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2019 Annual Groundwater Monitoring and Corrective Action Report

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2019 ANNUAL GROUNDWATER MONITORING AND CORRECTIVE ACTION REPORT

DUCK CREEK GYPSUM MANAGEMENT FACILITY POND, DUCK CREEK POWER STATION

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2019 ANNUAL GROUNDWATER MONITORING AND CORRECTIVE ACTION REPORT
DUCK CREEK GYPSUM MANAGEMENT FACILITY POND, DUCK CREEK POWER STATION

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Description	**Annual Report in Support of the CCR Rule Groundwater Monitoring Program**

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ACRONYMS AND ABBREVIATIONS

ASD	Alternate Source Demonstration
CCR	Coal Combustion Residuals
GMF	Gypsum Management Facility
SAP	Sampling and Analysis Plan
SSI	Statistically Significant Increase

EXECUTIVE SUMMARY

This report has been prepared to provide the information required by Title 40 of the Code of Federal Regulations (40 C.F.R.) § 257.90(e) for the Duck Creek Gypsum Management Facility (GMF) Pond located at Duck Creek Power Station near Canton, Illinois.

Groundwater is being monitored at Duck Creek GMF Pond in accordance with the Detection Monitoring Program requirements specified in 40 C.F.R. § 257.94.

No changes were made to the monitoring system in 2019 (no wells were installed or decommissioned).

The following Statistically Significant Increases (SSIs) of 40 C.F.R. Part 257 Appendix III parameter concentrations greater than background concentrations were determined during one or more sampling events in 2019:

- Calcium at wells G54S, G57S, G60s, and G64S
- Chloride at well G57S
- Sulfate at well G60S
- Total Dissolved Solids at wells G54S, G57S, and G60S

Alternate Source Demonstrations (ASDs) were completed for the SSIs referenced above and Duck Creek GMF Pond remains in the Detection Monitoring Program.

1. INTRODUCTION

This report has been prepared by Ramboll on behalf of Illinois Power Resources Generating, LLC, to provide the information required by 40 C.F.R. § 257.90(e) for Duck Creek GMF Pond located at Duck Creek Power Station near Canton, Illinois.

In accordance with 40 C.F.R. § 257.90(e), the owner or operator of a Coal Combustion Residuals (CCR) unit must prepare an Annual Groundwater Monitoring and Corrective Action Report for the preceding calendar year that documents the status of the Groundwater Monitoring and Corrective Action Program for the CCR unit, summarizes key actions completed, describes any problems encountered, discusses actions to resolve the problems, and projects key activities for the upcoming year. At a minimum, the Annual Report must contain the following information, to the extent available:

1. A map, aerial image, or diagram showing the CCR unit and all background (or upgradient) and downgradient monitoring wells, to include the well identification numbers, that are part of the groundwater monitoring program for the CCR unit.
2. Identification of any monitoring wells that were installed or decommissioned during the preceding year, along with a narrative description of why those actions were taken.
3. In addition to all the monitoring data obtained under §§ 257.90 through 257.98, a summary including the number of groundwater samples that were collected for analysis for each background and downgradient well, the dates the samples were collected, and whether the sample was required by the Detection Monitoring or Assessment Monitoring Programs.
4. A narrative discussion of any transition between monitoring programs (e.g., the date and circumstances for transitioning from Detection Monitoring to Assessment Monitoring in addition to identifying the constituent(s) detected at a Statistically Significant Increase relative to background levels).
5. Other information required to be included in the Annual Report as specified in §§ 257.90 through 257.98.

This report provides the required information for Duck Creek GMF Pond for calendar year 2019.

2. MONITORING AND CORRECTIVE ACTION PROGRAM STATUS

No changes have occurred to the monitoring program status in calendar year 2019, and Duck Creek GMF Pond remains in the Detection Monitoring Program in accordance with 40 C.F.R. § 257.94.

3. KEY ACTIONS COMPLETED IN 2019

The Detection Monitoring Program is summarized in Table A. The groundwater monitoring system, including the CCR unit and all background and downgradient monitoring wells, is presented in Figure 1. No changes were made to the monitoring system in 2019. In general, one groundwater sample was collected from each background and downgradient well during each monitoring event.[1] All samples were collected and analyzed in accordance with the Sampling and Analysis Plan (SAP) (NRT/OBG, 2017a). All monitoring data obtained under 40 C.F.R. §§ 257.90 through 257.98 (as applicable) in 2019 are presented in Table 1. Analytical data were evaluated in accordance with the Statistical Analysis Plan (NRT/OBG, 2017b) to determine any SSIs of Appendix III parameters relative to background concentrations.

Statistical background values are provided in Table 2.

Analytical results for the June, July, and October 2018 sampling events were provided in the 2018 Annual Groundwater Monitoring and Corrective Action Report.

Potential alternate sources were evaluated as outlined in the 40 C.F.R. § 257.94(e)(2). ASDs were completed and certified by a qualified professional engineer. The dates the ASDs were completed are provided in Table A. The ASDs completed in 2019 are included in Appendix A.

[1] Sampling was limited to G60S during the April 2019 sampling event to confirm Appendix III parameters initially detected at concentrations greater than statistical background values in the preceding sampling event to confirm SSIs, as allowed by the Statistical Analysis Plan.

Table A – 2018–2019 Detection Monitoring Program Summary

Sampling Date	Analytical Data Receipt Date	Parameters Collected	SSI(s)	SSI(s) Determination Date	ASD Completion Date
June 4 and 6, 2018	July 9, 2018	Appendix III	Calcium (G54S, G60S) Total Dissolved Solids (G54S, G57S)	October 7, 2018	January 7, 2019
July 6, 13, and 21, 2018	July 9, 2018	Appendix III Greater than Background [1]	NA	NA	NA
October 4, 11, 16, 17, and 20, 2018	January 16, 2019	Appendix III	Calcium (G54S, G57S, G60S) Chloride (G57S)	April 15, 2019	July 15, 2019
February 5-6, 2019	April 15, 2019	Appendix III	Calcium (G54S, G57S, G60S, G64S) Chloride (G57S) Total Dissolved Solids (G54S, G57S, G60S) Sulfate (G60S)	July 15, 2019	October 14, 2019
April 8, 2019	April 15, 2019	Appendix III Greater than Background [1]	NA	NA	NA
July 8 and 15, 2019	October 28, 2019	Appendix III	TBD	TBD	TBD

Notes:

NA: Not Applicable
TBD: To Be Determined
1. To confirm SSIs, as allowed by the Statistical Analysis Plan, groundwater samples were collected and analyzed for Appendix III parameters initially detected at concentrations greater than statistical background values in the preceding sampling event.

4. PROBLEMS ENCOUNTERED AND ACTIONS TO RESOLVE THE PROBLEMS

No problems were encountered with the Groundwater Monitoring Program during 2019. Groundwater samples were collected and analyzed in accordance with the SAP (NRT/OBG, 2017a), and all data were accepted.

5. KEY ACTIVITIES PLANNED FOR 2020

The following key activities are planned for 2020:

- Continuation of the Detection Monitoring Program with semi-annual sampling scheduled for the first and third quarters of 2020.
- Complete evaluation of analytical data from the downgradient wells, using background data to determine whether an SSI of Appendix III parameters detected at concentrations greater than background concentrations has occurred.
- If an SSI is identified, potential alternate sources (i.e., a source other than the CCR unit caused the SSI or that that SSI resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality) will be evaluated.
  - If an alternate source is demonstrated to be the cause of the SSI, a written demonstration will be completed within 90 days of SSI determination and included in the 2020 Annual Groundwater Monitoring and Corrective Action Report.
  - If an alternate source(s) is not identified to be the cause of the SSI, the applicable requirements of 40 C.F.R. §§ 257.94 through 257.98 as may apply in 2020 (e.g., Assessment Monitoring) will be met, including associated recordkeeping/notifications required by 40 C.F.R. §§ 257.105 through 257.108.

6. REFERENCES

Natural Resource Technology, an OBG Company (NRT/OBG), 2018. Sampling and Analysis Plan, Duck Creek GMF Pond, Duck Creek Power Station, Canton, Illinois, Project No. 2285, Revision 1, June 29, 2018.

Natural Resource Technology, an OBG Company (NRT/OBG), 2017b. Statistical Analysis Plan, Duck Creek Power Station, Edwards Power Station, Illinois Power Resources Generating, LLC, October 17, 2017.

TABLES

TABLE 1.
2019 ANALYTICAL RESULTS - GROUNDWATER ELEVATION AND APPENDIX III PARAMETERS
2019 ANNUAL GROUNDWATER MONITORING AND CORRECTIVE ACTION REPORT
DUCK CREEK POWER STATION
UNIT ID 203 - DUCK CREEK GMF POND
CANTON, ILLINOIS
DETECTION MONITORING PROGRAM

Well Identification Number	Latitude (Decimal Degrees)	Longitude (Decimal Degrees)	Date & Time Sampled	Depth to Groundwater (ft)[1]	Groundwater Elevation (ft NAVD88)	40 C.F.R. Part 257 Appendix III						
						Boron, total (mg/L) 6020A[2]	Calcium, total (mg/L) 6020A[2]	Chloride, total (mg/L) 9251[2]	Fluoride, total (mg/L) 9214[2]	pH (field) (S.U.) SM 4500 H+B[2]	Sulfate, total (mg/L) 9036[2]	Total Dissolved Solids (mg/L) SM 2540C[2]
Background / Upgradient Monitoring Wells												
G02S	40.512880	-89.991105	2/6/2019 12:37	8.74	613.19	0.048	99	2.5	0.379	7.0	<1.0	400
			4/8/2019 NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
			7/8/2019 13:04	10.87	611.06	0.050	96	<5.0	0.394	7.0	<1.0	420
G50S	40.508672	-89.990607	2/5/2019 10:04	15.55	608.10	0.016	86	7.6	<0.250	7.1	27	360
			4/8/2019 NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
			7/8/2019 9:47	11.76	611.89	0.018	88	9.6	0.351	7.4	34	420
G51S	40.506560	-89.990864	2/5/2019 11:47	13.81	605.85	0.012	90	14	0.330	6.8	50	380
			4/8/2019 NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
			7/8/2019 11:02	12.72	606.94	0.039	100	16	0.332	7.0	48	460
Downgradient Monitoring Wells												
G54S	40.504525	-89.988940	2/5/2019 13:15	39.00	583.98	0.032	130	2.3	0.283	7.1	44	590
			4/8/2019 NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
			7/15/2019 9:48	35.02	587.96	0.057	130	1.5	<0.250	7.1	46	590
G57S	40.505608	-89.987043	2/6/2019 9:18	23.39	599.37	0.016	130	23	0.349	7.2	54	520
			4/8/2019 NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
			7/15/2019 10:54	18.55	604.21	0.055	140	18	0.327	7.1	55	680
G60S	40.506732	-89.986815	2/6/2019 10:29	24.55	590.48	0.040	270	19	0.327	7.0	200	760
			4/8/2019 12:58	25.10	589.93	NA	160	13	NA	7.0	240	860
			7/15/2019 11:59	25.22	589.81	0.024	140	10	0.319	6.8	190	800
G64S	40.508365	-89.987011	2/6/2019 11:43	24.11	598.95	0.024	140	4.1	0.380	6.8	25	420
			4/8/2019 NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
			7/15/2019 14:03	23.20	599.86	0.023	100	3.2	0.333	7.2	25	490

[O: RAB 12/20/19, C: KLT 12/23/19]

Notes:

40 C.F.R. = Title 40 of the Code of Federal Regulations
ft = foot/feet
mg/L = milligrams per liter
NA = Not Analyzed
NAVD88 = North American Vertical Datum of 1988
NS = Not Sampled
S.U. = Standard Units
< = concentration is less than the concentration shown, which corresponds to the reporting limit for the method; estimated concentrations below the reporting limit and associated qualifiers are not provided since not utilized in statistics to determine Statistically Significant Increases (SSIs) over background.
[1]All depths to groundwater were measured on the first day of the sampling event.
[2]4-digit numbers represent SW-846 analytical methods.

TABLE 2.
STATISTICAL BACKGROUND VALUES
2019 ANNUAL GROUNDWATER MONITORING AND CORRECTIVE ACTION REPORT
DUCK CREEK POWER STATION
UNIT ID 203 - DUCK CREEK GMF POND
CANTON, ILLINOIS
DETECTION MONITORING PROGRAM

Parameter	Statistical Background Value (UPL)
40 C.F.R. Part 257 Appendix III	
Boron (mg/L)	0.07
Calcium (mg/L)	110
Chloride (mg/L)	20.9
Fluoride (mg/L)	0.564
pH (S.U.)	6.5 / 7.6
Sulfate (mg/L)	97
Total Dissolved Solids (mg/L)	490

[O: RAB 12/20/19, C: KLT 12/23/19]

Notes:
40 C.F.R. = Title 40 of the Code of Federal Regulations
mg/L = milligrams per liter
S.U. = Standard Units
UPL = Upper Prediction Limit

FIGURES

Y:\Mapping\Projects\222285\MXD\2019_AnnualGWM_CAR\Figure 1_GWS_WellLoc_DuckCreek_GMFP.mxd

PROJECT: 169000XXXX | DATED: 1/13/2020 | DESIGNER: GALARNMC

- UPGRADIENT MONITORING WELL LOCATION
- DOWNGRADIENT MONITORING WELL LOCATION
- CCR MONITORED UNIT

0 500 1,000 Feet

MONITORING WELL LOCATION MAP
DUCK CREEK GMF POND
UNIT ID:203

2019 ANNUAL GROUNDWATER MONITORING AND CORRECTIVE ACTION REPORT
VISTRA CCR RULE GROUNDWATER MONITORING
DUCK CREEK POWER STATION
CANTON, ILLINOIS

FIGURE 1

O'BRIEN & GERE ENGINEERS, INC.
A RAMBOLL COMPANY

RAMBOLL

APPENDIX A
ALTERNATE SOURCE DEMONSTRATIONS

40 C.F.R. § 257.94(e)(2): ALTERNATE SOURCE DEMONSTRATION
DUCK CREEK GMF POND
JANUARY 7, 2019

January 7, 2019

Title 40 of the Code of Federal Regulations (C.F.R.) § 257.94(e)(2) allows the owner or operator of a coal combustion residuals (CCR) unit 90 days from the date of determination of statistically significant increases (SSIs) over background for groundwater constituents listed in Appendix III of 40 C.F.R. Part 257 to complete a written demonstration that a source other than the CCR unit being monitored caused the SSI(s), or that the SSI(s) resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality ("alternate source demonstration").

This alternate source demonstration has been prepared on behalf of Illinois Power Resources Generating, LLC by O'Brien & Gere Engineers, Inc., part of Ramboll (OBG) to provide pertinent information pursuant to 40 C.F.R. § 257.94(e)(2) for the Duck Creek Gypsum Management Facility (GMF) Pond located near Canton, Illinois.

The second semi-annual detection monitoring samples (Detection Monitoring Round 2) were collected on June 4, 2018. In accordance with 40 C.F.R. Section 257.93(h)(2), statistical analysis of the data to identify SSIs of 40 C.F.R. Part 257 Appendix III parameters over background concentrations was completed within 90 days of receipt of the analytical data (July 9, 2018). The statistical determination identified the following SSIs at downgradient monitoring wells:

- Calcium at wells G54S, G57S, and G60S
- Total dissolved solids (TDS) at wells G54S and G57S

In accordance with the Statistical Analysis Plan[1], to confirm the SSIs, wells G54S, G57S, and G60S, were resampled on July 13 and 21, 2018 and analyzed only for the SSI parameters at each well. Following evaluation of analytical data from the resample, the following SSIs were confirmed:

- Calcium at wells G54S and G60S
- TDS at wells G54S and G57S

Pursuant to 40 C.F.R. § 257.94(e)(2), the following demonstrates that sources other than the GMF Pond were the cause of the SSIs listed above. This alternate source demonstration (ASD) was completed within 90 days of determination of the SSIs (October 7, 2018), as required by 40 C.F.R. § 257.94(e)(2).

ALTERNATE SOURCE DEMONSTRATION: LINES OF EVIDENCE

Lines of evidence supporting these ASDs include the following:

1. Downgradient calcium concentrations exceeded background prior to the unit being placed into service
2. Downgradient TDS concentrations exceeded background prior to the unit being placed into service
3. Proximity to historic coal mining activity
4. Concentrations of boron and sulfate, common indicators for CCR impacts to groundwater, in the downgradient wells are stable and at or below concentrations in the background wells

[1] Natural Resource Technology, an OBG Company, 2017, Statistical Analysis Plan, Duck Creek Power Station, Edwards Power Station, Illinois Power Resources Generating, LLC, October 17, 2017.

These lines of evidence are described and supported in greater detail below. The locations of the monitoring wells are shown on the attached Figure 1.

LINE OF EVIDENCE #1: CALCIUM CONCENTRATIONS AT MW60S EXCEEDED BACKGROUND PRIOR TO THE UNIT BEING PLACED INTO SERVICE

Calcium was detected at concentrations above the background Upper Prediction Limit (UPL) in groundwater samples collected from MW60S prior to the GMF Pond being placed into service in 2009.

MW60S is located side- to downgradient of the GMF Pond. A boxplot for calcium concentrations observed in groundwater samples collected from MW60S between March 2007 and November 2008 is shown in Figure 2. The average and median observed calcium concentrations are 116 and120 milligrams per liter (mg/L), respectively, which are both greater than the UPL of 110.23 mg/L. The UPL is based upon groundwater samples collected from background wells G50S and G51S from December 2015 through June 2017. Calcium concentrations at MW60S range from 87 to 150 mg/L and are most often between 94 mg/L (first quartile) and 133 mg/L (third quartile).

During Detection Monitoring Round 2 the calcium SSI at well G60S was determined at 150 mg/L and confirmed via resampling at 120 mg/L, which is within the range presented in the boxplot for MW60S. Calcium concentrations observed in G54S during Detection Monitoring Round 2 (130 mg/L) are similar to those observed in MW60S from 2007-2008.

