Response to Brian Rath questions.
February 2024

1) Special Condition 9(e) of the executed BUD states, *"Groundwater samples shall be field analyzed for temperature, specific conductance, and pH whenever a sample is withdrawn from a monitoring well. Furthermore, groundwater samples shall not be field-filtered prior to analysis by a laboratory certified by the DNR."* However, Page 14 (March 2023 lab report) of the submittal states, *"Samples were filtered in the field prior to preservation for metals analysis."* Please discontinue field filtering of all samples as this does not allow for proper analysis of the site's groundwater condition. If the field sampling did not occur and the note was an error, please provide written clarification of what occurred.

   The field filtering note was made in error. I am confused why such a note is there. In my discussions with Keystone, I noted that some samples had heavy concentrations of solids and asked if I should field filter as I would need to purchase the equipment if filtering was needed. Keystone responded that I was not to field filter and I did not purchase the equipment.

2) MW QW was noted as dry (since December 2022) on pages 5 and 7 of the submitted report. Please continue to discuss this in future reports, including whether or not this well should be replaced to obtain an adequate sample.

   The status of MW QW is addressed in the revised report.

3) Page 5 of the report submittal states in part, *"Groundwater samples are typically obtained on two semi-annual occasions with the most recent event taking place on June 19, 2023."* While this report references June 2023 samples within the narrative and in the associated Tables, the referenced lab report is from the March 2023 sampling event. Please provide the June 2023 lab report.

   The June 2023 chemical analyses replaces the March 2023 analyses in the revised June Semi-annual report.

4) With regard to Table 2 on page 6 of the report submission, only six parameters are noted when sampling for all Appendix D parameters was completed in March 2023. Further, there should be the March 2023 and June 2023 data for all Appendix D parameters in this and other report tables. Please revise and resubmit Table 2 and other applicable tables.

   It is my indent to continue the tables in the "word" document as is, noting only a portion of the chemical data. A table will be added to the Appendix for each monitoring well and the historic data for that particular well. The report discussion will address all analyses parameters.

5) Pages 7-8 of the report submittal state in part, *"Table 3 notes manganese concentrations exceeded the State of Iowa non-protected groundwater standard in MW QS and QNW. Cobalt concentrations exceeded the standard in MWs QNW, QS, and Q. Nickel exceeded the standard in MW QS."* Table 3 states that the results are for March 2023, but the analytics are only from the

June 2023 sampling. Please update the Table 3 title accordingly. Also, only the Cobalt exceedance of the non-protected groundwater standard was noted in monitoring well QS. Please reconcile and revise the narrative statement above with the results in Table 3.

Narrative for Table 3 has been addressed.

6) As was noted above, the Table 4 title indicates the results are from March 2023. However, the results are only from the June 2023 sampling. Please update Table 4 to include both sampling events and ensure all report tables and date references regarding sampling events are accurate.

Narrative for Table 4 has been addressed.

7) Page 8 of the report submittal states in part, *"Table 4 notes that the listed metals; manganese and molybdenum, were detected at concentrations that exceeds the State of Iowa protected groundwater standard. The exceedances are highlighted in yellow. The June 2023 sampling noted all of the six monitoring wells exceeded the manganese standard. One MW exceeded the molybdenum standard, QN."* Per the 2023 results, Cobalt was also detected at concentrations that exceeded the protected GW standard in 5 monitoring wells. Further, since MW-QW was dry, there are only 5 monitoring points that could have had exceedances. Please reconcile and resubmit Table 4 and the narrative statement above.

Narrative for Table 4 has been addressed.

8) Page 44 of the report submission states in part, *"For the most current data, there are no site prediction limit exceedances. Using intrawell comparisons with insufficient background, there are no control limit exceedances."* These conclusions appear to be based upon an incomplete number of parameters being analyzed - s versus all Appendix D parameters. Also, as noted above, statistics are only required as part of the Annual Water Quality Report submission. Please ensure the upcoming March 1st AWQR submission includes discussion on the findings of the required statistical analysis. As noted in the Beneficial Use Determination, statistics should commence when 4 data points are available, and the DNR requests this be expanded up to 8 as those become available.

Future statistical reviews will address all Appendix D parameters.

9) Total Suspended Solid (TSS) results in the attached March 2023 sampling exceeds our unofficial trigger for concern of 100 mg/L. As such, this very likely impacts the total metals lab results. However, this conflicts with the field filtering notation that was discussed above. Please provide a detailed discussion of your sampling procedures. In addition, please provide a discussion comparing TSS values to metals and make recommendations for changing sampling procedures as necessary to reduce TSS during future sampling events.

As discussed in our meeting, the ground water level has been dropping. When sampling the wells, the lower level of groundwater which results in the disturbance of the sediment at the bottom of the well which obviously influences the metal concentrations of the analyses as the medium being analyzed has a high concentration of solids.

10) Field forms do not provide sufficient detail regarding your field procedures. Please start using the forms on our website or ensure sufficient information is included on your forms for future sampling events.

IDNR field forms will be used ongoing.

First Semi-Annual 2023 Groundwater Sampling Report

Sand Management Site

Boone, Iowa

July 2023

Prepared by

STONE ENVIRONMENTAL ENGINEERING

1631 NW 30th Court
Ankeny, Iowa 50023

SEE-001-023-392

First Semi-Annual 2023
Groundwater Sampling Report
Sand Management Site

July 2023

	I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Iowa. _____ _____ Donn L Stone, P.E. Date License Number: 11461 My license renewal date is December 31, 2024

First Semi-Annual 2023
Groundwater Sampling Report
Sand Management Site

TABLE OF CONTENTS

1.0 INTRODUCTION

Besser Quinn owns a facility known as the Besser Quinn Sand Management Site. This site has received used foundry sand since 2000. The site is under closure procedures and is operating under DNR ID #08-BUD-08-99 as prepared by the Iowa Department of Natural Resource. The BUD requires groundwater monitoring for four quarters of a year and thence semi-annually. This report presents the findings of a sampling event during June 2023 to perform chemical analysis consistent with the BUD. The former chemical analyses were associated with the chemical analyses required for sand being deposited at the site. The semi-annual sampling program will continue with the next sampling event anticipated in November 2023.

1.1 OWNER INFORMATION

Besser Quinn Machine and Foundry
Division of the Besser International Pipe Machinery Corporation
1518 12th Street
Boone, Iowa 50036

Besser-Quinn Vice President - Pipe and Precast
Brian Christle - 515-432-3553

1.2 SITE LOCATION INFORMATION

The Quinn Quarry Reclamation site is located along Boone County Road E-41, which was formerly USA Highway 30. The street address of the site is 1159 216th Drive. Figure 1 notes the location of the Besser Quinn Sand Management Site.

1.3 HISTORIC DISSCUSSION

The initial development of the site required the determination of depth to groundwater and the collection of groundwater samples for chemical analysis. To accomplish these tasks, three groundwater wells were installed. Groundwater was found near 30' of depth and quality control samples did not note the presence of chemical at unacceptable concentrations.

2.0 SUBSURFACE CONDITIONS AND MONITORING WELLS

Monitoring wells were installed in 2000 as a function of the initial siting of the management site. In late 2018, the initial wells were checked and two of the wells were determined to be non-functionable. Two replacements wells were installed adjacent to the tow non-functional wells. Monitoring of the three functional wells did not present a defined groundwater flow direction and IDNR requested two additional wells to assist in defining the groundwater flow direction. After the completion of the fourth and fifth wells, IDNR geologic staff review satellite images and suggested that the management site was sighted on a narrow peninsula of glacial till surrounded by alluvium. Based on this observation, this location of the site could potentially have groundwater flow in several directions which could change with time.

Historic groundwater measurements note inconsistent trends in elevations, with some monitoring wells noting higher elevations than the previous sampling event, while the others were noted as lower than the previous sampling event. Groundwater surface elevations for the December 2022 sampling event were all noted as lower than the previous sampling event. MW QW was noted as dry. Table 1 presents the current groundwater elevations compared the to the previous sampling event measurements.

Table 1
Groundwater Depth
July 2023

Monitoring well	Depth to water	Height of Riser	Well Screen	Surface Elevation	Groundwater Elevation June 2023	Previous Elevation March 2023
QN	27.00	2.60	26’-36’	909.82	882.67	882.82
QNE	32.98	3.33	18'-50'	919.14	888.80	886.16
QNW	45.94	3.04	18'-50'	922.01	875.51	876.07
QS	41.42	3.13	18'-50'	916.18	874.74	874.76
QE	34.00	2.72	24’-34’	915.76	880.54	881.76
QW	dry	3.05	34’-44’	912.19		

3.0 REVIEW OF GROUNDWATER ANALYSIS

Groundwater samples are typically obtained on two semi-annual occasions with the most recent event taking place on June 19, 2023. The samples were subjected to the analysis outlined in the BUD. Table 2 presents some of the concentration of detected materials in the groundwater

samples. The full analysis and a summary of historic analyses compared to groundwater standards is in the appendix. The BUD lists certain VOC compounds for analysis, further the BUD states that the groundwater analysis need not be performed on the VOC compounds if there are not found to be present in the sand being placed at the site. Per the most recent sand analysis, no VOCs were noted as present.

Table 2
Historic Groundwater Analysis, ppm
March, June, September & December 2020, June 2021 & December 2021, June 2022
March 2023, June 2023

Monitoring well	Manganese Total Metal	Molybdenum Total Metal	Barium Total Metal	Boron Total Metal	Cobalt Total Metal	Nickel Total Metal
QN - March	1.15	0.358	0.205	0.544	0.0039	0.019
QN - June	0.945	0.265	0.089	0.479	0.0035	0.020
QN-September	0.857	0.246	0.079	0.481	0.0029	0.017
QN - December	1.10	0.250	0.104	0.520	0.0039	0.016
QN – June 2021	0.955	0.223	0.122	0.661	0.0034	0.013
QN – Dec. 2021	0.614	0.184	0.126	0.634	0.0025	0.017
QN – June 2022	0.333	0.024	0.056	0.124	0.0008	0020
QN – Dec. 2022	0.922	0.134	0.043	0.523	0.0059	0.025
QN – March 2023	0.782	0.124	0.0445	0.654	0.0027	0.016
QN – June 2023	0.689	0.115	0.0881	0.603	0.0061	0.0121
QNE - March	1.46	0.115	0.149	1.15	0.0038	0.016
QNE - June	0.616	0.021	0.104	0.476	0.0019	0.018
QNE-September	0.698	0.023	0.094	0.0752	0.0011	0.015
QNE - December	0.604	0.023	0.097	0.739	0.0013	0.012
QNE – June 2021	0.397	0.020	0.096	0.749	0.0006	ND
QNE – Dec. 2021	0.431	0.020	0.097	0.730	0.0007	ND
QNE – June 2022	0.313	0.018	0.100	0.608	0.0005	ND
QNE – Dec. 2022	0.399	0.014	0.096	0.632	0.0043	ND
QNE – Mar2023	0.639	0.0129	0.0907	0.671	0.0011	0.0053
QNE – June 2023	0.347	0.0117	0.100	0.620	0.0062	0.0044
QNW -March	1.04	ND	0.226	0.174	0.0033	ND
QNW - June	0.302	ND	0.170	ND	0.0074	0.010
QNW-September	0.056	ND	0.245	0.198	0.0004	ND
QNW- December	0.045	ND	0.287	0.247	0.0004	ND
QNW – June 2021	0.701	ND	0.260	0.163	0.0033	ND
QNW- Dec. 2021	0.714	ND	0.309	0.0277	0.0067	ND
QNW – June 2022	5.24	0.018	1.82	0.122	0.0804	0.100

QNW – Dec. 2022	9.88	0.020	1.40	0.296	0.0581	0.091
QNW -Mar 2023	0.105	ND	0.195	0.147	0.0007	0.0040
QNW– June 2023	0.512	ND	0.249	0.138	0.0030	0.0056
QS - March	16.6	0.02	2.99	0.162	0.227	0.338
QS - June	0.658	ND	0.256	ND	0.0103	0.021
QS-September	0.419	ND	0.250	ND	0.0064	0.015
QS - December	1.08	ND	0.384	ND	0.0135	0.025
QS – June 2021	0.429	ND	0.261	0.114	0.007	0.012
QS – Dec. 2021	0.078	ND	0.202	ND	0.0038	ND
QS – June 2022	20.0	0.022	3.89	0.139	0.226	0.336
QS – Dec. 2022	12.0	0.014	2.68	0.135	0.192	0.229
QS – Mar 2023	ND	ND	0.188	ND	ND	ND
QS – June 2023	2.42	ND	0.719	0.106	0.0357	0.0456
QE - March	1.29	ND	0.120	0.293	0.0048	0.011
QE - June	1.02	ND	0.114	0.185	0.002	ND
QE-September	0.808	ND	0.063	0.524	0.0004	ND
QE - December	0.776	0.010	0.052	0.523	0.0042	0.015
QE – June 2021	2.07	ND	0.0065	0.504	0.0017	ND
QE – Dec. 2021	3.01	ND	0.077	0.489	0.0024	0.015
QE – June 2022	0.719	ND	0.069	ND	0.0023	ND
QE – Dec 2022	1.5	0.019	0.152	0.645	0.0293	0.043
QE – Mar 2023	1.39	0.0041	0.637	0.167	0.0066	0.0157
QE – June 2023	3.03	0.0040	0.0778	0.385	0.0076	0.0116
QW - March	0.082	ND	0.176	ND	0.0012	ND
QW - June	0.024	ND	0.151	ND	0.0004	ND
QW-September	0.023	ND	0.156	ND	0.0004	ND
QW - December	0.049	ND	0.170	ND	0.0009	ND
QW – June 2021	0.504	ND	0.284	ND	0.0082	0.016
QW – Dec. 2021	0.059	ND	0.189	ND	0.0013	ND
QW – June 2022	2.02	ND	0.628	ND	0.0308	0.053
QW – Dec. 2022	Dry	Dry	Dry	Dry	Dry	Dry
QW – Mar 2023	Dry	Dry	Dry	Dry	Dry	Dry
QW – June 2023	Dry	Dry	Dry	Dry	Dry	Dry

Table 2 notes that selected metals exhibit concentrations fairly consistent between June 2022, and December 2022. Again, MW QW was noted as dry and no groundwater sample was obtained. Manganese was noted at higher concentrations during the current sampling event, with the exception of MW QS. MW QE noted the presence of all metals, three of which were noted as non-detect during the June 0200 sampling.

Table 3 presented below compares the ground water to the State of Iowa non-protected groundwater standard. Table 3 notes manganese concentrations exceeded the State of Iowa non-protected groundwater standard in MW QS and QNW. No concentration exceedances with respect to the non-protected groundwater standard were noted.

Table 3
Groundwater Analysis to Non-Protected Groundwater Std., ppm
June 2023

Monitoring well	Manganese Total Metal	Molybdenum Total Metal	Barium Total Metal	Boron Total Metal	Cobalt Total Metal	Nickel Total Metal
Non-Protected GW standard	4.9	0.2	10	30	0.01	0.7
QN –June 2023	0.689	0.115	0.0881	0.603	0.0061	0.0121
QNE – June 2023	0.347	0.0117	0.100	0.620	0.0062	0.0044
QNW – June 2023	0.512	ND	0.249	0.138	0.0030	0.0056
QS – June 2023	2.42	ND	0.719	0.106	0.0357	0.0456
QE –June 2023	3.03	0.0040	0.0778	0.385	0.0076	0.0116
QW – June 2023	Dry	Dry	Dry	Dry	Dry	Dry

Table 4
Groundwater Analysis to Protected Groundwater Std., ppm
June 2023

Monitoring well	Manganese Total Metal	Molybdenum Total Metal	Barium Total Metal	Boron Total Metal	Cobalt Total Metal	Nickel Total Metal
Protected GW standard	0.3	0.04	2.0	6.0	0.0021	0.1
QN –June 2023	0.689	0.115	0.0881	0.603	0.0061	0.0121
QNE – June 2023	0.347	0.0117	0.100	0.620	0.0062	0.0044
QNW – June 2023	0.512	ND	0.249	0.138	0.0030	0.0056
QS – June 2023	2.42	ND	0.719	0.106	0.0357	0.0456
QE –June 2023	3.03	0.0040	0.0778	0.385	0.0076	0.0116
QW – June 2023	Dry	Dry	Dry	Dry	Dry	Dry

Table 4 notes that the listed metals; cobalt, manganese and molybdenum, were detected at concentrations that exceeds the State of Iowa protected groundwater standard. The exceedances are highlighted in yellow. The June 2023 sampling noted five monitoring wells exceeded the manganese standard. One MW exceeded the molybdenum standard, QN. One MW exceeded the cobalt standard, QS.

Other parameters note listed in Table 3 as exceeding the protected groundwater standard are nickel in MW QS, lead in MW QS, arsenic in MW QS and QN.

A statistical analysis of the groundwater surface and metal concentration trends was performed by Otter Creek Environmental Services, L.L.C., Elgin, Illinois. A copy of the report is included in the Appendix.

4.0 SUMMARY

This sampling report presents data from the first semi-annual groundwater sampling event for 2023. The current concentrations, for the most part, are consistent with the previous sampling events and analysis. Future sampling events will be undertaken to develop site averages for chemical parameters.

Monitoring well QW has been noted as dry starting with the December 2022 sampling event. Monitoring wells QNW, QNE, and QS have noted limited amount of groundwater present that last three sampling events such that obtaining a sample without heavy solids content is difficult. These four wells are noting as being located in a heavy glacial till soil which is known for limited permeability. The question of deeper wells presents itself. A review of the historic water levels suggest little if any commonality between the groundwater levels from well to well, for any sampling event some water levels may raise while others fall. At the present, we suggest gathering more data on the sand deposited at the site and reviewing groundwater elevation history to present and discussions regarding the need and placement for additional monitoring wells.

We question the need to continue analyzing for all the parameters noted in Appendix D of the BUD. The intent of the chemical analysis is to determine if the chemical parameters noted in the deposited foundry sand are leaching into the groundwater. The foundry sand was not subjected to all of the noted parameters in Appendix D. From that thought we may be analyzing for chemicals that would not be expected to be present. And, the parameters noted as present in the wells may not be present in the deposited sand. We plan to obtain sand samples from several locations at the site and have them analyzed for the Appendix D list. Also, several chemical parameters have been historically noted as non-detect. Once that task is completed, a request will be presented to modify the Appendix D list to reflect the chemicals expected to be present.

Based on the comparison to the Iowa state wide groundwater standards, the concentrations noted with this sampling event notes several metals as non-compliant with the standard. Sampling and reporting will continue until the life of the BUD is complete.

Appendix A

Chemical Analysis

ANALYTICAL REPORT

July 06, 2023

Work Order: 1GF1741

Report To	Work Order Information
Donn Stone Stone Environmental Engineering 1631 NW 30th Court Ankeny, IA 50021	Date Received: 6/19/2023 11:33:00AM Collector: Stone, D. Phone: (515) 689-7701 PO Number:

Project: SEE 001

Project Number: [none]

Analyte	Result	MRL	Batch	Method	Analyst	Analyzed	Qualifier
1GF1741-01 MW Q N				Matrix: Water		Collected: 06/19/23 07:07	
Formaldehyde	<10.0 ug/L	10.0	1GF0999	EPA 8315	EPP	06/22/23 12:26	
Total Organic Halogens (TOX)	<0.010 mg/L	0.010	1GG0179	EPA 9020	LNH	07/06/23 10:53	
COD, total	**29 mg/L**	**20**	1GF1360	EPA 410.4	JLW	06/27/23 16:31	
Nitrogen, Ammonia	**4.64 mg/L**	**0.10**	1GF1552	TIMBERLINE	JAH	06/29/23 13:21	
Phenols, total	**0.044 mg/L**	**0.035**	1GF1516	EPA 420.1	RMC	06/29/23 15:29	
Solids, total suspended	**134 mg/L**	**5**	1GF0974	USGS I-3765-85	MEAH	06/20/23 11:20	
Chloride	**43.2 mg/L**	**1.0**	1GF1493	EPA 9056	TJB	06/27/23 14:45	
Fluoride	**0.2 mg/L**	**0.1**	1GF1493	EPA 9056	TJB	06/27/23 14:45	
Sulfate	**612 mg/L**	**10.0**	1GF1549	EPA 9056	TJM	06/28/23 16:40	
Silver, total	<0.0040 mg/L	0.0040	1GF1058	EPA 6020A	RVV	06/23/23 0:40	
Aluminum, total	**0.148 mg/L**	**0.050**	1GF1209	EPA 6010B	JAR	06/23/23 21:18	
Arsenic, total	**0.0108 mg/L**	**0.0040**	1GF1058	EPA 6020A	RVV	06/23/23 0:40	
Barium, total	**0.0881 mg/L**	**0.0040**	1GF1058	EPA 6020A	RVV	06/23/23 0:40	
Beryllium, total	<0.0040 mg/L	0.0040	1GF1058	EPA 6020A	RVV	06/23/23 0:40	
Boron, total	**0.603 mg/L**	**0.100**	1GF1209	EPA 6010B	JAR	06/23/23 21:18	
Cadmium, total	**0.0008 mg/L**	**0.0008**	1GF1058	EPA 6020A	RVV	06/23/23 0:40	
Cobalt, total	**0.0061 mg/L**	**0.0004**	1GF1058	EPA 6020A	RVV	06/23/23 0:40	
Chromium, total	<0.0080 mg/L	0.0080	1GF1058	EPA 6020A	RVV	06/23/23 0:40	
Copper, total	<0.0040 mg/L	0.0040	1GF1058	EPA 6020A	RVV	06/23/23 0:40	
Iron, total	**2.97 mg/L**	**0.100**	1GF1209	EPA 6010B	JAR	06/23/23 21:18	
Mercury, total	<0.00050 mg/L	0.00050	1GF0984	EPA 7470A	JAR	06/21/23 11:28	
Magnesium, total	**90.9 mg/L**	**0.100**	1GF1209	EPA 6010B	JAR	06/23/23 21:18	
Manganese, total	**0.689 mg/L**	**0.0040**	1GF1058	EPA 6020A	RVV	06/23/23 0:40	
Molybdenum, total	**0.115 mg/L**	**0.0040**	1GF1058	EPA 6020A	RVV	06/23/23 0:40	
Nickel, total	**0.0121 mg/L**	**0.0040**	1GF1058	EPA 6020A	RVV	06/23/23 0:40	
Lead, total	<0.0040 mg/L	0.0040	1GF1058	EPA 6020A	RVV	06/23/23 0:40	
Antimony, total	<0.0020 mg/L	0.0020	1GF1058	EPA 6020A	RVV	06/23/23 0:40	
Selenium, total	<0.0040 mg/L	0.0040	1GF1058	EPA 6020A	RVV	06/23/23 0:40	
Thallium, total	<0.0020 mg/L	0.0020	1GF1058	EPA 6020A	RVV	06/23/23 0:40	

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety. Samples were preserved in accordance with 40 CFR for pH adjustment unless otherwise noted. MRL= Method Reporting Limit.

