank samples met the above suggested frequency as recommended in the Montana Department of Environmental Quality, 2018. Montana Environmental Quality Data Validation Guidelines for Evaluating Analytical Data, January 26, 2018.

Were all of the Sample Collection Blanks Free of Analyte Contamination?			**Comments**
	Yes	X	
	No		

Comments

Were Sample Collection Duplicates Collected as Required?			**Comments**
	Yes	X	
	No		

Comments
The total number of sample collection duplicates met the suggested frequency of 1/20 (one duplicate per twenty samples collected) as listed in the Talen Montana Colstrip Steam Electric Station 2022 East Fork Armells Creek Synoptic Run Work Plan.

Were Sample Collection Duplicates Within the Relative Percent Differences (RPD) or low level +/- PRDL Data Validation Quality Control Limits?			**Comments**
	Yes	X	
	No		

Comments
The sample collection duplicate parameters were all within data validation quality control limits.

DATA QUALITY OBJECTIVES:

PRECISION, ACCURACY, REPRESENTATIVENESS, COMPLETENESS, COMPARABILITY

PRECISION

Was the precision acceptable?			**Comments**
	Yes	X	
	No		

Comments

Precision is the measure of variability of individual sample measurements. Field precision was determined by comparison of field sample collection duplicate results. Laboratory precision was determined by examination of laboratory duplicate results. Evaluation of field and laboratory duplicates for precision was done using the Relative Percent Difference (RPD). The RPD is defined as the difference between two duplicate samples divided by the mean and expressed as a percent. Control limits are taken from the US EPA, 2016. National Functional Guidelines for Inorganic Superfund Data Review (2017).

The suggested precision objective goal is for 90% of aqueous field sample collection duplicates to be in agreement with duplicate sample results within a RPD of 20% when both the sample concentrations (original and duplicate) are greater than five times the PRDL and one times the PRDL when either of the sample concentrations are less than five times the PRDL.

Laboratory and field precision is calculated at 100%.

Overall field and laboratory precision is acceptable.

ACCURACY

Was the accuracy acceptable?			**Comments**
	Yes	X	
	No		

Comments

Accuracy is the agreement between a measured value and a 'true' value. Accuracy is assessed using field collection blanks (field collection equipment/rinsate blanks), field collection reference standards, laboratory matrix spikes, laboratory control standards (LCS), laboratory method blanks, and laboratory fortified blanks. Control limits are taken from the US EPA, 2017 National Functional Guidelines for Inorganic Superfund Data Review (2017).

The suggested target accuracy is evaluation of 90% of all the applicable QC samples as listed above to be within control limits.

The overall field and laboratory accuracy is acceptable.

REPRESENTATIVENESS			
Was the data accurately represented?	**Comments**		
	Yes	X	
	No		

Comments

Representativeness is the degree to which sample data accurately and precisely represent the characteristics of a population, variations in a parameter at a sampling point, or an environmental condition that they are intended to represent.

All sample data was accurately represented. The 2022 synoptic run monitoring was carried out correctly and followed established field and laboratory procedures.

COMPLETENESS			
Was the Completeness Goal Met for this Project?	**Comments**		
	Yes	X	
	No		

Comments

Completeness is the overall ratio of the number of samples planned versus the number of samples collected with valid analyses.
A total of 16 samples were planned and 15 were collected. A sample could not be collected from PRT (Power Road Tributary) as it was dry. Determination of completeness included a review of chain of custody records, laboratory analytical methods and detection limits, and laboratory case narratives. Completeness also included 100% review of the laboratory sample data results and QC summary reports. All of the data received by the laboratory are usable, and no data were missing or rejected.
Completeness goals are set at 90-100%. Completeness for the Talen Montana, Synoptic Run project is calculated at 99%.

What Was the Percent Completeness?

Comments

Completeness of the data is calculated at 100% and is acceptable.

COMPARABILITY			
Was the Comparability Goal Met for this Project?	**Comments**		
	Yes	X	
	No		

Comments

Comparability is the expression of confidence with which one data set can be compared with another. Comparability of data is achieved by consistently following standard field and laboratory procedures and by using standard measurement units in reporting analytical data.

All of the data compared well with previous data sets.

Other General Comments or Observations.