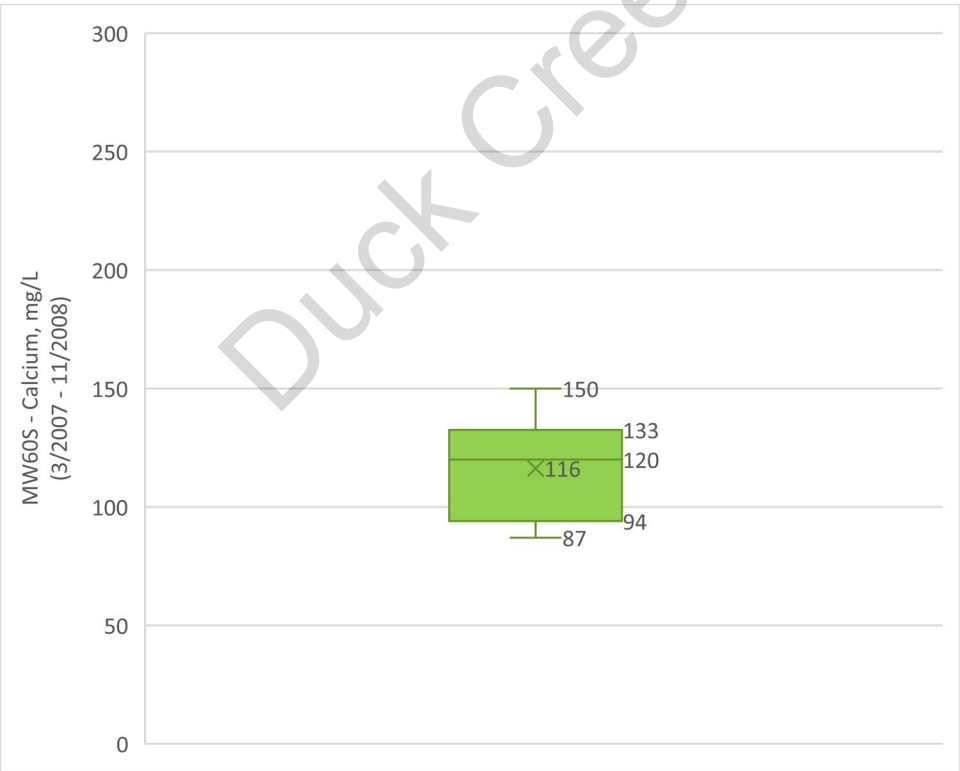


Figure 2. Boxplot of calcium concentrations observed in groundwater samples collected from MW60S from March 2007 through November 2008.

LINE OF EVIDENCE #2: TDS CONCENTRATIONS AT G60S EXCEEDED BACKGROUND PRIOR TO THE UNIT BEING PLACED INTO SERVICE

Total Dissolved Solids (TDS) was detected at concentrations above the background Upper Prediction Limit (UPL) in groundwater samples collected from MW60S prior to the GMF Pond being placed into service in 2009.

MW60S is located side- to downgradient of the GMF Pond. A boxplot for TDS concentrations observed in groundwater samples collected from MW60S between March 2007 and November 2008 is shown in Figure 3. The average and median observed TDS concentrations are 555 and 560 mg/L, respectively, which are both greater than the UPL of 490 mg/L. The UPL is based upon groundwater samples collected from background wells G50S and G51S from December 2015 through June 2017. TDS concentrations at MW60S range from 460 to 690 mg/L, and are most often between 530 mg/L (first quartile) and 580 mg/L (third quartile).

During Detection Monitoring Round 2 the TDS SSIs at wells G54S and G57S were both determined at 500 mg/L and both confirmed via resampling at 540 mg/L, which is within the range presented in the boxplot.

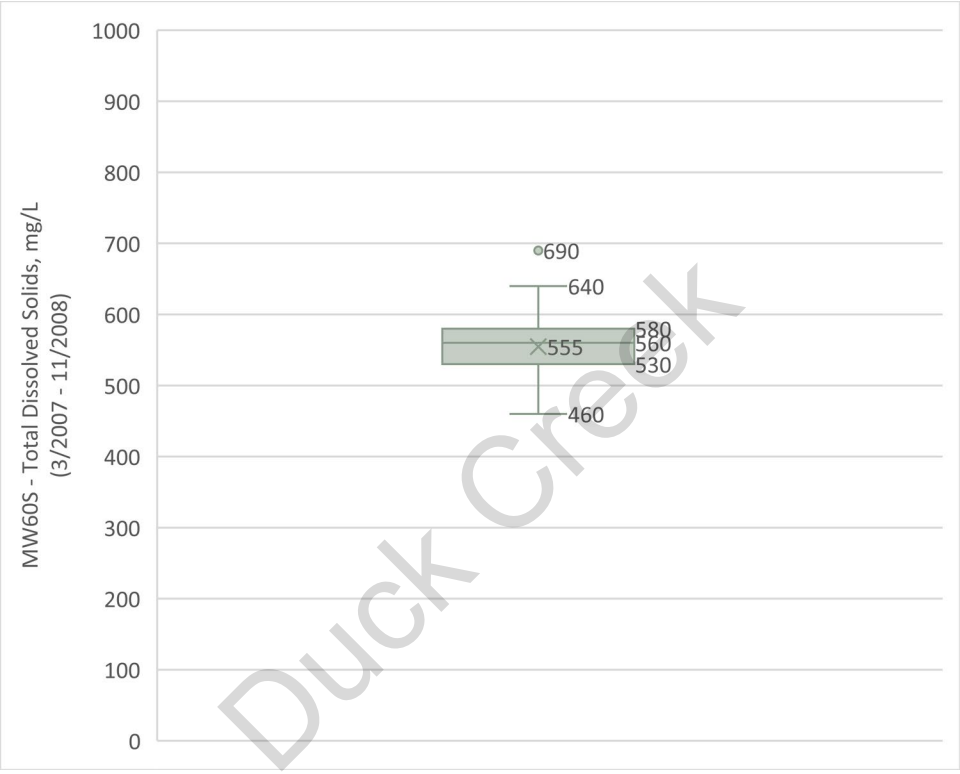


Figure 3. Boxplot of TDS concentrations observed in groundwater samples collected from MW60S from March 2007 through November 2008.

LINE OF EVIDENCE #3: PROXIMITY TO HISTORIC COAL MINING ACTIVITY

The area surrounding the GMF Pond consists primarily of unmined coal and reclaimed surface mine land. The extents of the nearby mines are shown in the attached Figure 4. The coal in this area has a sulfur content greater than 2.5 pounds (lbs) of sulfur per million BTUs, the highest sulfur classification used by Illinois State Geological Survey[2].

[2] "Illinois Coal Reserves Assessment and Database Development: Final Report", Open File Series 1997-4, Illinois State Geological Survey, Coal Section, 1997.

The coal varies in depth from 0 to 50 feet (ft) below ground surface (bgs). The wells associated with the monitoring system established for the Duck Creek GMF Pond pursuant to 40 C.F.R. § 257.91 are screened between 23 and 48 ft bgs. Potentiometric data indicates that groundwater flows to the southeast as shown on the attached Figure 1. The monitoring wells are located 2,000 to 4,000 ft downgradient of the nearby mines (Figure 4).

State of Illinois groundwater quality regulations (Illinois Administrative Code Title 35 Part 620 Groundwater Quality) acknowledge that water quality is adversely affected in areas where coal mining activity has occurred. The groundwater standards for chloride, iron, manganese, sulfates, TDS, and pH within previously mined areas are the existing concentrations.

A study of groundwater quality near surface coal mines, performed by the U.S. Geological Survey (USGS)[3], provides data on the effects of mines on groundwater quality. The study evaluated regional differences in major ionic composition of groundwater in unmined and mined areas using Piper diagrams (Figure 5). Groundwater samples collected from wells downgradient of the reclaimed mine areas in the study have high concentrations of carbonate-bicarbonate anions as well as moderate concentrations of calcium cations. The ionic composition of groundwater samples collected from the GMF Pond monitoring wells is shown on Figure 6. The positions of the GMF Pond monitoring well samples shown on Figure 6 are tightly grouped and demonstrate very high concentrations of carbonate-bicarbonate anions, similar to those from the USGS study, but with no dominant cation. Table 1 summarizes the ionic composition.

The ionic composition of water samples collected from the GMF Pond is significantly different than that observed in groundwater. Pond water samples are very high in magnesium with no dominant anion. The groundwater samples and the pond water samples have minimal variance as evident by the tight groupings; a mixing zone is not apparent between the pond water and groundwater samples.

The similarities in groundwater ionic composition shown in Figures 5 and 6, Table 1, and the proximity of the GMF Pond to historic coal mining activity demonstrate that mining activity has affected groundwater quality at the Duck Creek GMF Pond.

[3] "Ground-Water Quality in Unmined Areas and Near Reclaimed Surface Coal Mines in the Northern and Central Appalachian Coal Regions, Pennsylvania and West Virginia", Scientific Investigations Report 2006-5059, US Geological Survey, 2006.

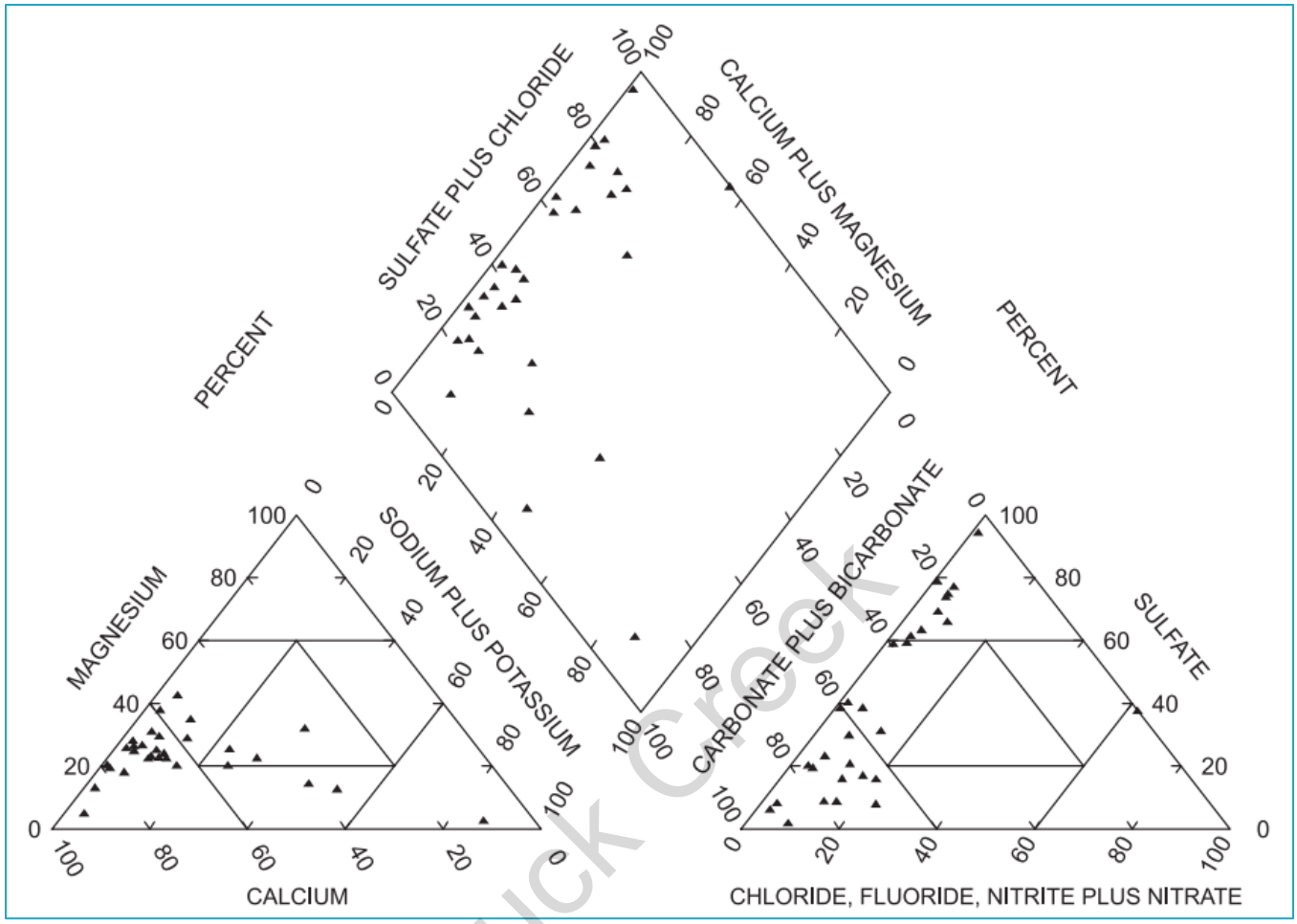


Figure 5. Piper diagram showing ionic composition of groundwater downgradient of reclaimed surface coal mines in high-sulfur coal regions (modified from USGS)

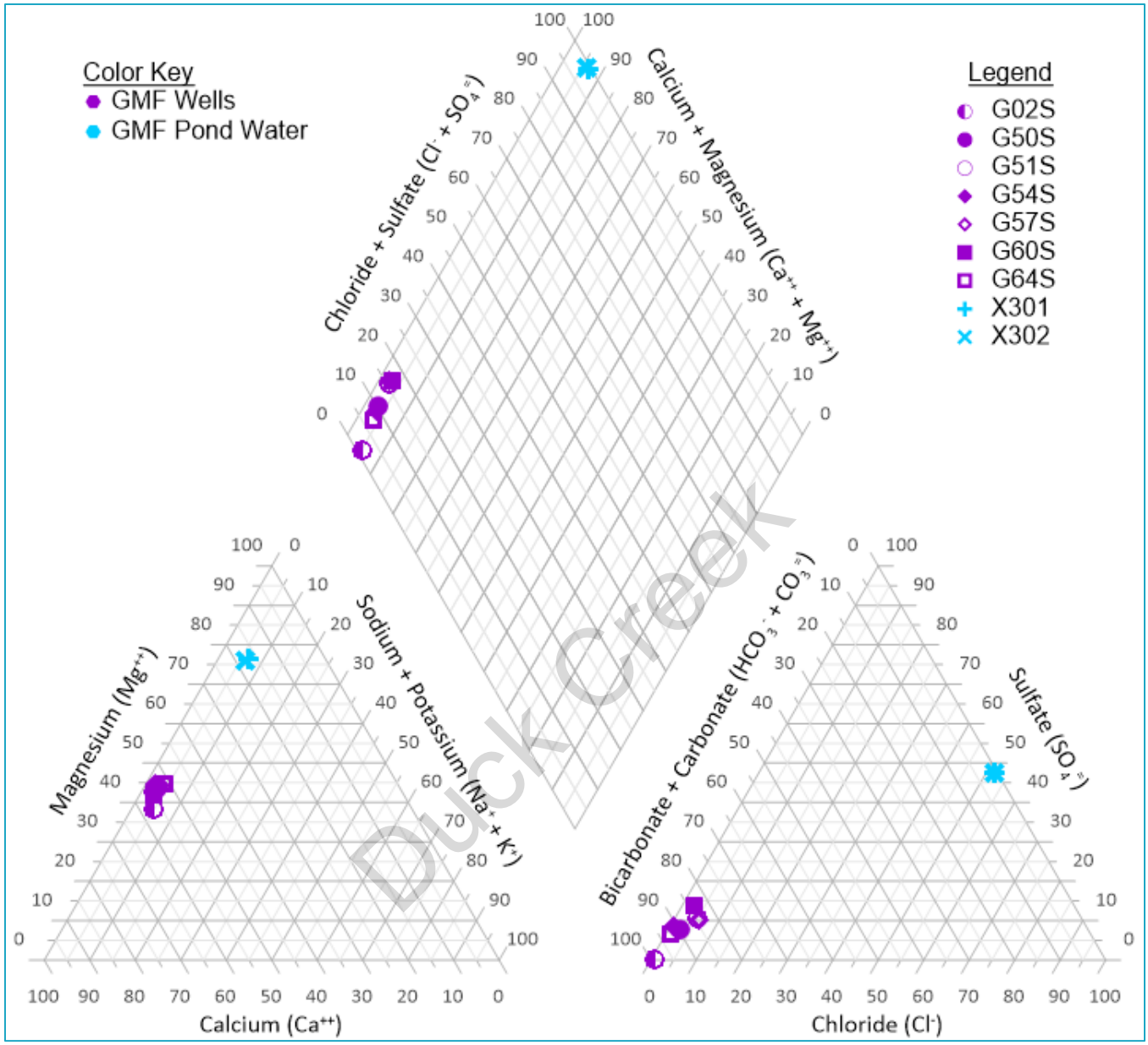


Figure 6. Piper diagram showing ionic composition of samples of groundwater and pond water associated with the Duck Creek GMF Pond

Grouping	Purple (Figure 6)	Blue (Figure 6)	Black (Figure 5)
Locations	Duck Creek GMF Pond Groundwater	Duck Creek GMF Pond Water	Groundwater from Reclaimed Surface Coal Mines Study
Dominant Cation	No dominant cation	High Magnesium	Calcium
Dominant Anion	Very High Carbonate-Bicarbonate	No dominant anion	High Carbonate-Bicarbonate

Table 1. Comparison of ionic classification of groundwater associated with the Duck Creek GMF, water from the Duck Creek GMF pond and groundwater downgradient of reclaimed surface coal mines in high-sulfur coal regions

LINE OF EVIDENCE #4: CONCENTRATIONS OF SULFATE AND BORON, COMMON INDICATORS FOR CCR IMPACTS TO GROUNDWATER, IN THE DOWNGRADIENT WELLS ARE STABLE AND AT OR BELOW CONCENTRATIONS IN THE BACKGROUND WELLS

Boron and sulfate are common indicators of CCR impacts to groundwater due to their leachability from CCR and mobility in groundwater; however, concentrations of both boron and sulfate downgradient of the GMF Pond are below their respective background UPLs. Both boron and sulfate are discussed in greater detail below.

Boron

Maximum boron concentrations measured in groundwater at downgradient wells in 2015-2018 ranged from <0.01 to 0.059 mg/L, or one and one quarter to seven times lower than the UPL. A time series for boron is provided in Figure 7 and boxplots are shown in Figure 8.

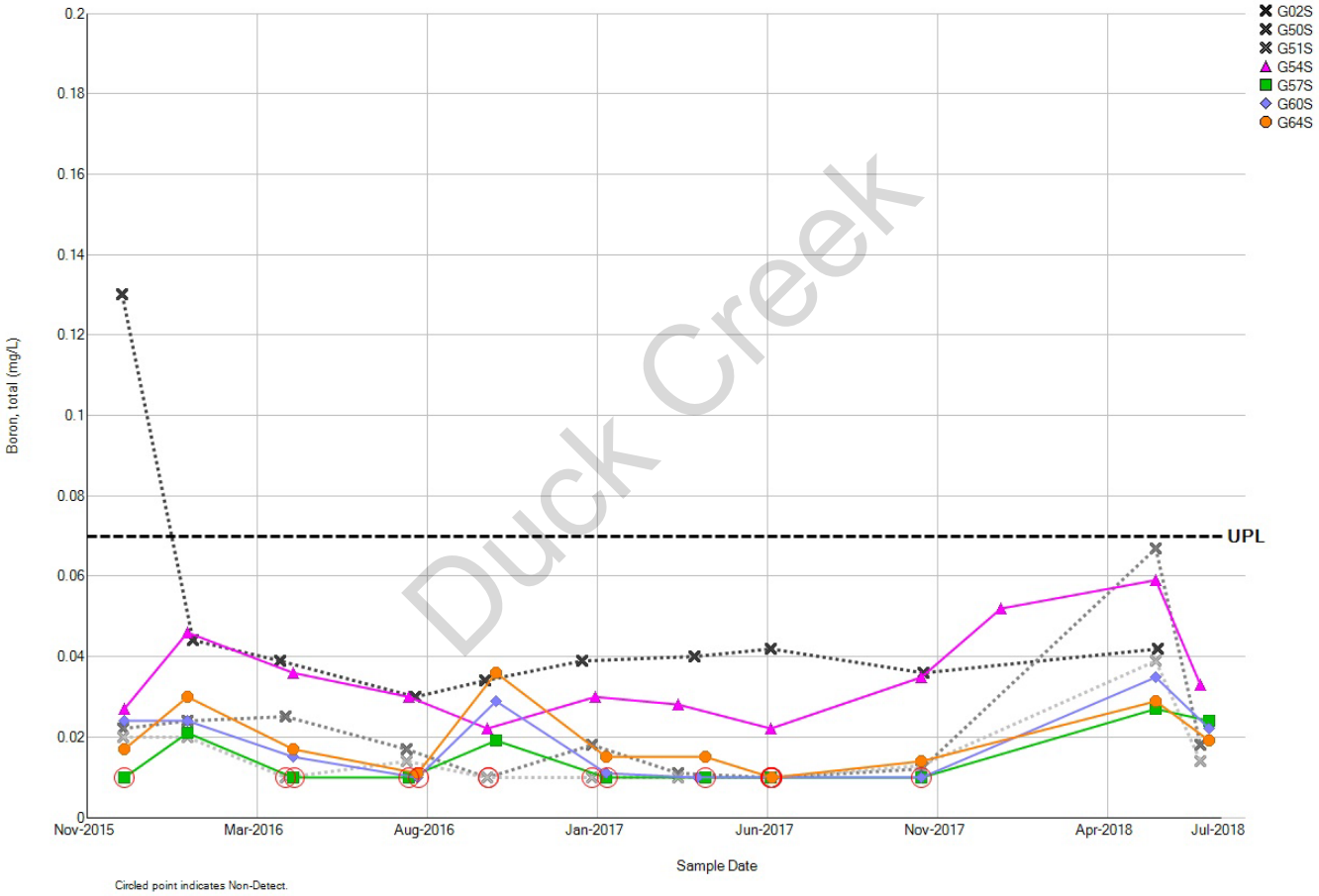


Figure 7. Boron time series; red circles indicate non-detects at the reporting limit concentration.