Stone Environmental Engineering
1631 NW 30th Court
Ankeny, IA 50021

July 06, 2023

Work Order: 1GF1741

Analyte	Result	MRL	Batch	Method	Analyst	Analyzed	Qualifier
1GF1741-01 MW Q N				Matrix: Water		Collected: 06/19/23 07:07	
Vanadium, total	<0.0200 mg/L	0.0200	1GF1058	EPA 6020A	RVV	06/23/23 0:40	
Zinc, total	<0.0200 mg/L	0.0200	1GF1058	EPA 6020A	RVV	06/23/23 0:40	
1GF1741-02 MW Q NE				Matrix: Water		Collected: 06/19/23 07:21	
Formaldehyde	<10.0 ug/L	10.0	1GF0999	EPA 8315	EPP	06/22/23 12:45	
Total Organic Halogens (TOX)	<0.010 mg/L	0.010	1GG0179	EPA 9020	LNH	07/06/23 10:53	
COD, total	<20 mg/L	20	1GF1360	EPA 410.4	JLW	06/27/23 16:31	
Nitrogen, Ammonia	**1.27 mg/L**	**0.10**	1GF1552	TIMBERLINE	JAH	06/29/23 13:22	
Phenols, total	<0.035 mg/L	0.035	1GF1516	EPA 420.1	RMC	06/29/23 15:29	
Solids, total suspended	**21 mg/L**	**2**	1GF0974	USGS I-3765-85	MEAH	06/20/23 11:20	
Chloride	**8.4 mg/L**	**1.0**	1GF1493	EPA 9056	TJB	06/27/23 15:03	
Fluoride	**0.2 mg/L**	**0.1**	1GF1493	EPA 9056	TJB	06/27/23 15:03	
Sulfate	**274 mg/L**	**10.0**	1GF1549	EPA 9056	TJM	06/28/23 16:58	
Silver, total	<0.0040 mg/L	0.0040	1GF1058	EPA 6020A	RVV	06/23/23 1:05	
Aluminum, total	**0.120 mg/L**	**0.050**	1GF1209	EPA 6010B	JAR	06/23/23 21:43	
Arsenic, total	<0.0040 mg/L	0.0040	1GF1058	EPA 6020A	RVV	06/23/23 1:05	
Barium, total	**0.100 mg/L**	**0.0040**	1GF1058	EPA 6020A	RVV	06/23/23 1:05	
Beryllium, total	<0.0040 mg/L	0.0040	1GF1058	EPA 6020A	RVV	06/23/23 1:05	
Boron, total	**0.620 mg/L**	**0.100**	1GF1209	EPA 6010B	JAR	06/23/23 21:43	
Cadmium, total	<0.0008 mg/L	0.0008	1GF1058	EPA 6020A	RVV	06/23/23 1:05	
Cobalt, total	**0.0062 mg/L**	**0.0004**	1GF1058	EPA 6020A	RVV	06/23/23 1:05	
Chromium, total	<0.0080 mg/L	0.0080	1GF1058	EPA 6020A	RVV	06/23/23 1:05	
Copper, total	<0.0040 mg/L	0.0040	1GF1058	EPA 6020A	RVV	06/23/23 1:05	
Iron, total	**0.465 mg/L**	**0.100**	1GF1209	EPA 6010B	JAR	06/23/23 21:43	
Mercury, total	<0.00050 mg/L	0.00050	1GF0984	EPA 7470A	JAR	06/21/23 11:30	
Magnesium, total	**62.0 mg/L**	**0.100**	1GF1209	EPA 6010B	JAR	06/23/23 21:43	
Manganese, total	**0.347 mg/L**	**0.0040**	1GF1058	EPA 6020A	RVV	06/23/23 1:05	
Molybdenum, total	**0.0117 mg/L**	**0.0040**	1GF1058	EPA 6020A	RVV	06/23/23 1:05	
Nickel, total	**0.0044 mg/L**	**0.0040**	1GF1058	EPA 6020A	RVV	06/23/23 1:05	
Lead, total	<0.0040 mg/L	0.0040	1GF1058	EPA 6020A	RVV	06/23/23 1:05	
Antimony, total	<0.0020 mg/L	0.0020	1GF1058	EPA 6020A	RVV	06/23/23 1:05	
Selenium, total	<0.0040 mg/L	0.0040	1GF1058	EPA 6020A	RVV	06/23/23 1:05	
Thallium, total	<0.0020 mg/L	0.0020	1GF1058	EPA 6020A	RVV	06/23/23 1:05	
Vanadium, total	<0.0200 mg/L	0.0200	1GF1058	EPA 6020A	RVV	06/23/23 1:05	
Zinc, total	<0.0200 mg/L	0.0200	1GF1058	EPA 6020A	RVV	06/23/23 1:05	
1GF1741-03 MW Q NW				Matrix: Water		Collected: 06/19/23 07:40	
Formaldehyde	<10.0 ug/L	10.0	1GF0999	EPA 8315	EPP	06/22/23 13:04	
Total Organic Halogens (TOX)	**0.038 mg/L**	**0.010**	1GG0179	EPA 9020	LNH	07/06/23 10:53	TOX-2
COD, total	<20 mg/L	20	1GF1360	EPA 410.4	JLW	06/27/23 16:31	

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Stone Environmental Engineering
1631 NW 30th Court
Ankeny, IA 50021

Work Order: 1GF1741

Analyte	Result	MRL	Batch	Method	Analyst	Analyzed	Qualifier
1GF1741-03 MW Q NW				Matrix: Water		Collected: 06/19/23 07:40	
Nitrogen, Ammonia	<0.10 mg/L	0.10	1GF1552	TIMBERLINE	JAH	06/29/23 13:24	
Phenols, total	**0.054 mg/L**	**0.035**	1GF1516	EPA 420.1	RMC	06/29/23 15:29	
Solids, total suspended	**4780 mg/L**	**50**	1GF0974	USGS I-3765-85	MEAH	06/20/23 11:20	
Chloride	**265 mg/L**	**10.0**	1GF1549	EPA 9056	TJM	06/28/23 17:16	
Fluoride	**0.2 mg/L**	**0.1**	1GF1493	EPA 9056	TJB	06/27/23 15:21	
Sulfate	**152 mg/L**	**10.0**	1GF1549	EPA 9056	TJM	06/28/23 17:16	
Silver, total	<0.0040 mg/L	0.0040	1GF1058	EPA 6020A	RVV	06/23/23 1:11	
Aluminum, total	**1.42 mg/L**	**0.050**	1GF1209	EPA 6010B	JAR	06/23/23 21:49	
Arsenic, total	<0.0040 mg/L	0.0040	1GF1058	EPA 6020A	RVV	06/23/23 1:11	
Barium, total	**0.249 mg/L**	**0.0040**	1GF1058	EPA 6020A	RVV	06/23/23 1:11	
Beryllium, total	<0.0040 mg/L	0.0040	1GF1058	EPA 6020A	RVV	06/23/23 1:11	
Boron, total	**0.138 mg/L**	**0.100**	1GF1209	EPA 6010B	JAR	06/23/23 21:49	
Cadmium, total	<0.0008 mg/L	0.0008	1GF1058	EPA 6020A	RVV	06/23/23 1:11	
Cobalt, total	**0.0030 mg/L**	**0.0004**	1GF1058	EPA 6020A	RVV	06/23/23 1:11	
Chromium, total	<0.0080 mg/L	0.0080	1GF1058	EPA 6020A	RVV	06/23/23 1:11	
Copper, total	<0.0040 mg/L	0.0040	1GF1058	EPA 6020A	RVV	06/23/23 1:11	
Iron, total	**3.30 mg/L**	**0.100**	1GF1209	EPA 6010B	JAR	06/23/23 21:49	
Mercury, total	<0.00050 mg/L	0.00050	1GF0984	EPA 7470A	JAR	06/21/23 11:32	
Magnesium, total	**51.0 mg/L**	**0.100**	1GF1209	EPA 6010B	JAR	06/23/23 21:49	
Manganese, total	**0.512 mg/L**	**0.0040**	1GF1058	EPA 6020A	RVV	06/23/23 1:11	
Molybdenum, total	<0.0040 mg/L	0.0040	1GF1058	EPA 6020A	RVV	06/23/23 1:11	
Nickel, total	**0.0056 mg/L**	**0.0040**	1GF1058	EPA 6020A	RVV	06/23/23 1:11	
Lead, total	<0.0040 mg/L	0.0040	1GF1058	EPA 6020A	RVV	06/23/23 1:11	
Antimony, total	<0.0020 mg/L	0.0020	1GF1058	EPA 6020A	RVV	06/23/23 1:11	
Selenium, total	<0.0040 mg/L	0.0040	1GF1058	EPA 6020A	RVV	06/23/23 1:11	
Thallium, total	<0.0020 mg/L	0.0020	1GF1058	EPA 6020A	RVV	06/23/23 1:11	
Vanadium, total	<0.0200 mg/L	0.0200	1GF1058	EPA 6020A	RVV	06/23/23 1:11	
Zinc, total	<0.0200 mg/L	0.0200	1GF1058	EPA 6020A	RVV	06/23/23 1:11	
1GF1741-04 MW Q S				Matrix: Water		Collected: 06/19/23 08:10	
Formaldehyde	<10.0 ug/L	10.0	1GF0999	EPA 8315	EPP	06/22/23 13:23	
Total Organic Halogens (TOX)	<0.010 mg/L	0.010	1GG0179	EPA 9020	LNH	07/06/23 10:53	
COD, total	<20 mg/L	20	1GF1360	EPA 410.4	JLW	06/27/23 16:31	
Nitrogen, Ammonia	**0.10 mg/L**	**0.10**	1GF1552	TIMBERLINE	JAH	06/29/23 13:25	
Phenols, total	<0.035 mg/L	0.035	1GF1516	EPA 420.1	RMC	06/29/23 15:29	
Solids, total suspended	**4130 mg/L**	**67**	1GF0974	USGS I-3765-85	MEAH	06/20/23 11:20	
Chloride	**18.8 mg/L**	**1.0**	1GF1493	EPA 9056	TJB	06/27/23 15:39	
Fluoride	<0.1 mg/L	0.1	1GF1493	EPA 9056	TJB	06/27/23 15:39	
Sulfate	**148 mg/L**	**5.0**	1GF1549	EPA 9056	TJM	06/28/23 17:35	

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Stone Environmental Engineering
1631 NW 30th Court
Ankeny, IA 50021

July 06, 2023

Work Order: 1GF1741

Analyte	Result	MRL	Batch	Method	Analyst	Analyzed	Qualifier
1GF1741-04 MW Q S				Matrix: Water		Collected: 06/19/23 08:10	
Silver, total	<0.0040 mg/L	0.0040	1GF1058	EPA 6020A	RVV	06/23/23 1:17	
Aluminum, total	**8.98 mg/L**	**0.050**	1GF1209	EPA 6010B	JAR	06/23/23 21:55	
Arsenic, total	**0.0252 mg/L**	**0.0040**	1GF1058	EPA 6020A	RVV	06/23/23 1:17	
Barium, total	**0.719 mg/L**	**0.0040**	1GF1058	EPA 6020A	RVV	06/23/23 1:17	
Beryllium, total	<0.0040 mg/L	0.0040	1GF1058	EPA 6020A	RVV	06/23/23 1:17	
Boron, total	**0.106 mg/L**	**0.100**	1GF1209	EPA 6010B	JAR	06/23/23 21:55	
Cadmium, total	<0.0008 mg/L	0.0008	1GF1058	EPA 6020A	RVV	06/23/23 1:17	
Cobalt, total	**0.0357 mg/L**	**0.0004**	1GF1058	EPA 6020A	RVV	06/23/23 1:17	
Chromium, total	**0.0168 mg/L**	**0.0080**	1GF1058	EPA 6020A	RVV	06/23/23 1:17	
Copper, total	**0.0359 mg/L**	**0.0040**	1GF1058	EPA 6020A	RVV	06/23/23 1:17	
Iron, total	**51.6 mg/L**	**0.100**	1GF1209	EPA 6010B	JAR	06/23/23 21:55	
Mercury, total	<0.00050 mg/L	0.00050	1GF0984	EPA 7470A	JAR	06/21/23 11:34	
Magnesium, total	**71.1 mg/L**	**0.100**	1GF1209	EPA 6010B	JAR	06/23/23 21:55	
Molybdenum, total	<0.0040 mg/L	0.0040	1GF1058	EPA 6020A	RVV	06/23/23 1:17	
Nickel, total	**0.0456 mg/L**	**0.0040**	1GF1058	EPA 6020A	RVV	06/23/23 1:17	
Lead, total	**0.0196 mg/L**	**0.0040**	1GF1058	EPA 6020A	RVV	06/23/23 1:17	
Antimony, total	<0.0020 mg/L	0.0020	1GF1058	EPA 6020A	RVV	06/23/23 1:17	
Selenium, total	**0.0042 mg/L**	**0.0040**	1GF1058	EPA 6020A	RVV	06/23/23 1:17	
Thallium, total	<0.0020 mg/L	0.0020	1GF1058	EPA 6020A	RVV	06/23/23 1:17	
Vanadium, total	**0.0365 mg/L**	**0.0200**	1GF1058	EPA 6020A	RVV	06/23/23 1:17	
Zinc, total	**0.0731 mg/L**	**0.0200**	1GF1058	EPA 6020A	RVV	06/23/23 1:17	
1GF1741-04RE1 MW Q S				Matrix: Water		Collected: 06/19/23 08:10	
Manganese, total	**2.42 mg/L**	**0.100**	1GF1058	EPA 6020A	RVV	06/23/23 13:28	
1GF1741-05 MW Q E				Matrix: Water		Collected: 06/19/23 08:23	
Formaldehyde	<10.0 ug/L	10.0	1GF0999	EPA 8315	EPP	06/22/23 13:42	
Total Organic Halogens (TOX)	<0.010 mg/L	0.010	1GG0179	EPA 9020	LNH	07/06/23 10:53	
COD, total	**21 mg/L**	**20**	1GF1360	EPA 410.4	JLW	06/27/23 16:31	
Nitrogen, Ammonia	**1.03 mg/L**	**0.10**	1GF1552	TIMBERLINE	JAH	06/29/23 13:26	
Phenols, total	<0.035 mg/L	0.035	1GF1516	EPA 420.1	RMC	06/29/23 15:29	
Solids, total suspended	**122 mg/L**	**5**	1GF0974	USGS I-3765-85	MEAH	06/20/23 11:20	
Chloride	**17.4 mg/L**	**1.0**	1GF1493	EPA 9056	TJB	06/27/23 17:28	
Fluoride	**0.3 mg/L**	**0.1**	1GF1493	EPA 9056	TJB	06/27/23 17:28	
Sulfate	**765 mg/L**	**10.0**	1GF1549	EPA 9056	TJM	06/28/23 17:53	
Silver, total	<0.0040 mg/L	0.0040	1GF1058	EPA 6020A	RVV	06/23/23 1:23	
Aluminum, total	**0.298 mg/L**	**0.050**	1GF1209	EPA 6010B	JAR	06/23/23 22:01	
Arsenic, total	**0.0082 mg/L**	**0.0040**	1GF1058	EPA 6020A	RVV	06/23/23 1:23	
Barium, total	**0.0778 mg/L**	**0.0040**	1GF1058	EPA 6020A	RVV	06/23/23 1:23	
Beryllium, total	<0.0040 mg/L	0.0040	1GF1058	EPA 6020A	RVV	06/23/23 1:23	
Boron, total	**0.385 mg/L**	**0.100**	1GF1209	EPA 6010B	JAR	06/23/23 22:01	

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Stone Environmental Engineering
1631 NW 30th Court
Ankeny, IA 50021

Work Order: 1GF1741

Analyte	Result	MRL	Batch	Method	Analyst	Analyzed	Qualifier
1GF1741-05 MW Q E				Matrix: Water		Collected: 06/19/23 08:23	
Cadmium, total	<0.0008 mg/L	0.0008	1GF1058	EPA 6020A	RVV	06/23/23 1:23	
Cobalt, total	**0.0076 mg/L**	**0.0004**	1GF1058	EPA 6020A	RVV	06/23/23 1:23	
Chromium, total	<0.0080 mg/L	0.0080	1GF1058	EPA 6020A	RVV	06/23/23 1:23	
Copper, total	<0.0040 mg/L	0.0040	1GF1058	EPA 6020A	RVV	06/23/23 1:23	
Iron, total	**9.09 mg/L**	**0.100**	1GF1209	EPA 6010B	JAR	06/23/23 22:01	
Mercury, total	<0.00050 mg/L	0.00050	1GF0984	EPA 7470A	JAR	06/21/23 11:36	
Magnesium, total	**117 mg/L**	**0.100**	1GF1209	EPA 6010B	JAR	06/23/23 22:01	
Molybdenum, total	**0.0040 mg/L**	**0.0040**	1GF1058	EPA 6020A	RVV	06/23/23 1:23	
Nickel, total	**0.0116 mg/L**	**0.0040**	1GF1058	EPA 6020A	RVV	06/23/23 1:23	
Lead, total	<0.0040 mg/L	0.0040	1GF1058	EPA 6020A	RVV	06/23/23 1:23	
Antimony, total	<0.0020 mg/L	0.0020	1GF1058	EPA 6020A	RVV	06/23/23 1:23	
Selenium, total	<0.0040 mg/L	0.0040	1GF1058	EPA 6020A	RVV	06/23/23 1:23	
Thallium, total	<0.0020 mg/L	0.0020	1GF1058	EPA 6020A	RVV	06/23/23 1:23	
Vanadium, total	<0.0200 mg/L	0.0200	1GF1058	EPA 6020A	RVV	06/23/23 1:23	
Zinc, total	<0.0200 mg/L	0.0200	1GF1058	EPA 6020A	RVV	06/23/23 1:23	
1GF1741-05RE1 MW Q E				Matrix: Water		Collected: 06/19/23 08:23	
Manganese, total	**3.03 mg/L**	**0.100**	1GF1058	EPA 6020A	RVV	06/23/23 13:28	

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Stone Environmental Engineering
1631 NW 30th Court
Ankeny, IA 50021

Work Order: 1GF1741

Determination of Carbonyl Compounds - Quality Control

Keystone Laboratories - Newton

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 1GF0999 - EPA 8315 Aldehydes										
Blank (1GF0999-BLK1)				Prepared: 06/20/23 Analyzed: 06/22/23						
Formaldehyde	ND	10.0	ug/L							
LCS (1GF0999-BS1)				Prepared: 06/20/23 Analyzed: 06/22/23						
Formaldehyde	553.9	10.0	ug/L	500.000		111	61-142			
Matrix Spike (1GF0999-MS1)	**Source: 1GF1741-01**			Prepared: 06/20/23 Analyzed: 06/22/23						
Formaldehyde	541.2	10.0	ug/L	500.000	ND	108	48-148			
Matrix Spike Dup (1GF0999-MSD1)	**Source: 1GF1741-01**			Prepared: 06/20/23 Analyzed: 06/22/23						
Formaldehyde	529.5	10.0	ug/L	500.000	ND	106	48-148	2.19	30	

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Stone Environmental Engineering
1631 NW 30th Court
Ankeny, IA 50021

Work Order: 1GF1741

Determination of Conventional Chemistry Parameters - Quality Control

Keystone Laboratories - Newton

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 1GF0974 - Wet Chem Preparation										
Blank (1GF0974-BLK1)				Prepared: 06/19/23 Analyzed: 06/20/23						
Solids, total suspended	ND	1	mg/L							
LCS (1GF0974-BS1)				Prepared: 06/19/23 Analyzed: 06/20/23						
Solids, total suspended	13.9	1	mg/L	15.0000		92.7	74-114			
Duplicate (1GF0974-DUP1)		**Source: 1GF1708-01**		Prepared: 06/19/23 Analyzed: 06/20/23						
Solids, total suspended	625	25	mg/L		588			6.19	30	
Batch 1GF1360 - Wet Chem Preparation										
Blank (1GF1360-BLK1)				Prepared & Analyzed: 06/27/23						
COD, total	ND	20	mg/L							
LCS (1GF1360-BS1)				Prepared & Analyzed: 06/27/23						
COD, total	103	27	mg/L	97.3333		106	90-110			
Matrix Spike (1GF1360-MS1)		**Source: 1GF1741-01**		Prepared & Analyzed: 06/27/23						
COD, total	123	27	mg/L	97.3333	29.0	96.3	90-110			
Matrix Spike Dup (1GF1360-MSD1)		**Source: 1GF1741-01**		Prepared & Analyzed: 06/27/23						
COD, total	124	27	mg/L	97.3333	29.0	98.1	90-110	1.42	10	
Batch 1GF1516 - Wet Chem Preparation										
Blank (1GF1516-BLK1)				Prepared: 06/28/23 Analyzed: 06/29/23						
Phenols, total	ND	0.035	mg/L							

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Stone Environmental Engineering
1631 NW 30th Court
Ankeny, IA 50021

Work Order: 1GF1741

Determination of Conventional Chemistry Parameters - Quality Control

Keystone Laboratories - Newton

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 1GF1516 - Wet Chem Preparation										
LCS (1GF1516-BS1)				Prepared: 06/28/23 Analyzed: 06/29/23						
Phenols, total	0.386	0.035	mg/L	0.400000		96.6	62-110			
Matrix Spike (1GF1516-MS1)		**Source: 1GF1741-01**		Prepared: 06/28/23 Analyzed: 06/29/23						
Phenols, total	0.370	0.035	mg/L	0.400000	0.0442	81.6	57-124			
Matrix Spike Dup (1GF1516-MSD1)		**Source: 1GF1741-01**		Prepared: 06/28/23 Analyzed: 06/29/23						
Phenols, total	0.374	0.035	mg/L	0.400000	0.0442	82.3	57-124	0.851	21	
Batch 1GF1552 - General Prep HPLC/IC										
Blank (1GF1552-BLK1)				Prepared & Analyzed: 06/29/23						
Nitrogen, Ammonia	ND	0.10	mg/L							
Blank (1GF1552-BLK2)				Prepared & Analyzed: 06/29/23						
Nitrogen, Ammonia	ND	0.10	mg/L							
LCS (1GF1552-BS1)				Prepared & Analyzed: 06/29/23						
Nitrogen, Ammonia	5.05	0.10	mg/L	5.00000		101	90-114			
LCS (1GF1552-BS2)				Prepared & Analyzed: 06/29/23						
Nitrogen, Ammonia	5.10	0.10	mg/L	5.00000		102	90-114			
Matrix Spike (1GF1552-MS1)		**Source: 1GF2143-01**		Prepared & Analyzed: 06/29/23						
Nitrogen, Ammonia	5.27	0.10	mg/L	5.00000	0.142	102	84-115			
Matrix Spike (1GF1552-MS2)		**Source: 1GF2144-01**		Prepared & Analyzed: 06/29/23						
Nitrogen, Ammonia	5.86	0.10	mg/L	5.00000	0.668	104	84-115			

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Stone Environmental Engineering
1631 NW 30th Court
Ankeny, IA 50021

Work Order: 1GF1741

Determination of Conventional Chemistry Parameters - Quality Control

Keystone Laboratories - Newton

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 1GF1552 - General Prep HPLC/IC										
Matrix Spike Dup (1GF1552-MSD1)		**Source: 1GF2143-01**		Prepared & Analyzed: 06/29/23						
Nitrogen, Ammonia	5.37	0.10	mg/L	5.00000	0.142	105	84-115	2.04	20	
Matrix Spike Dup (1GF1552-MSD2)		**Source: 1GF2144-01**		Prepared & Analyzed: 06/29/23						
Nitrogen, Ammonia	5.88	0.10	mg/L	5.00000	0.668	104	84-115	0.452	20	
Batch 1GG0179 - TOX/TX/EOX										
Blank (1GG0179-BLK1)				Prepared: 07/05/23 Analyzed: 07/06/23						
Total Organic Halogens (TOX)	ND	0.010	mg/L							
LCS (1GG0179-BS1)				Prepared: 07/05/23 Analyzed: 07/06/23						
Total Organic Halogens (TOX)	0.1152	0.010	mg/L	0.111060		104	76-114			
LCS Dup (1GG0179-BSD1)				Prepared: 07/05/23 Analyzed: 07/06/23						
Total Organic Halogens (TOX)	0.1060	0.010	mg/L	0.111060		95.5	76-114	8.32	18	
Reference (1GG0179-SRM1)				Prepared: 07/05/23 Analyzed: 07/06/23						
Total Organic Halogens (TOX)	0.1074	0.010	mg/L	0.108908		98.6	90-110			
Reference (1GG0179-SRM2)				Prepared: 07/05/23 Analyzed: 07/06/23						
Total Organic Halogens (TOX)	0.1017	0.010	mg/L	0.108908		93.4	90-110			
Reference (1GG0179-SRM3)				Prepared: 07/05/23 Analyzed: 07/06/23						
Total Organic Halogens (TOX)	0.1040	0.010	mg/L	0.108908		95.5	90-110			