Comments:

QUALIFIERS:

Laboratory Qualifiers

Energy Laboratories Qualifiers

D - RL increased due to sample matrix.

L - Lowest available reporting limit for the analytical method used.

H - Analysis performed past recommended holding time.

E - Estimated value. Result exceeds the instrument upper quantitation limit.

Pace Analytical Services Qualifiers

D3 - Sample was diluted due to the presence of high levels of non-target analytes or other matrix interference.

D4 - Sample diluted due to the presence of high levels of target analytes.

E - Analyte concentration exceeded the calibration range, result is estimated.

H6 - Analysis performed past recommended holding time.

J - Estimated

M1 - Matrix spike recovery exceeded QC limits, accepted based on laboratory control sample (LCS) recovery.

M6 - Matrix spike and matrix spike duplicate recovery not evaluated due to sample dilution.

R3 - RPD value was outside control limits due to uncertainty of values at or near the PRL.

Hydrometrics Data Validation Qualifiers

Hydrometrics Validation Qualifiers

U - Analyte analyzed for, but not detected

J - Analyte identified, but value is estimated

J+ - Result is estimated and may be biased high

J- - Result is estimated and may be biased low

A - Anomalous value

E - Value is estimated

R - Rejected, data are unusable.

H - Holding Time

REFERENCES:

US EPA, 2017. US Environmental Protection Agency National Functional Guidelines for Inorganic Superfund Methods Data Review EPA-540-R-2017-001; January 2017.

US EPA, 2012. US Environmental Protection Agency Contract Laboratory Program, Statement of Work For Inorganic Superfund Methods, Multi-Media, Multi-Concentration, ISM02.0; November 2012.

Montana Department of Environmental Quality Data Validation Guidelines for Evaluating Analytical Data, January 26, 2018.

Talen Montana Colstrip Steam Electric Station 2022 East Fork Armells Creek Synoptic Run Work Plan

ATTACHMENTS

Tables:

Table 1. Summary of Laboratory Methods And Detection Limits

Table 2. Summary of Samples Evaluated

Water Quality Report:

Data Summary Analysis Report

TABLE 1. 2022 SYNOPTIC RUN SURFACE WATER ANALYTICAL PARAMETERS

Constituent	USEPA Analytical Method	Requested Laboratory Reporting Limit (mg/L) Unless Noted
Dissolved Oxygen	Field	
pH		
Temperature		
Specific Conductivity @ 25° C		
ORP (Oxidation Reduction Potential)	Field	
pH	150.2/A 4500 H B	0.1 s.u.
Specific Conductivity @ 25° C	120.1/A 2510 B	1 µmhos/cm
Total Dissolved Solids, filterable	A2540 C	10
Total Alkalinity as $CaCO_3$ (Hardness)	310.1 or SM A2320B	4
Bicarbonate	SM A2320B	4
Carbonate	310.1 or SM A2320B	4
Bromide	300.0	0.5
Sulfate	300.0	1.0
Chloride	300.0	1.0
Calcium(1)	200.7/200.8	1.0
Magnesium(1)	200.7/200.8	1.0
Sodium(1)	200.7/200.8	1.0
Potassium(1)	200.7/200.8	1.0
Nitrate+Nitrite as Nitrogen	353.2	0.01
Boron(2)	200.7/200.8	0.05
Cobalt(2)	200.7/200.8	0.005
Lithium(2)	200.7/200.8	0.01
Manganese(2)	200.7/200.8	0.001
Mercury(2)	245.1	0.0001
Molybdenum(2)	200.7/200.8	0.001
Selenium(2)	200.7/200.8	0.0006

(1) Dissolved analysis only
(2) Metals will be analyzed as Total Recoverable and Dissolved