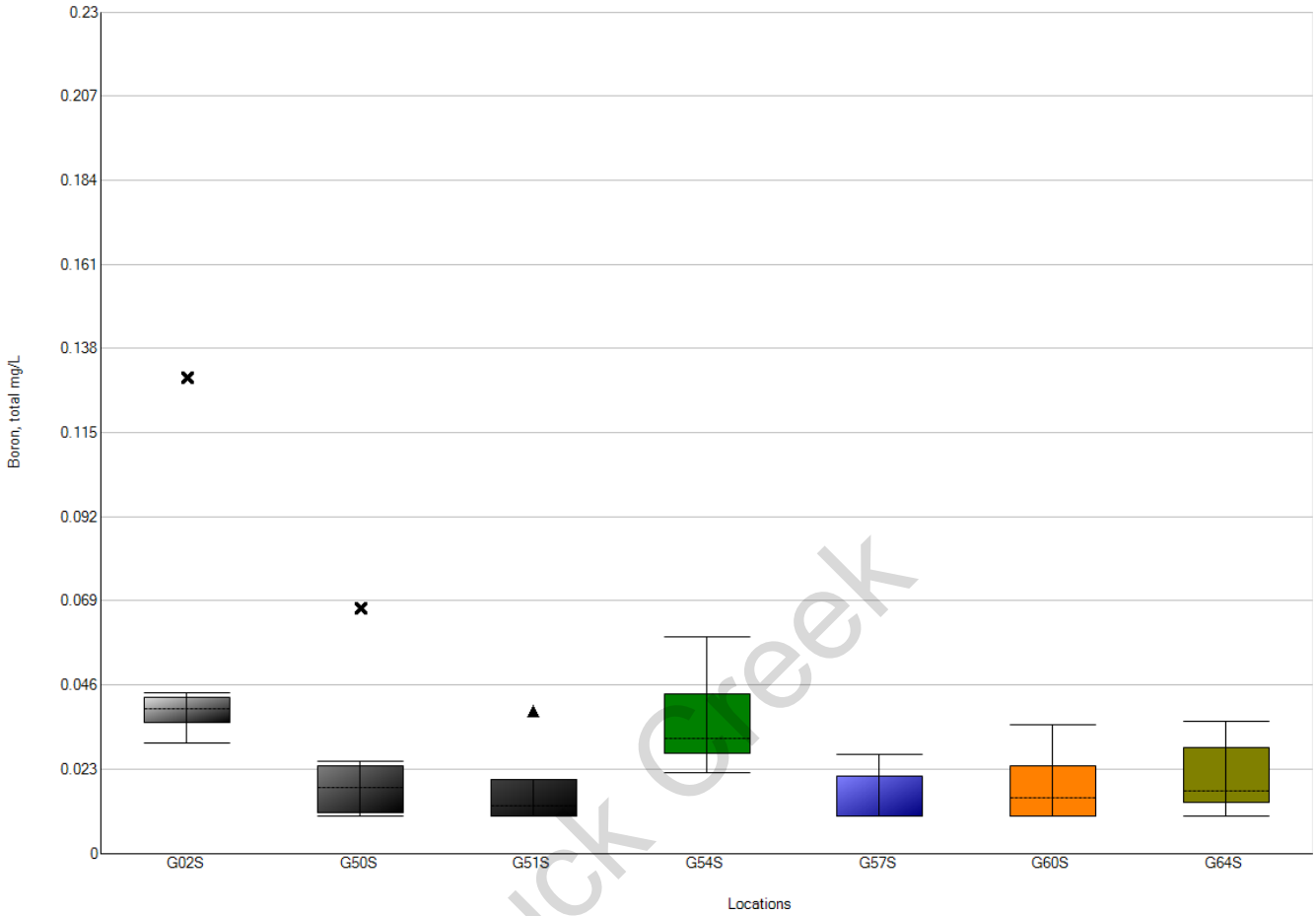


Figure 8. Boron boxplots

The time series and boxplots demonstrate the following observations about the wells:

- All boron concentrations in downgradient wells are below the UPL of 0.07 mg/L, determined from background monitoring wells G02S, G50S, and G51S.
- The relatively level lines on the time series indicate that there is little variance in the results at each well. The minimal variance is also supported by the height of the boxplots. The upper and lower lines of the boxes are the 25th and 75th quartiles, respectively; the closer these two lines are to each other, the lower the overall variance is for that location.

Mann-Kendall trend analysis tests were performed (Attachment A) to determine if concentrations at each well were increasing, decreasing or stable (i.e., no statistically significant upward or downward trend). If the Mann-Kendall test did not identify a trend, the coefficient of variation (CV) was calculated (Attachment C) to determine if the concentrations are stable (i.e. CV less than or equal to 1), or if there if there is too much data variability to draw a conclusion.

Boron concentrations are stable in background and downgradient wells. Table 2 provides summary statistics, including variance and trend per well.

Monitoring Well	Boron (mg/L)				
	Minimum	Maximum	Median	Standard Deviation	Trend
G02S	0.030	0.130	0.040	0.029	stable
G50S	<0.010	0.067	0.018	0.016	stable
G51S	<0.010	0.039	0.013	0.009	stable
G54S	0.022	0.059	0.032	0.012	stable
G57S	<0.010	0.027	0.010	0.007	stable
G60S	<0.010	0.035	0.015	0.009	stable
G64S	<0.010	0.036	0.017	0.008	stable

Table 2. Maximum, minimum, median, variance and trend of boron concentrations in groundwater

Sulfate

Maximum sulfate concentrations measured in groundwater at downgradient wells in 2015-2018 ranged from 25 to 73 mg/L, or one and a half to four times lower than the UPL. A time series for sulfate is provided in Figure 9 and boxplots are shown in Figure 10.

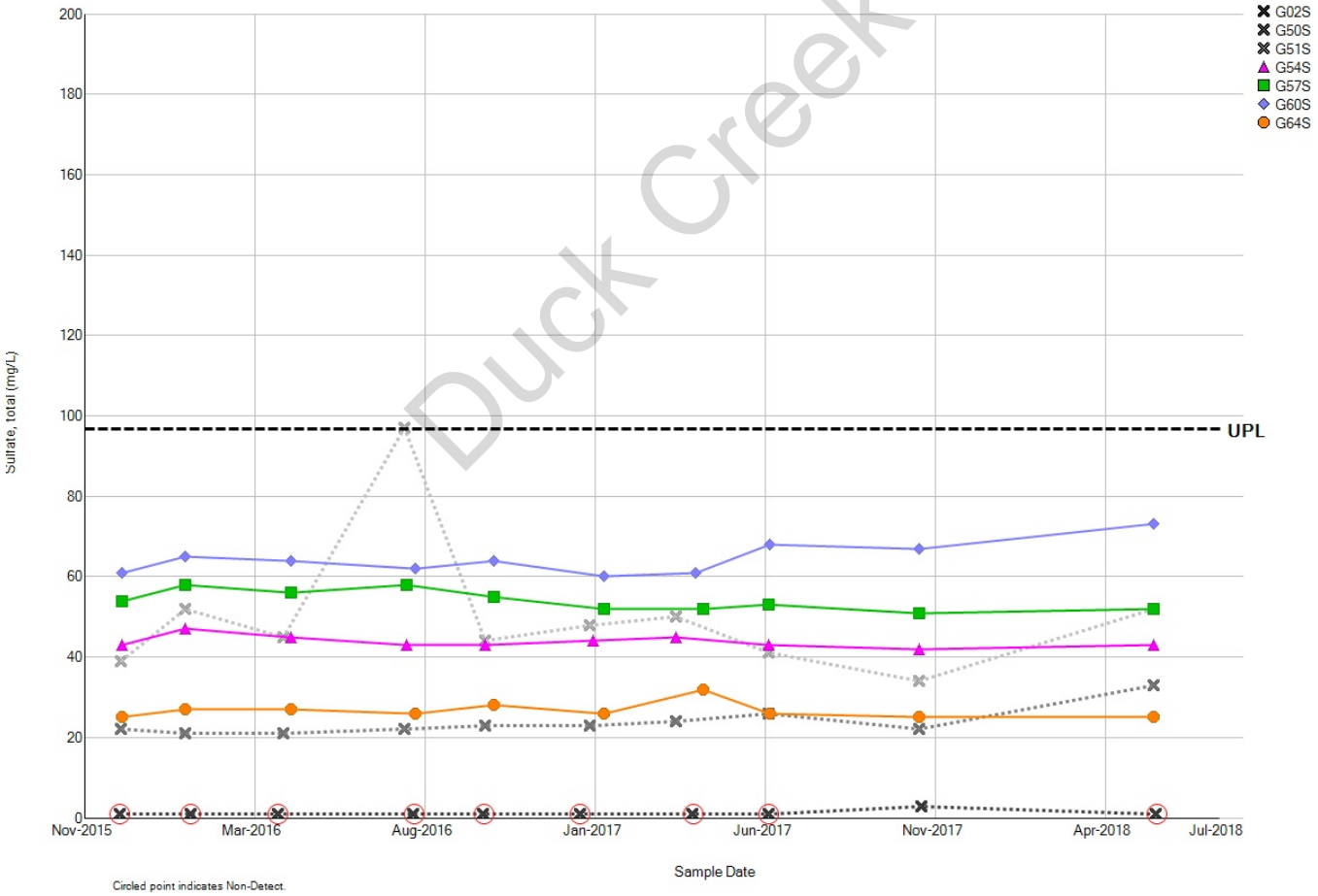


Figure 9. Sulfate time series; red circles indicate non-detects at the reporting limit concentration.

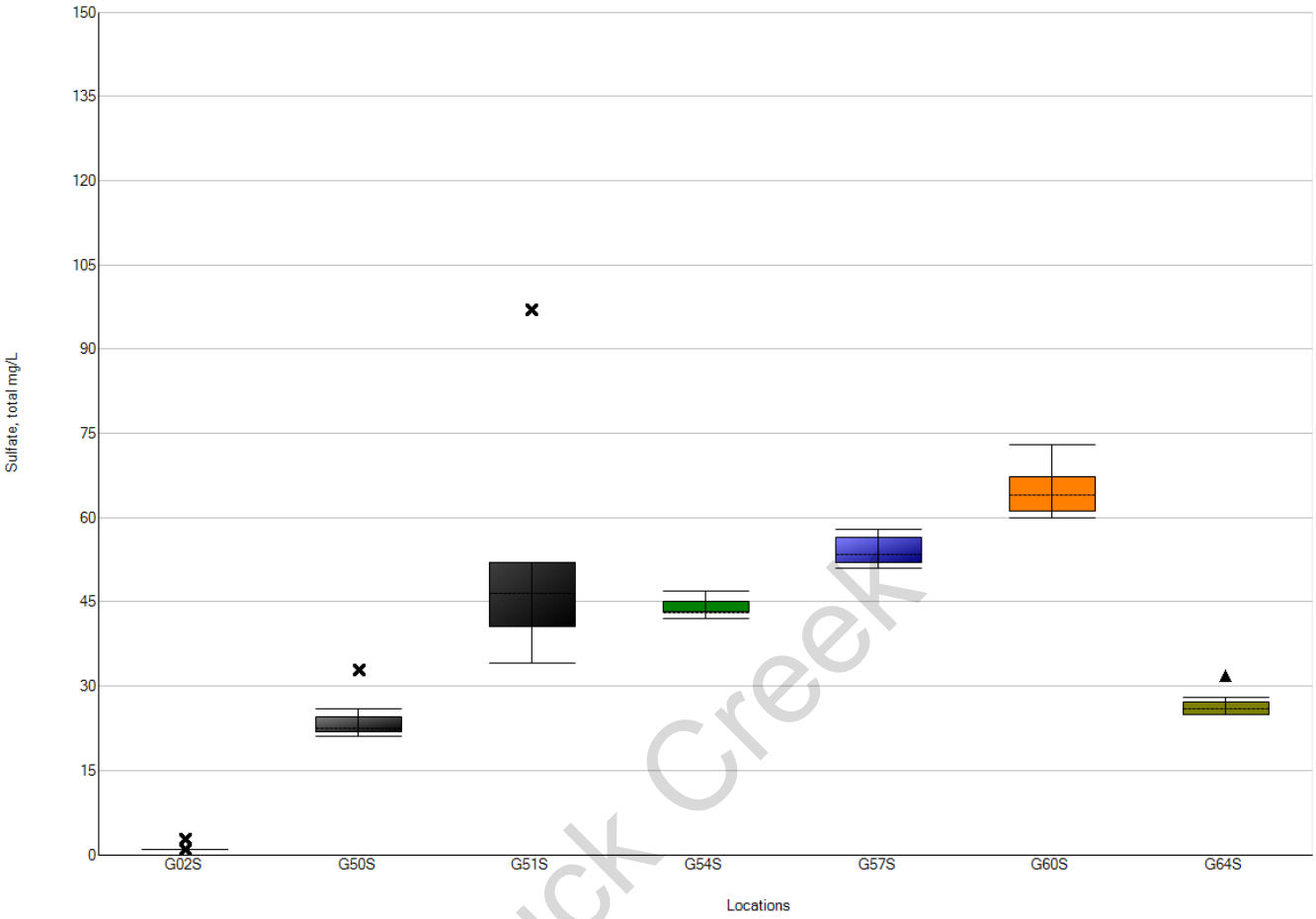


Figure 10. Sulfate boxplot

The time series and boxplots demonstrate the following observations about the wells:

- All sulfate concentrations in downgradient wells are substantially below the UPL of 97 mg/L, determined from background monitoring wells G02S, G50S and G51S.
- The relatively level lines on the time series indicate that there is little variance in the results at each well. The minimal variance is also supported by the height of the boxplots. The upper and lower lines of the boxes are the 25th and 75th quartiles, respectively; the closer these two lines are to each other, the lower the overall variance is for that location.

Mann-Kendall trend analysis tests were performed (Attachment B) to determine if concentrations at each well were increasing, decreasing or stable. If the Mann-Kendall test did not identify a trend, the coefficient of variation (CV) was calculated (Attachment C) to determine if the concentrations are stable (i.e. CV less than or equal to 1), or if there if there is too much data variability to draw a conclusion.

Sulfate concentrations are stable in background wells G02S and G51S, and downgradient wells G54S, G60S and G64S. Sulfate concentrations are increasing in background well G50S and decreasing in downgradient well G57S. Table 3 provides summary statistics, including variance and trend per well.

Monitoring Well	Sulfate (mg/L)				
	Minimum	Maximum	Median	Standard Deviation	Trend
G02S	<1.0	2.9	1.0	0.6	stable
G50S	21.0	33.0	22.5	3.6	upward
G51S	34.0	97.0	46.5	17.4	stable
G54S	42.0	47.0	43.0	1.5	stable
G57S	51.0	58.0	53.5	2.6	downward
G60S	60.0	73.0	64.0	4.0	stable
G64S	25.0	32.0	26.0	2.1	stable

Table 3. Maximum, minimum, median and variance of sulfate in groundwater

Based on these three lines of evidence, it has been demonstrated that the calcium SSIs at G54S and G60S, and total dissolved solids SSIs at G54s and G57S are not due to the Duck Creek GMF but are from an alternate anthropogenic source.

This information serves as the written alternate source demonstration prepared in accordance with 40 C.F.R. § 257.94(e)(2) that the SSIs observed during the detection monitoring program were not due to the CCR unit but were from historic coal mining activity and other anthropogenic impacts. Therefore, an assessment monitoring program is not required and the Duck Creek GMF Pond will remain in detection monitoring.