Stone Environmental Engineering
1631 NW 30th Court
Ankeny, IA 50021

Work Order: 1GF1741

Determination of Inorganic Anions - Quality Control

Keystone Laboratories - Newton

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 1GF1493 - General Prep HPLC/IC										
Blank (1GF1493-BLK1)				Prepared & Analyzed: 06/27/23						
Fluoride	ND	0.1	mg/L							
Chloride	ND	1.0	"							
Blank (1GF1493-BLK2)				Prepared & Analyzed: 06/27/23						
Fluoride	ND	0.1	mg/L							
Chloride	ND	1.0	"							
Blank (1GF1493-BLK3)				Prepared & Analyzed: 06/27/23						
Fluoride	ND	0.1	mg/L							
Chloride	ND	1.0	"							
LCS (1GF1493-BS1)				Prepared & Analyzed: 06/27/23						
Fluoride	1.34	0.1	mg/L	1.35958		98.3	80-120			
Chloride	16.51	1.0	"	15.7086		105	80-120			
LCS (1GF1493-BS2)				Prepared & Analyzed: 06/27/23						
Fluoride	1.52	0.1	mg/L	1.35958		112	80-120			
Chloride	16.40	1.0	"	15.7086		104	80-120			
LCS Dup (1GF1493-BSD1)				Prepared & Analyzed: 06/27/23						
Fluoride	1.37	0.1	mg/L	1.35958		101	80-120	2.22	10	
Chloride	16.44	1.0	"	15.7086		105	80-120	0.473	10	
LCS Dup (1GF1493-BSD2)				Prepared & Analyzed: 06/27/23						
Fluoride	1.52	0.1	mg/L	1.35958		112	80-120	0.395	10	
Chloride	16.46	1.0	"	15.7086		105	80-120	0.414	10	
Matrix Spike (1GF1493-MS1)	**Source: 1GF1882-01**			Prepared & Analyzed: 06/27/23						
Fluoride	7.74	0.5	mg/L	6.79792	ND	114	77-121			
Chloride	175.8	5.0	"	78.5428	90.12	109	81-116			

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Stone Environmental Engineering
1631 NW 30th Court
Ankeny, IA 50021

Work Order: 1GF1741

Determination of Inorganic Anions - Quality Control

Keystone Laboratories - Newton

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 1GF1493 - General Prep HPLC/IC										
Matrix Spike (1GF1493-MS2)	**Source: 1GF1944-08**			Prepared: 06/27/23 Analyzed: 06/28/23						
Fluoride	6.87	0.5	mg/L	6.79792	0.33	96.2	77-121			
Chloride	143.8	5.0	"	78.5428	58.26	109	81-116			
Matrix Spike Dup (1GF1493-MSD1)	**Source: 1GF1882-01**			Prepared & Analyzed: 06/27/23						
Fluoride	7.74	0.5	mg/L	6.79792	ND	114	77-121	0.129	10	
Chloride	177.7	5.0	"	78.5428	90.12	112	81-116	1.06	10	
Matrix Spike Dup (1GF1493-MSD2)	**Source: 1GF1944-08**			Prepared: 06/27/23 Analyzed: 06/28/23						
Fluoride	7.23	0.5	mg/L	6.79792	0.33	102	77-121	5.11	10	
Chloride	147.7	5.0	"	78.5428	58.26	114	81-116	2.69	10	
Batch 1GF1549 - General Prep HPLC/IC										
Blank (1GF1549-BLK1)				Prepared & Analyzed: 06/28/23						
Chloride	ND	1.0	mg/L							
Sulfate	ND	1.0	"							
Blank (1GF1549-BLK2)				Prepared & Analyzed: 06/28/23						
Chloride	ND	1.0	mg/L							
Sulfate	ND	1.0	"							
LCS (1GF1549-BS1)				Prepared & Analyzed: 06/28/23						
Chloride	16.48	1.0	mg/L	15.7086		105	80-120			
Sulfate	36.74	1.0	"	34.3648		107	80-120			
LCS Dup (1GF1549-BSD1)				Prepared & Analyzed: 06/28/23						
Chloride	16.36	1.0	mg/L	15.7086		104	80-120	0.749	10	
Sulfate	36.77	1.0	"	34.3648		107	80-120	0.101	10	

Stone Environmental Engineering
1631 NW 30th Court
Ankeny, IA 50021

Work Order: 1GF1741

Determination of Inorganic Anions - Quality Control

Keystone Laboratories - Newton

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 1GF1549 - General Prep HPLC/IC										
Matrix Spike (1GF1549-MS1)		**Source: 1GF2546-01**		Prepared & Analyzed: 06/28/23						
Chloride	34.81	1.0	mg/L	15.7086	18.15	106	81-116			
Sulfate	288.2	1.0	"	34.3648	271.7	48.0	87-113			QM-4X
Matrix Spike Dup (1GF1549-MSD1)		**Source: 1GF2546-01**		Prepared & Analyzed: 06/28/23						
Chloride	36.35	1.0	mg/L	15.7086	18.15	116	81-116	4.32	10	
Sulfate	295.9	1.0	"	34.3648	271.7	70.3	87-113	2.63	10	QM-4X

Stone Environmental Engineering
1631 NW 30th Court
Ankeny, IA 50021

Work Order: 1GF1741

Determination of Total Metals - Quality Control

Keystone Laboratories - Newton

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 1GF0984 - EPA 7470A Hg Water										
Blank (1GF0984-BLK1)				Prepared: 06/20/23 Analyzed: 06/21/23						
Mercury, total	ND	0.00050	mg/L							
LCS (1GF0984-BS1)				Prepared: 06/20/23 Analyzed: 06/21/23						
Mercury, total	0.00277	0.00050	mg/L	0.00250000		111	80-120			
Matrix Spike (1GF0984-MS1)		**Source: 1GF1476-01**		Prepared: 06/20/23 Analyzed: 06/21/23						
Mercury, total	0.00282	0.00050	mg/L	0.00250000	ND	113	75-125			
Matrix Spike Dup (1GF0984-MSD1)		**Source: 1GF1476-01**		Prepared: 06/20/23 Analyzed: 06/21/23						
Mercury, total	0.00276	0.00050	mg/L	0.00250000	ND	110	75-125	2.14	20	
Batch 1GF1058 - EPA 3005A Total Recoverable Metals										
Blank (1GF1058-BLK1)				Prepared: 06/21/23 Analyzed: 06/23/23						
Antimony, total	ND	0.0020	mg/L							
Arsenic, total	ND	0.0040	"							
Barium, total	ND	0.0040	"							
Beryllium, total	ND	0.0040	"							
Cadmium, total	ND	0.0008	"							
Chromium, total	ND	0.0080	"							
Cobalt, total	ND	0.0004	"							
Copper, total	ND	0.0040	"							
Lead, total	ND	0.0040	"							
Manganese, total	ND	0.0040	"							
Molybdenum, total	ND	0.0040	"							
Nickel, total	ND	0.0040	"							
Selenium, total	ND	0.0040	"							
Silver, total	ND	0.0040	"							
Thallium, total	ND	0.0020	"							
Vanadium, total	ND	0.0200	"							
Zinc, total	ND	0.0200	"							

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Stone Environmental Engineering
1631 NW 30th Court
Ankeny, IA 50021

Work Order: 1GF1741

Determination of Total Metals - Quality Control

Keystone Laboratories - Newton

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 1GF1058 - EPA 3005A Total Recoverable Metals										
LCS (1GF1058-BS1)				Prepared: 06/21/23 Analyzed: 06/23/23						
Antimony, total	0.0952	0.0020	mg/L	0.100000		95.2	80-120			
Arsenic, total	0.0970	0.0040	"	0.100000		97.0	80-120			
Barium, total	0.104	0.0040	"	0.100000		104	80-120			
Beryllium, total	0.100	0.0040	"	0.100000		100	80-120			
Cadmium, total	0.0979	0.0008	"	0.100000		97.9	80-120			
Chromium, total	0.0966	0.0080	"	0.100000		96.6	80-120			
Cobalt, total	0.101	0.0004	"	0.100000		101	80-120			
Copper, total	0.107	0.0040	"	0.100000		107	80-120			
Lead, total	0.100	0.0040	"	0.100000		100	80-120			
Manganese, total	0.0951	0.0040	"	0.100000		95.1	80-120			
Molybdenum, total	0.0987	0.0040	"	0.100000		98.7	80-120			
Nickel, total	0.105	0.0040	"	0.100000		105	80-120			
Selenium, total	0.0961	0.0040	"	0.100000		96.1	80-120			
Silver, total	0.104	0.0040	"	0.100000		104	80-120			
Thallium, total	0.0987	0.0020	"	0.100000		98.7	80-120			
Vanadium, total	0.105	0.0200	"	0.100000		105	80-120			
Zinc, total	0.103	0.0200	"	0.100000		103	80-120			
Matrix Spike (1GF1058-MS1)		**Source: 1GF1741-01**		Prepared: 06/21/23 Analyzed: 06/23/23						
Antimony, total	0.103	0.0020	mg/L	0.100000	ND	103	75-125			
Arsenic, total	0.120	0.0040	"	0.100000	0.0108	109	75-125			
Barium, total	0.209	0.0040	"	0.100000	0.0881	121	75-125			
Beryllium, total	0.101	0.0040	"	0.100000	ND	101	75-125			
Cadmium, total	0.101	0.0008	"	0.100000	0.0008	101	75-125			
Chromium, total	0.104	0.0080	"	0.100000	0.0024	101	75-125			
Cobalt, total	0.114	0.0004	"	0.100000	0.0061	108	75-125			
Copper, total	0.101	0.0040	"	0.100000	0.0029	98.1	75-125			
Lead, total	0.101	0.0040	"	0.100000	0.0014	99.6	75-125			
Manganese, total	0.832	0.0040	"	0.100000	0.689	143	75-125			QM-07
Molybdenum, total	0.244	0.0040	"	0.100000	0.115	130	75-125			QM-07
Nickel, total	0.118	0.0040	"	0.100000	0.0121	106	75-125			
Selenium, total	0.1057	0.0040	"	0.100000	ND	106	75-125			
Silver, total	0.108	0.0040	"	0.100000	ND	108	75-125			
Thallium, total	0.101	0.0020	"	0.100000	ND	101	75-125			
Vanadium, total	0.114	0.0200	"	0.100000	ND	114	75-125			
Zinc, total	0.116	0.0200	"	0.100000	ND	116	75-125			

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Stone Environmental Engineering
1631 NW 30th Court
Ankeny, IA 50021

Work Order: 1GF1741

Determination of Total Metals - Quality Control

Keystone Laboratories - Newton

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 1GF1058 - EPA 3005A Total Recoverable Metals										
Matrix Spike Dup (1GF1058-MSD1)	**Source: 1GF1741-01**			Prepared: 06/21/23 Analyzed: 06/23/23						
Antimony, total	0.106	0.0020	mg/L	0.100000	ND	106	75-125	3.05	20	
Arsenic, total	0.122	0.0040	"	0.100000	0.0108	111	75-125	1.33	20	
Barium, total	0.211	0.0040	"	0.100000	0.0881	123	75-125	1.16	20	
Beryllium, total	0.105	0.0040	"	0.100000	ND	105	75-125	3.81	20	
Cadmium, total	0.104	0.0008	"	0.100000	0.0008	103	75-125	2.72	20	
Chromium, total	0.104	0.0080	"	0.100000	0.0024	102	75-125	0.483	20	
Cobalt, total	0.113	0.0004	"	0.100000	0.0061	107	75-125	1.03	20	
Copper, total	0.102	0.0040	"	0.100000	0.0029	98.8	75-125	0.666	20	
Lead, total	0.102	0.0040	"	0.100000	0.0014	101	75-125	0.985	20	
Manganese, total	0.823	0.0040	"	0.100000	0.689	135	75-125	0.995	20	QM-07
Molybdenum, total	0.242	0.0040	"	0.100000	0.115	128	75-125	0.803	20	QM-07
Nickel, total	0.118	0.0040	"	0.100000	0.0121	106	75-125	0.0153	20	
Selenium, total	0.1072	0.0040	"	0.100000	ND	107	75-125	1.40	20	
Silver, total	0.109	0.0040	"	0.100000	ND	109	75-125	1.18	20	
Thallium, total	0.102	0.0020	"	0.100000	ND	102	75-125	1.76	20	
Vanadium, total	0.116	0.0200	"	0.100000	ND	116	75-125	1.67	20	
Zinc, total	0.115	0.0200	"	0.100000	ND	115	75-125	0.297	20	
Post Spike (1GF1058-PS1)	**Source: 1GF1741-01**			Prepared: 06/21/23 Analyzed: 06/23/23						
Antimony, total	0.0798		mg/L	0.0800000	0.0003	99.4	80-120			
Arsenic, total	0.0934		"	0.0800000	0.0106	103	80-120			
Barium, total	0.169		"	0.0800000	0.0864	104	80-120			
Beryllium, total	0.0768		"	0.0800000	0.00001	96.0	80-120			
Cadmium, total	0.0767		"	0.0800000	0.0008	94.9	80-120			
Chromium, total	0.0781		"	0.0800000	0.0023	94.8	80-120			
Cobalt, total	0.0877		"	0.0800000	0.0060	102	80-120			
Copper, total	0.0772		"	0.0800000	0.0029	92.9	80-120			
Lead, total	0.0763		"	0.0800000	0.0014	93.6	80-120			
Manganese, total	0.748		"	0.0800000	0.675	90.6	80-120			
Molybdenum, total	0.205		"	0.0800000	0.112	116	80-120			
Nickel, total	0.0919		"	0.0800000	0.0118	100	80-120			
Selenium, total	0.0787		"	0.0800000	0.0012	96.8	80-120			
Silver, total	0.0822		"	0.0800000	0.0006	102	80-120			
Thallium, total	0.0776		"	0.0800000	0.00002	96.9	80-120			
Vanadium, total	0.0898		"	0.0800000	0.0122	96.9	80-120			
Zinc, total	0.0882		"	0.0800000	0.0134	93.5	80-120			

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Stone Environmental Engineering
1631 NW 30th Court
Ankeny, IA 50021

Work Order: 1GF1741

Determination of Total Metals - Quality Control

Keystone Laboratories - Newton

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 1GF1209 - EPA 3010A Digestion (Water)										
Blank (1GF1209-BLK1)				Prepared: 06/22/23 Analyzed: 06/23/23						
Aluminum, total	ND	0.050	mg/L							
Boron, total	ND	0.100	"							
Iron, total	ND	0.100	"							
Magnesium, total	ND	0.100	"							
LCS (1GF1209-BS1)				Prepared: 06/22/23 Analyzed: 06/23/23						
Aluminum, total	2.31	0.050	mg/L	2.20000		105	80-120			
Boron, total	0.238	0.100	"	0.200000		119	80-120			
Iron, total	2.44	0.100	"	2.20000		111	80-120			
Magnesium, total	2.30	0.100	"	2.20000		104	80-120			
Matrix Spike (1GF1209-MS1)		**Source: 1GF1741-01**		Prepared: 06/22/23 Analyzed: 06/23/23						
Aluminum, total	3.00	0.050	mg/L	2.20000	0.148	129	75-125			QM-07
Boron, total	0.807	0.100	"	0.200000	0.603	102	75-125			
Iron, total	5.86	0.100	"	2.20000	2.97	131	75-125			QM-07
Magnesium, total	93.4	0.100	"	2.20000	90.9	112	75-125			
Matrix Spike Dup (1GF1209-MSD1)		**Source: 1GF1741-01**		Prepared: 06/22/23 Analyzed: 06/23/23						
Aluminum, total	2.85	0.050	mg/L	2.20000	0.148	123	75-125	4.97	20	
Boron, total	0.833	0.100	"	0.200000	0.603	115	75-125	3.21	20	
Iron, total	5.50	0.100	"	2.20000	2.97	115	75-125	6.24	20	
Magnesium, total	96.4	0.100	"	2.20000	90.9	249	75-125	3.19	20	QM-4X
Post Spike (1GF1209-PS1)		**Source: 1GF1741-01**		Prepared: 06/22/23 Analyzed: 06/23/23						
Aluminum, total	8.86		mg/L	8.80000	0.148	99.0	80-120			
Boron, total	1.50		"	0.800000	0.603	112	80-120			
Iron, total	12.0		"	8.80000	2.97	103	80-120			
Magnesium, total	104		"	8.80000	90.9	153	80-120			PS-4X

ND = Non Detect; REC= Recovery; RPD= Relative Percent Difference

Stone Environmental Engineering
1631 NW 30th Court
Ankeny, IA 50021

Work Order: 1GF1741

Certified Analyses Included In This Report

Method/Matrix	Analyte	Certifications
EPA 410.4 in Water		
	COD, total	KS-NT,SIA1X
EPA 420.1 in Water		
	Phenols, total	KS-NT,SIA1X
EPA 6010B in Water		
	Aluminum, total	KS-NT,SIA1X
	Boron, total	KS-NT,SIA1X
	Iron, total	KS-NT,SIA1X
	Magnesium, total	KS-NT,SIA1X
EPA 6020A in Water		
	Antimony, total	SIA1X,KS-NT
	Arsenic, total	SIA1X,KS-NT
	Barium, total	SIA1X,KS-NT
	Beryllium, total	SIA1X,KS-NT
	Cadmium, total	SIA1X,KS-NT
	Chromium, total	SIA1X,KS-NT
	Cobalt, total	SIA1X,KS-NT
	Copper, total	SIA1X,KS-NT
	Lead, total	SIA1X,KS-NT
	Manganese, total	SIA1X,KS-NT
	Molybdenum, total	SIA1X
	Nickel, total	SIA1X,KS-NT
	Selenium, total	SIA1X,KS-NT
	Silver, total	SIA1X,KS-NT
	Thallium, total	SIA1X,KS-NT
	Vanadium, total	SIA1X,KS-NT
	Zinc, total	SIA1X,KS-NT
EPA 7470A in Water		
	Mercury, total	KS-NT,SIA1X
EPA 8315 in Water		
	Formaldehyde	SIA1X
EPA 9020 in Water		
	Total Organic Halogens (TOX)	KS-NT,SIA1X
EPA 9056 in Water		
	Fluoride	KS-NT,SIA1X
	Chloride	KS-NT,SIA1X
	Sulfate	KS-NT,SIA1X
TIMBERLINE in Water		
	Nitrogen, Ammonia	SIA1X,KS-NT
USGS I-3765-85 in Water		
	Solids, total suspended	SIA1X,KS-NT

Code	Description	Number	Expires
KS-KC	Kansas Department of Health and Environment-KC	E-10110	04/30/2024
KS-NT	Kansas Department of Health and Environment (NELAP)	E-10287	10/31/2023
MO-KC	Missouri Department of Natural Resources (KC)	140	04/30/2024
MO-NT	Missouri Department of Natural Resources (Newton)	10170	04/30/2026
SIA1X	Iowa Dept. of Natural Resources	95	02/01/2024

Notes and Definitions

PS-4X	The spike recovery was outside of QC acceptance limits for the Post Spike due to analyte concentration at 4 times or greater the spike concentration.
QM-07	The spike recovery and/or RPD was outside acceptance limits for the MS and/or MSD. The batch was accepted based on acceptable LCS recovery.
QM-4X	The spike recovery was outside of QC acceptance limits for the MS and/or MSD due to analyte concentration at 4 times or greater the spike concentration.
TOX-2	Repeated analysis of this sample consistently exceeded greater than 10% breakthrough to the second column.

End of Report

Dara Hanson

Keystone Laboratories

Dara Hanson For Heather Tisdale
Project Manager I

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety. Samples were preserved in accordance with 40 CFR for pH adjustment unless otherwise noted. MRL= Method Reporting Limit.

CHAIN OF CU

Keystone LABORATORIES, INC.