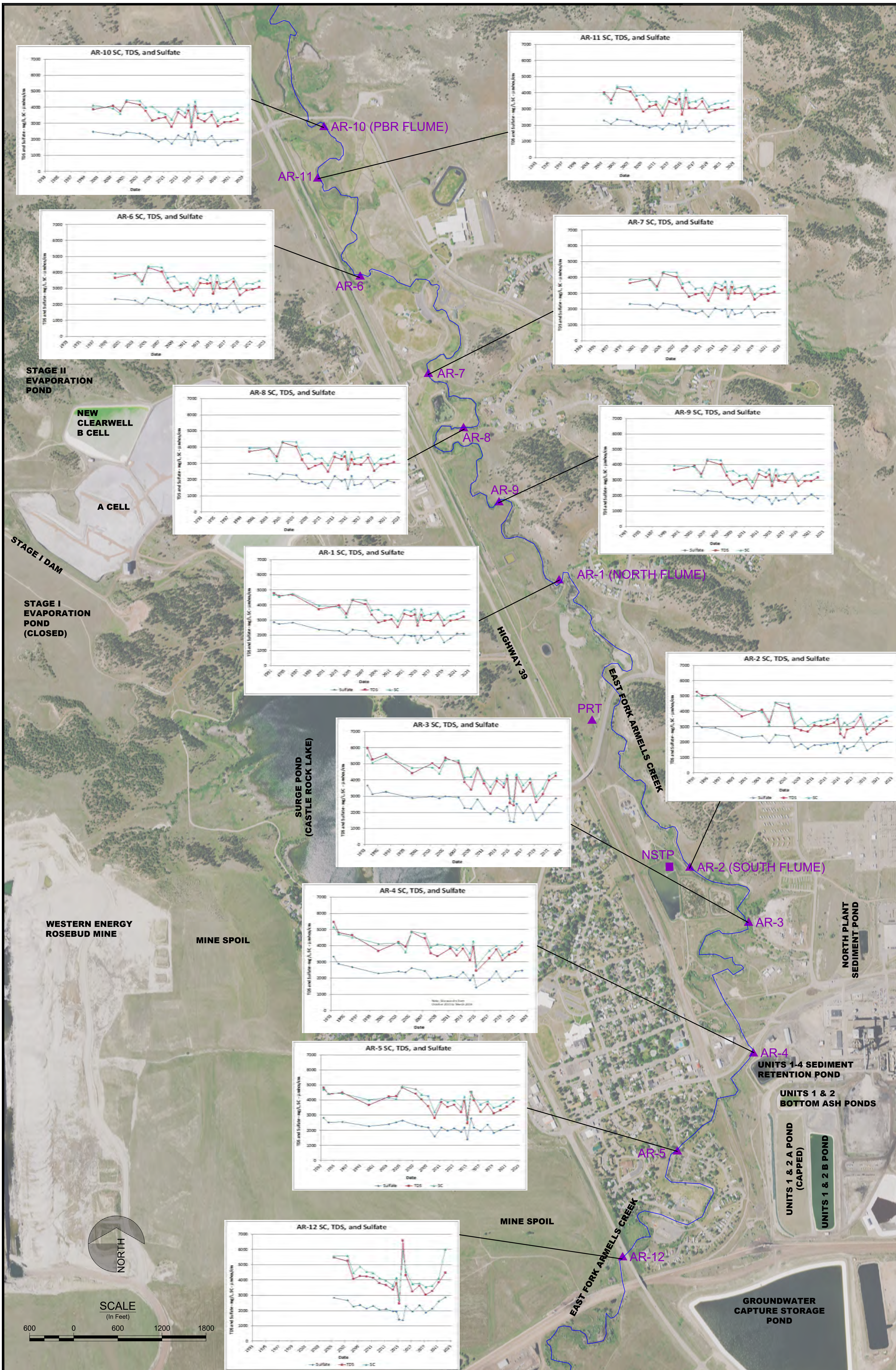
Hydrometrics, Inc.
Consulting Scientists and Engineers