Attachments

Figure 1	Duck Creek GMF Pond (Unit ID: 203) Uppermost Aquifer unit Groundwater Elevation Contour Map July 2, 2018
Figure 4	Coal Mine Coverage Area Near Duck Creek GMF Pond (Unit ID: 203)
Attachment A	Boron Mann-Kendall Trend Analyses
Attachment B	Sulfate Mann-Kendall Trend Analyses
Attachment C	Coefficient of Variation Evaluation

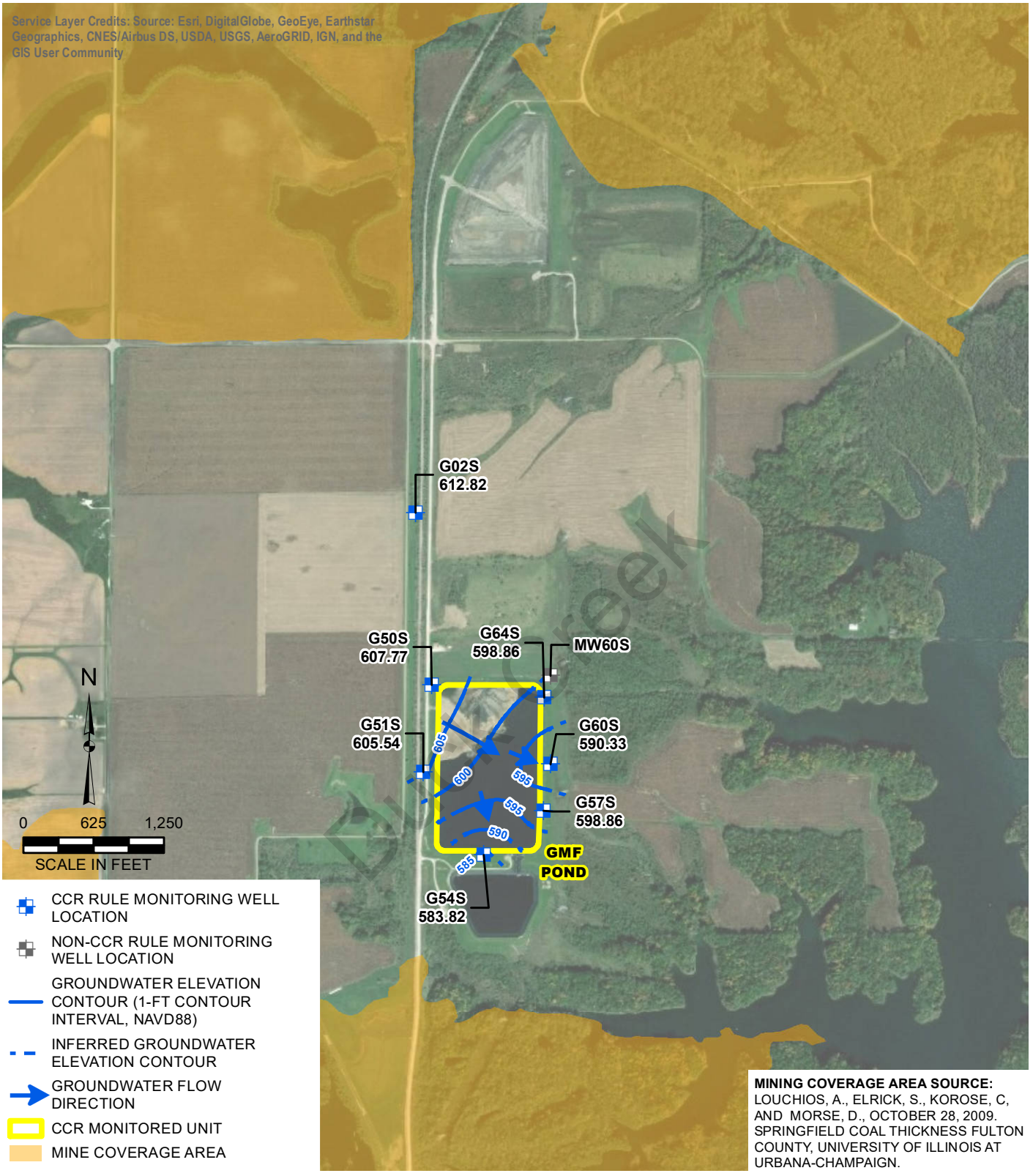
I, Eric J. Tlachac, a qualified professional engineer in good standing in the State of Illinois, certify that the information in this report is accurate as of the date of my signature below. The content of this report is not to be used for other than its intended purpose and meaning, or for extrapolations beyond the interpretations contained herein.

Eric J. Tlachac
Qualified Professional Engineer
062-063091
Illinois
O'Brien & Gere Engineers, Inc., part of Ramboll
Date: January 7, 2019

I, Nicole M. Pagano, a professional geologist in good standing in the State of Illinois, certify that the information in this report is accurate as of the date of my signature below. The content of this report is not to be used for other than its intended purpose and meaning, or for extrapolations beyond the interpretations contained herein.

Nicole M. Pagano
Professional Geologist
196-000750
O'Brien & Gere Engineers, Inc., part of Ramboll
Date: January 7, 2019

Figures



MINING COVERAGE AREA SOURCE:
LOUCHIOS, A., ELRICK, S., KOROSE, C, AND MORSE, D., OCTOBER 28, 2009. SPRINGFIELD COAL THICKNESS FULTON COUNTY, UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN.

DRAWN BY/DATE:
SDS 1/7/19
REVIEWED BY/DATE:
KLT 1/7/19
APPROVED BY/DATE:
NMP 1/7/19

DUCK CREEK GMF POND (UNIT ID: 203)
UPPERMOST AQUIFER UNIT
GROUNDWATER ELEVATION CONTOUR MAP
JULY 2, 2018

ALTERNATE SOURCE DEMONSTRATION
DUCK CREEK POWER STATION
CANTON, ILLINOIS

FIGURE NO: 1

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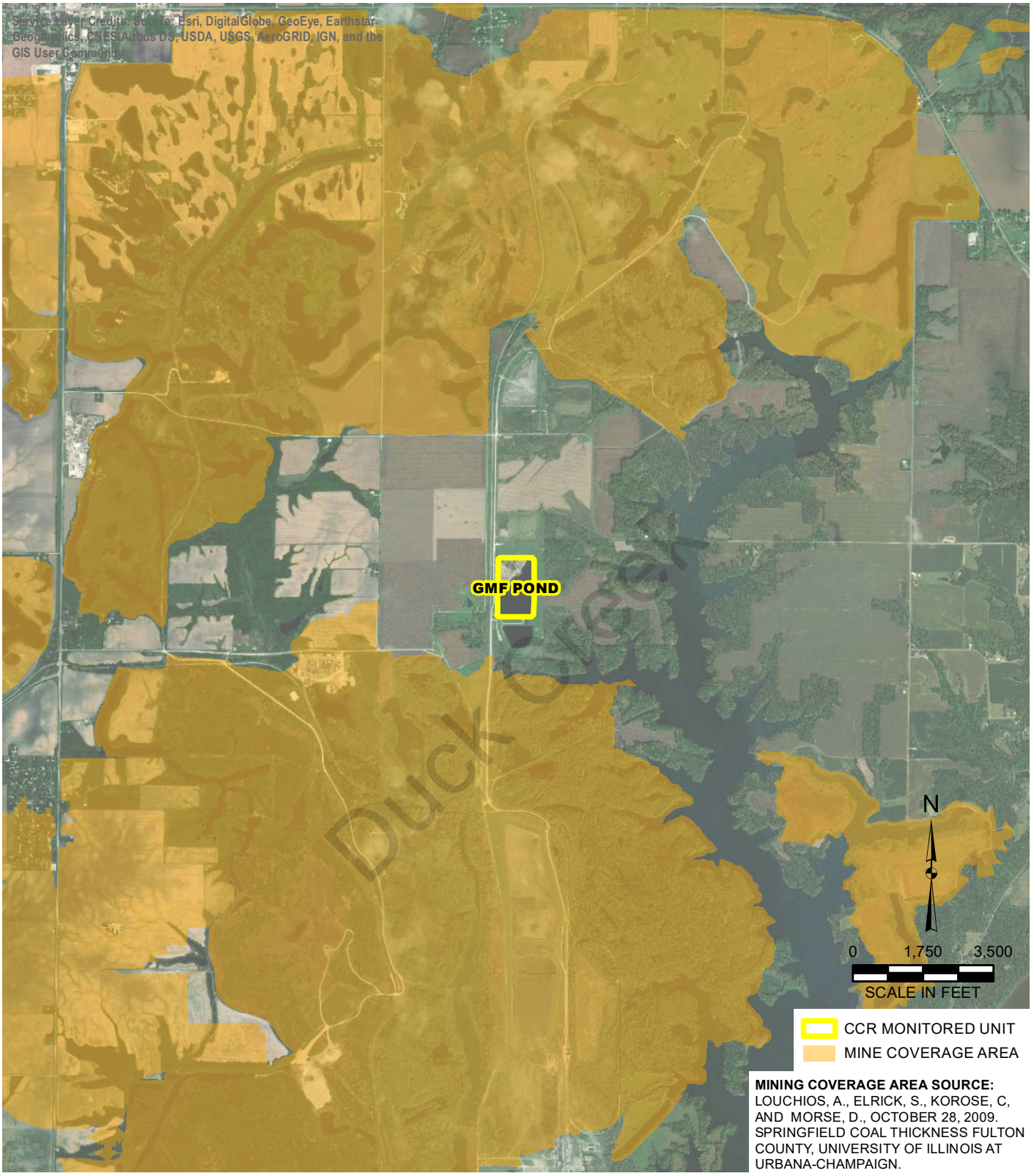

MINING COVERAGE AREA SOURCE:
LOUCHIOS, A., ELRICK, S., KOROSE, C, AND MORSE, D., OCTOBER 28, 2009. SPRINGFIELD COAL THICKNESS FULTON COUNTY, UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN.

DRAWN BY/DATE:
SDS 4/9/18
REVIEWED BY/DATE:
EJT 4/9/18
APPROVED BY/DATE:
NMP 4/9/18

COAL MINE COVERAGE AREA
NEAR DUCK CREEK GMF POND (UNIT ID: 203)

ALTERNATE SOURCE DEMONSTRATION
DUCK CREEK POWER STATION
CANTON, ILLINOIS

FIGURE NO: 4

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Attachment A

Boron Mann-Kendall Trend Analyses

Duck Creek
Mann-Kendall Trend Analysis

User Supplied Information

Location ID:	**G02S**	**Parameter Code:**	**01022**
Location Class:		**Parameter:**	**B, tot**
Location Type:		**Units:**	**mg/L**
Confidence Level:	**95.00%**	**Period Length:**	**1 month(s)**
Date Range: 12/02/2015 to 07/31/2018		**Limit Name:**	
		Averaged:	**No**

Trend Analysis

Trend of the least squares straight line		
Slope (fitted to data):	-0.000045	mg/L per day
R-Squared error of fit:	0.198477	
Sen's Non-parametric estimate of the slope (One-Sided Test)		
Median Slope:	-0.000002	mg/L per day
Lower Confidence Limit of Slope, M1:	-0.000042	mg/L per day
Upper Confidence Limit of Slope, M2+1:	0.000012	mg/L per day
Non-parametric Mann-Kendall Test for Trend		
S Statistic:	-0.180	
Z test:	1.645	
At the 95.0 % Confidence Level (One-Sided Test):	None	

Duck Creek
Mann-Kendall Trend Analysis

User Supplied Information

Location ID:	**G50S**	**Parameter Code:**	**01022**
Location Class:		**Parameter:**	**B, tot**
Location Type:		**Units:**	**mg/L**
Confidence Level:	**95.00%**	**Period Length:**	**1 month(s)**
Date Range: 12/02/2015 to 07/31/2018		**Limit Name:**	
		Averaged:	**No**

Trend Analysis

Trend of the least squares straight line		
Slope (fitted to data):	0.000014	mg/L per day
R-Squared error of fit:	0.075865	
Sen's Non-parametric estimate of the slope (One-Sided Test)		
Median Slope:	-0.000009	mg/L per day
Lower Confidence Limit of Slope, M1:	-0.000026	mg/L per day
Upper Confidence Limit of Slope, M2+1:	0.000021	mg/L per day
Non-parametric Mann-Kendall Test for Trend		
S Statistic:	-0.470	
Z test:	1.645	
At the 95.0 % Confidence Level (One-Sided Test):	None	

Duck Creek
Mann-Kendall Trend Analysis

User Supplied Information

Location ID:	**G51S**	**Parameter Code:**	**01022**
Location Class:		**Parameter:**	**B, tot**
Location Type:		**Units:**	**mg/L**
Confidence Level:	**95.00%**	**Period Length:**	**1 month(s)**
Date Range: 12/02/2015 to 07/31/2018		**Limit Name:**	
		Averaged:	**No**

Trend Analysis

Trend of the least squares straight line		
Slope (fitted to data):	0.000009	mg/L per day
R-Squared error of fit:	0.076968	
Sen's Non-parametric estimate of the slope (One-Sided Test)		
Median Slope:	0.000000	mg/L per day
Lower Confidence Limit of Slope, M1:	-0.000019	mg/L per day
Upper Confidence Limit of Slope, M2+1:	0.000016	mg/L per day
Non-parametric Mann-Kendall Test for Trend		
S Statistic:	0.000	
Z test:	1.645	
At the 95.0 % Confidence Level (One-Sided Test):	None	

Duck Creek
Mann-Kendall Trend Analysis

User Supplied Information

Location ID:	**G54S**	**Parameter Code:**	**01022**
Location Class:		**Parameter:**	**B, tot**
Location Type:		**Units:**	**mg/L**
Confidence Level:	**95.00%**	**Period Length:**	**1 month(s)**
Date Range: 12/02/2015 to 07/31/2018		**Limit Name:**	
		Averaged:	**No**

Trend Analysis

Trend of the least squares straight line

Slope (fitted to data):	0.000013	mg/L per day
R-Squared error of fit:	0.140652	

Sen's Non-parametric estimate of the slope (One-Sided Test)

Median Slope:	0.000008	mg/L per day
Lower Confidence Limit of Slope, M1:	-0.000014	mg/L per day
Upper Confidence Limit of Slope, M2+1:	0.000033	mg/L per day

Non-parametric Mann-Kendall Test for Trend

S Statistic:	0.758
Z test:	1.645
At the 95.0 % Confidence Level (One-Sided Test):	None

Duck Creek
Mann-Kendall Trend Analysis

User Supplied Information

Location ID:	**G57S**	**Parameter Code:**	**01022**
Location Class:		**Parameter:**	**B, tot**
Location Type:		**Units:**	**mg/L**
Confidence Level:	**95.00%**	**Period Length:**	**1 month(s)**
Date Range: 12/02/2015 to 07/31/2018		**Limit Name:**	
		Averaged:	**No**

Trend Analysis

Trend of the least squares straight line

Slope (fitted to data):	0.000012	mg/L per day
R-Squared error of fit:	0.171336	

Sen's Non-parametric estimate of the slope (One-Sided Test)

Median Slope:	0.000000	mg/L per day
Lower Confidence Limit of Slope, M1:	0.000000	mg/L per day
Upper Confidence Limit of Slope, M2+1:	0.000017	mg/L per day

Non-parametric Mann-Kendall Test for Trend

S Statistic:	0.819
Z test:	1.645
At the 95.0 % Confidence Level (One-Sided Test):	None

Duck Creek
Mann-Kendall Trend Analysis

User Supplied Information

Location ID:	**G60S**	**Parameter Code:**	**01022**
Location Class:		**Parameter:**	**B, tot**
Location Type:		**Units:**	**mg/L**
Confidence Level:	**95.00%**	**Period Length:**	**1 month(s)**
Date Range: 12/02/2015 to 07/31/2018		**Limit Name:**	
		Averaged:	**No**

Trend Analysis

Trend of the least squares straight line		
Slope (fitted to data):	0.000003	mg/L per day
R-Squared error of fit:	0.007800	
Sen's Non-parametric estimate of the slope (One-Sided Test)		
Median Slope:	-0.000002	mg/L per day
Lower Confidence Limit of Slope, M1:	-0.000030	mg/L per day
Upper Confidence Limit of Slope, M2+1:	0.000018	mg/L per day
Non-parametric Mann-Kendall Test for Trend		
S Statistic:	-0.393	
Z test:	1.645	
At the 95.0 % Confidence Level (One-Sided Test):	None	

Duck Creek
Mann-Kendall Trend Analysis

User Supplied Information

Location ID:	**G64S**	**Parameter Code:**	**01022**
Location Class:		**Parameter:**	**B, tot**
Location Type:		**Units:**	**mg/L**
Confidence Level:	**95.00%**	**Period Length:**	**1 month(s)**
Date Range: 12/02/2015 to 07/31/2018		**Limit Name:**	
		Averaged:	**No**

Trend Analysis

Trend of the least squares straight line		
Slope (fitted to data):	-0.000002	mg/L per day
R-Squared error of fit:	0.004123	
Sen's Non-parametric estimate of the slope (One-Sided Test)		
Median Slope:	-0.000004	mg/L per day
Lower Confidence Limit of Slope, M1:	-0.000023	mg/L per day
Upper Confidence Limit of Slope, M2+1:	0.000013	mg/L per day
Non-parametric Mann-Kendall Test for Trend		
S Statistic:	-0.470	
Z test:	1.645	
At the 95.0 % Confidence Level (One-Sided Test):	None	

Attachment B

Sulfate Mann-Kendall Trend Analyses

Duck Creek
Mann-Kendall Trend Analysis

User Supplied Information

Location ID:	**G02S**	**Parameter Code:**	**00945**
Location Class:		**Parameter:**	**SO4, tot**
Location Type:		**Units:**	**mg/L**
Confidence Level:	**95.00%**	**Period Length:**	**1 month(s)**
Date Range: 12/02/2015 to 07/31/2018		**Limit Name:**	
		Averaged:	**No**

Trend Analysis

Trend of the least squares straight line

Slope (fitted to data):	0.000994	mg/L per day
R-Squared error of fit:	0.146861	

Sen's Non-parametric estimate of the slope (One-Sided Test)

Median Slope:	0.000000	mg/L per day
Lower Confidence Limit of Slope, M1:	0.000000	mg/L per day
Upper Confidence Limit of Slope, M2+1:	0.000000	mg/L per day

Non-parametric Mann-Kendall Test for Trend

S Statistic:	1.044
Z test:	1.645
At the 95.0 % Confidence Level (One-Sided Test):	None

Duck Creek
Mann-Kendall Trend Analysis

User Supplied Information

Location ID:	**G50S**	**Parameter Code:**	**00945**
Location Class:		**Parameter:**	**SO4, tot**
Location Type:		**Units:**	**mg/L**
Confidence Level:	**95.00%**	**Period Length:**	**1 month(s)**
Date Range: 12/02/2015 to 07/31/2018		**Limit Name:**	
		Averaged:	**No**

Trend Analysis

Trend of the least squares straight line

Slope (fitted to data):	0.009503	mg/L per day
R-Squared error of fit:	0.595812	

Sen's Non-parametric estimate of the slope (One-Sided Test)

Median Slope:	0.007380	mg/L per day
Lower Confidence Limit of Slope, M1:	0.002104	mg/L per day
Upper Confidence Limit of Slope, M2+1:	0.012223	mg/L per day

Non-parametric Mann-Kendall Test for Trend

S Statistic:	2.472
Z test:	1.645
At the 95.0 % Confidence Level (One-Sided Test):	Upward

Duck Creek
Mann-Kendall Trend Analysis

User Supplied Information

Location ID:	**G51S**	**Parameter Code:**	**00945**
Location Class:		**Parameter:**	**SO4, tot**
Location Type:		**Units:**	**mg/L**
Confidence Level:	**95.00%**	**Period Length:**	**1 month(s)**
Date Range: 12/02/2015 to 07/31/2018		**Limit Name:**	
		Averaged:	**No**

Trend Analysis

Trend of the least squares straight line

Slope (fitted to data):	-0.009108	mg/L per day
R-Squared error of fit:	0.023195	

Sen's Non-parametric estimate of the slope (One-Sided Test)

Median Slope:	-0.004608	mg/L per day
Lower Confidence Limit of Slope, M1:	-0.029275	mg/L per day
Upper Confidence Limit of Slope, M2+1:	0.015114	mg/L per day

Non-parametric Mann-Kendall Test for Trend

S Statistic:	-0.090
Z test:	1.645
At the 95.0 % Confidence Level (One-Sided Test):	None

Duck Creek
Mann-Kendall Trend Analysis

User Supplied Information

Location ID:	**G54S**	**Parameter Code:**	**00945**
Location Class:		**Parameter:**	**SO4, tot**
Location Type:		**Units:**	**mg/L**
Confidence Level:	**95.00%**	**Period Length:**	**1 month(s)**
Date Range: 12/02/2015 to 07/31/2018		**Limit Name:**	
		Averaged:	**No**

Trend Analysis

Trend of the least squares straight line

Slope (fitted to data):	-0.002476	mg/L per day
R-Squared error of fit:	0.238224	

Sen's Non-parametric estimate of the slope (One-Sided Test)

Median Slope:	-0.002016	mg/L per day
Lower Confidence Limit of Slope, M1:	-0.005427	mg/L per day
Upper Confidence Limit of Slope, M2+1:	0.000000	mg/L per day