600 East 17th Street Sou
Newton, IA 50208
641-792-8451

1GF1741

Stone Environmental Engineering
PM: Heather Tisdale

rinted: 6/14/2023 2:27:25PM
www.keystonelabs.co

SITE INFORMATION
Sampler: D. Stone
Project: SEE 001

REPORT TO
Donn Stone
Stone Environmental Engineering
1631 NW 30th Court
Ankeny, IA 50021

INVOICE TO
Donn Stone
Stone Environmental Engineering
1631 NW 30th Court
Ankeny, IA 50021

SPECIAL INSTRUCTIONS
None

Turn Around Time
☐ Standard ☐ RUSH, need by ___/___/___

LAB USE ONLY
Work Order 1GF1741
Temperature 3.5/15.1
Turn-Cooler: No

- ☐ Custody Seal
- ☒ Containers Intact
- ☒ COC/Labels Agree
- ☐ Preservation Confirmed
- ☒ Received on Ice

Number	Sample Identification / Client ID	Matrix	Sample Type	Date	Time	Number of Containers	Analyses	Lab Sample Number
01-001	MW QN	Water	GRAB	6/19	0707	6	8315@Formaldehyde, 9020-100, ag-t-6020, al-t-6010, as-t-6020, ba-t-6020, be-t-6020, b-t-6010, cd-t-6020, cl-9056-w, cod-t-410.4, co-t-6020, cr-t-6020, cu-t-6020, f-9056, fe-t-6010, hg-t-7470, mg-t-6010, mn-t-6020, mo-t-6020, nh3-timberline, ni-t-6020, pb-t-6020, phenol-t-420.1, sb-t-6020, se-t-6020, so4-9056-w, tl-t-6020, tss-i-3765-85, v-t-6020, zn-t-6020	01

Relinquished By: D. Stone — Date/Time: 6/19 0930
Received By — Date/Time
Relinquished By — Date/Time
Received for Lab By: [signature] — Date/Time: 6/19/23 11:33

Remarks:

Original - Lab Copy Yellow - Sampler Copy

Keystone LABORATORIES, INC.
600 East 17th Street Sou
Newton, IA 50208
641-792-8451

1 G F 1 7 4 1

Stone Environmental Engineering
PM: Heather Tisdale

Printed: 6/14/2023 2:27:25PM
www.keystonelabs.co

SITE INFORMATION
Sampler: D Stone
Project: SEE 001

REPORT TO
Donn Stone
Stone Environmental Engineering
1631 NW 30th Court
Ankeny, IA 50021

INVOICE TO
Donn Stone
Stone Environmental Engineering
1631 NW 30th Court
Ankeny, IA 50021

SPECIAL INSTRUCTIONS
None

Turn Around Time
☐ Standard ☐ RUSH, need by ___/___/___

LAB USE ONLY
Work Order 1GF1741
Temperature 3.5/15.1
Turn-Cooler: No

- ☐ Custody Seal
- ☒ Containers Intact
- ☒ COC/Labels Agree
- ☐ Preservation Confirmed
- ☒ Received on Ice

Number	Sample Identification / Client ID	Matrix	Sample Type	Date	Time	Number of Containers	Analyses	Lab Sample Number
01-002	MW 9 NE	Water	GRAB	6/19	0721	6	8315@Formaldehyde, 9020-100, ag-t-6020, al-t-6010, as-t-6020, ba-t-6020, be-t-6020, b-t-6010, cd-t-6020, cl-9056-w, cod-t-410.4, co-t-6020, cr-t-6020, cu-t-6020, f-9056, fe-t-6010, hg-t-7470, mg-t-6010, mn-t-6020, mo-t-6020, nh3-timberline, ni-t-6020, pb-t-6020, phenol-t-420.1, sb-t-6020, se-t-6020, so4-9056-w, tl-t-6020, tss-i-3765-85, v-t-6020, zn-t-6020	02

Relinquished By: DS 6/19 0930 (Date/Time)
Received By: (Date/Time)
Relinquished By: (Date/Time)
Received for Lab By: 6/19/23 11:33 (Date/Time)

Remarks:

Original - Lab Copy Yellow - Sampler Copy

CHAIN OF CUSTODY RECORD

Keystone LABORATORIES, INC.
600 East 17th Street Sui
Newton, IA 50208
641-792-8451

1GF1741

Stone Environmental Engineering
PM: Heather Tisdale

Printed: 8/14/2023 2:27:25PM
www.keystonelabs.co

SITE INFORMATION
Sampler: D. Stone
Project: SEE 001

SPECIAL INSTRUCTIONS
None
Turn Around Time
☐ Standard ☐ RUSH, need by __/__/__

REPORT TO
Donn Stone
Stone Environmental Engineering
1631 NW 30th Court
Ankeny, IA 50021

Donn Stone
Stone Environmental Engineering
1631 NW 30th Court
Ankeny, IA 50021

LAB USE ONLY
Work Order 1GF1741
Temperature 3.5/15.1
Turn-Cooler: No

☐ Custody Seal
☒ Containers Intact
☒ COC/Labels Agree
☐ Preservation Confirmed
☒ Received on Ice

Number	Sample Identification / Client ID	Matrix	Sample Type	Date	Time	Number of Containers	Analyses	Lab Sample Number
01-003	MW-QNW	Water	GRAB	6/19	0740	6	8315@Formaldehyde, 9020-100, ag-t-6020, al-t-6010, as-t-6020, ba-t-6020, be-t-6020, b-t-6010, cd-t-6020, cl-9056-w, cod-t-410.4, co-t-6020, cr-t-6020, cu-t-6020, f-9056, fe-t-6010, hg-t-7470, mg-t-6010, mn-t-6020, mo-t-6020, nh3-timberline, ni-t-6020, pb-t-6020, phenol-t-420.1, sb-t-6020, se-t-6020, so4-9056-w, tl-t-6020, tss-t-3765-85, v-t-6020, zn-t-6020	03

Relinquished By: [signature] Date/Time: 6/19 0930
Received By: Date/Time:
Relinquished By: Date/Time:
Received for Lab By: [signature] Date/Time: 6/19/23 11:33

Remarks:

Original - Lab Copy Yellow - Sampler Copy

CHAIN OF CUSTODY RECORD

Keystone LABORATORIES, INC.
600 East 17th Str
Newton, IA 5020
641-792-8451

1GF1741

Stone Environmental Engineering
PM: Heather Tisdale

Printed: 6/14/2023 2:27:25PM
www.keystonelabs.co

SITE INFORMATION
Sampler: D. Stone
Project: SEE 001

REP
Donn Stone
Stone Environmental Engineering
1631 NW 30th Court
Ankeny, IA 50021

CE TO
Donn Stone
Stone Environmental Engineering
1631 NW 30th Court
Ankeny, IA 50021

SPECIAL INSTRUCTIONS
None

Turn Around Time
☐ Standard ☐ RUSH, need by ___/___/___

LAB USE ONLY
Work Order 1GF1741
Temperature 3.5 / 15.1
Turn-Cooler: No

- ☐ Custody Seal
- ☒ Containers Intact
- ☒ COC/Labels Agree
- ☐ Preservation Confirmed
- ☒ Received on Ice

Number	Sample Identification / Client ID	Matrix	Sample Type	Date	Time	Number of Containers	Analyses	Lab Sample Number
01-004	MW 9S	Water	GRAB	6/19	0810	6	8315@Formaldehyde, 9020-100, ag-t-6020, al-t-6010, as-t-6020, ba-t-6020, be-t-6020, b-t-6010, cd-t-6020, cl-9056-w, cod-t-410.4, co-t-6020, cr-t-6020, cu-t-6020, f-9056, fe-t-6010, hg-t-7470, mg-t-6010, mn-t-6020, mo-t-6020, nh3-timberline, ni-t-6020, pb-t-6020, phenol-t-420.1, sb-t-6020, se-t-6020, so4-9056-w, tl-t-6020, tss-i-3765-85, v-t-6020, zn-t-6020	04

Relinquished By: [signature] Date/Time: 6/19 0930
Received By: Date/Time:
Relinquished By: Date/Time:
Received for Lab By: [signature] Date/Time: 6/19/23 11:33

Remarks:

Original - Lab Copy Yellow - Sampler Copy

CHAIN OF CUSTODY RECORD

Keystone LABORATORIES, INC.
600 East 17th Street Sc
Newton, IA 50208
641-792-8451

1GF1741

Stone Environmental Engineering
PM: Heather Tisdale

Printed: 6/14/2023 2:27:25PM
www.keystonelabs.co

SITE INFORMATION

Sampler: D. Stone

Project:
SEE 001

SPECIAL INSTRUCTIONS

None

Turn Around Time
☐ Standard ☐ RUSH, need by ___/___/___

REPORT TO

Donn Stone
Stone Environmental Engineering
1631 NW 30th Court
Ankeny, IA 50021

Donn Stone
Stone Environmental Engineering
1631 NW 30th Court
Ankeny, IA 50021

LAB USE ONLY

Work Order 1GF1741
Temperature 3.5/15.1
Turn-Cooler: No

☐ Custody Seal
☒ Containers Intact
☒ COC/Labels Agree
☐ Preservation Confirmed
☒ Received on Ice

Number	Sample Identification / Client ID	Matrix	Sample Type	Date	Time	Number of Containers	Analyses	Lab Sample Number
01-005	MW 9 E	Water	GRAB	6/19	0823	6	8315@Formaldehyde, 9020-100, ag-t-6020, al-t-6010, as-t-6020, ba-t-6020, be-t-6020, b-t-6010, cd-t-6020, cl-9056-w, cod-t-410.4, co-t-6020, cr-t-6020, cu-t-6020, f-9056, fe-t-6010, hg-t-7470, mg-t-6010, mn-t-6020, mo-t-6020, nh3-timberline, ni-t-6020, pb-t-6020, phenol-t-420.1, sb-t-6020, se-t-6020, so4-9056-w, tl-t-6020, tss-t-3765-85, v-t-6020, zn-t-6020	05

Relinquished By: [signature] Date/Time: 6/19 0930

Received By: Date/Time:

Relinquished By: Date/Time:

Received for Lab By: [signature] 6/19/23 11:33 Date/Time:

Remarks:

Original - Lab Copy Yellow - Sampler Copy

Protected Groundwater Source

	Aluminum	Anitmony	Arsenic	Barium	Beryllium	Boron	Cadmium	Chloride	Chromium	Cobalt	Copper	Lead	Magnesium	Manganese	Mercury	Molybdenum	Nickel	Selenium	Silver	Sulfate	Thallium	Vanadium	Zinc
		0.06	0.01	2	0.004	1	0.005		0.021	0.0021	1.3	0.015		0.3	0.002	0.04	0.1	0.05	0.1		0.002	0.049	2
6-Dec-22		ND	0.0046	0.096	ND	0.632	ND		ND	0.0043	ND			0.399	ND	0.014	ND	ND	ND		ND	ND	ND
22-Mar-23	ND	ND	ND	0.0907	ND	0.671	ND	7.4	ND	0.0011	ND	ND	61.8	0.639	ND	0.0129	0.0053	ND	ND	253	ND	ND	ND
19-Jun-23	0.12	ND	ND	0.1	ND	0.62	ND	8.4	ND	0.0062	ND	ND	62	0.347	ND	0.0117	0.0044	ND	ND	274	ND	ND	ND

Non-Protected Groundwater Source

	Aluminum	Anitmony	Arsenic	Barium	Beryllium	Boron	Cadmium	Chloride	Chromium	Cobalt	Copper	Lead	Magnesium	Manganese	Mercury	Molybdenum	Nickel	Selenium	Silver	Sulfate	Thallium	Vanadium	Zinc
		0.32	0.05	10	0.02	7	0.025		0.01	0.01	6.5	0.075		4.9	0.01	0.2	0.7	0.25	0.5		0.01	0.24	10
6-Dec-22		ND	0.0046	0.096	ND	0.632	ND		ND	0.0043	ND			0.399	ND	0.014	ND	ND	ND		ND	ND	ND
22-Mar-23	ND	ND	ND	0.0907	ND	0.671	ND	7.4	ND	0.0011	ND	ND	61.8	0.639	ND	0.0129	0.0053	ND	ND	253	ND	ND	ND
19-Jun-23	0.12	ND	ND	0.1	ND	0.62	ND	8.4	ND	0.0062	ND	ND	62	0.347	ND	0.0117	0.0044	ND	ND	274	ND	ND	ND

	Aluminum	Anitmony	Arsenic	Barium	Beryllium	Boron	Cadmium	Chloride	Chromium	Cobalt	Copper	Lead	Magnesium	Manganese	Mercury	Molybdenum	Nickel	Selenium	Silver	Sulfate	Thallium	Vanadium	Zinc
		0.06	0.01	2	0.004	1	0.005		0.021	0.0021	1.3	0.015		0.3	0.002	0.04	0.1	0.05	0.1		0.002	0.049	2
6-Dec-22		ND	0.0653	1.4	ND	0.296	ND		0.083	0.0581	0.084	0.055		9.88	0.0011	0.02	0.091	ND	ND		ND	0.164	0.198
22-Mar-23	ND	ND	ND	0.195	ND	0.147	ND	398	ND	0.0007	ND	ND	63.4	0.105	ND	ND	0.004	ND	ND	158	ND	ND	ND
19-Jun-23	1.42	ND	ND	0.249	ND	0.138	ND	265	ND	0.003	ND	ND	51	0.512	ND	ND	0.0056	ND	ND	152	ND	ND	ND

Non-Protected Groundwater Source

	Aluminum	Anitmony	Arsenic	Barium	Beryllium	Boron	Cadmium	Chloride	Chromium	Cobalt	Copper	Lead	Magnesium	Manganese	Mercury	Molybdenum	Nickel	Selenium	Silver	Sulfate	Thallium	Vanadium	Zinc
		0.32	0.05	10	0.02	7	0.025		0.01	0.01	6.5	0.075		4.9	0.01	0.2	0.7	0.25	0.5		0.01	0.24	10
6-Dec-22		ND	0.0653	1.4	ND	0.296	ND		0.083	0.0581	0.084	0.055		9.88	0.0011	0.02	0.091	ND	ND		ND	0.164	0.198
22-Mar-23	ND	ND	ND	0.195	ND	0.147	ND	398	ND	0.0007	ND	ND	63.4	0.105	ND	ND	0.004	ND	ND	158	ND	ND	ND
19-Jun-23	1.42	ND	ND	0.249	ND	0.138	ND	265	ND	0.003	ND	ND	51	0.512	ND	ND	0.0056	ND	ND	152	ND	ND	ND

Protected Groundwater Source

	Aluminum	Anitmony	Arsenic	Barium	Beryllium	Boron	Cadmium	Chloride	Chromium	Cobalt	Copper	Lead	Magnesium	Manganese	Mercury	Molybdenum	Nickel	Selenium	Silver	Sulfate	Thallium	Vanadium	Zinc
		0.06	0.01	2	0.004	1	0.005		0.021	0.0021	1.3	0.015		0.3	0.002	0.04	0.1	0.05	0.1		0.002	0.049	2
6-Dec-22			0.0411	0.152	ND	0.645	ND		ND	0.0293	ND	ND		1.5	ND	0.019	0.043	ND	ND		ND	ND	0.036
22-Mar-23	0.051	ND	ND	0.0637	ND	0.167	ND	15.6	ND	0.0066	ND	ND	78.7	1.39	ND	0.0041	0.0157	ND	ND	748	ND	ND	ND
19-Jun-23	0.298	ND	0.0082	0.0778	ND	0.385	ND	17.4	ND	0.0076	ND	ND	117	3.03	ND	0.004	0.0116	ND	ND	765	ND	ND	ND

Non-Protected Groundwater Source

	Aluminum	Anitmony	Arsenic	Barium	Beryllium	Boron	Cadmium	Chloride	Chromium	Cobalt	Copper	Lead	Magnesium	Manganese	Mercury	Molybdenum	Nickel	Selenium	Silver	Sulfate	Thallium	Vanadium	Zinc
		0.32	0.05	10	0.02	7	0.025		0.01	0.01	6.5	0.075		4.9	0.01	0.2	0.7	0.25	0.5		0.01	0.24	10
6-Dec-22			0.0411	0.152	ND	0.645	ND		ND	0.0293	ND	ND		1.5	ND	0.019	0.043	ND	ND		ND	ND	0.036
22-Mar-23	0.051	ND	ND	0.0637	ND	0.167	ND	15.6	ND	0.0066	ND	ND	78.7	1.39	ND	0.0041	0.0157	ND	ND	748	ND	ND	ND
19-Jun-23	0.298	ND	0.0082	0.0778	ND	0.385	ND	17.4	ND	0.0076	ND	ND	117	3.03	ND	0.004	0.0116	ND	ND	765	ND	ND	ND

Protected Groundwater Source

	Aluminum	Anitmony	Arsenic	Barium	Beryllium	Boron	Cadmium	Chloride	Chromium	Cobalt	Copper	Lead	Magnesium	Manganese	Mercury	Molybdenum	Nickel	Selenium	Silver	Sulfate	Thallium	Vanadium	Zinc
		0.06	0.01	2	0.004	1	0.005		0.021	0.0021	1.3	0.015		0.3	0.002	0.04	0.1	0.05	0.1		0.002	0.049	2
6-Dec-22			0.0045	0.043	ND	0.523	ND		ND	0.0059	ND	ND		0.922	ND	0.134	0.25	ND	ND		ND	ND	0.28
22-Mar-23	ND	ND	0.0056	0.0445	ND	0.654	ND	38.4	ND	0.0027	ND	ND	98.9	0.782	ND	0.124	0.0106	ND	ND	543	ND	ND	ND
19-Jun-23	0.148	ND	0.0108	0.0881	ND	0.603	0.0008	43.2	ND	0.0061	ND	ND	90.9	0.689	ND	0.115	0.0121	ND	ND	612	ND	ND	ND

Non-Protected Groundwater Source

	Aluminum	Anitmony	Arsenic	Barium	Beryllium	Boron	Cadmium	Chloride	Chromium	Cobalt	Copper	Lead	Magnesium	Manganese	Mercury	Molybdenum	Nickel	Selenium	Silver	Sulfate	Thallium	Vanadium	Zinc
		0.32	0.05	10	0.02	7	0.025		0.01	0.01	6.5	0.075		4.9	0.01	0.2	0.7	0.25	0.5		0.01	0.24	10
6-Dec-22			0.0045	0.043	ND	0.523	ND		ND	0.0059	ND	ND		0.922	ND	0.134	0.25	ND	ND		ND	ND	0.28
22-Mar-23	ND	ND	0.0056	0.0445	ND	0.654	ND	38.4	ND	0.0027	ND	ND	98.9	0.782	ND	0.124	0.0106	ND	ND	543	ND	ND	ND
19-Jun-23	0.148	ND	0.0108	0.0881	ND	0.603	0.0008	43.2	ND	0.0061	ND	ND	90.9	0.689	ND	0.115	0.0121	ND	ND	612	ND	ND	ND

Protected Groundwater Source

	Aluminum	Anitmony	Arsenic	Barium	Beryllium	Boron	Cadmium	Chloride	Chromium	Cobalt	Copper	Lead	Magnesium	Manganese	Mercury	Molybdenum	Nickel	Selenium	Silver	Sulfate	Thallium	Vanadium	Zinc
		0.06	0.01	2	0.004	1	0.005		0.021	0.0021	1.3	0.015		0.3	0.002	0.04	0.1	0.05	0.1		0.002	0.049	2
6-Dec-22	No Sample, dry well																						
22-Mar-23	No Sample, dry well																						
19-Jun-23	No Sample, dry well																						

Non-Protected Groundwater Source

	Aluminum	Anitmony	Arsenic	Barium	Beryllium	Boron	Cadmium	Chloride	Chromium	Cobalt	Copper	Lead	Magnesium	Manganese	Mercury	Molybdenum	Nickel	Selenium	Silver	Sulfate	Thallium	Vanadium	Zinc
		0.32	0.05	10	0.02	7	0.025		0.01	0.01	6.5	0.075		4.9	0.01	0.2	0.7	0.25	0.5		0.01	0.24	10
6-Dec-22	No Sample, dry well																						
22-Mar-23	No Sample, dry well																						
19-Jun-23	No Sample, dry well																						

Protected Groundwater Source

	Aluminum	Anitmony	Arsenic	Barium	Beryllium	Boron	Cadmium	Chloride	Chromium	Cobalt	Copper	Lead	Magnesium	Manganese	Mercury	Molybdenum	Nickel	Selenium	Silver	Sulfate	Thallium	Vanadium	Zinc
		0.06	0.01	2	0.004	1	0.005		0.021	0.0021	1.3	0.015		0.3	0.002	0.04	0.1	0.05	0.1		0.002	0.049	2
6-Dec-22		0.0038	0.137	2.68	ND	0.135	ND		0.11	0.192	0.216	0.106		12	0.00111	0.014	0.229	ND	ND		ND	0.232	0.392
22-Mar-23	0.051	ND	ND	0.188	ND	ND	ND	15.6	ND	ND	ND	ND	48.4	ND	ND	ND	ND	ND	ND	748	ND	ND	ND
19-Jun-23	8.98	ND	0.0252	0.719	ND	0.106	0.0008	18.8	0.0168	0.0357	0.0359	0.0196	71.1	2.42	ND	ND	0.0456	0.0042	ND	148	ND	0.0365	0.0731

Non-Protected Groundwater Source

	Aluminum	Anitmony	Arsenic	Barium	Beryllium	Boron	Cadmium	Chloride	Chromium	Cobalt	Copper	Lead	Magnesium	Manganese	Mercury	Molybdenum	Nickel	Selenium	Silver	Sulfate	Thallium	Vanadium	Zinc
		0.32	0.05	10	0.02	7	0.025		0.1	0.01	6.5	0.075		4.9	0.01	0.2	0.7	0.25	0.5		0.01	0.24	10
6-Dec-22		0.0038	0.137	2.68	ND	0.135	ND		0.11	0.192	0.216	0.106		12	0.00111	0.014	0.229	ND	ND		ND	0.232	0.392
22-Mar-23	0.051	ND	ND	0.188	ND	ND	ND	15.6	ND	ND	ND	ND	48.4	ND	ND	ND	ND	ND	ND	748	ND	ND	ND
19-Jun-23	8.98	ND	0.0252	0.719	ND	0.106	0.0008	18.8	0.0168	0.0357	0.0359	0.0196	71.1	2.42	ND	ND	0.0456	0.0042	ND	148	ND	0.0365	0.0731

Results of the Ground Water Statistics

for Besser Quinn Quarry

First Semi-Annual Monitoring Event in 2023

Prepared for:
Besser Quinn Quarry
Boone, IA 50036

and

Stone Environmental Engineering
Ankeny, IA 50021

Prepared by:
Jeffrey A. Holmgren
Otter Creek Environmental Services, L.L.C.
40W565 Foxwick Court
Elgin, IL 60124
(847) 464-1355

July 2023

INTRODUCTION

This report contains the results of the statistical analyses used to evaluate the ground water data obtained during the first semi-annual monitoring event in 2023 at Besser Quinn Quarry. The ground water at Besser Quinn Quarry is monitored by wells QE, QN, QNE, QNW, QS, and QW. These monitoring wells were sampled on June 19, 2023 and analyzed for the parameters required by permit. Well QW was reported to be dry.

The statistical plan is designed to detect a release from the facility at the earliest indication so that it is protective of human health and the environment. Both interwell and intrawell methodologies are described and then applied to the Besser Quinn Quarry data. The statistical plan conforms with IAC 567, Chapter 113.10, USEPA Guidance document ("*Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Unified Guidance"*, March 2009), and the American Society for Testing and Materials (ASTM) standard D6312-98, *Developing Appropriate Statistical Approaches for Ground-Water Detection Monitoring Programs*.

Ground Water Monitoring Program

The groundwater monitoring network for Besser Quinn Quarry includes wells QE, QN, QNE, QNW, QS, and QW. Each of the groundwater monitoring wells is to be sampled at least semiannually and analyzed for the detection monitoring parameters listed below.

Detection monitoring constituents for Besser Quinn Quarry
Barium, Total
Boron, Total
Cobalt, Total
Manganese, Total
Molybdenum, Total
Nickel, Total

The ground water data obtained during the first semi-annual monitoring event in 2023 are summarized in Attachment A. The historical ground water data obtained from 2019 through the first semi-annual monitoring event in 2023 are summarized in Attachment B.

STATISTICAL METHODOLOGIES FOR DETECTION MONITORING

IAC 567, Chapter 113.10(4) provides several options for statistically evaluating the ground water data at those wells that monitor the open cells or contiguous MSWLF units. The preferred methods for comparing ground water data are using either prediction limits or using control charts. Both of these methods were applied to the Besser Quinn Quarry data using the DUMPStat® statistical program. DUMPStat® is a program for the statistical analysis of groundwater monitoring data using methods described in "Statistical Methods for Groundwater Monitoring" by Dr. Robert D. Gibbons. The DUMPStat program is completely consistent with all USEPA regulations and guidance and the ASTM D6312-98 guidance. Ground water statistics are to be done on the constituents listed.

Interwell Statistics: Upgradient versus Downgradient Comparisons

Interwell statistics are appropriate when the upgradient and downgradient wells monitor the same ground water formation and there is similar variability in the upgradient and downgradient zones. Site prediction limits are determined by pooling the historical ground water data from hydraulically upgradient wells. This statistical method compares the current downgradient determinations to site prediction limits and checks for exceedances. The type of prediction limit utilized (e.g., parametric or nonparametric) is based on the detection frequency and the data distribution of each parameter in the background data. The distribution of the background data is tested for normality using the Shapiro-Wilk test (Gibbons, 1994 and USEPA 1992). If the constituent is normally distributed, a normal prediction limit is used. If normality is rejected by the Shapiro-Wilk test, the background data is transformed by taking the natural logarithm. The Shapiro-Wilk test is then reapplied on the transformed data. If it is not rejected, lognormal prediction limits are used. If after transforming the data, normality is still rejected, nonparametric prediction limits are used for that analyte. The nonparametric prediction limit is the largest determination in the background measurements. For constituents where the background detection frequency is greater than 0% but less than 50%, nonparametric prediction limits will be used. If the detection frequency is 0% after thirteen samples have been collected, the practical quantitation limit (PQL) becomes the nonparametric prediction limit.

Results of the Interwell Statistics

The background data used in this statistical analysis includes the ground water data collected from ground water wells QE, QN, and QNE during the period from 2020 through the current data. A summary of the background data from monitoring wells QE, QN, and QNE is listed in Attachment C, Table 1 "Upgradient Data". This statistical method compares the current downgradient determinations to site prediction limits and checks for exceedances.

Table 2 "Most Current Downgradient Monitoring Data", summarizes the current data from downgradient wells QNW, QS, and QW, compared to the site prediction limits. Prediction limit exceedances are flagged with asterisks. For the most current data, the site prediction limit exceedances detected are summarized in the table below.