Table 2. Summary Of Samples Evaluated

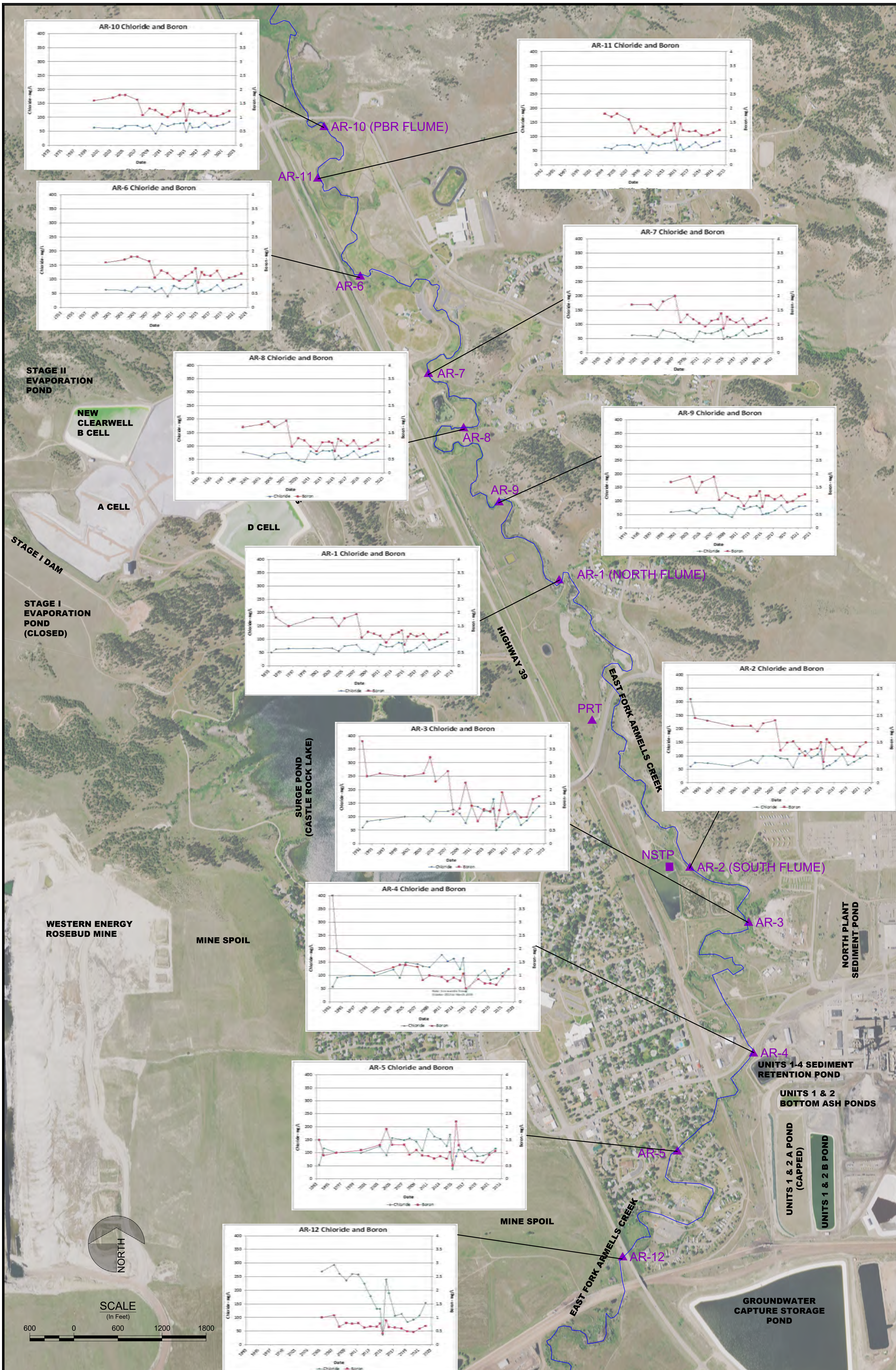
Lab	Lab Project Batch ID	Location Code	Sample Code	Date	Location Area	Sample Type	Matrix
EL	B22031973	AR-10PBR	TLN-2203-100	3/23/2022	EF Armells Creek	Planned Monitoring Sample	W
EL	B22031973	AR-11	TLN-2203-101	3/23/2022	EF Armells Creek	Planned Monitoring Sample	W
EL	B22031973	AR-6	TLN-2203-102	3/23/2022	EF Armells Creek	Planned Monitoring Sample	W
EL	B22031973	AR-7	TLN-2203-103	3/23/2022	EF Armells Creek	Planned Monitoring Sample	W
EL	B22031973	AR-8	TLN-2203-104	3/23/2022	EF Armells Creek	Planned Monitoring Sample	W
EL	B22031973	AR-9	TLN-2203-105	3/23/2022	EF Armells Creek	Planned Monitoring Sample	W
EL	B22031973	AR-1NF	TLN-2203-106	3/23/2022	EF Armells Creek	Planned Monitoring Sample	W
EL	B22031973	AR-2SF	TLN-2203-108	3/23/2022	EF Armells Creek	Planned Monitoring Sample	W
EL	B22031973	NSTP	TLN-2203-109	3/23/2022	EF Armells Creek	Planned Monitoring Sample	W
EL	B22031973	AR-3	TLN-2203-110	3/23/2022	EF Armells Creek	Planned Monitoring Sample	W
EL	B22031973	AR-4	TLN-2203-111	3/23/2022	EF Armells Creek	Planned Monitoring Sample	W
EL	B22031973	AR-5	TLN-2203-112	3/23/2022	EF Armells Creek	Planned Monitoring Sample	W
EL	B22031973	AR-12	TLN-2203-113	3/23/2022	EF Armells Creek	Planned Monitoring Sample	W
EL	B22031973	DI Blank	TLN-2203-114	3/23/2022	Field QC	Field QC Blank	W
EL	B22031973	AR-1NF (Dup)	TLN-2203-115	3/23/2022	Field QC	Field QC Duplicate	W
EL	B22031973	PRT	TLN-2203-107	3/23/2022	Field QC	Observation	W