Non-parametric Mann-Kendall Test for Trend

S Statistic:	-1.255
Z test:	1.645
At the 95.0 % Confidence Level (One-Sided Test):	None

Duck Creek
Mann-Kendall Trend Analysis

User Supplied Information

Location ID:	**G57S**	**Parameter Code:**	**00945**
Location Class:		**Parameter:**	**SO4, tot**
Location Type:		**Units:**	**mg/L**
Confidence Level:	**95.00%**	**Period Length:**	**1 month(s)**
Date Range: 12/02/2015 to 07/31/2018		**Limit Name:**	
		Averaged:	**No**

Trend Analysis

Trend of the least squares straight line		
Slope (fitted to data):	-0.006425	mg/L per day
R-Squared error of fit:	0.537357	
Sen's Non-parametric estimate of the slope (One-Sided Test)		
Median Slope:	-0.005587	mg/L per day
Lower Confidence Limit of Slope, M1:	-0.010989	mg/L per day
Upper Confidence Limit of Slope, M2+1:	-0.001960	mg/L per day
Non-parametric Mann-Kendall Test for Trend		
S Statistic:	-2.188	
Z test:	1.645	
At the 95.0 % Confidence Level (One-Sided Test):	Downward	

Duck Creek
Mann-Kendall Trend Analysis

User Supplied Information

Location ID:	**G60S**	**Parameter Code:**	**00945**
Location Class:		**Parameter:**	**SO4, tot**
Location Type:		**Units:**	**mg/L**
Confidence Level:	**95.00%**	**Period Length:**	**1 month(s)**
Date Range: 12/02/2015 to 07/31/2018		**Limit Name:**	
		Averaged:	**No**

Trend Analysis

Trend of the least squares straight line

Slope (fitted to data):	0.009127	mg/L per day
R-Squared error of fit:	0.446277	

Sen's Non-parametric estimate of the slope (One-Sided Test)

Median Slope:	0.009119	mg/L per day
Lower Confidence Limit of Slope, M1:	-0.003163	mg/L per day
Upper Confidence Limit of Slope, M2+1:	0.016021	mg/L per day

Non-parametric Mann-Kendall Test for Trend

S Statistic:	1.262
Z test:	1.645
At the 95.0 % Confidence Level (One-Sided Test):	None

Duck Creek
Mann-Kendall Trend Analysis

User Supplied Information

Location ID:	**G64S**	**Parameter Code:**	**00945**
Location Class:		**Parameter:**	**SO4, tot**
Location Type:		**Units:**	**mg/L**
Confidence Level:	**95.00%**	**Period Length:**	**1 month(s)**
Date Range: 12/02/2015 to 07/31/2018		**Limit Name:**	
		Averaged:	**No**

Trend Analysis

Trend of the least squares straight line		
Slope (fitted to data):	-0.000548	mg/L per day
R-Squared error of fit:	0.005722	
Sen's Non-parametric estimate of the slope (One-Sided Test)		
Median Slope:	-0.001531	mg/L per day
Lower Confidence Limit of Slope, M1:	-0.003279	mg/L per day
Upper Confidence Limit of Slope, M2+1:	0.002848	mg/L per day
Non-parametric Mann-Kendall Test for Trend		
S Statistic:	-0.648	
Z test:	1.645	
At the 95.0 % Confidence Level (One-Sided Test):	None	

Attachment C

Coefficient of Variation Evaluation

Duck Creek

Coefficient of Variation
Date Range: 12/02/2015 to 7/31/2018

Boron, total (mg/L)

Location	Count	Mean	Std Dev	% Non-Detects	CV
G02S	10	0.048	0.029	0.00	0.61
G50S	11	0.021	0.016	18.18	0.76
G51S	11	0.015	0.009	36.36	0.56
G54S	12	0.035	0.012	0.00	0.33
G57S	11	0.015	0.007	63.64	0.46
G60S	11	0.018	0.009	18.18	0.50
G64S	11	0.019	0.008	9.09	0.44

Sulfate, total (mg/L)

Location	Count	Mean	Std Dev	% Non-Detects	CV
G02S	10	1.190	0.601	90.00	0.50
G50S	10	23.700	3.592	0.00	0.15
G51S	10	50.200	17.447	0.00	0.35
G54S	10	43.800	1.476	0.00	0.03
G57S	10	54.100	2.558	0.00	0.05
G60S	10	64.500	3.979	0.00	0.06
G64S	10	26.700	2.111	0.00	0.08

CV=Std Dev/ Mean

40 C.F.R. § 257.94(e)(2): ALTERNATE SOURCE DEMONSTRATION
DUCK CREEK GMF POND
JULY 15, 2019

July 15, 2019

Title 40 of the Code of Federal Regulations (C.F.R.) § 257.94(e)(2) allows the owner or operator of a coal combustion residuals (CCR) unit 90 days from the date of determination of statistically significant increases (SSIs) over background for groundwater constituents listed in Appendix III of 40 C.F.R. Part 257 to complete a written demonstration that a source other than the CCR unit being monitored caused the SSI(s), or that the SSI(s) resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality (Alternate Source Demonstration [ASD]).

This ASD has been prepared on behalf of Illinois Power Resources Generating, LLC by O'Brien & Gere Engineers, Inc., part of Ramboll (OBG) to provide pertinent information pursuant to 40 C.F.R. § 257.94(e)(2) for the Duck Creek Gypsum Management Facility (GMF) Pond located near Canton, Illinois.

The third semi-annual detection monitoring samples (Detection Monitoring Round 3 [D3]) were collected between October 4-20, 2018 and analytical data were received on January 16, 2019. In accordance with 40 C.F.R. § 257.93(h)(2), statistical analysis of the data to identify SSIs of 40 C.F.R. Part 257 Appendix III parameters over background concentrations was completed by April 15, 2019, within 90 days of receipt of the analytical data. The statistical determination identified the following SSIs at downgradient monitoring wells:

- Calcium at wells G54S, G57S, and G60S
- Chloride at well G57S

Because Detection Monitoring Round 4 (D4) was completed on February 5-6, 2019, prior to SSIs referenced above being determined for D3 (April 15, 2019), results from D4 were used to confirm the D3 SSIs in accordance with the Statistical Analysis Plan[1]. Following evaluation of analytical data from D4, the following SSIs were confirmed for D3:

- Calcium at wells G54S, G57, and G60S
- Chloride at well G57S

Pursuant to 40 C.F.R. § 257.94(e)(2), the following demonstrates that sources other than the GMF Pond were the cause of the SSIs listed above. This ASD was completed by July 15, 2019, within 90 days of determination of the SSIs, as required by 40 C.F.R. § 257.94(e)(2).

ALTERNATE SOURCE DEMONSTRATION: LINES OF EVIDENCE

Lines of evidence supporting this ASD include the following:

1. The ionic composition of GMF Pond water is different from the ionic composition of groundwater.
2. Proximity of the GMF Pond to historic coal mining activity and related groundwater quality impacts.
3. Calcium was present in groundwater in the vicinity of the GMF Pond prior to the unit being placed into service at concentrations that exceeded current CCR compliance background concentrations.
4. Elevated concentrations of chloride in regional background.

[1] Natural Resource Technology, an OBG Company, 2017, Statistical Analysis Plan, Duck Creek Power Station, Edwards Power Station, Illinois Power Resources Generating, LLC, October 17, 2017.

5. Concentrations of boron, a common indicator for CCR impacts to groundwater, in the downgradient wells are stable and near or below concentrations in the background wells.

These lines of evidence are described and supported in greater detail below. The locations of the monitoring wells are shown on the attached Figure 1.

LINE OF EVIDENCE #1: THE IONIC COMPOSITION OF GMF POND WATER IS DIFFERENT FROM THE IONIC COMPOSITION OF GROUNDWATER

Piper diagrams graphically represent ionic composition of aqueous solutions. A Piper diagram displays the position of water samples relative to their major cation and anion content, providing the information needed to identify compositional categories or groupings. Figure 2, on the following page, is a Piper diagram that displays the ionic composition of groundwater samples from the background and downgradient monitoring wells associated with the GMF Pond and surface water samples collected from the GMF Pond in Quarter 2 2017. The ionic compositional groupings identified are shown in the black and green ellipses on the diamond portion of the Piper diagram. These are summarized in Table 1 and discussed in more detail below.

The results can be categorized into two distinct groups. Groundwater samples from the GMF Pond background and downgradient wells (enclosed within a black ellipse) have a high to very high percentage of carbonate-bicarbonate anions and no dominant cation. Samples of surface water from the GMF Pond (enclosed within a green ellipse) are compositionally distinct from the background and downgradient groundwater, and have a high percentage of magnesium cations and no dominant anion. The dissimilar ionic compositions of the GMF Pond background and downgradient groundwater and the GMF Pond surface water indicates that the GMF Pond surface water is not the source of CCR constituents detected in GMF Pond groundwater.

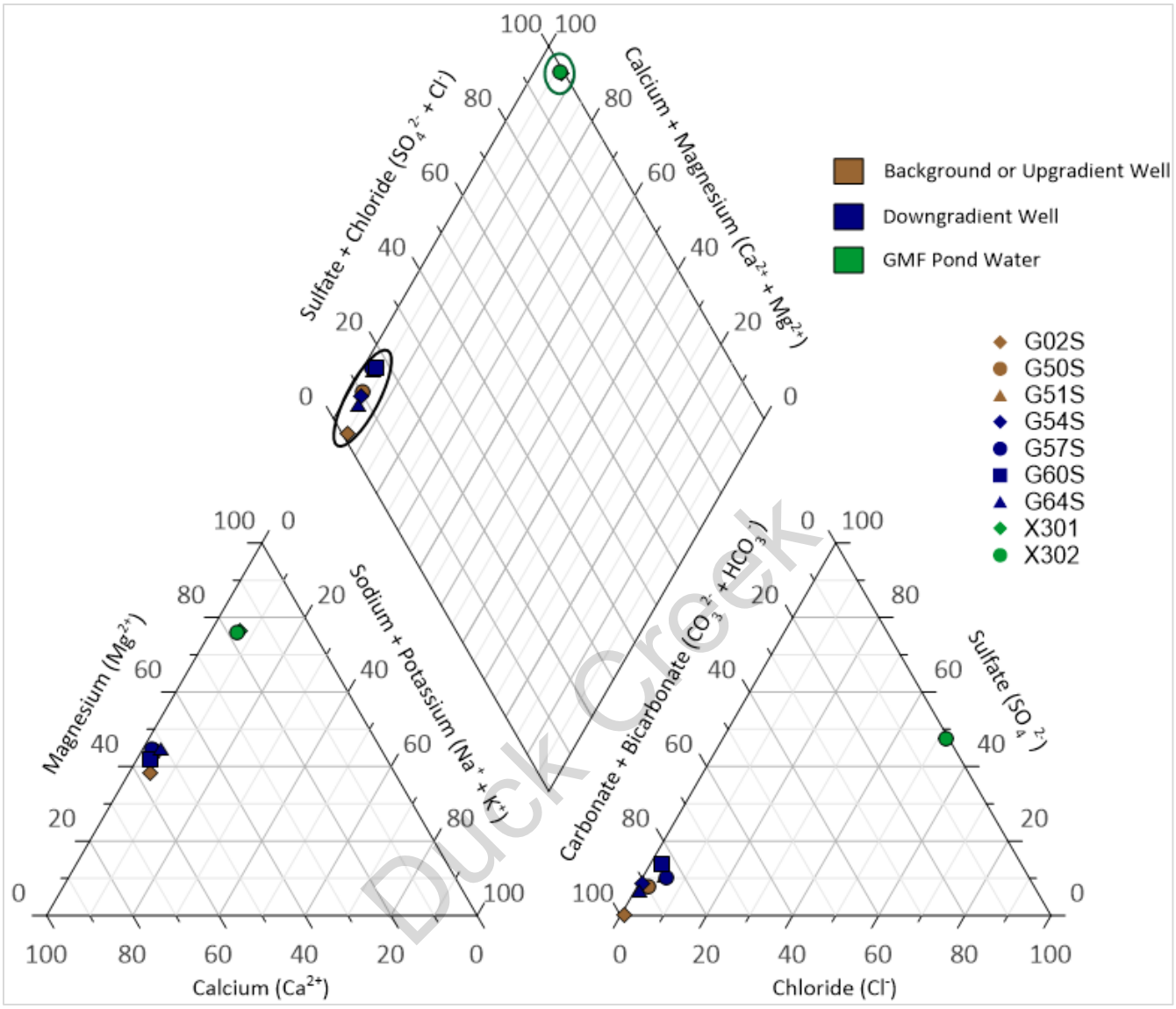


Figure 2. Piper Diagram Showing Ionic Composition of Samples of Groundwater and Pond Water Associated with the Duck Creek GMF Pond.

Grouping	Blue/Brown (Figure 6)	Green (Figure 6)	Black (Figure 5)
Locations	Duck Creek GMF Pond Groundwater	Duck Creek GMF Pond Water	Groundwater from Reclaimed Surface Coal Mines Study
Dominant Cation	No dominant cation	**High Magnesium**	**Moderate to High Calcium**
Dominant Anion	**High to Very High Carbonate-Bicarbonate**	No dominant anion	**Moderate to High Carbonate-Bicarbonate**

Table 1. Summary of Ionic Classification.

LINE OF EVIDENCE #2: PROXIMITY OF THE GMF POND TO HISTORIC COAL MINING ACTIVITY AND RELATED GROUNDWATER QUALITY IMPACTS

The area surrounding the GMF Pond consists primarily of unmined coal and reclaimed surface mine land. The extents of the nearby mines are shown in the attached Figure 3. The coal in this area has a sulfur content greater

than 2.5 pounds (lbs) of sulfur per million BTUs, the highest sulfur classification used by Illinois State Geological Survey[2].

The coal varies in depth from 0 to 50 feet (ft) below ground surface (bgs). The wells associated with the monitoring system established for the Duck Creek GMF Pond pursuant to 40 C.F.R. § 257.91 are screened between 23 and 48 ft bgs. Potentiometric data indicates that groundwater flows to the southeast as shown on the attached Figure 1. The monitoring wells are located 2,000 to 4,000 ft downgradient of the nearby mines (Figure 3).

A study of groundwater quality near surface coal mines, performed by the U.S. Geological Survey (USGS)[3], provides data on the effects of mines on groundwater quality. The study evaluated regional differences in major ionic composition of groundwater in unmined and mined areas using Piper diagrams (Figure 4). Groundwater samples collected from wells downgradient of the reclaimed mine areas in the study have a moderate to high percentage of carbonate-bicarbonate anions as well as a moderate to high percentage of calcium cations and are classified as calcium bicarbonate water.

State of Illinois groundwater quality regulations (Illinois Administrative Code [IAC] Title 35 Part 620 Groundwater Quality) acknowledge that water quality is adversely affected in areas where coal mining activity has occurred. The groundwater quality standards for chloride, iron, manganese, sulfate, TDS and pH within previously mined areas are the existing concentrations (35IAC § 620.440).

Table 1 above includes the ionic composition of groundwater near reclaimed surface coal mines along with ionic composition of GMF Pond water samples and groundwater samples collected from the background and downgradient groundwater monitoring wells at the GMF Pond. The ionic composition of groundwater associated with reclaimed surface coal mines is similar to the ionic composition of groundwater samples collected from background and downgradient groundwater monitoring wells at the GMF Pond in that the dominant anion is carbonate-bicarbonate.

The proximity of the GMF Pond to historic coal mining activity and similarities in the ionic composition of groundwater in areas of reclaimed surface coal mines and in the GMF Pond groundwater samples demonstrate that mining activity has affected groundwater quality at the Duck Creek GMF Pond.

[2] "Illinois Coal Reserves Assessment and Database Development: Final Report", Open File Series 1997-4, Illinois State Geological Survey, Coal Section, 1997.
[3] "Ground-Water Quality in Unmined Areas and Near Reclaimed Surface Coal Mines in the Northern and Central Appalachian Coal Regions, Pennsylvania and West Virginia", Scientific Investigations Report 2006-5059, US Geological Survey, 2006.

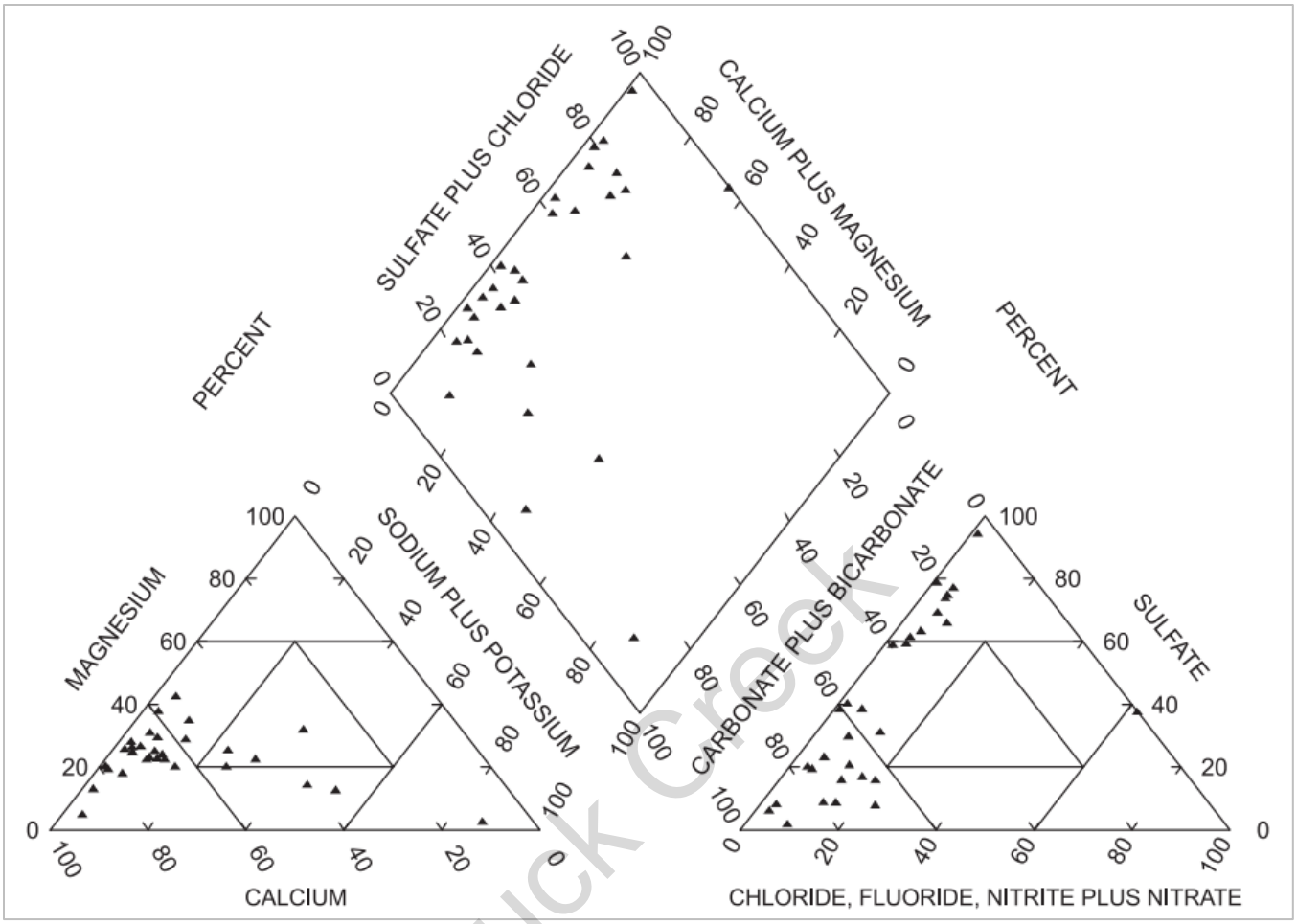


Figure 4. Piper Diagram Showing Ionic Composition of Groundwater Downgradient of Reclaimed Surface Coal Mines in High-Sulfur Coal Regions (Modified from USGS).