Prediction Limit Exceedances at Besser Quinn Quarry during the First Semi-Annual Monitoring Event in 2023

Well	Parameter	Result	Prediction Limit	Prediction Limit Type	Verified/ Awaiting verification
QNW	Barium, mg/L	0.249	0.2205	Lognormal	Awaiting verification
QS	Barium, mg/L	0.719	0.2205	Lognormal	Awaiting verification
	Cobalt, mg/L	0.0357	0.0264	Lognormal	Awaiting verification
	Nickel, mg/L	0.0456	0.0303	Normal	Awaiting verification

The detection frequencies of the parameters in the up and down gradient monitoring wells are summarized in Table 3. Table 4 summarizes the results of the Shapiro-Wilk test. Table 5 is a summary of the statistics and prediction limits determined. Time series graphs of each of the parameters at each well with the corresponding prediction limits are attached.

A statistical power curve indicates the expected false assessments for the site as a whole. The false positive rate for interwell analyses is the percentage of failures when the upgradient versus downgradient true mean difference equals zero. False negative rate indicates the chance of missing contamination at a single well for a single constituent. The statistical power is a function of the number of wells included, the number of constituents compared, the detection frequencies, and the data distributions involved. For interwell analysis, the site-wide false positive rate is 1% and the test becomes sensitive to 5 standard deviation unit increases over background.

Intrawell statistics

Intrawell statistics are appropriate for facilities where the upgradient wells do not accurately characterize the natural ground water conditions downgradient from the facility. This may be due to different hydrogeological conditions where the wells are screened, having too few upgradient wells to account for the spatial variability, or the site exhibiting no definable hydraulic gradient. Intrawell statistics compare new measurements to the historical data at each ground water monitoring well independently. It is recommended that at least eight background samples be obtained prior to performing the statistics.

The most useful technique for intrawell comparisons is the combined Shewhart-CUSUM control chart. This control chart procedure is useful because it will detect releases both in terms of the constituent concentration and cumulative increases. This method is also extremely sensitive to sudden and gradual releases. A requirement for constructing these control charts is that the parameter is detected at a frequency greater than or equal to 25%, otherwise the data variance is not properly defined.

The combined Shewhart-CUSUM control chart assumes that the data are independent and normally distributed with a fixed mean and a constant variance. Independent data is much more critical than the normality assumption. To achieve independence, it is recommended that data are collected no more frequently than quarterly to account for seasonal variation. The combined Shewhart-CUSUM control chart is extremely robust to deviations from normality. Because the control charts do not use a specific multiplier based on a normal distribution, it is more conservative to assume normality.

It is recommended that at least eight rounds of data be available to provide a reliable estimate of the mean and standard deviation of the parameter concentration, although the control charts will be generated with as few as four data points. Having only four data points may produce greater uncertainty in the mean and standard deviation of the background data, leading to higher control limits, thus having a potentially high false negative rate.

Many groundwater monitoring parameters are not detected at a frequency great enough to generate the combined Shewhart-CUSUM control charts. For constituents that are detected less than 25% of the time at a particular well, the data should be plotted as a time series until a sufficient number of data points are available to provide a 99% confidence nonparametric prediction limit. Thirteen independent measurements (with 1 resample) are necessary to achieve a 99% confidence (1% false positive rate) nonparametric prediction limit. Eight independent measurements (for pass 1 of 2 resamples) are necessary to achieve a 99% confidence nonparametric prediction limit. The nonparametric prediction limit is the largest determination out of the data set collected for that well and parameter. If the detection frequency is 0% after thirteen samples have been collected, the practical quantitation limit (PQL) becomes the

nonparametric prediction limit.

In developing the statistical background, the historical data must be thoroughly screened for anomalous data due to sampling error, analytical error, or simply by chance alone. An erroneous data point, if not removed prior to the mean and variance computations, would yield a larger control limit thus increasing the false negative rate. The DUMPStat® program screens for outliers using the Dixon test. If the Dixon test indicates an outlier, the value is compared to three times the median value for intrawell analyses. If the value fails both criteria of the two-stage screening, the value is considered a statistical outlier and will not be used in the mean and variance determinations. Anomalous data will still be plotted on the graphs (with a unique symbol) but will not be included in the calculations.

The verification resample plan is an integral function of the statistical plan to reduce the probability that anomalous data obtained after the background has been established, is indicative of a release.

The background data for each well and constituent is tested for existing trends using Sen's nonparametric estimate of trend. If contamination exists prior to completing the background, the control limits could be potentially high and this control chart method would not be able to detect an increasing trend unless the increase is severe.

Results of the Intrawell Statistics

The monitoring constituents at wells QE, QN, QNE, QNW, and QS were evaluated using the combined Shewhart-CUSUM control chart method. The previous background included the four rounds of data obtained from March 2020 through December 2020. Since a minimum of eight rounds of data is recommended, the background was updated to include data obtained from March 2020 through December 2022.

A summary of the intrawell statistics is included in Attachment D, Table 1 "Summary Statistics and Intermediate Computations for Combined Shewhart-CUSUM Control Charts." The control charts or time series graphs follow the summary table. For the most current data, there were no control limit exceedances detected. No increasing trends were detected in the background data.

A control chart factor was selected to provide a balance of the site-wide false positive and false negative rates. A statistical power curve indicates the expected false assessments for the site as a whole. The site-wide false positive rate is 6% and the test becomes sensitive to 4 standard deviation units over background.

CONCLUSIONS

This document describes a comprehensive statistical plan designated for the Besser Quinn Quarry. The groundwater monitoring network for Besser Quinn Quarry includes wells QE, QN, QNE, QNW, QS, and QW. The ground water data was compared to background using prediction limits (interwell) and using control charts (intrawell). For the most current data, there are site prediction limit exceedances for barium at QNS, barium at QS, cobalt at QS, and nickel at QS awaiting verification. Using intrawell comparisons, there are no control limit exceedances.

Attachment A

Ground Water Data

Table 1

Analytical Data Summary for 6/19/2023

Constituents	Units	QE	QN	QNE	QNW	QS
Barium, Total	mg/L	.0778	.0881	.1000	.2490	.7190
Boron, Total	mg/L	.385	.603	.620	.138	.106
Cobalt, Total	mg/L	.0076	.0061	.0062	.0030	.0357
Manganese, Total	mg/L	3.030	.689	.347	.512	2.420
Molybdenum, Total	mg/L	.0040	.1150	.0117	<.0040	<.0040
Nickel, Total	mg/L	.0116	.0121	.0044	.0056	.0456

* - The displayed value is the arithmetic mean of multiple database matches.

Attachment B

Historical Ground Water Data

Table 1

Analytical Data Summary for QE

Constituents	Units	3/1/2020	6/15/2020	9/1/2020	12/9/2020	6/10/2021	12/9/2021	6/21/2022	12/6/2022	3/22/2023	6/19/2023
Barium, Total	mg/L	.1200	.1140	.0630	.0520	.0065	.0770	.0690	.1520	.0637	.0778
Boron, Total	mg/L	.293	.185	.524	.523	.504	.489	<.100	.645	.167	.385
Cobalt, Total	mg/L	.0048	.0020	.0004	.0042	.0017	.0024	.0023	.0293	.0066	.0076
Manganese, Total	mg/L	1.290	1.020	.808	.776	2.070	3.010	.719	1.500	1.390	3.030
Molybdenum, Total	mg/L	<.0100	<.0100	<.0100	.0100	<.0100	<.0100	<.0100	.0190	.0041	.0040
Nickel, Total	mg/L	.0110	<.0100	<.0100	.0150	<.0100	.0150	<.0100	.0430	.0157	.0116

* - The displayed value is the arithmetic mean of multiple database matches.

Table 2

Analytical Data Summary for QN

Constituents	Units	3/1/2020	6/15/2020	9/1/2020	12/9/2020	6/10/2021	12/9/2021	6/21/2022	12/6/2022	3/22/2023	6/19/2023
Barium, Total	mg/L	.2050	.0890	.0790	.1040	.1220	.1260	.0560	.0430	.0445	.0881
Boron, Total	mg/L	.544	.479	.481	.520	.661	.634	.124	.523	.654	.603
Cobalt, Total	mg/L	.0039	.0035	.0029	.0039	.0034	.0025	.0008	.0059	.0027	.0061
Manganese, Total	mg/L	1.150	.945	.857	1.100	.955	.614	.333	.922	.782	.689
Molybdenum, Total	mg/L	.358	.265	.246	.250	.223	.184	.024	.134	.124	.115
Nickel, Total	mg/L	.0190	.0200	.0170	.0160	.0130	.0170	.0200	.0250	.0106	.0121

* - The displayed value is the arithmetic mean of multiple database matches.

Table 3

Analytical Data Summary for QNE

Constituents	Units	3/1/2020	6/15/2020	9/1/2020	12/9/2020	6/10/2021	12/9/2021	6/21/2022	12/6/2022	3/22/2023	6/19/2023
Barium, Total	mg/L	.1490	.1040	.0940	.0970	.0960	.0970	.1000	.0960	.0907	.1000
Boron, Total	mg/L	1.1500	.4760	.0752	.7390	.7490	.7300	.6080	.6320	.6710	.6200
Cobalt, Total	mg/L	.0038	.0019	.0011	.0013	.0006	.0007	.0005	.0043	.0011	.0062
Manganese, Total	mg/L	1.460	.616	.698	.604	.397	.431	.313	.399	.639	.347
Molybdenum, Total	mg/L	.1150	.0210	.0230	.0230	.0200	.0200	.0180	.0140	.0129	.0117
Nickel, Total	mg/L	.0160	.0180	.0150	.0120	<.0100	<.0100	<.0100	<.0100	.0053	.0044

* - The displayed value is the arithmetic mean of multiple database matches.

Table 4

Analytical Data Summary for QNW

Constituents	Units	3/1/2020	6/15/2020	9/1/2020	12/9/2020	6/10/2021	12/9/2021	6/21/2022	12/6/2022	3/22/2023	6/19/2023
Barium, Total	mg/L	.226	.170	.245	.287	.260	.309	1.820	1.400	.195	.249
Boron, Total	mg/L	.174	<.010	.198	.247	.163	.277	.122	.296	.147	.138
Cobalt, Total	mg/L	.0033	.0074	.0004	.0004	.0033	.0067	.0804	.0581	.0007	.0030
Manganese, Total	mg/L	1.040	.302	.056	.045	.701	.714	5.240	9.880	.105	.512
Molybdenum, Total	mg/L	<.010	<.010	<.010	<.010	<.010	<.010	.018	.020	<.004	<.004
Nickel, Total	mg/L	<.0100	.0100	<.0100	<.0100	<.0100	<.0100	.1000	.0910	.0040	.0056

* - The displayed value is the arithmetic mean of multiple database matches.

Table 5

Analytical Data Summary for QS

Constituents	Units	3/1/2020	6/15/2020	9/1/2020	12/9/2020	6/10/2021	12/9/2021	6/21/2022	12/6/2022	3/22/2023	6/19/2023
Barium, Total	mg/L	2.990	.256	.250	.384	.261	.202	3.890	2.680	.188	.719
Boron, Total	mg/L	.162	<.010	<.010	<.010	.114	<.100	.139	.135	<.100	.106
Cobalt, Total	mg/L	.2270	.0103	.0064	.0135	.0070	.0038	.2260	.1920	<.0004	.0357
Manganese, Total	mg/L	16.600	.658	.419	1.080	.429	.078	20.000	12.000	<.004	2.420
Molybdenum, Total	mg/L	.020	<.010	<.010	<.010	<.010	<.010	.022	.014	<.004	<.004
Nickel, Total	mg/L	.3380	.0210	.0150	.0250	.0120	<.0100	.3360	.2290	<.0040	.0456

* - The displayed value is the arithmetic mean of multiple database matches.

Table 6

Analytical Data Summary for QW

Constituents	Units	3/1/2020	6/15/2020	9/1/2020	12/9/2020	6/10/2021	12/9/2021	6/21/2022
Barium, Total	mg/L	.176	.151	.156	.170	.284	.189	.628
Boron, Total	mg/L	<.01	<.01	<.01	<.01	<.01	<.10	<.10
Cobalt, Total	mg/L	.0012	.0004	.0004	.0009	.0082	.0013	.0308
Manganese, Total	mg/L	.082	.024	.023	.049	.504	.059	2.020
Molybdenum, Total	mg/L	<.01	<.01	<.01	<.01	<.01	<.01	<.01
Nickel, Total	mg/L	<.010	<.010	<.010	<.010	.016	<.010	.053

* - The displayed value is the arithmetic mean of multiple database matches.

Attachment C

Summary Tables and Graphs for the Interwell Comparisons

Table 1

Upgradient Data

Constituent	Units	Well	Date		Result	Adjusted	
Barium, Total	mg/L	QE	03/01/2020		0.1200		
Barium, Total	mg/L	QE	06/15/2020		0.1140		
Barium, Total	mg/L	QE	09/01/2020		0.0630		
Barium, Total	mg/L	QE	12/09/2020		0.0520		
Barium, Total	mg/L	QE	06/10/2021		0.0065		*
Barium, Total	mg/L	QE	12/09/2021		0.0770		
Barium, Total	mg/L	QE	06/21/2022		0.0690		
Barium, Total	mg/L	QE	12/06/2022		0.1520		
Barium, Total	mg/L	QE	03/22/2023		0.0637		
Barium, Total	mg/L	QE	06/19/2023		0.0778		
Boron, Total	mg/L	QE	03/01/2020		0.2930		
Boron, Total	mg/L	QE	06/15/2020		0.1850		
Boron, Total	mg/L	QE	09/01/2020		0.5240		
Boron, Total	mg/L	QE	12/09/2020		0.5230		
Boron, Total	mg/L	QE	06/10/2021		0.5040		
Boron, Total	mg/L	QE	12/09/2021		0.4890		
Boron, Total	mg/L	QE	06/21/2022	ND	0.1000		
Boron, Total	mg/L	QE	12/06/2022		0.6450		
Boron, Total	mg/L	QE	03/22/2023		0.1670		
Boron, Total	mg/L	QE	06/19/2023		0.3850		
Cobalt, Total	mg/L	QE	03/01/2020		0.0048		
Cobalt, Total	mg/L	QE	06/15/2020		0.0020		
Cobalt, Total	mg/L	QE	09/01/2020		0.0004		
Cobalt, Total	mg/L	QE	12/09/2020		0.0042		
Cobalt, Total	mg/L	QE	06/10/2021		0.0017		
Cobalt, Total	mg/L	QE	12/09/2021		0.0024		
Cobalt, Total	mg/L	QE	06/21/2022		0.0023		
Cobalt, Total	mg/L	QE	12/06/2022		0.0293		
Cobalt, Total	mg/L	QE	03/22/2023		0.0066		
Cobalt, Total	mg/L	QE	06/19/2023		0.0076		
Manganese, Total	mg/L	QE	03/01/2020		1.2900		
Manganese, Total	mg/L	QE	06/15/2020		1.0200		
Manganese, Total	mg/L	QE	09/01/2020		0.8080		
Manganese, Total	mg/L	QE	12/09/2020		0.7760		
Manganese, Total	mg/L	QE	06/10/2021		2.0700		
Manganese, Total	mg/L	QE	12/09/2021		3.0100		
Manganese, Total	mg/L	QE	06/21/2022		0.7190		
Manganese, Total	mg/L	QE	12/06/2022		1.5000		
Manganese, Total	mg/L	QE	03/22/2023		1.3900		
Manganese, Total	mg/L	QE	06/19/2023		3.0300		
Molybdenum, Total	mg/L	QE	03/01/2020	ND	0.0100		
Molybdenum, Total	mg/L	QE	06/15/2020	ND	0.0100		
Molybdenum, Total	mg/L	QE	09/01/2020	ND	0.0100		
Molybdenum, Total	mg/L	QE	12/09/2020		0.0100		
Molybdenum, Total	mg/L	QE	06/10/2021	ND	0.0100		
Molybdenum, Total	mg/L	QE	12/09/2021	ND	0.0100		
Molybdenum, Total	mg/L	QE	06/21/2022	ND	0.0100		
Molybdenum, Total	mg/L	QE	12/06/2022		0.0190		
Molybdenum, Total	mg/L	QE	03/22/2023		0.0041		
Molybdenum, Total	mg/L	QE	06/19/2023		0.0040		
Nickel, Total	mg/L	QE	03/01/2020		0.0110		
Nickel, Total	mg/L	QE	06/15/2020	ND	0.0100		
Nickel, Total	mg/L	QE	09/01/2020	ND	0.0100		
Nickel, Total	mg/L	QE	12/09/2020		0.0150		
Nickel, Total	mg/L	QE	06/10/2021	ND	0.0100		
Nickel, Total	mg/L	QE	12/09/2021		0.0150		
Nickel, Total	mg/L	QE	06/21/2022	ND	0.0100		
Nickel, Total	mg/L	QE	12/06/2022		0.0430		*
Nickel, Total	mg/L	QE	03/22/2023		0.0157		
Nickel, Total	mg/L	QE	06/19/2023		0.0116		
Barium, Total	mg/L	QN	03/01/2020		0.2050		
Barium, Total	mg/L	QN	06/15/2020		0.0890		
Barium, Total	mg/L	QN	09/01/2020		0.0790		
Barium, Total	mg/L	QN	12/09/2020		0.1040		
Barium, Total	mg/L	QN	06/10/2021		0.1220		
Barium, Total	mg/L	QN	12/09/2021		0.1260		
Barium, Total	mg/L	QN	06/21/2022		0.0560		
Barium, Total	mg/L	QN	12/06/2022		0.0430		
Barium, Total	mg/L	QN	03/22/2023		0.0445		
Barium, Total	mg/L	QN	06/19/2023		0.0881		
Boron, Total	mg/L	QN	03/01/2020		0.5440		
Boron, Total	mg/L	QN	06/15/2020		0.4790		
Boron, Total	mg/L	QN	09/01/2020		0.4810		
Boron, Total	mg/L	QN	12/09/2020		0.5200		

* - Outlier for that well and constituent.
** - ND value replaced with median RL.
*** - ND value replaced with manual RL.
ND = Not detected, Result = detection limit.

Table 1

Upgradient Data

Constituent	Units	Well	Date		Result	Adjusted	
Boron, Total	mg/L	QN	06/10/2021		0.6610		
Boron, Total	mg/L	QN	12/09/2021		0.6340		
Boron, Total	mg/L	QN	06/21/2022		0.1240		*
Boron, Total	mg/L	QN	12/06/2022		0.5230		
Boron, Total	mg/L	QN	03/22/2023		0.6540		
Boron, Total	mg/L	QN	06/19/2023		0.6030		
Cobalt, Total	mg/L	QN	03/01/2020		0.0039		
Cobalt, Total	mg/L	QN	06/15/2020		0.0035		
Cobalt, Total	mg/L	QN	09/01/2020		0.0029		
Cobalt, Total	mg/L	QN	12/09/2020		0.0039		
Cobalt, Total	mg/L	QN	06/10/2021		0.0034		
Cobalt, Total	mg/L	QN	12/09/2021		0.0025		
Cobalt, Total	mg/L	QN	06/21/2022		0.0008		
Cobalt, Total	mg/L	QN	12/06/2022		0.0059		
Cobalt, Total	mg/L	QN	03/22/2023		0.0027		
Cobalt, Total	mg/L	QN	06/19/2023		0.0061		
Manganese, Total	mg/L	QN	03/01/2020		1.1500		
Manganese, Total	mg/L	QN	06/15/2020		0.9450		
Manganese, Total	mg/L	QN	09/01/2020		0.8570		
Manganese, Total	mg/L	QN	12/09/2020		1.1000		
Manganese, Total	mg/L	QN	06/10/2021		0.9550		
Manganese, Total	mg/L	QN	12/09/2021		0.6140		
Manganese, Total	mg/L	QN	06/21/2022		0.3330		
Manganese, Total	mg/L	QN	12/06/2022		0.9220		
Manganese, Total	mg/L	QN	03/22/2023		0.7820		
Manganese, Total	mg/L	QN	06/19/2023		0.6890		
Molybdenum, Total	mg/L	QN	03/01/2020		0.3580		
Molybdenum, Total	mg/L	QN	06/15/2020		0.2650		
Molybdenum, Total	mg/L	QN	09/01/2020		0.2460		
Molybdenum, Total	mg/L	QN	12/09/2020		0.2500		
Molybdenum, Total	mg/L	QN	06/10/2021		0.2230		
Molybdenum, Total	mg/L	QN	12/09/2021		0.1840		
Molybdenum, Total	mg/L	QN	06/21/2022		0.0240		*
Molybdenum, Total	mg/L	QN	12/06/2022		0.1340		
Molybdenum, Total	mg/L	QN	03/22/2023		0.1240		
Molybdenum, Total	mg/L	QN	06/19/2023		0.1150		
Nickel, Total	mg/L	QN	03/01/2020		0.0190		
Nickel, Total	mg/L	QN	06/15/2020		0.0200		
Nickel, Total	mg/L	QN	09/01/2020		0.0170		
Nickel, Total	mg/L	QN	12/09/2020		0.0160		
Nickel, Total	mg/L	QN	06/10/2021		0.0130		
Nickel, Total	mg/L	QN	12/09/2021		0.0170		
Nickel, Total	mg/L	QN	06/21/2022		0.0200		
Nickel, Total	mg/L	QN	12/06/2022		0.0250		
Nickel, Total	mg/L	QN	03/22/2023		0.0106		
Nickel, Total	mg/L	QN	06/19/2023		0.0121		
Barium, Total	mg/L	QNE	03/01/2020		0.1490		
Barium, Total	mg/L	QNE	06/15/2020		0.1040		
Barium, Total	mg/L	QNE	09/01/2020		0.0940		
Barium, Total	mg/L	QNE	12/09/2020		0.0970		
Barium, Total	mg/L	QNE	06/10/2021		0.0960		
Barium, Total	mg/L	QNE	12/09/2021		0.0970		
Barium, Total	mg/L	QNE	06/21/2022		0.1000		
Barium, Total	mg/L	QNE	12/06/2022		0.0960		
Barium, Total	mg/L	QNE	03/22/2023		0.0907		
Barium, Total	mg/L	QNE	06/19/2023		0.1000		
Boron, Total	mg/L	QNE	03/01/2020		1.1500		
Boron, Total	mg/L	QNE	06/15/2020		0.4760		
Boron, Total	mg/L	QNE	09/01/2020		0.0752		*
Boron, Total	mg/L	QNE	12/09/2020		0.7390		
Boron, Total	mg/L	QNE	06/10/2021		0.7490		
Boron, Total	mg/L	QNE	12/09/2021		0.7300		
Boron, Total	mg/L	QNE	06/21/2022		0.6080		
Boron, Total	mg/L	QNE	12/06/2022		0.6320		
Boron, Total	mg/L	QNE	03/22/2023		0.6710		
Boron, Total	mg/L	QNE	06/19/2023		0.6200		
Cobalt, Total	mg/L	QNE	03/01/2020		0.0038		
Cobalt, Total	mg/L	QNE	06/15/2020		0.0019		
Cobalt, Total	mg/L	QNE	09/01/2020		0.0011		
Cobalt, Total	mg/L	QNE	12/09/2020		0.0013		
Cobalt, Total	mg/L	QNE	06/10/2021		0.0006		
Cobalt, Total	mg/L	QNE	12/09/2021		0.0007		
Cobalt, Total	mg/L	QNE	06/21/2022		0.0005		
Cobalt, Total	mg/L	QNE	12/06/2022		0.0043		

* - Outlier for that well and constituent.
** - ND value replaced with median RL.
*** - ND value replaced with manual RL.
ND = Not detected, Result = detection limit.