Talen - Synoptic Run WQ March 2022																		
Station Name		Units	AR-10PBR	AR-11	AR-12	AR-1NF	AR-1NF(Dup)	AR-2SF	AR-3	AR-4	AR-5	AR-6	AR-7	AR-8	AR-9	NSTP	PRT	Blank
Sample ID			TLN-2203-10	TLN-2203-10	TLN-2203-113	TLN-2203-106	TLN-2203-115	TLN-2203-108	TLN-2203-110	TLN-2203-111	TLN-2203-112	TLN-2203-10	TLN-2203-103	TLN-2203-104	TLN-2203-105	TLN-2203-109	TLN-2203-107	TLN-2203-114
Sample Date			3/23/2022	3/23/2022	3/23/2022	3/23/2022	3/23/2022	3/23/2022	3/23/2022	3/23/2022	3/23/2022	3/23/2022	3/23/2022	3/23/2022	3/23/2022	3/23/2022	3/23/2022	3/23/2022
Physical																		
FLOW		gpm	0.865	0.883	Frozen	0.497		0.145	0.308	0.0823	0.104	0.883	0.775	0.596	1.277	NA	NO SAMPLE	
OXYGEN (O) (FLD)	DIS	mg/L	6.32	7	1.44	5.51		5.45	5.97	6.01	4.38	6.76	5.81	6.09	5.75	3.81		
pH - FLD		s.u.	7.82	7.89	7.12	7.76		7.66	7.42	7.7	7.38	7.91	7.82	7.84	7.8	7.76		
XIDATION REDUCTION POTENTIAL		mV	105.4	NA	-51.2	125.9		102.8	62.5	110.3	80.5	109.7	119.9	143.1	128.8	104.5		
pH - LAB		s.u.	8.1	8.2	7.8	8.1	8.0	8.1	7.8	8.0	7.8	8.2	8.1	8.1	8.1	8.1		6.6
SC (UMHOS/CM AT 25 C)		umhos/cm	3,420	3,320	4,560	3,420	3,450	3,560	4,300	4,100	4,030	3,260	3,300	3,300	3,370	1,990		<5
SC (UMHOS/CM AT 25 C) (FLD)		umhos/cm	3,656	3,508	6,000	3,600		3,682	4,469	4,240	4,170	3,472	3,461	3,500	3,548	2,175		
TDS (MEASURED AT 180 C)		mg/L	3,220	3,100	4,470	3,220	3,220	3,370	4,250	4,000	3,910	3,080	3,080	3,080	3,170	1,390		<10
TOTAL SUSPENDED SOLIDS		mg/L	<10	<10	27	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	69		<10
WATER TEMPERATURE (FLD)		C	0.2	0.5	1.7	1.9		9.2	6	5.3	4.1	0.5	0.2	0.4	1.1	10		
Major Constituents																		
BICARBONATE ALK AS HCO3		mg/L	560	549	679	587	587	574	685	681	659	544	557	554	577	508		<4
BROMIDE (BR)		mg/L	<0.5	<0.5	<0.5	0.5	0.6	0.7	1.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5
CARBONATE AS CO3		mg/L	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4		<4
CHLORIDE (CL)		mg/L	83	83	154	92	89	102	139	123	116	81	78	80	81	106		<0.5
SULFATE (SO4)		mg/L	1,930	1,970	2,860	2,110	2,000	2,010	2,870	2,470	2,360	1,900	1,800	1,830	1,820	598		<1
TOTAL ALKALINITY AS CACO3		mg/L	459	453	557	481	481	471	562	559	540	451	457	455	473	417		<4
CALCIUM (CA)	DIS	mg/L	270	265	358	294	284	310	368	345	331	268	273	272	280	106		<0.5
MAGNESIUM (MG)	DIS	mg/L	316	305	502	318	319	339	452	441	429	299	303	302	313	116		<0.5
POTASSIUM (K)	DIS	mg/L	13	13	16	13	12	12	13	12	13	13	13	12	12	33		<1