LINE OF EVIDENCE #3: CALCIUM WAS PRESENT IN GROUNDWATER IN THE VICINITY OF THE GMF POND PRIOR TO THE UNIT BEING PLACED INTO SERVICE AT CONCENTRATIONS THAT EXCEEEDED CURRENT CCR BACKGROUND CONCENTRATIONS

As discussed in the previous Line of Evidence, Piper diagrams published by the USGS in 2006 indicated that the groundwater in the area where the GMF Pond would be built was classified as calcium-bicarbonate water. The GMF Pond was placed in service in 2009. MW60S was present prior to 2009 and was located side- to downgradient of where the GMF Pond was constructed.

A box plot for calcium concentrations observed in groundwater samples collected from MW60S between March 2007 and November 2008 is shown in Figure 5. Calcium concentrations ranged from 87 to 150 milligrams per liter (mg/L) and the average and median observed calcium concentrations were 116 and 120 mg/L, respectively. Calcium concentrations were most often between 94 mg/ L (first quartile) and 133 mg/L (third quartile).

Figure 5. Box Plot of Calcium Concentrations Observed in Groundwater Samples Collected from MW60S Between March 2007 and November 2008.

During D3, a calcium SSI at monitoring well G60S was determined at 120 mg/L and confirmed via resampling at 270 mg/L. The initial sample concentration is within the statistical range presented in the box plot, and the resample concentration is higher. Calcium SSIs observed in G54S and G57S during D3 (130 mg/L) and confirmed based upon the concentrations observed during D4 (130 mg/L) are similar to those observed in MW60S from 2007-2008.

The classification of the groundwater in the area as calcium-bicarbonate water and calcium concentrations in downgradient monitoring wells G54S, G57S, and G60S that are generally consistent with those observed in groundwater prior to the GMF Pond being placed into service indicates that the GMF Pond is not the source of calcium SSIs in downgradient monitoring wells.

LINE OF EVIDENCE #4: ELEVATED CONCENTRATIONS OF CHLORIDE IN REGIONAL BACKGROUND

Figure 7 below was modified from a bulletin released by the Illinois State Water Survey and the Prairie Research Institute, University of Illinois at Urbana-Champaign[4], and shows that there are multiple wells in Fulton and the adjacent counties screened at similar depths as G57S that have chloride concentrations of 20-30 mg/L, similar to the observed SSI concentration at G57S (22 mg/L).

[4] Kelly, W.R., Panno, S.V., Hackely, K., 2012, The Sources, Distribution, and Trends of Chloride in the Waters of Illinois; Illinois State Water Survey, Prairie Research Institute, University of Illinois at Urbana-Champaign, Bulletin B-74.

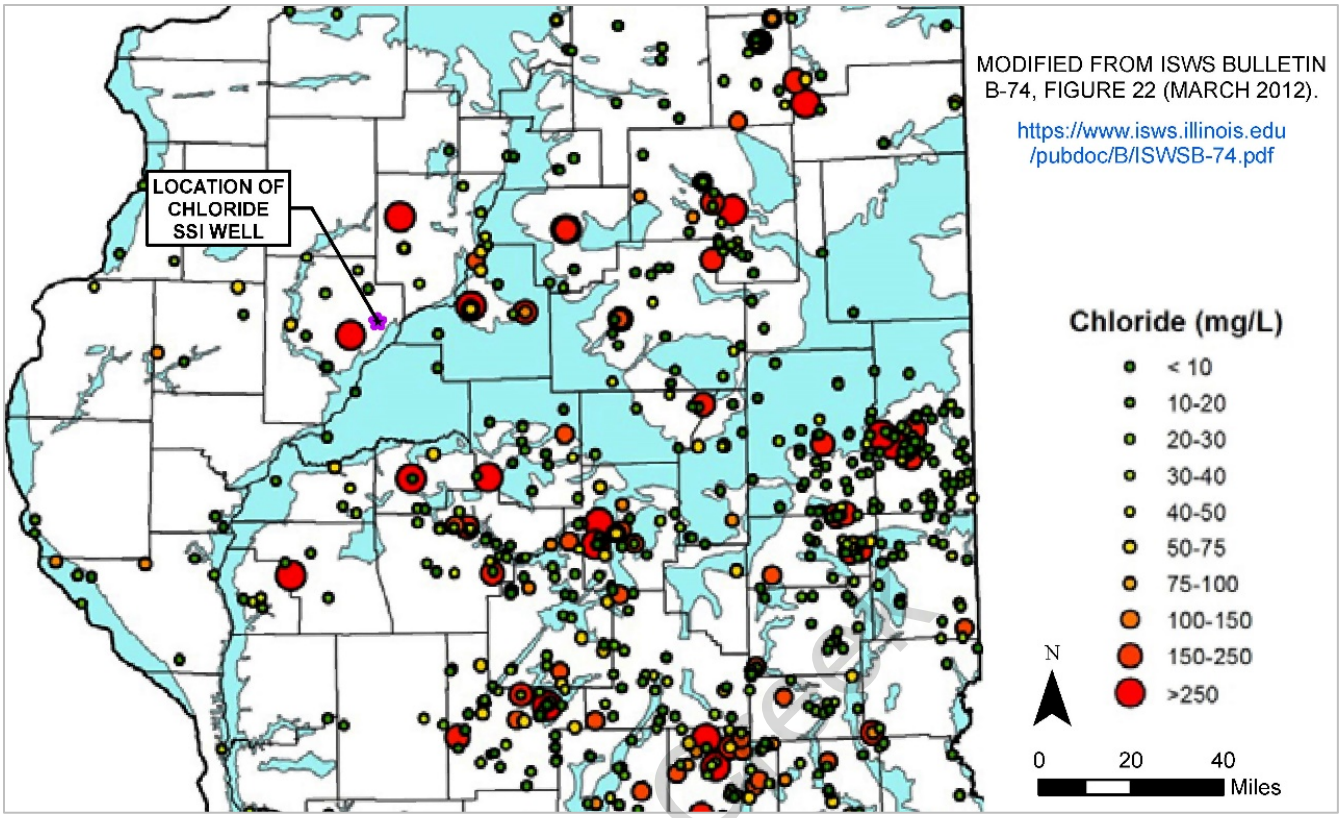


Figure 7. Chloride Concentrations in Wells 50 Feet Deep or Less Open to Quaternary-Age Sand and Gravel Aquifers. Locations of significant Quaternary-age sand and gravel aquifers indicated by light blue shading.

The similarity of observed chloride concentrations in groundwater throughout the region to the concentration observed in G57S indicates that the SSI determined at G57S is due to the natural variability of regional chloride concentrations in groundwater, and not due to the GMF Pond.

LINE OF EVIDENCE #5: CONCENTRATIONS OF BORON, A COMMON INDICATOR FOR CCR IMPACTS TO GROUNDWATER, IN THE DOWNGRADIENT WELLS ARE STABLE AND NEAR OR BELOW CONCENTRATIONS IN THE BACKGROUND WELLS

Boron is a common indicator of CCR impacts to groundwater due to its leachability from CCR and mobility in groundwater If a constituent other than boron is identified as an SSI but boron is not also identified as elevated over background, it is unlikely that leakage from the CCR unit is the source of the SSI. Concentrations of boron downgradient from the GMF Pond are below concentrations in background (and the upper prediction limit [UPL]). Maximum boron concentrations measured in groundwater at downgradient wells between 2015 and 2019 ranged from 0.022 mg/L to 0.059 mg/L, below the UPL of 0.07 mg/L. A time series plot for boron is provided in Figure 8 and box plots are shown in Figure 9.

The time series plot and box plots demonstrate the following observations:

- All boron concentrations in downgradient wells are below the UPL of 0.07 mg/L, determined from background monitoring wells G02S, G50S, and G51S.
- There is little variability over time in the results at each well as shown by the height of the box plots. The upper and lower lines of the boxes are the 25th and 75th quartiles, the closer these two lines are to each other, the lower the overall variability is for that location.

Mann-Kendall trend analysis tests were performed (Attachment A1) to determine if concentrations at each well were increasing, decreasing or stable (i.e., no statistically significant upward or downward trend). If the Mann-

Kendall test did not identify a trend, the coefficient of variation (CV) was calculated (Attachment A2) to determine if the concentrations are too variable to identify a trend (i.e., CV greater than or equal to 1).

Boron concentrations are stable in background and downgradient wells. Table 2 provides summary statistics, including variability and trend per well. Stable boron concentrations in downgradient monitoring wells below background concentrations demonstrate that the GMF Pond is not the source of CCR constituents detected in the downgradient monitoring wells.

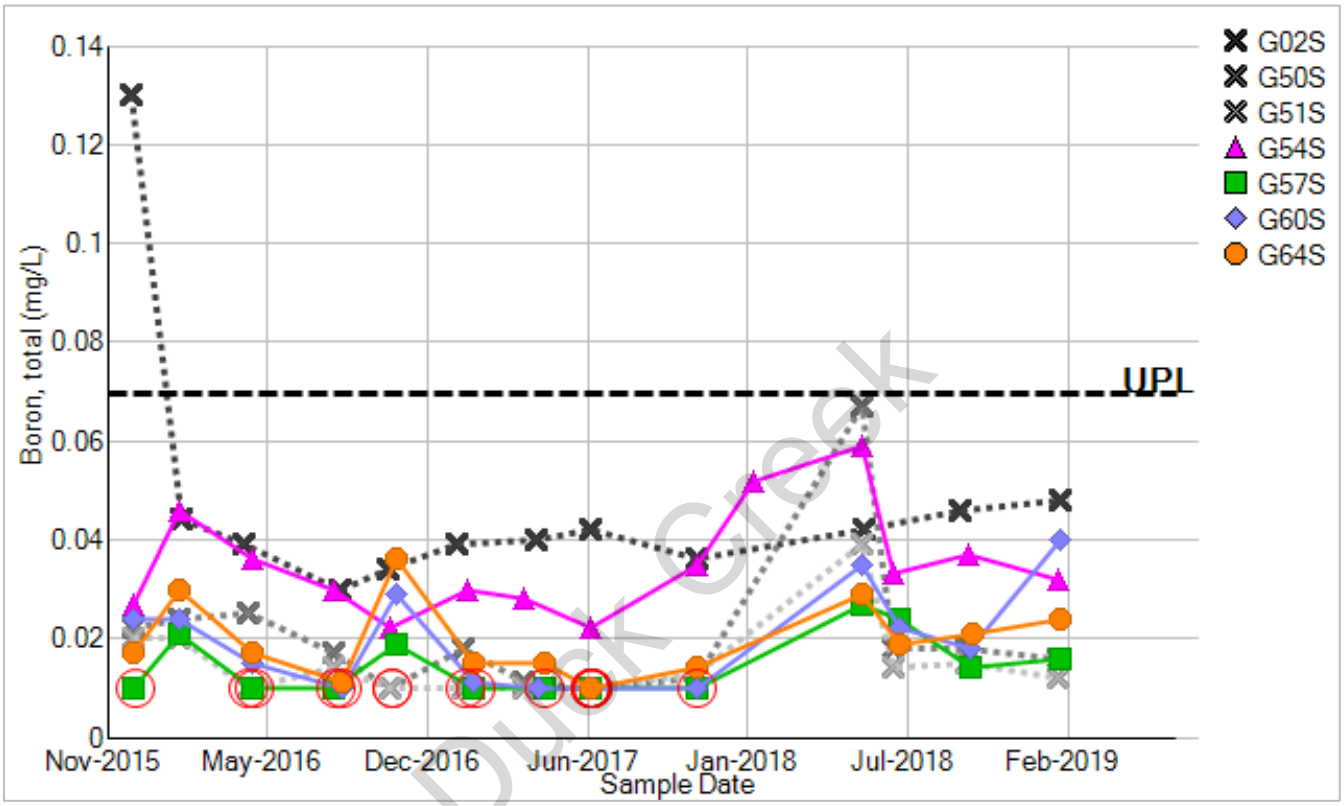


Figure 8. Boron Time Series.

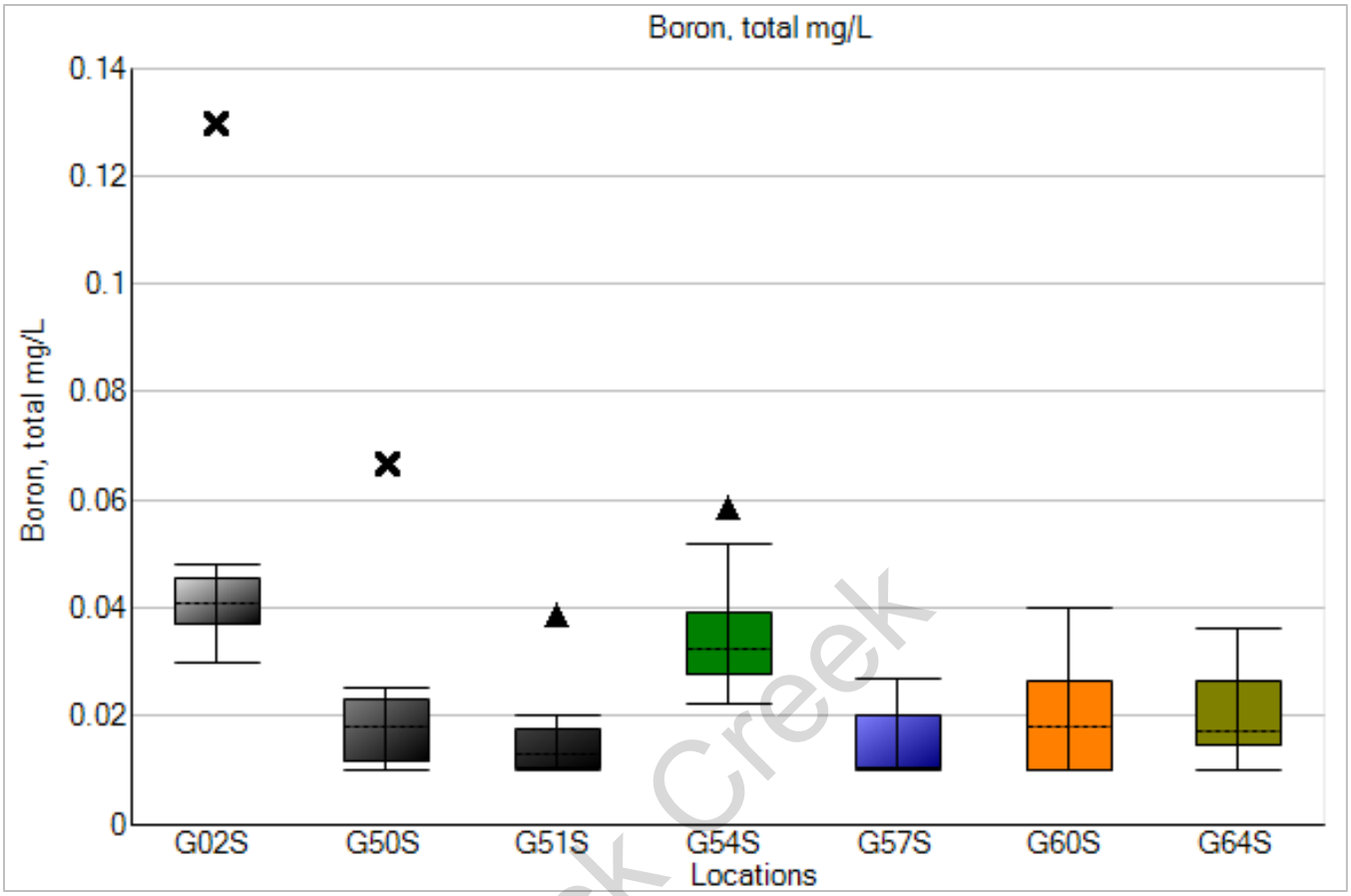


Figure 9. Boron Box Plots.

Monitoring Well	Boron (mg/L) Minimum	Maximum	Median	Standard Deviation	Trend	CV
G02S	0.030	0.130	0.041	0.026	stable	0.56
G50S	<0.010	0.067	0.018	0.015	stable	0.72
G51S	<0.010	0.039	0.013	0.008	stable	0.53
G54S	0.022	0.059	0.033	0.011	stable	0.31
G57S	<0.010	0.027	0.01	0.006	stable	0.42
G60S	<0.010	0.040	0.018	0.010	stable	0.51
G64S	<0.010	0.036	0.017	0.008	stable	0.40

Table 2. Minimum, Maximum, Median, Standard Deviation, Trend, and Coefficient of Variation of Boron in Groundwater.

Based on these five lines of evidence, it has been demonstrated that the Duck Creek GMF Pond is not the source of the calcium SSIs at G54S, G57S, and G60S and chloride SSI at G57S .

This information serves as the written ASD prepared in accordance with 40 C.F.R. § 257.94(e)(2) that the SSIs observed during the detection monitoring program were not due to the CCR unit. Therefore, an assessment monitoring program is not required and the Duck Creek GMF Pond will remain in detection monitoring.

Attachments

Figure 1	Duck Creek GMF Pond (Unit ID: 203) Uppermost Aquifer Unit Groundwater Elevation Contour Map October 2, 2018
Figure 3	Coal Mine Coverage Area Near Duck Creek GMF Pond (Unit ID: 203)
Attachment A1	Mann-Kendall Trend Analyses
Attachment A2	Coefficient of Variation Evaluation

I, Eric J. Tlachac, a qualified professional engineer in good standing in the State of Illinois, certify that the information in this report is accurate as of the date of my signature below. The content of this report is not to be used for other than its intended purpose and meaning, or for extrapolations beyond the interpretations contained herein.