Table 1

Upgradient Data

Constituent	Units	Well	Date		Result	Adjusted	
Cobalt, Total	mg/L	QNE	03/22/2023		0.0011		
Cobalt, Total	mg/L	QNE	06/19/2023		0.0062		
Manganese, Total	mg/L	QNE	03/01/2020		1.4600		
Manganese, Total	mg/L	QNE	06/15/2020		0.6160		
Manganese, Total	mg/L	QNE	09/01/2020		0.6980		
Manganese, Total	mg/L	QNE	12/09/2020		0.6040		
Manganese, Total	mg/L	QNE	06/10/2021		0.3970		
Manganese, Total	mg/L	QNE	12/09/2021		0.4310		
Manganese, Total	mg/L	QNE	06/21/2022		0.3130		
Manganese, Total	mg/L	QNE	12/06/2022		0.3990		
Manganese, Total	mg/L	QNE	03/22/2023		0.6390		
Manganese, Total	mg/L	QNE	06/19/2023		0.3470		
Molybdenum, Total	mg/L	QNE	03/01/2020		0.1150		*
Molybdenum, Total	mg/L	QNE	06/15/2020		0.0210		
Molybdenum, Total	mg/L	QNE	09/01/2020		0.0230		
Molybdenum, Total	mg/L	QNE	12/09/2020		0.0230		
Molybdenum, Total	mg/L	QNE	06/10/2021		0.0200		
Molybdenum, Total	mg/L	QNE	12/09/2021		0.0200		
Molybdenum, Total	mg/L	QNE	06/21/2022		0.0180		
Molybdenum, Total	mg/L	QNE	12/06/2022		0.0140		
Molybdenum, Total	mg/L	QNE	03/22/2023		0.0129		
Molybdenum, Total	mg/L	QNE	06/19/2023		0.0117		
Nickel, Total	mg/L	QNE	03/01/2020		0.0160		
Nickel, Total	mg/L	QNE	06/15/2020		0.0180		
Nickel, Total	mg/L	QNE	09/01/2020		0.0150		
Nickel, Total	mg/L	QNE	12/09/2020		0.0120		
Nickel, Total	mg/L	QNE	06/10/2021	ND	0.0100		
Nickel, Total	mg/L	QNE	12/09/2021	ND	0.0100		
Nickel, Total	mg/L	QNE	06/21/2022	ND	0.0100		
Nickel, Total	mg/L	QNE	12/06/2022	ND	0.0100		
Nickel, Total	mg/L	QNE	03/22/2023		0.0053		
Nickel, Total	mg/L	QNE	06/19/2023		0.0044		

* - Outlier for that well and constituent.
** - ND value replaced with median RL.
*** - ND value replaced with manual RL.
ND = Not detected, Result = detection limit.

Table 2

Most Current Downgradient Monitoring Data

Constituent	Units	Well	Date		Result		Pred. Limit
Barium, Total	mg/L	QNW	06/19/2023		0.2490	*	0.2205
Boron, Total	mg/L	QNW	06/19/2023		0.1380		1.0814
Cobalt, Total	mg/L	QNW	06/19/2023		0.0030		0.0264
Manganese, Total	mg/L	QNW	06/19/2023		0.5120		3.6415
Molybdenum, Total	mg/L	QNW	06/19/2023	ND	0.0040		0.3403
Nickel, Total	mg/L	QNW	06/19/2023		0.0056		0.0303
Barium, Total	mg/L	QS	06/19/2023		0.7190	*	0.2205
Boron, Total	mg/L	QS	06/19/2023		0.1060		1.0814
Cobalt, Total	mg/L	QS	06/19/2023		0.0357	*	0.0264
Manganese, Total	mg/L	QS	06/19/2023		2.4200		3.6415
Molybdenum, Total	mg/L	QS	06/19/2023	ND	0.0040		0.3403
Nickel, Total	mg/L	QS	06/19/2023		0.0456	*	0.0303

* - Current value failed - awaiting verification.
** - Current value passed - previous exceedance not verified.
*** - Current value failed - exceedance verified.
**** - Current value passed - awaiting one more verification.
***** - Insufficient background data to compute prediction limit.
ND = Not Detected, Result = detection limit.

Table 3

Detection Frequencies in Upgradient and Downgradient Wells

Constituent	Detect	Upgradient N	Proportion	Detect	Downgradient N	Proportion
Barium, Total	29	29	1.000	20	20	1.000
Boron, Total	27	28	0.964	14	20	0.700
Cobalt, Total	30	30	1.000	19	20	0.950
Manganese, Total	30	30	1.000	19	20	0.950
Molybdenum, Total	22	28	0.786	5	20	0.250
Nickel, Total	21	29	0.724	13	20	0.650

N = Total number of measurements in all wells.
Detect = Total number of detections in all wells.
Proportion = Detect/N.

Table 4

Shapiro-Wilk Multiple Group Test of Normality

Constituent	Detect	N	Detect Freq	G raw	G log	G cbrt	G sqrt	G sqr	G cub	Crit Value	Dist Form	Model Type
Barium, Total	29	29	1.000	3.639	2.011					2.326	lognor	lognor
Boron, Total	27	28	0.964	1.791	1.616					2.326	normal	normal
Cobalt, Total	30	30	1.000	3.441	0.625					2.326	lognor	lognor
Manganese, Total	30	30	1.000	2.382	1.734					2.326	lognor	lognor
Molybdenum, Total	22	28	0.786	0.953	1.022					2.326	normal	normal
Nickel, Total	21	29	0.724	0.531	1.020					2.326	normal	normal

* - Distribution override for that constituent.
Fit to distribution is confirmed if G <= critical value.
Model type may not match distributional form when detection frequency < 50%.

Table 5

Summary Statistics and Prediction Limits

Constituent	Units	Detect	N	Mean	SD	alpha	Factor	Pred Limit	Type	Conf
Barium, Total	mg/L	29	29	-2.4098	0.3578	0.0100	2.5090	0.2205	lognor	
Boron, Total	mg/L	27	28	0.5425	0.2142	0.0100	2.5161	1.0814	normal	
Cobalt, Total	mg/L	30	30	-5.9745	0.9348	0.0100	2.5024	0.0264	lognor	
Manganese, Total	mg/L	30	30	-0.1827	0.5895	0.0100	2.5024	3.6415	lognor	
Molybdenum, Total	mg/L	22	28	0.0750	0.1055	0.0100	2.5161	0.3403	normal	
Nickel, Total	mg/L	21	29	0.0106	0.0078	0.0100	2.5090	0.0303	normal	

Conf = confidence level for passing initial test or one verification resample at all downgradient wells for a single constituent (nonparametric test only).
* - Insufficient Data.
** - Calculated limit raised to Manual Reporting Limit.
*** - Nonparametric limit based on ND value.
For transformed data, mean and SD in transformed units and prediction limit in original units.
All sample sizes and statistics are based on outlier free data.
For nonparametric limits, median reporting limits are substituted for extreme reporting limit values.

Table 6

Dixon's Test Outliers
1% Significance Level

Constituent	Units	Well	Date	Result	ND Qualifier	Date Range	N	Critical Value
Barium, Total	mg/L	QE	06/10/2021	0.0065		03/01/2020-06/19/2023	10	0.5972
Nickel, Total	mg/L	QE	12/06/2022	0.0430		03/01/2020-06/19/2023	10	0.5972
Boron, Total	mg/L	QN	06/21/2022	0.1240		03/01/2020-06/19/2023	10	0.5972
Molybdenum, Total	mg/L	QN	06/21/2022	0.0240		03/01/2020-06/19/2023	10	0.5972
Boron, Total	mg/L	QNE	09/01/2020	0.0752		03/01/2020-06/19/2023	10	0.5972
Molybdenum, Total	mg/L	QNE	03/01/2020	0.1150		03/01/2020-06/19/2023	10	0.5972

N = Total number of independent measurements in background at each well.
Date Range = Dates of the first and last measurements included in background at each well.
Critical Value depends on the significance level and on N-1 when the two most extreme values are tested or N for the most extreme value.

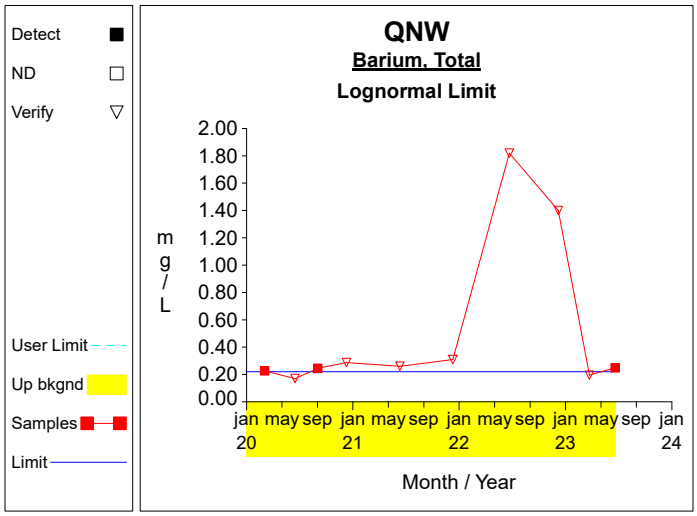
Table 8

Historical Downgradient Data for Constituent-Well Combinations that Failed the Current Statistical Evaluation or are in Verification Resampling Mode

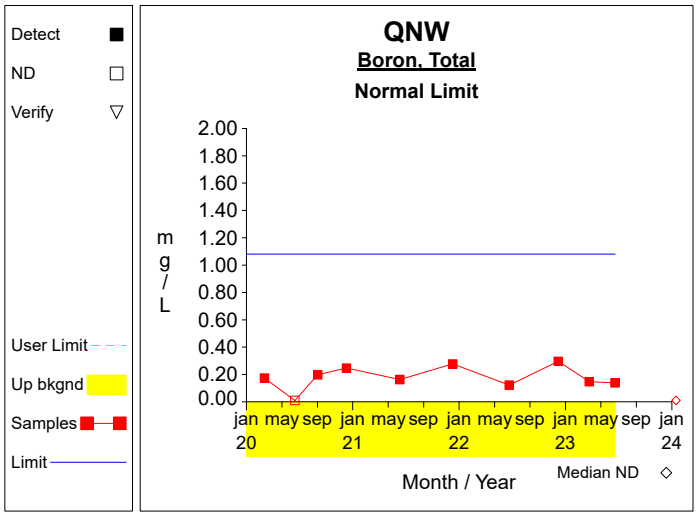
Constituent	Units	Well	Date		Result		Pred. Limit
Barium, Total	mg/L	QNW	03/01/2020		0.2260	*	0.2205
Barium, Total	mg/L	QNW	06/15/2020		0.1700		0.2205
Barium, Total	mg/L	QNW	09/01/2020		0.2450	*	0.2205
Barium, Total	mg/L	QNW	12/09/2020		0.2870	*	0.2205
Barium, Total	mg/L	QNW	06/10/2021		0.2600	*	0.2205
Barium, Total	mg/L	QNW	12/09/2021		0.3090	*	0.2205
Barium, Total	mg/L	QNW	06/21/2022		1.8200	*	0.2205
Barium, Total	mg/L	QNW	12/06/2022		1.4000	*	0.2205
Barium, Total	mg/L	QNW	03/22/2023		0.1950		0.2205
Barium, Total	mg/L	QNW	06/19/2023		0.2490	*	0.2205
Barium, Total	mg/L	QS	03/01/2020		2.9900	*	0.2205
Barium, Total	mg/L	QS	06/15/2020		0.2560	*	0.2205
Barium, Total	mg/L	QS	09/01/2020		0.2500	*	0.2205
Barium, Total	mg/L	QS	12/09/2020		0.3840	*	0.2205
Barium, Total	mg/L	QS	06/10/2021		0.2610	*	0.2205
Barium, Total	mg/L	QS	12/09/2021		0.2020		0.2205
Barium, Total	mg/L	QS	06/21/2022		3.8900	*	0.2205
Barium, Total	mg/L	QS	12/06/2022		2.6800	*	0.2205
Barium, Total	mg/L	QS	03/22/2023		0.1880		0.2205
Barium, Total	mg/L	QS	06/19/2023		0.7190	*	0.2205
Cobalt, Total	mg/L	QS	03/01/2020		0.2270	*	0.0264
Cobalt, Total	mg/L	QS	06/15/2020		0.0103		0.0264
Cobalt, Total	mg/L	QS	09/01/2020		0.0064		0.0264
Cobalt, Total	mg/L	QS	12/09/2020		0.0135		0.0264
Cobalt, Total	mg/L	QS	06/10/2021		0.0070		0.0264
Cobalt, Total	mg/L	QS	12/09/2021		0.0038		0.0264
Cobalt, Total	mg/L	QS	06/21/2022		0.2260	*	0.0264
Cobalt, Total	mg/L	QS	12/06/2022		0.1920	*	0.0264
Cobalt, Total	mg/L	QS	03/22/2023	ND	0.0004		0.0264
Cobalt, Total	mg/L	QS	06/19/2023		0.0357	*	0.0264
Nickel, Total	mg/L	QS	03/01/2020		0.3380	*	0.0303
Nickel, Total	mg/L	QS	06/15/2020		0.0210		0.0303
Nickel, Total	mg/L	QS	09/01/2020		0.0150		0.0303
Nickel, Total	mg/L	QS	12/09/2020		0.0250		0.0303
Nickel, Total	mg/L	QS	06/10/2021		0.0120		0.0303
Nickel, Total	mg/L	QS	12/09/2021	ND	0.0100		0.0303
Nickel, Total	mg/L	QS	06/21/2022		0.3360	*	0.0303
Nickel, Total	mg/L	QS	12/06/2022		0.2290	*	0.0303
Nickel, Total	mg/L	QS	03/22/2023	ND	0.0040		0.0303
Nickel, Total	mg/L	QS	06/19/2023		0.0456	*	0.0303

* - Significantly increased over background.
** - Detect at limit for 100% NDs in background (NPPL only).
*** - Manual exclusion.
ND = Not Detected, Result = detection limit.