SODIUM (NA)	DIS	mg/L	207	198	273	195	194	189	247	226	221	187	189	188	193	165		<0.2
Nutrients																		
NITRATE + NITRITE AS N		mg/L	0.05	0.04	0.03	0.15	0.15	0.08	0.05	0.18	0.50	0.05	0.09	0.08	0.12	0.14		<0.01
NITROGEN, TOTAL (Persulfate)		mg/L	0.5	0.5	2.0	0.6	0.6	1.0	0.7	1.1	1.5	0.5	0.6	0.6	0.6	22.3		<0.1
PHOSPHORUS (P)	TOT	mg/L	0.035	0.040	0.161	0.051	0.052	0.020	0.022	0.032	0.039	0.050	0.050	0.056	0.066	10.7		<0.005
Metals & Minor Constituents																		
BORON (B)	DIS	mg/L	1.23	1.23	0.69	1.25	1.24	1.50	1.75	1.24	1.07	1.20	1.22	1.22	1.24	0.81		<0.05
BORON (B)	TRC	mg/L	1.34	1.39	0.72	1.31	1.34	1.61	1.77	1.29	1.06	1.34	1.29	1.35	1.31	0.84		<0.05
COBALT (CO)	DIS	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		<0.005
COBALT (CO)	TRC	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		<0.005
LITHIUM (LI)	DIS	mg/L	0.08	0.07	0.2	0.09	0.08	0.08	<0.1	<0.1	<0.1	0.07	0.07	0.08	0.08	0.07		<0.01
LITHIUM (LI)	TRC	mg/L	0.08	0.09	0.14	0.08	0.08	0.09	0.09	0.09	0.10	0.08	0.08	0.08	0.08	0.07		<0.01
MANGANESE (MN)	DIS	mg/L	0.159	0.150	2.23	0.155	0.154	0.832	0.642	0.302	0.940	0.111	0.117	0.124	0.164	0.055		<0.001
MANGANESE (MN)	TRC	mg/L	0.161	0.151	2.22	0.171	0.184	0.848	0.660	0.316	0.928	0.119	0.128	0.130	0.187	0.069		<0.001
MERCURY (HG)	DIS	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001		<0.0001
MERCURY (HG)	TRC	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001		<0.0001
MOLYBDENUM (MO)	DIS	mg/L	0.002	0.002	0.004	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.003	0.002	<0.001		<0.001
MOLYBDENUM (MO)	TRC	mg/L	0.002	0.002	0.003	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	<0.001		<0.001
SELENIUM (SE)	DIS	mg/L	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006		<0.0006
SELENIUM (SE)	TRC	mg/L	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006		<0.0006

EXHIBITS



LEGEND	Hydrometrics, Inc.			DRAWING FILE NUMBER
▲AR-12 SYNOPTIC RUN SURFACE WATER SITE	Consulting Scientists and Engineers Billings, Montana 59106 3602 Hesper Road (406) 656-1172	MARCH 23, 2022 EAST FORK ARMELLS CREEK SYNOPTIC RUN REPORT	TOTAL DISSOLVED SOLIDS, SPECIFIC CONDUCTANCE AND SULFATE	903622B003 AUTOCAD 2000 DRAWING (DWG) EXHIBIT 1



LEGEND

▲ AR-12 SYNOPTIC RUN SURFACE WATER SITE

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EAST FORK ARMELLS CREEK
SYNOPTIC RUN REPORT

CHLORIDE AND BORON

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