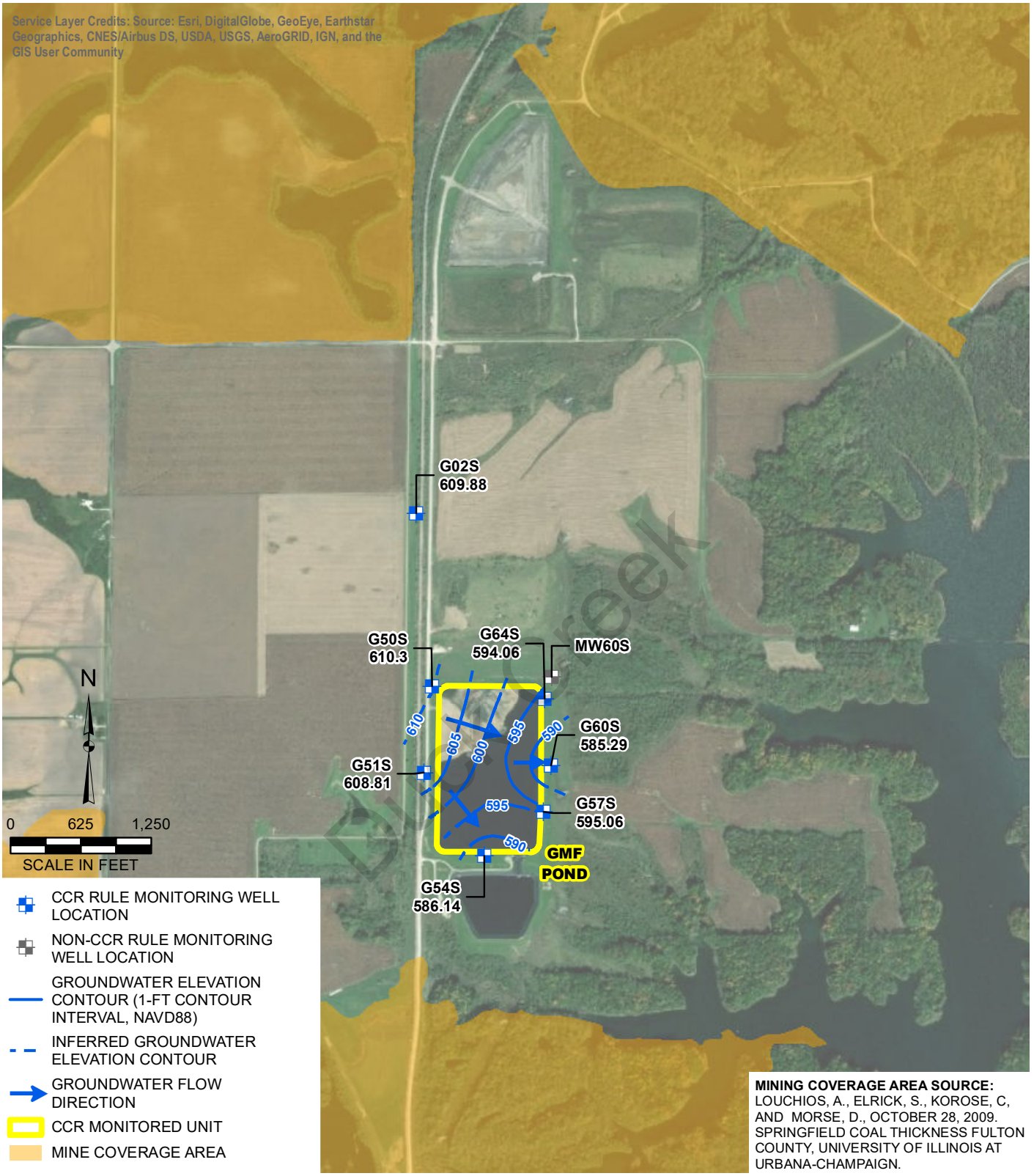
Eric J. Tlachac
Qualified Professional Engineer
062-063091
Illinois
O'Brien & Gere Engineers, Inc., a Ramboll Company
Date: July 15, 2019

I, Nicole M. Pagano, a professional geologist in good standing in the State of Illinois, certify that the information in this report is accurate as of the date of my signature below. The content of this report is not to be used for other than its intended purpose and meaning, or for extrapolations beyond the interpretations contained herein.

Nicole M. Pagano
Professional Geologist
196-000750
O'Brien & Gere Engineers, Inc., a Ramboll Company
Date: July 15, 2019

Attachments

Figures



MINING COVERAGE AREA SOURCE: LOUCHIOS, A., ELRICK, S., KOROSE, C, AND MORSE, D., OCTOBER 28, 2009. SPRINGFIELD COAL THICKNESS FULTON COUNTY, UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN.

DRAWN BY:
MPG
REVIEWED BY:
KLT
APPROVED BY:
NMP

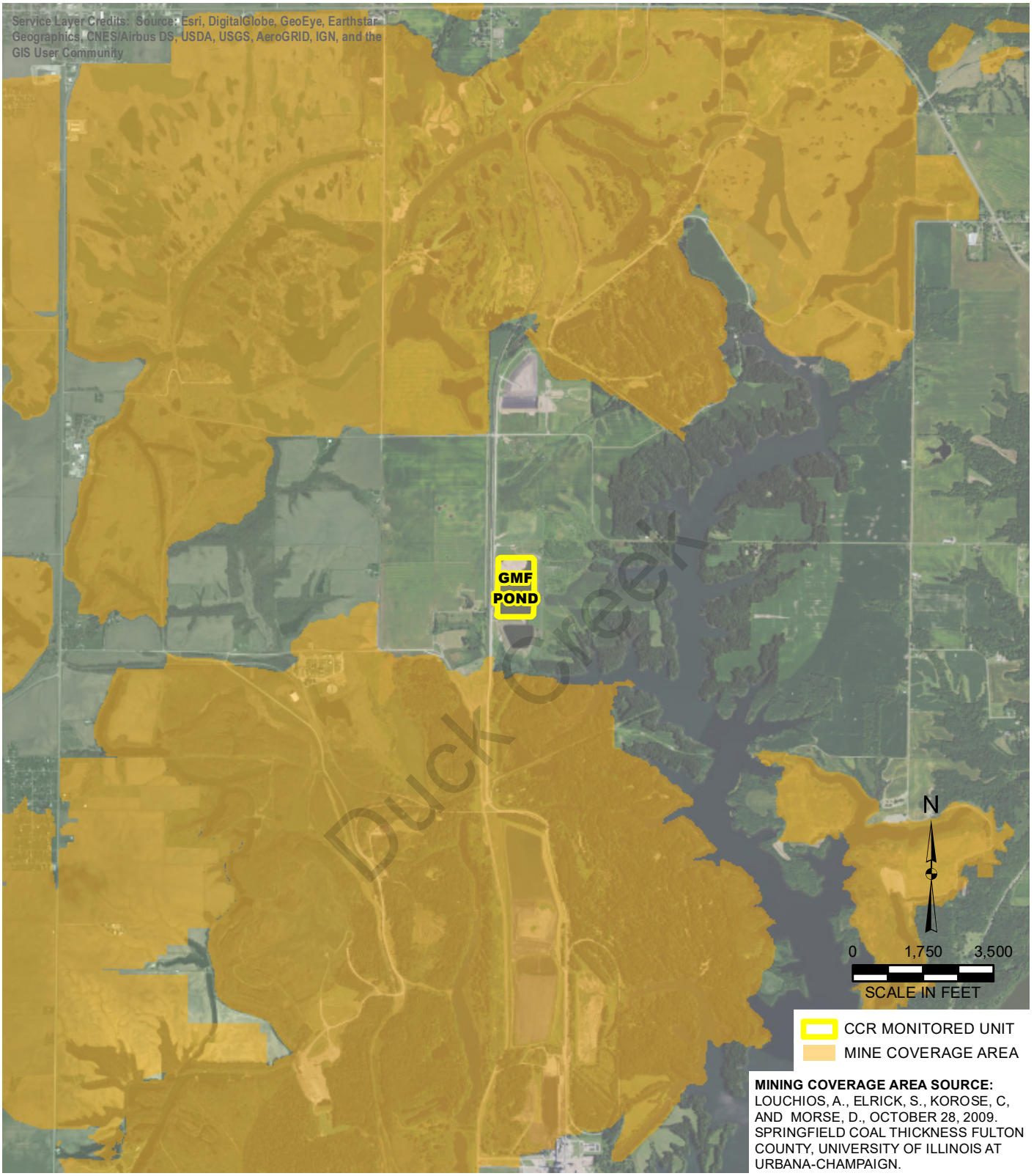
DUCK CREEK GMF POND (UNIT ID: 203)
UPPERMOST AQUIFER UNIT
GROUNDWATER ELEVATION CONTOUR MAP
OCTOBER 2, 2018

ALTERNATE SOURCE DEMONSTRATION
DUCK CREEK POWER STATION
CANTON, ILLINOIS

PROJECT NO: 72753

FIGURE NO: 1

Y:\Mapping\Projects\222285\MXD\Alt_Source_Dem\Figure 1_DuckCreekGMFP_GWC_1810_Mining.mxd Author: STOLZSD;



MINING COVERAGE AREA SOURCE:
LOUCHIOS, A., ELRICK, S., KOROSE, C, AND MORSE, D., OCTOBER 28, 2009. SPRINGFIELD COAL THICKNESS FULTON COUNTY, UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN.

DRAWN BY/DATE:
SDS 4/9/18
REVIEWED BY/DATE:
EJT 4/9/18
APPROVED BY/DATE:
NMP 4/9/18

COAL MINE COVERAGE AREA
NEAR DUCK CREEK GMF POND (UNIT ID: 203)

ALTERNATE SOURCE DEMONSTRATION
DUCK CREEK POWER STATION
CANTON, ILLINOIS

FIGURE NO: 3

Y:\Mapping\Projects\221228\MXD\Alt_Source_Dem\Figure 4_DuckCreekGMFP_Mining.mxd Author: stolzsd

Attachment A1

Mann-Kendall Trend Analyses

Duck Creek
Mann-Kendall Trend Analysis

User Supplied Information

Location ID:	**G02S**	**Parameter Code:**	**01022**
Location Class:		**Parameter:**	**B, tot**
Location Type:		**Units:**	**mg/L**
Confidence Level:	**95.00%**	**Period Length:**	**1 month(s)**
Date Range: 12/02/2015 to 03/31/2019		**Limit Name:**	
		Averaged:	**No**

Trend Analysis

Trend of the least squares straight line		
Slope (fitted to data):	-0.000022	mg/L per day
R-Squared error of fit:	0.097751	
Sen's Non-parametric estimate of the slope (One-Sided Test)		
Median Slope:	0.000006	mg/L per day
Lower Confidence Limit of Slope, M1:	-0.000010	mg/L per day
Upper Confidence Limit of Slope, M2+1:	0.000013	mg/L per day
Non-parametric Mann-Kendall Test for Trend		
S Statistic:	0.896	
Z test:	1.645	
At the 95.0 % Confidence Level (One-Sided Test):	None	

Duck Creek
Mann-Kendall Trend Analysis

User Supplied Information

Location ID:	**G50S**	**Parameter Code:**	**01022**
Location Class:		**Parameter:**	**B, tot**
Location Type:		**Units:**	**mg/L**
Confidence Level:	**95.00%**	**Period Length:**	**1 month(s)**
Date Range: 12/02/2015 to 03/31/2019		**Limit Name:**	
		Averaged:	**No**

Trend Analysis

Trend of the least squares straight line

Slope (fitted to data):	0.000006	mg/L per day
R-Squared error of fit:	0.024341	

Sen's Non-parametric estimate of the slope (One-Sided Test)

Median Slope:	-0.000004	mg/L per day
Lower Confidence Limit of Slope, M1:	-0.000018	mg/L per day
Upper Confidence Limit of Slope, M2+1:	0.000012	mg/L per day

Non-parametric Mann-Kendall Test for Trend

S Statistic:	-0.554
Z test:	1.645
At the 95.0 % Confidence Level (One-Sided Test):	None

Duck Creek
Mann-Kendall Trend Analysis

User Supplied Information

Location ID:	**G51S**	**Parameter Code:**	**01022**
Location Class:		**Parameter:**	**B, tot**
Location Type:		**Units:**	**mg/L**
Confidence Level:	**95.00%**	**Period Length:**	**1 month(s)**
Date Range: 12/02/2015 to 03/31/2019		**Limit Name:**	
		Averaged:	**No**

Trend Analysis

Trend of the least squares straight line

Slope (fitted to data):	0.000005	mg/L per day
R-Squared error of fit:	0.041674	

Sen's Non-parametric estimate of the slope (One-Sided Test)

Median Slope:	0.000000	mg/L per day
Lower Confidence Limit of Slope, M1:	-0.000007	mg/L per day
Upper Confidence Limit of Slope, M2+1:	0.000011	mg/L per day

Non-parametric Mann-Kendall Test for Trend

S Statistic:	0.187
Z test:	1.645
At the 95.0 % Confidence Level (One-Sided Test):	None

Duck Creek
Mann-Kendall Trend Analysis

User Supplied Information

Location ID:	**G54S**	**Parameter Code:**	**01022**
Location Class:		**Parameter:**	**B, tot**
Location Type:		**Units:**	**mg/L**
Confidence Level:	**95.00%**	**Period Length:**	**1 month(s)**
Date Range: 12/02/2015 to 03/31/2019		**Limit Name:**	
		Averaged:	**No**

Trend Analysis

Trend of the least squares straight line		
Slope (fitted to data):	0.000008	mg/L per day
R-Squared error of fit:	0.077887	
Sen's Non-parametric estimate of the slope (One-Sided Test)		
Median Slope:	0.000006	mg/L per day
Lower Confidence Limit of Slope, M1:	-0.000008	mg/L per day
Upper Confidence Limit of Slope, M2+1:	0.000017	mg/L per day
Non-parametric Mann-Kendall Test for Trend		
S Statistic:	0.879	
Z test:	1.645	
At the 95.0 % Confidence Level (One-Sided Test):	None	

Duck Creek
Mann-Kendall Trend Analysis

User Supplied Information

Location ID:	**G57S**	**Parameter Code:**	**01022**
Location Class:		**Parameter:**	**B, tot**
Location Type:		**Units:**	**mg/L**
Confidence Level:	**95.00%**	**Period Length:**	**1 month(s)**
Date Range: 12/02/2015 to 03/31/2019		**Limit Name:**	
		Averaged:	**No**

Trend Analysis

Trend of the least squares straight line

Slope (fitted to data):	0.000009	mg/L per day
R-Squared error of fit:	0.173265	

Sen's Non-parametric estimate of the slope (One-Sided Test)

Median Slope:	0.000000	mg/L per day
Lower Confidence Limit of Slope, M1:	0.000000	mg/L per day
Upper Confidence Limit of Slope, M2+1:	0.000015	mg/L per day

Non-parametric Mann-Kendall Test for Trend

S Statistic:	1.068
Z test:	1.645
At the 95.0 % Confidence Level (One-Sided Test):	None

Duck Creek
Mann-Kendall Trend Analysis

User Supplied Information

Location ID:	**G60S**	**Parameter Code:**	**01022**
Location Class:		**Parameter:**	**B, tot**
Location Type:		**Units:**	**mg/L**
Confidence Level:	**95.00%**	**Period Length:**	**1 month(s)**
Date Range: 12/02/2015 to 03/31/2019		**Limit Name:**	
		Averaged:	**No**

Trend Analysis

Trend of the least squares straight line

Slope (fitted to data):	0.000010	mg/L per day
R-Squared error of fit:	0.110581	

Sen's Non-parametric estimate of the slope (One-Sided Test)

Median Slope:	0.000009	mg/L per day
Lower Confidence Limit of Slope, M1:	-0.000014	mg/L per day
Upper Confidence Limit of Slope, M2+1:	0.000020	mg/L per day

Non-parametric Mann-Kendall Test for Trend

S Statistic:	0.368
Z test:	1.645
At the 95.0 % Confidence Level (One-Sided Test):	None

Duck Creek
Mann-Kendall Trend Analysis

User Supplied Information

Location ID:	**G64S**	**Parameter Code:**	**01022**
Location Class:		**Parameter:**	**B, tot**
Location Type:		**Units:**	**mg/L**
Confidence Level:	**95.00%**	**Period Length:**	**1 month(s)**
Date Range: 12/02/2015 to 03/31/2019		**Limit Name:**	
		Averaged:	**No**

Trend Analysis

Trend of the least squares straight line

Slope (fitted to data):	0.000001	mg/L per day
R-Squared error of fit:	0.003330	

Sen's Non-parametric estimate of the slope (One-Sided Test)

Median Slope:	0.000002	mg/L per day
Lower Confidence Limit of Slope, M1:	-0.000010	mg/L per day
Upper Confidence Limit of Slope, M2+1:	0.000013	mg/L per day

Non-parametric Mann-Kendall Test for Trend

S Statistic:	0.184
Z test:	1.645
At the 95.0 % Confidence Level (One-Sided Test):	None

Attachment A2

Coefficient of Variation Evaluation

Duck Creek

Coefficient of Variation
Date Range: 12/02/2015 to 3/31/2019

Boron, total (mg/L)

Location	Count	Mean	Std Dev	% Non-Detects	CV
G02S	12	0.048	0.026	0.00	0.56
G50S	13	0.021	0.015	15.38	0.72
G51S	13	0.015	0.008	30.77	0.53
G54S	14	0.035	0.011	0.00	0.31
G57S	13	0.015	0.006	53.85	0.42
G60S	13	0.020	0.010	15.38	0.51
G64S	13	0.020	0.008	7.69	0.40

CV=Std Dev/ Mean

40 C.F.R. § 257.94(e)(2): ALTERNATE SOURCE DEMONSTRATION
DUCK CREEK GMF POND
OCTOBER 14, 2019

October 14, 2019

Title 40 of the Code of Federal Regulations (C.F.R.) § 257.94(e)(2) allows the owner or operator of a Coal Combustion Residuals (CCR) unit 90 days from the date of determination of Statistically Significant Increases (SSIs) over background for groundwater constituents listed in Appendix III of 40 C.F.R. Part 257 to complete a written demonstration that a source other than the CCR unit being monitored caused the SSI(s), or that the SSI(s) resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality (Alternate Source Demonstration [ASD]).

This ASD has been prepared on behalf of Illinois Power Resources Generating, LLC by O'Brien & Gere Engineers, Inc., part of Ramboll (OBG) to provide pertinent information pursuant to 40 C.F.R. § 257.94(e)(2) for the Duck Creek Gypsum Management Facility (GMF) Pond located near Canton, Illinois.

The fourth semi-annual detection monitoring samples (Detection Monitoring Round 4 [D4]) were collected on February 5-6, 2019 and analytical data were received on April 15, 2019. In accordance with 40 C.F.R. § 257.93(h)(2), statistical analysis of the data to identify SSIs of 40 C.F.R. Part 257 Subpart D Appendix III parameters over background concentrations was completed by July 15, 2019, within 90 days of receipt of the analytical data. The statistical determination identified the following SSIs at downgradient monitoring wells:

- Calcium at wells G54S, G57S, G60S, and G64S
- Chloride at well G57S
- Sulfate at well G60S
- TDS at wells G54S, G57S, and G60S

In accordance with the Statistical Analysis Plan,[1] well G60S was resampled on April 8, 2019 and analyzed only for the SSI parameters to confirm the SSIs. Concentrations of Appendix III parameters observed at G60S during D4 were anomalous with previously observed concentrations. Observed concentrations at the other wells were consistent with those previously observed. Following evaluation of analytical data from the resample for G60S, the following SSIs were confirmed:

- Calcium at wells G54S, G57S, G60S, and G64S
- Chloride at G57S
- Sulfate at G60S
- TDS at wells G54S, G57S, and G60S

Pursuant to 40 C.F.R. § 257.94(e)(2), the following demonstrates that sources other than the GMF Pond were the cause of the SSIs listed above. This ASD was completed by October 14, 2019, within 90 days of determination of the SSIs, as required by 40 C.F.R. § 257.94(e)(2).