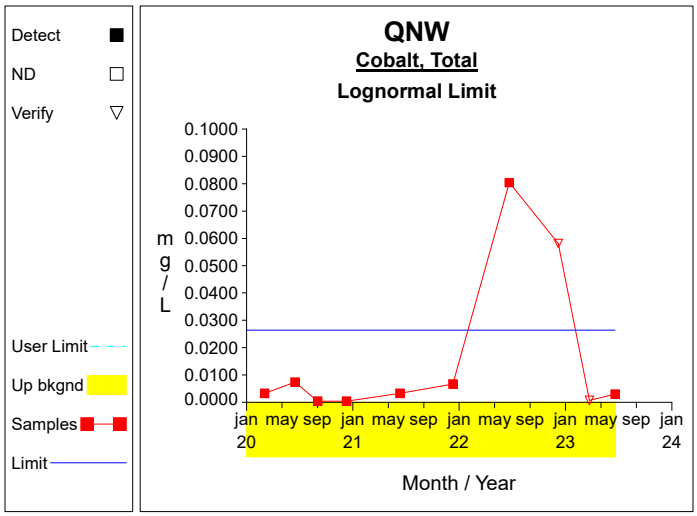
Up vs. Down Prediction Limits



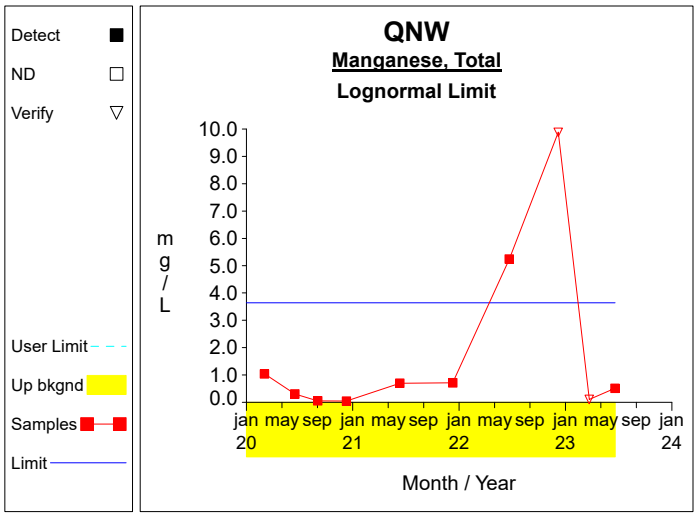
Graph 1



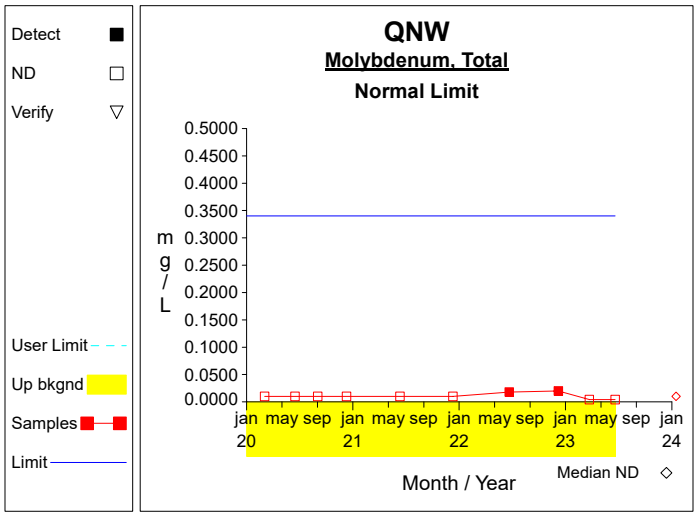
Graph 2



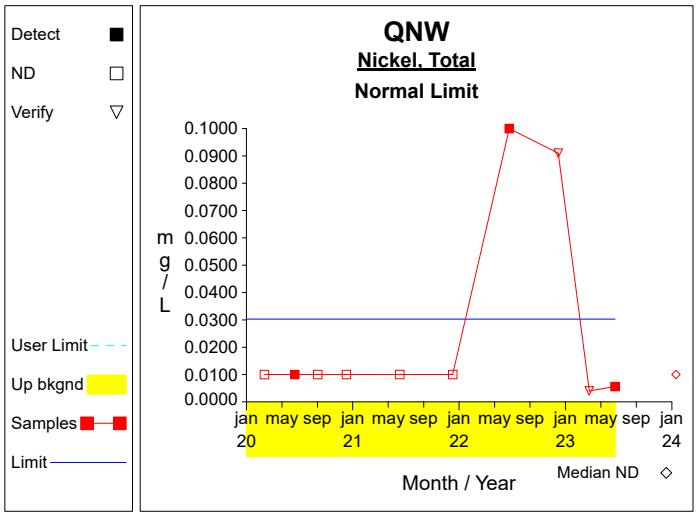
Graph 3



Graph 4



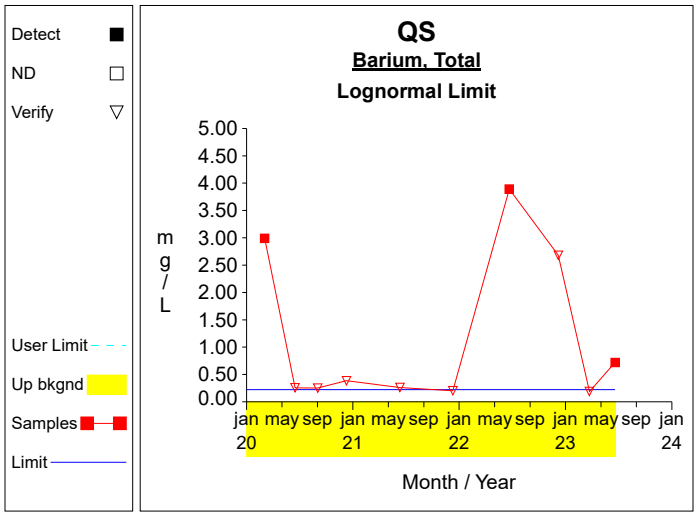
Graph 5



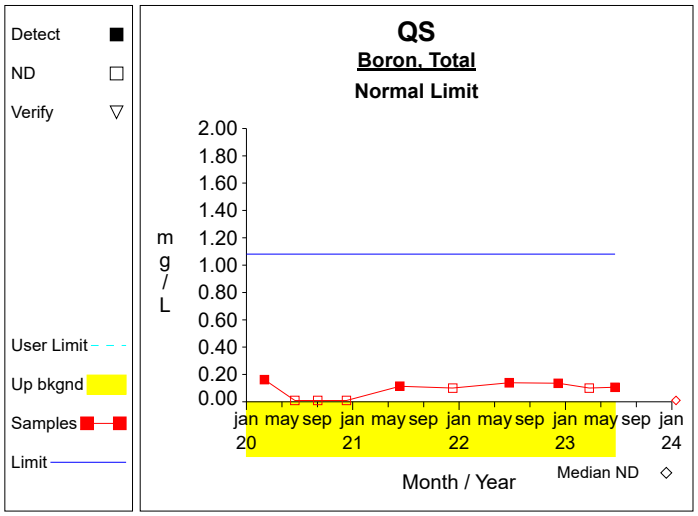
Graph 6

Prepared by: Otter Creek Environmental

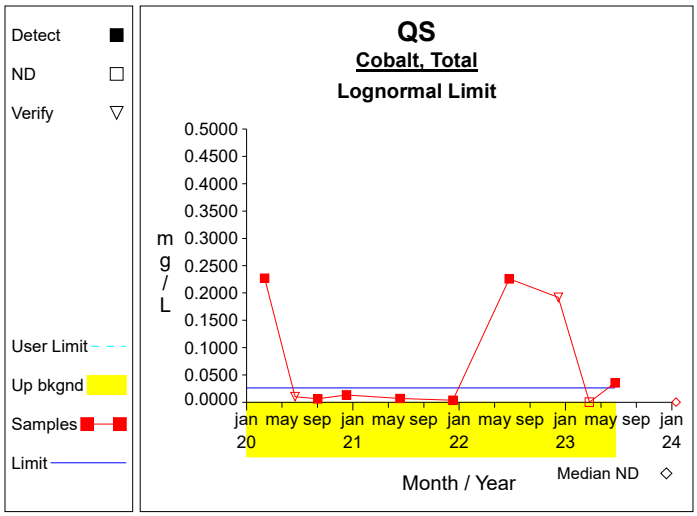
Up vs. Down Prediction Limits



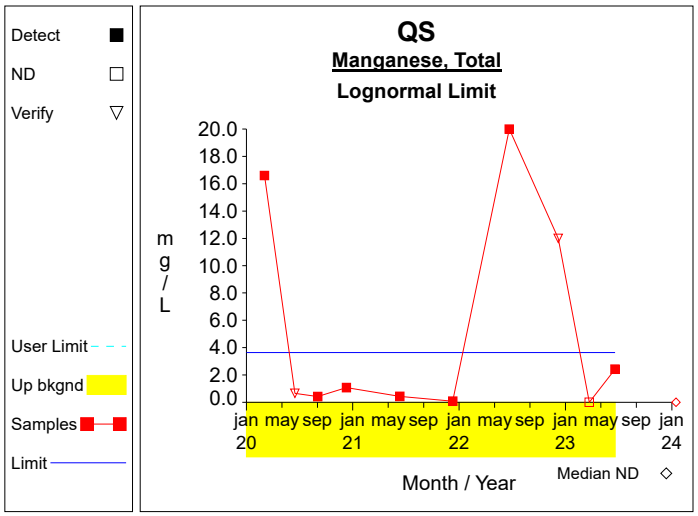
Graph 7



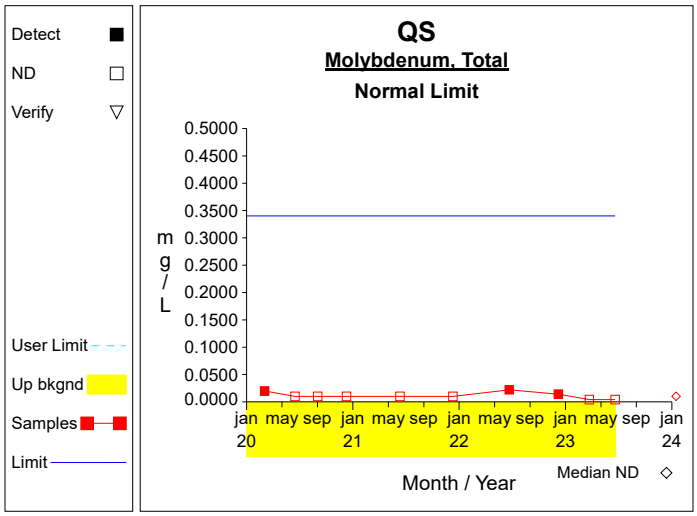
Graph 8



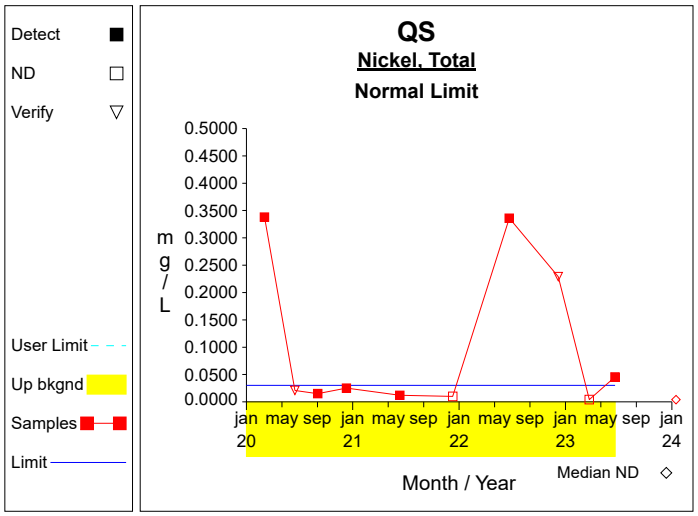
Graph 9



Graph 10



Graph 11

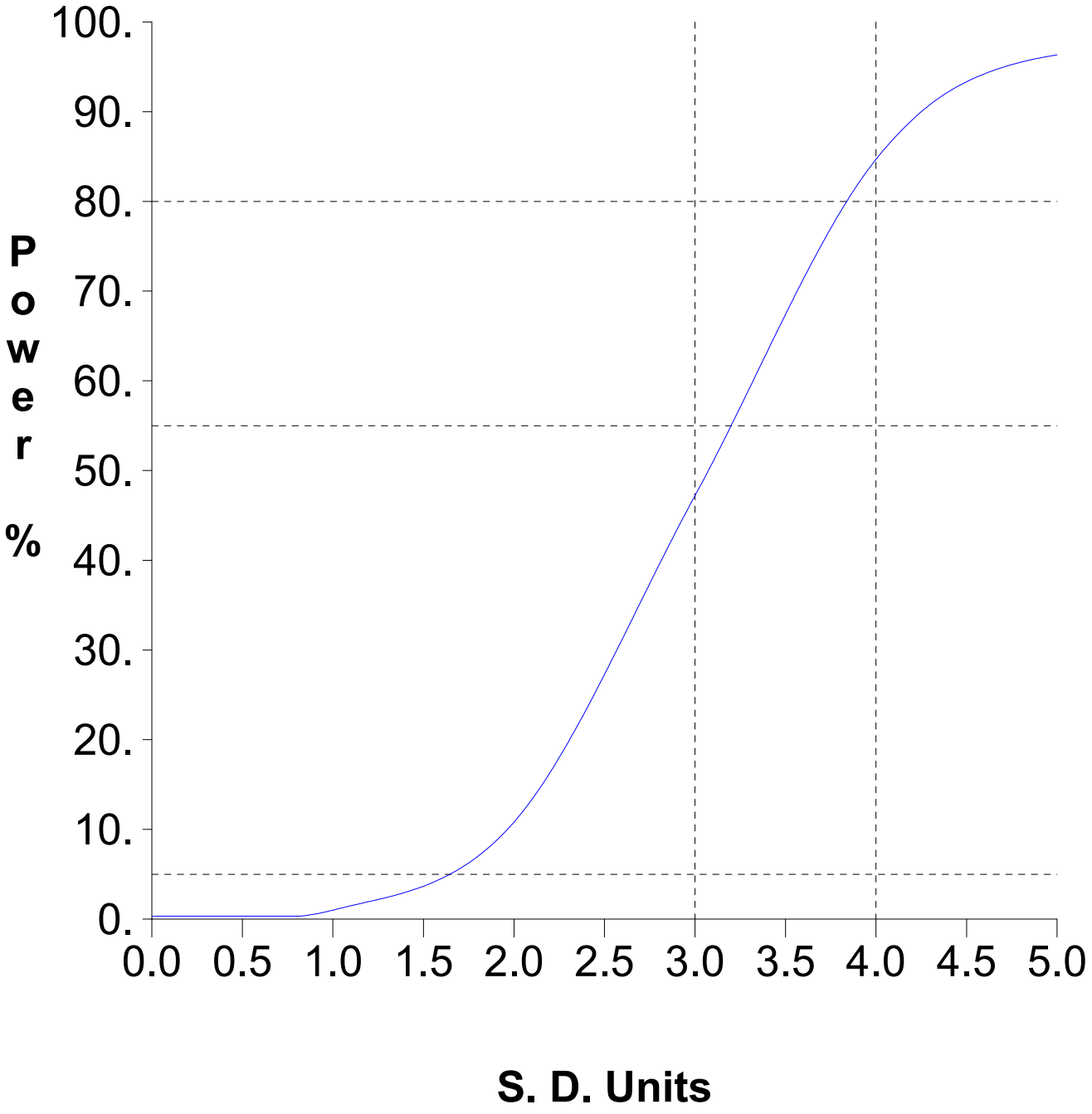


Graph 12

Prepared by: Otter Creek Environmental

False Positive and False Negative Rates for Current

Upgradient vs. Downgradient Monitoring Program



Attachment D

Summary Tables and Graphs for the Intrawell Comparisons

Table 1

Summary Statistics and Intermediate Computations for Combined Shewhart-CUSUM Control Charts

Constituent	Units	Well	N(back)	N(mon)	N(tot)	Mean	SD	R(i-1)	R(i)	S(i-1)	S(i)	Limit	Type	Conf	
Barium, Total	mg/L	QE	7	2	10	0.0924	0.0367	0.0637	0.0778	0.0924	0.0924	0.3307	normal		
Boron, Total	mg/L	QE	8	2	10	0.4079	0.1914	0.1670	0.3850	0.4079	0.4079	1.6520	normal		
Cobalt, Total	mg/L	QE	8	2	10	0.0059	0.0096	0.0066	0.0076	0.0059	0.0059	0.0680	normal		
Manganese, Total	mg/L	QE	8	2	10	1.3991	0.7938	1.3900	3.0300	1.3991	2.2362	6.5590	normal		
Molybdenum, Total	mg/L	QE	8	2	10	0.0111	0.0032	0.0041	0.0040	0.0111	0.0111	0.0318	normal		
Nickel, Total	mg/L	QE	7	2	10	0.0116	0.0024	0.0157	0.0116	0.0133	0.0116	0.0270	normal		
Barium, Total	mg/L	QN	8	2	10	0.1030	0.0505	0.0445	0.0881	0.1030	0.1030	0.4315	normal		
Boron, Total	mg/L	QN	7	2	10	0.5489	0.0717	0.6540	0.6030	0.5823	0.5648	1.0148	normal		
Cobalt, Total	mg/L	QN	7	2	10	0.0037	0.0011	0.0027	0.0061	0.0037	0.0050	0.0108	normal		
Manganese, Total	mg/L	QN	8	2	10	0.8595	0.2673	0.7820	0.6890	0.8595	0.8595	2.5968	normal		
Molybdenum, Total	mg/L	QN	7	2	10	0.2371	0.0699	0.1240	0.1150	0.2371	0.2371	0.6913	normal		
Nickel, Total	mg/L	QN	8	2	10	0.0184	0.0035	0.0106	0.0121	0.0184	0.0184	0.0414	normal		
Barium, Total	mg/L	QNE	8	2	10	0.1041	0.0184	0.0907	0.1000	0.1041	0.1041	0.2236	normal		
Boron, Total	mg/L	QNE	7	2	10	0.7263	0.2105	0.6710	0.6200	0.7263	0.7263	2.0942	normal		
Cobalt, Total	mg/L	QNE	8	2	10	0.0018	0.0015	0.0011	0.0062	0.0018	0.0047	0.0114	normal		
Manganese, Total	mg/L	QNE	8	2	10	0.6148	0.3665	0.6390	0.3470	0.6148	0.6148	2.9970	normal		
Molybdenum, Total	mg/L	QNE	7	2	10	0.0199	0.0031	0.0129	0.0117	0.0199	0.0199	0.0402	normal		
Nickel, Total	mg/L	QNE	8	2	10	0.0126	0.0032	0.0053	0.0044	0.0126	0.0126	0.0337	normal		
Barium, Total	mg/L	QNW	6	2	10	0.2495	0.0489	0.1950	0.2490	0.2495	0.2495	0.5673	normal		
Boron, Total	mg/L	QNW	7	2	10	0.2110	0.0641	0.1470	0.1380	0.2110	0.2110	0.6275	normal		
Cobalt, Total	mg/L	QNW	8	2	10	0.0200	0.0311	0.0007	0.0030	0.0200	0.0200	0.2220	normal		
Manganese, Total	mg/L	QNW	8	2	10	2.2473	3.5224	0.1050	0.5120	2.2473	2.2473	25.1427	normal		
Molybdenum, Total	mg/L	QNW	8	2	10	0.0123	0.0042	0.0040	0.0040	0.0123	0.0123	0.0396	normal		
Nickel, Total	mg/L	QNW	6	2	10								nonpar *		**
Barium, Total	mg/L	QS	8	2	10	1.3641	1.5470	0.1880	0.7190	1.3641	1.3641	11.4196	normal		
Boron, Total	mg/L	QS	8	2	10	0.0738	0.0694	0.1000	0.1060	0.0738	0.0738	0.5246	normal		
Cobalt, Total	mg/L	QS	8	2	10	0.0857	0.1076	0.0004	0.0357	0.0857	0.0857	0.7851	normal		
Manganese, Total	mg/L	QS	8	2	10	6.4080	8.3924	0.0040	2.4200	6.4080	6.4080	60.9585	normal		
Molybdenum, Total	mg/L	QS	8	2	10	0.0133	0.0050	0.0040	0.0040	0.0133	0.0133	0.0458	normal		
Nickel, Total	mg/L	QS	8	2	10	0.1233	0.1510	0.0040	0.0456	0.1233	0.1233	1.1047	normal		

N(back) and N(mon) = Non-outlier measurements in the background and monitoring periods.
N(tot) = All independent measurements for that constituent and well.
For transformed data, mean and SD in transformed units and control limit in original units.
Conf = confidence level for passing initial test or one verification resample (nonparametric test only).
* - Insufficient Data.
** - Detection Frequency < 25%.
*** - Zero Variance.

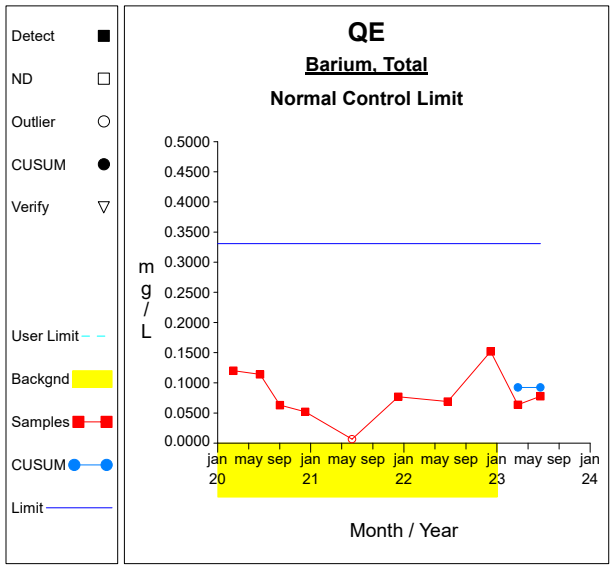
Table 4

Dixon's Test Outliers
1% Significance Level

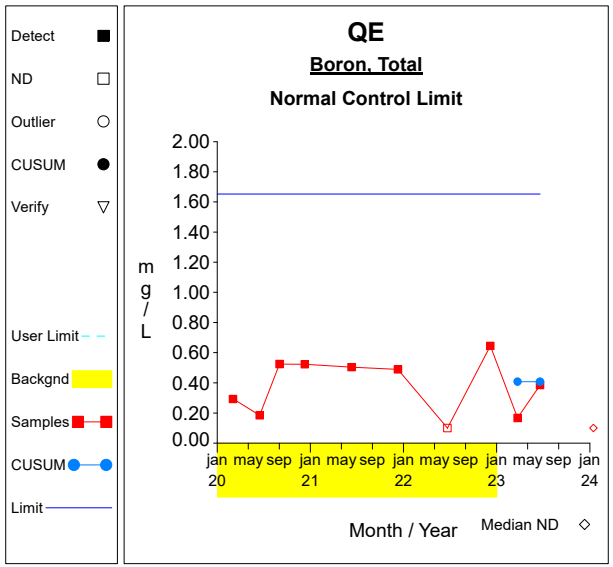
Constituent	Units	Well	Date	Result	ND Qualifier	Date Range	N	Critical Value
Barium, Total	mg/L	QE	06/10/2021	0.0065		03/01/2020-12/06/2022	8	0.6808
Nickel, Total	mg/L	QE	12/06/2022	0.0430		03/01/2020-12/06/2022	8	0.6808
Boron, Total	mg/L	QN	06/21/2022	0.1240		03/01/2020-12/06/2022	8	0.6808
Cobalt, Total	mg/L	QN	06/21/2022	0.0008		03/01/2020-12/06/2022	8	0.6808
Molybdenum, Total	mg/L	QN	06/21/2022	0.0240		03/01/2020-12/06/2022	8	0.6808
Boron, Total	mg/L	QNE	09/01/2020	0.0752		03/01/2020-12/06/2022	8	0.6808
Molybdenum, Total	mg/L	QNE	03/01/2020	0.1150		03/01/2020-12/06/2022	8	0.6808
Barium, Total	mg/L	QNW	06/21/2022	1.8200		03/01/2020-12/06/2022	8	0.6371
Barium, Total	mg/L	QNW	12/06/2022	1.4000		03/01/2020-12/06/2022	8	0.6371
Boron, Total	mg/L	QNW	06/15/2020	0.0100	< 0.0100	03/01/2020-12/06/2022	8	0.6808
Nickel, Total	mg/L	QNW	06/21/2022	0.1000		03/01/2020-12/06/2022	8	0.6371
Nickel, Total	mg/L	QNW	12/06/2022	0.0910		03/01/2020-12/06/2022	8	0.6371

N = Total number of independent measurements in background at each well.
Date Range = Dates of the first and last measurements included in background at each well.
Critical Value depends on the significance level and on N-1 when the two most extreme values are tested or N for the most extreme value.

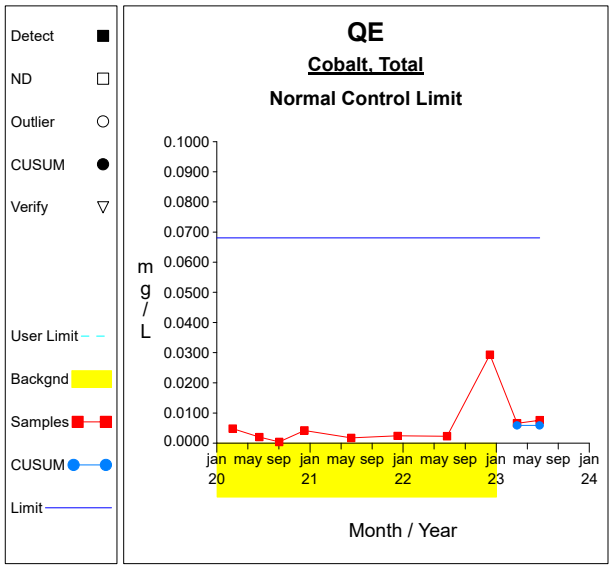
Intra-Well Control Charts / Prediction Limits



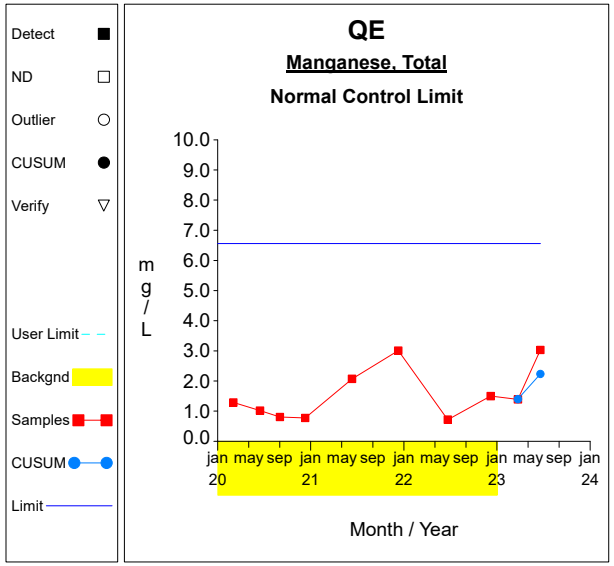
Graph 1



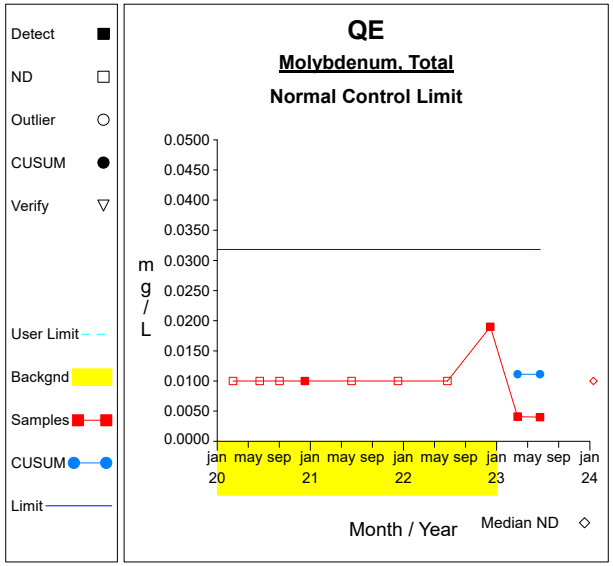
Graph 2



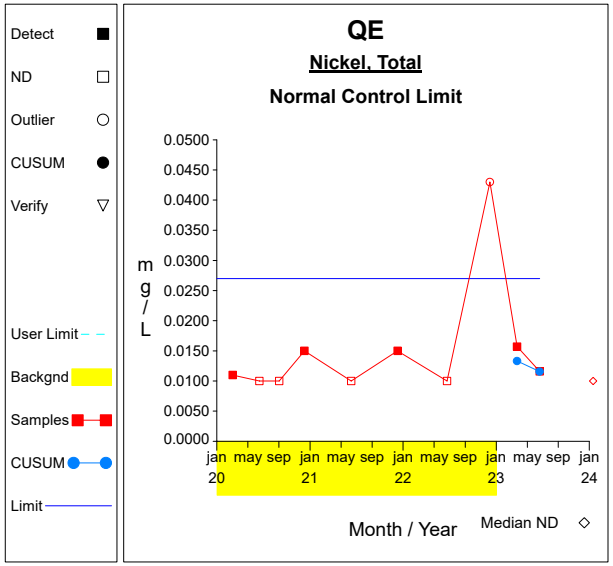
Graph 3



Graph 4



Graph 5



Graph 6

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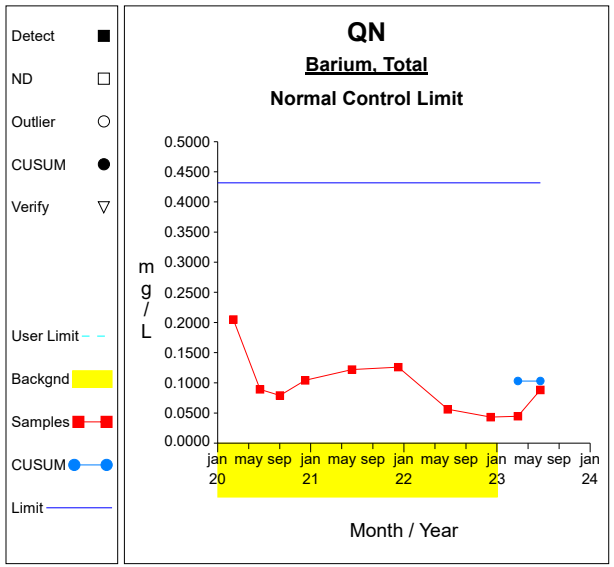
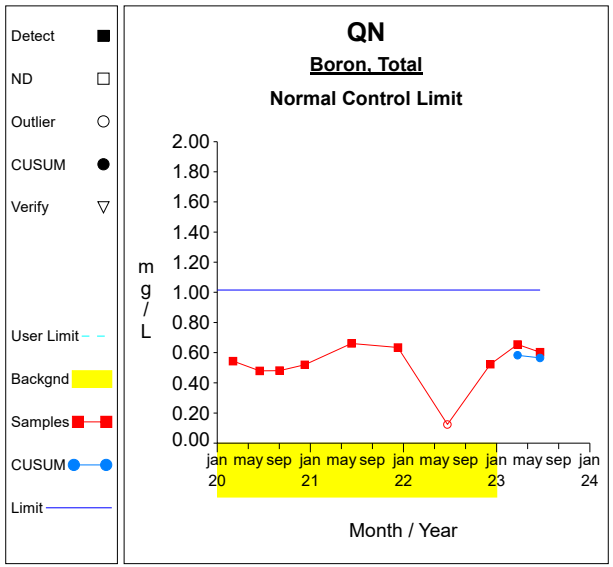
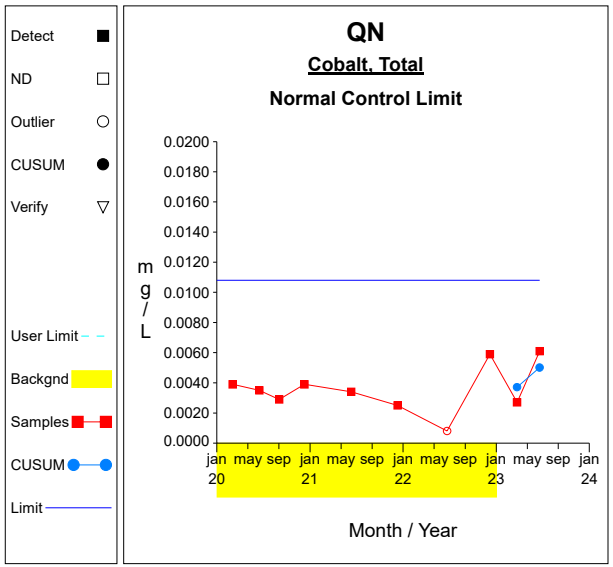
Intra-Well Control Charts / Prediction Limits



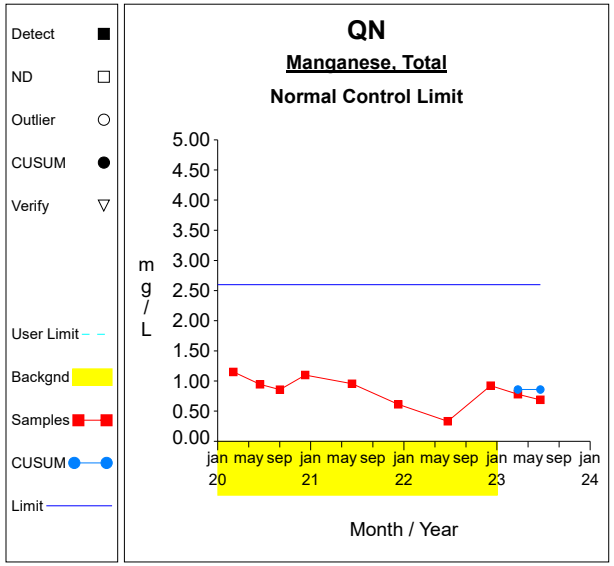
Graph 7



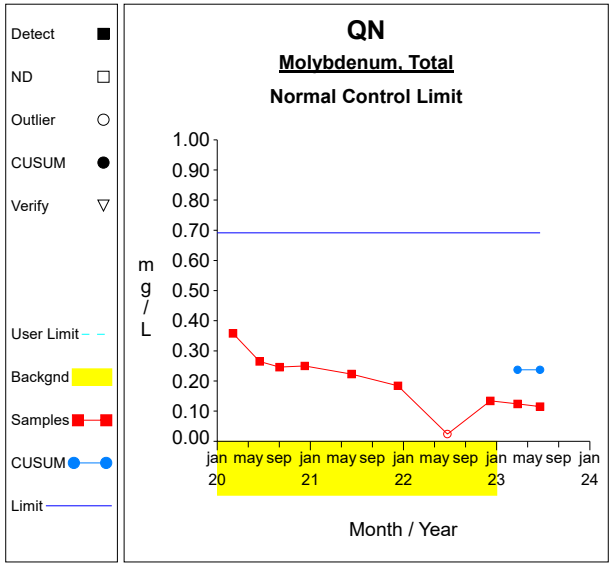
Graph 8



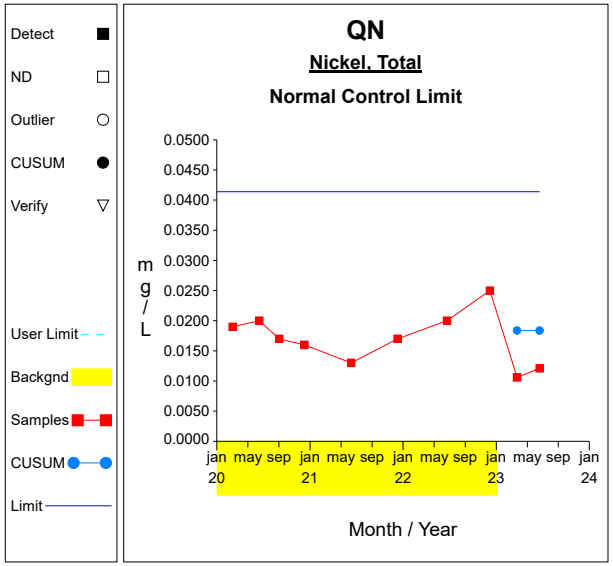
Graph 9



Graph 10



Graph 11



Graph 12

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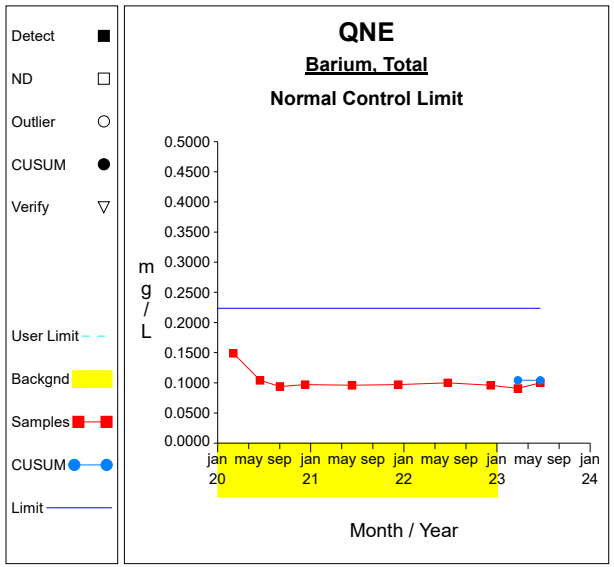
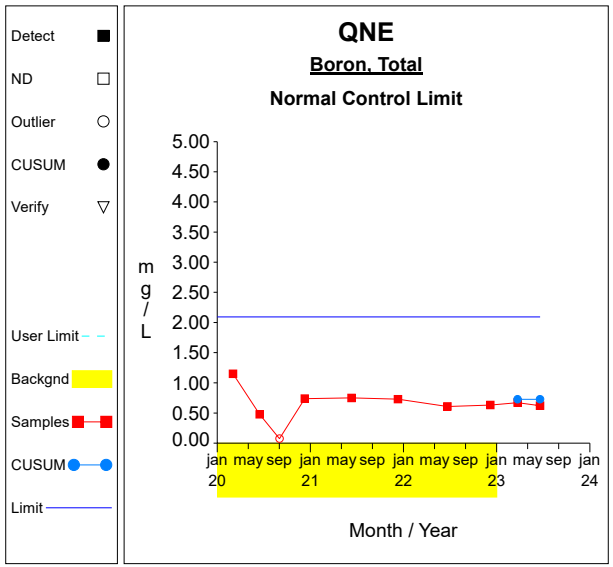
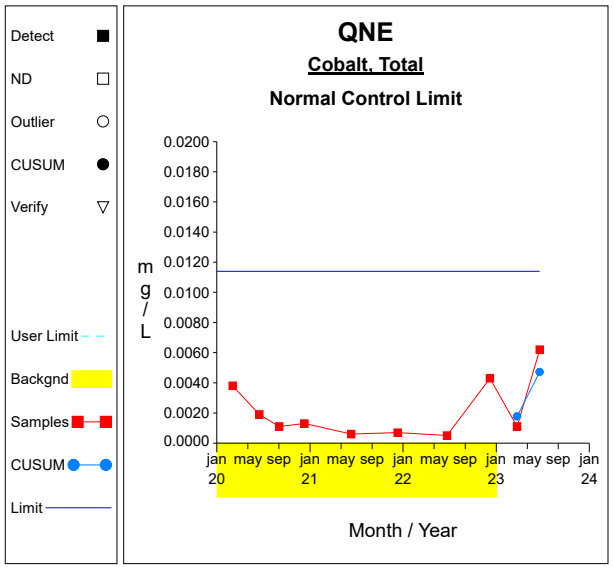
Intra-Well Control Charts / Prediction Limits



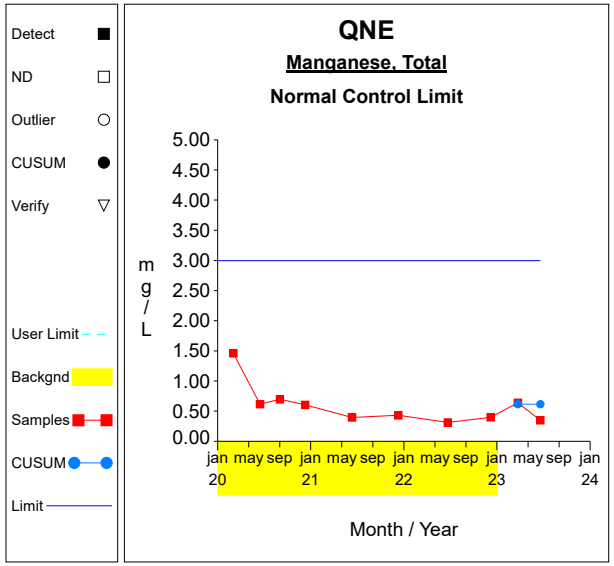
Graph 13



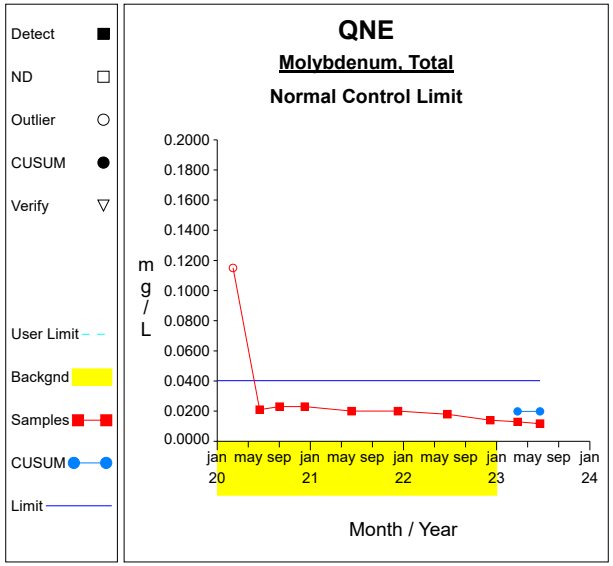
Graph 14



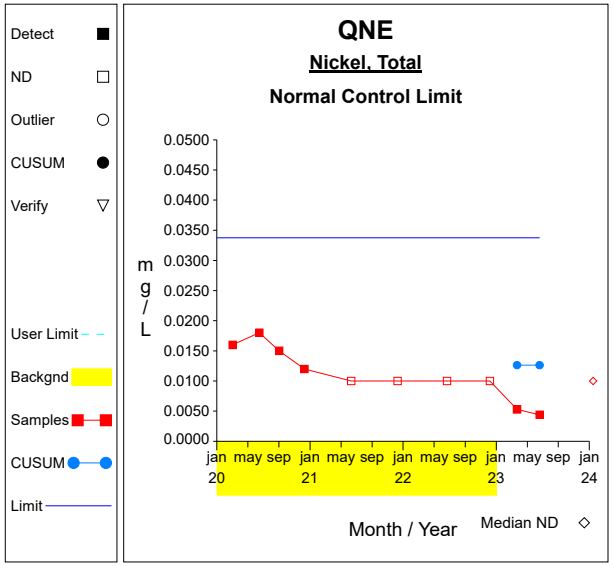
Graph 15



Graph 16



Graph 17



Graph 18

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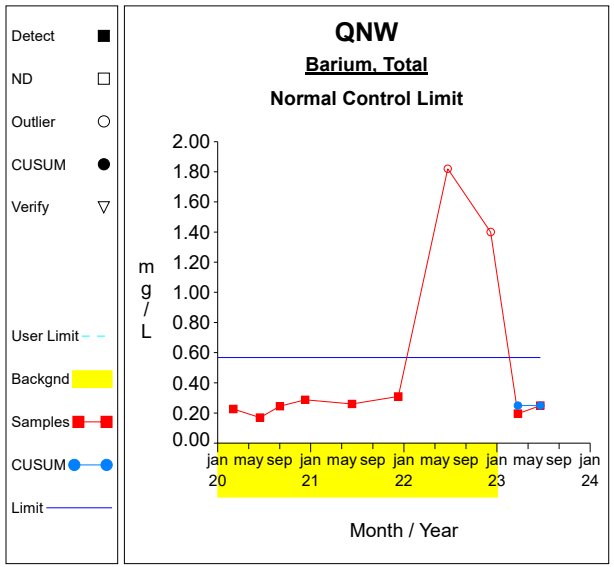
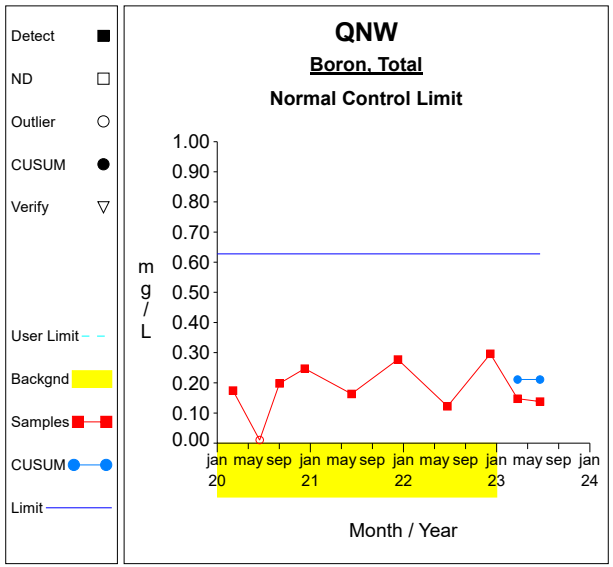
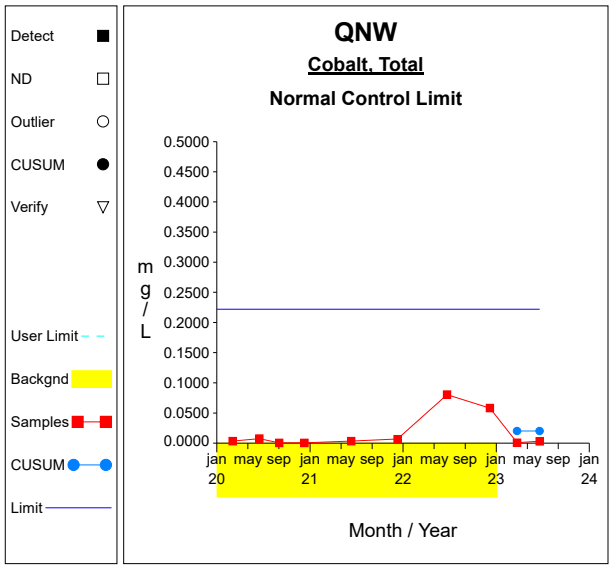
Intra-Well Control Charts / Prediction Limits



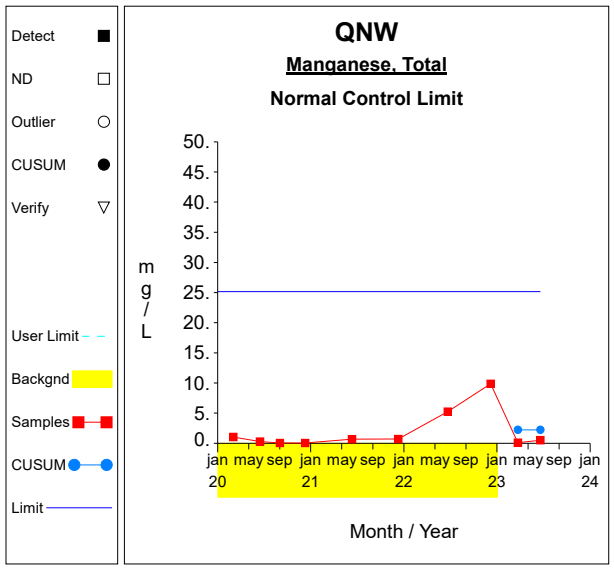
Graph 19



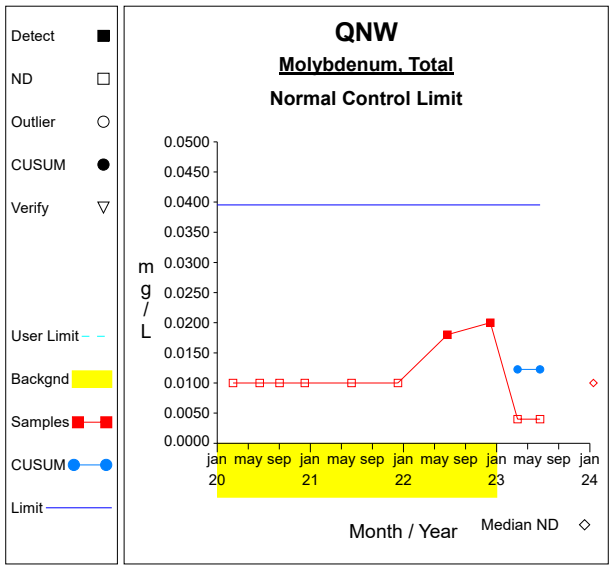
Graph 20



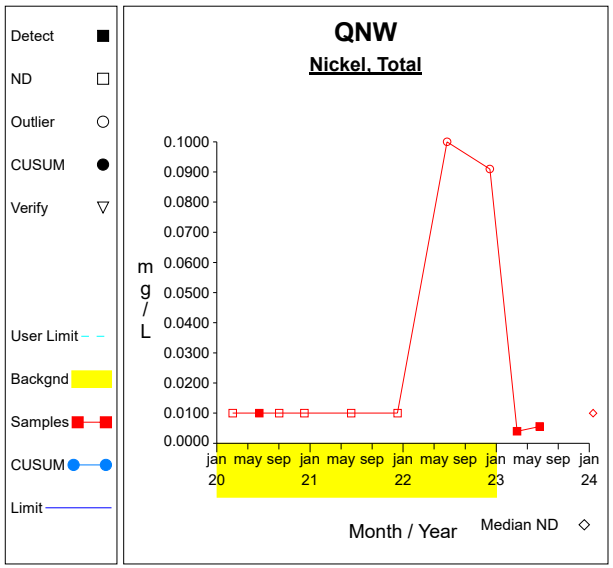
Graph 21



Graph 22



Graph 23



Graph 24

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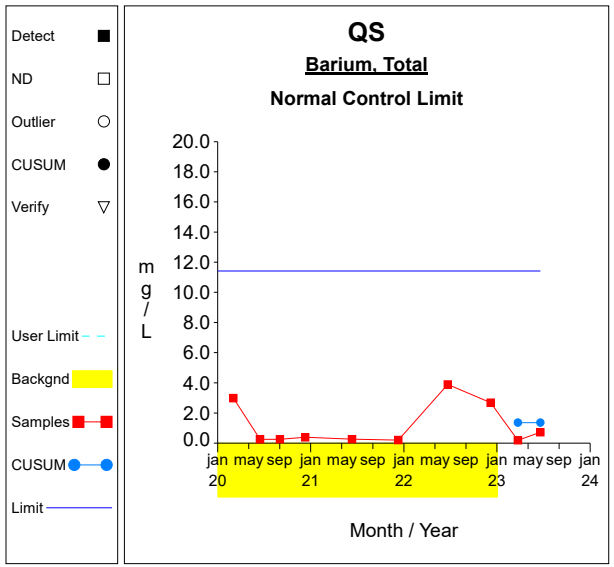
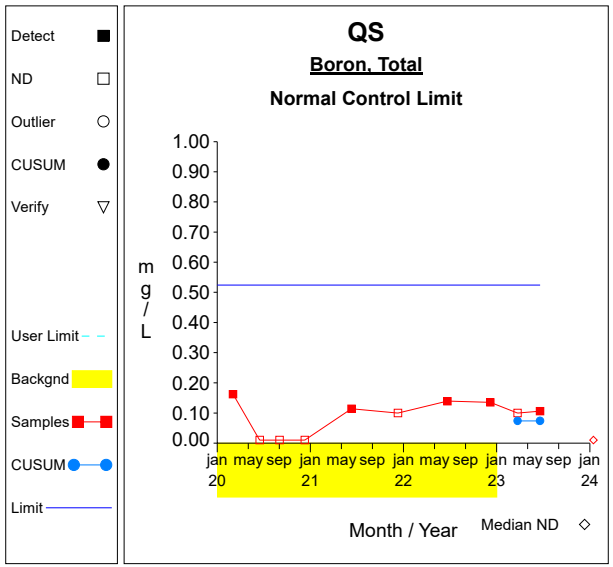
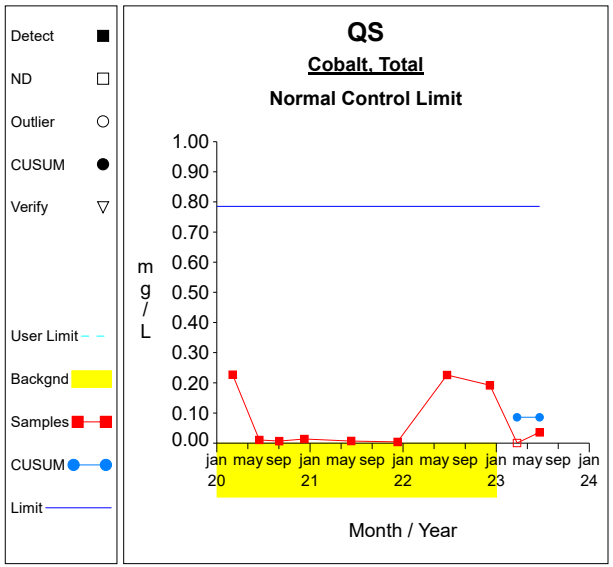
Intra-Well Control Charts / Prediction Limits



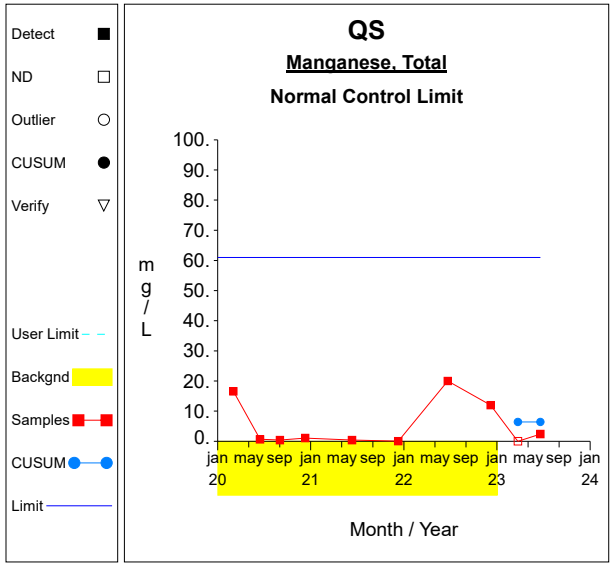
Graph 25



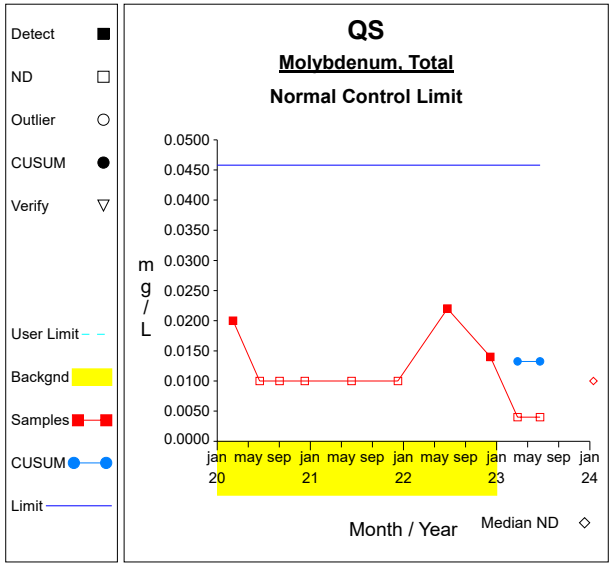
Graph 26



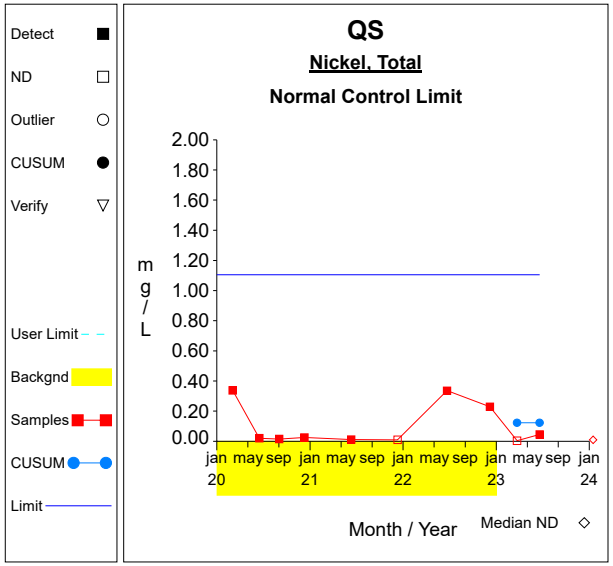
Graph 27



Graph 28



Graph 29



Graph 30

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False Positive and False Negative Rates for Current Intra-Well Control Charts Monitoring Program