ALTERNATE SOURCE DEMONSTRATION: LINES OF EVIDENCE

Lines of evidence supporting this ASD include the following:

[1] Natural Resource Technology, an OBG Company, 2017, Statistical Analysis Plan, Duck Creek Power Station, Edwards Power Station, Illinois Power Resources Generating, LLC, October 17, 2017.

1. The ionic composition of GMF Pond water is different from the ionic composition of groundwater.
2. Proximity of the GMF Pond to historic coal mining activity and related groundwater quality impacts.
3. Calcium was present in groundwater in the vicinity of the GMF Pond prior to the unit being placed into service at concentrations that exceeded current CCR compliance background concentrations.
4. TDS was present in groundwater in the vicinity of the GMF Pond prior to the unit being placed into service at concentrations that exceeded current CCR compliance background concentrations.
5. Elevated concentrations of chloride in regional background.
6. Concentrations of boron, a common indicator for CCR impacts to groundwater, are near or below background concentrations and are stable in downgradient wells.

These lines of evidence are described and supported in greater detail below. The locations of the monitoring wells are shown on the attached Figure 1.

LINE OF EVIDENCE #1: THE IONIC COMPOSITION OF GMF POND WATER IS DIFFERENT FROM THE IONIC COMPOSITION OF GROUNDWATER

Piper diagrams graphically represent ionic composition of aqueous solutions. A Piper diagram displays the position of water samples relative to their major cation and anion content, providing the information needed to identify compositional categories or groupings. Figure 2, on the following page, is a Piper diagram that displays the ionic composition of groundwater samples from the background and downgradient monitoring wells associated with the GMF Pond and surface water samples collected from the GMF Pond in Quarter 2 2017. The ionic compositional groupings identified are shown in the black and green ellipses on the diamond portion of the Piper diagram. These are summarized in Table 1 and discussed in more detail below.

The results can be categorized into two distinct groups. Groundwater samples from the GMF Pond background and downgradient wells (enclosed within a black ellipse) have a high to very high percentage of carbonate-bicarbonate anions and no dominant cation. Samples of surface water from the GMF Pond (enclosed within a green ellipse) are compositionally distinct from the background and downgradient groundwater, and have a high percentage of magnesium cations and no dominant anion. The dissimilar ionic compositions of the GMF Pond background and downgradient groundwater and the GMF Pond surface water indicates that the GMF Pond surface water is not the source of CCR constituents detected in GMF Pond groundwater.

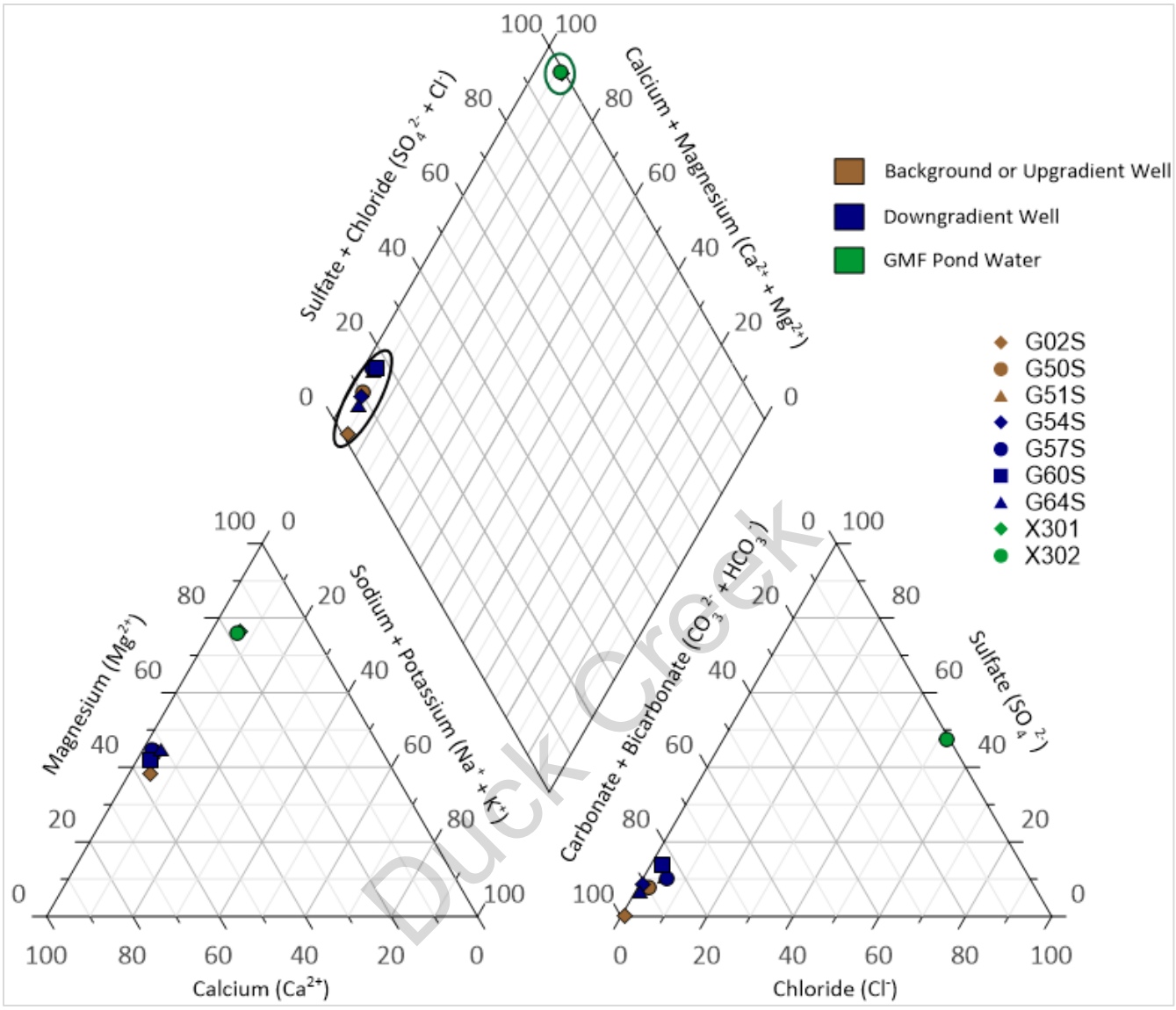


Figure 2. Piper Diagram Showing Ionic Composition of Samples of Groundwater and Pond Water Associated with the Duck Creek GMF Pond.

Grouping	Blue/Brown (Figure 6)	Green (Figure 6)	Black (Figure 5)
Locations	Duck Creek GMF Pond Groundwater	Duck Creek GMF Pond Water	Groundwater from Reclaimed Surface Coal Mines Study
Dominant Cation	No dominant cation	**High Magnesium**	**Moderate to High Calcium**
Dominant Anion	**High to Very High Carbonate-Bicarbonate**	No dominant anion	**Moderate to High Carbonate-Bicarbonate**

Table 1. Summary of Ionic Classification.

LINE OF EVIDENCE #2: PROXIMITY OF THE GMF POND TO HISTORIC COAL MINING ACTIVITY AND RELATED GROUNDWATER QUALITY IMPACTS

The area surrounding the GMF Pond consists primarily of unmined coal and reclaimed surface mine land. The extents of the nearby mines are shown in the attached Figure 4. The coal in this area has a sulfur content greater than 2.5 pounds (lbs) of sulfur per million BTUs, the highest sulfur classification used by Illinois State Geological Survey[2].

The coal in the area varies in depth from 0 to 50 feet (ft) below ground surface (bgs). The wells associated with the monitoring system established for the Duck Creek GMF Pond pursuant to 40 C.F.R. § 257.91 are screened between 23 and 48 ft bgs. Potentiometric data indicates that groundwater flows to the southeast as shown on the attached Figure 1[3]. The monitoring wells are located 2,000 to 4,000 ft downgradient of the nearby mines (Figure 3).

A study of groundwater quality near surface coal mines, performed by the U.S. Geological Survey (USGS)[4], provides data on the effects of mines on groundwater quality. The study evaluated regional differences in major ionic composition of groundwater in unmined and mined areas using Piper diagrams (Figure 4). Groundwater samples collected from wells downgradient of the reclaimed mine areas in the study have a moderate to high percentage of carbonate-bicarbonate anions as well as a moderate to high percentage of calcium cations and are classified as calcium bicarbonate water.

State of Illinois groundwater quality regulations (Illinois Administrative Code [IAC] Title 35 Part 620 Groundwater Quality) acknowledge that water quality is adversely affected in areas where coal mining activity has occurred. The groundwater quality standards for chloride, iron, manganese, sulfate, TDS and pH within previously mined areas are the existing concentrations (35IAC § 620.440).

Table 1 above includes the ionic composition of groundwater near reclaimed surface coal mines along with ionic composition of GMF Pond water samples and groundwater samples collected from the background and downgradient groundwater monitoring wells at the GMF Pond. The ionic composition of groundwater associated with reclaimed surface coal mines is similar to the ionic composition of groundwater samples collected from background and downgradient groundwater monitoring wells at the GMF Pond in that the dominant anion is carbonate-bicarbonate.

The proximity of the GMF Pond to historic coal mining activity and similarities in the ionic composition of groundwater in areas of reclaimed surface coal mines and in the GMF Pond groundwater samples demonstrate that mining activity has affected groundwater quality at the GMF Pond.

[2] "Illinois Coal Reserves Assessment and Database Development: Final Report", Open File Series 1997-4, Illinois State Geological Survey, Coal Section, 1997.
[3] The groundwater elevation contours shown on Figure 1 were measured on January 7, 2019, the first day of a combined sampling event at Duck Creek Power Station for the three CCR units located there and for multiple monitoring programs required by both federal and state regulatory agencies. Groundwater sampling for D4 occurred on February 5-6, 2019.
[4] "Ground-Water Quality in Unmined Areas and Near Reclaimed Surface Coal Mines in the Northern and Central Appalachian Coal Regions, Pennsylvania and West Virginia", Scientific Investigations Report 2006-5059, US Geological Survey, 2006.

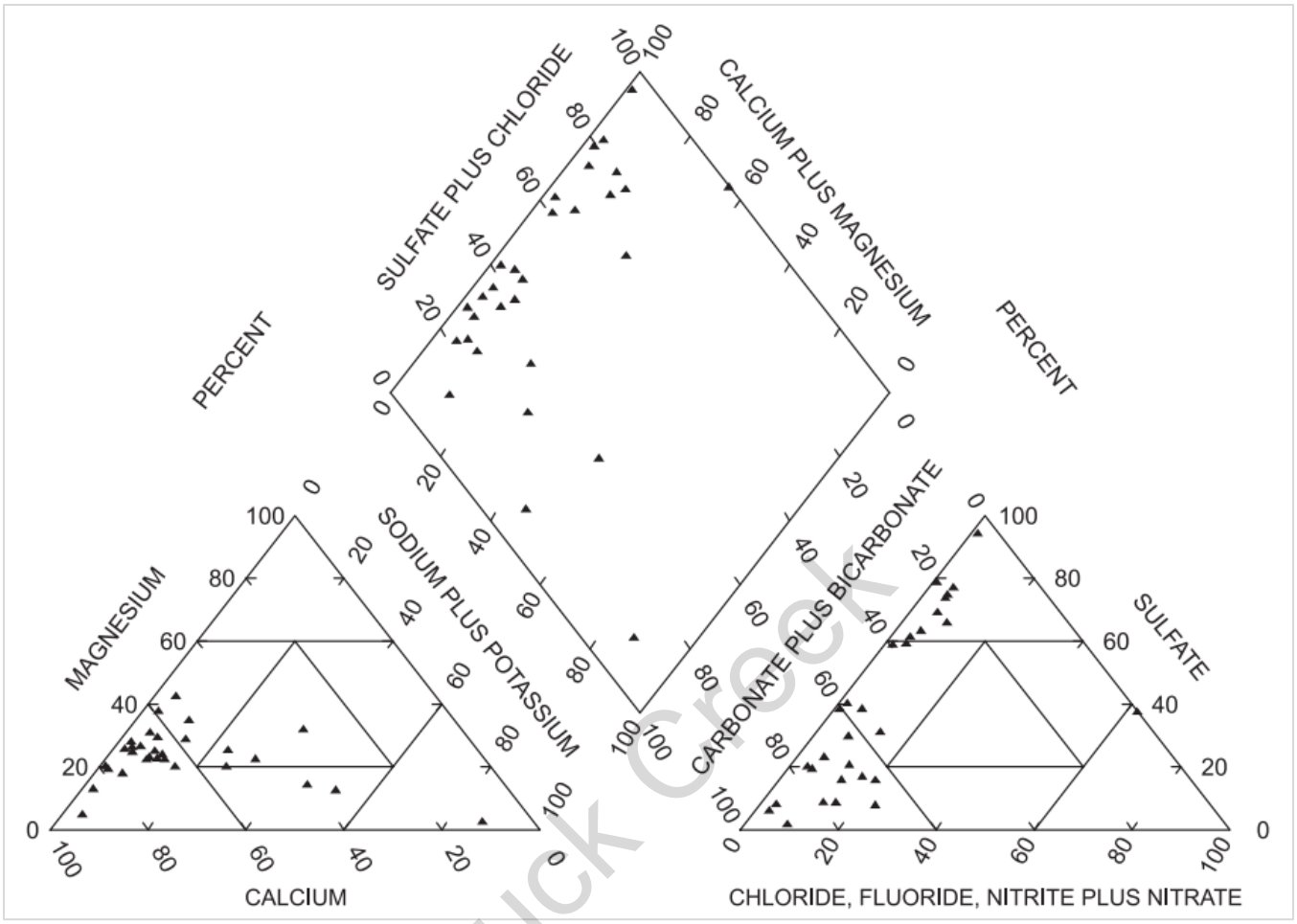


Figure 4. Piper Diagram Showing Ionic Composition of Groundwater Downgradient of Reclaimed Surface Coal Mines in High-Sulfur Coal Regions (Modified from USGS).

LINE OF EVIDENCE #3: CALCIUM WAS PRESENT IN GROUNDWATER IN THE VICINITY OF THE GMF POND PRIOR TO THE UNIT BEING PLACED INTO SERVICE AT CONCENTRATIONS THAT EXCEEDED CURRENT CCR COMPLIANCE BACKGROUND CONCENTRATIONS

As discussed in the previous Line of Evidence, Piper diagrams published by the USGS in 2006 indicated that the groundwater in the area where the GMF Pond would be built was classified as calcium-bicarbonate water. The GMF Pond was placed in service in 2009. MW60S was present prior to 2009 and was located side- to downgradient of where the GMF Pond was constructed.

A box plot for calcium concentrations observed in groundwater samples collected from MW60S between March 2007 and November 2008 is shown in Figure 5. Calcium concentrations ranged from 87 to 150 milligrams per liter (mg/L), and the average and median observed concentrations were 116 and 120 mg/L, respectively. Calcium concentrations were most often between 94 mg/L (first quartile) and 133 mg/L (third quartile).

During D4, SSIs for calcium were determined at downgradient monitoring wells G54S, G57S, G60S, and G64S at concentrations of 130 mg/L, 130 mg/L, 270 mg/L and 140 mg/L respectively. The calcium SSI at monitoring well G60S was confirmed via resampling to be 160 mg/L.

The classification of the groundwater in the area as calcium-bicarbonate water and calcium concentrations in downgradient monitoring wells G54S, G57S, and G64S that are generally consistent with those observed in

groundwater prior to the GMF Pond being placed into service indicates that the GMF Pond is not the source of calcium SSIs in downgradient monitoring wells.

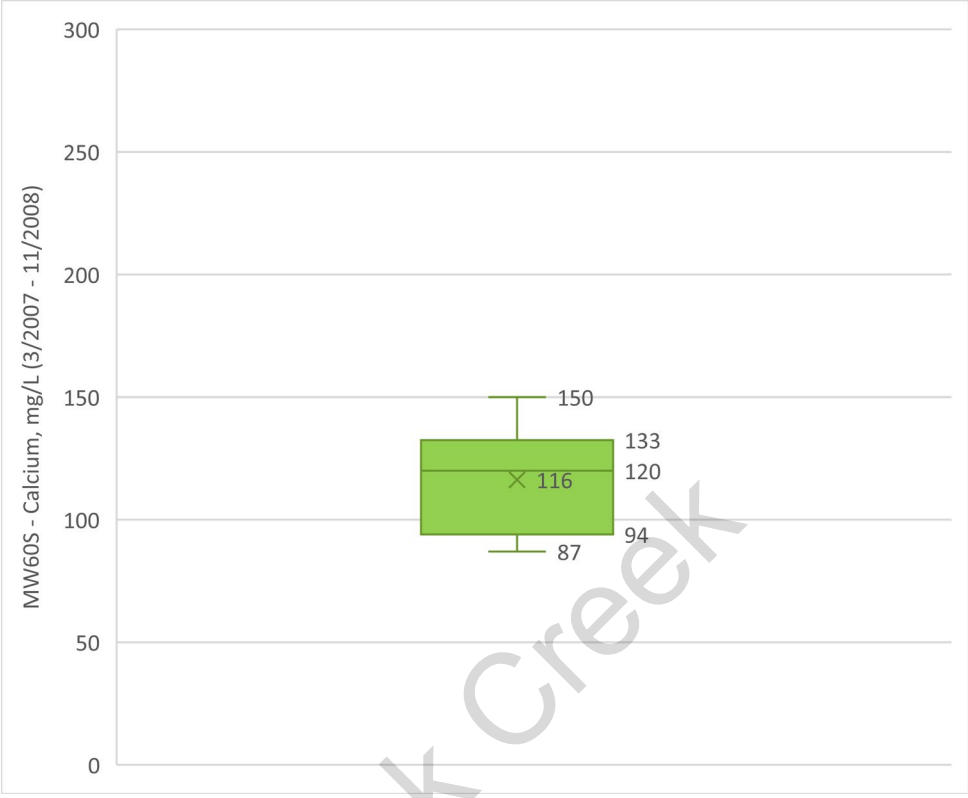


Figure 5. Box plot of Calcium Concentrations Observed in Groundwater Samples Collected from MW60S Between March 2007 and November 2008.

LINE OF EVIDENCE #4: TDS WAS PRESENT IN GROUNDWATER IN THE VICINITY OF THE GMF POND PRIOR TO THE UNIT BEING PLACED INTO SERVICE AT CONCENTRATOINS THAT EXCEEDED CURRENT CCR COMPLIANCE BACKGROUND CONCENTRATION

As noted in Line of Evidence #2, State of Illinois groundwater quality regulations acknowledge that TDS is present at elevated concentrations in areas where coal mining activity has occurred. TDS was detected at elevated concentrations in groundwater samples collected from MW60S prior to the GMF Pond being placed into service in 2009.

A box plot for TDS concentrations in groundwater samples collected at MW60S from 2007-2008 is shown in Figure 6. TDS concentrations range from 460 to 690 mg/L, with the average and median being 555 and 560 mg/L, respectively. TDS concentrations were most often between 530 mg/L (first quartile) to 580 mg/L (third quartile).

During D4, SSIs for TDS were determined at downgradient monitoring wells G54S and G57S at 590 and 520mg/L, respectively. The TDS SSI at G60S was determined at 760 mg/L and confirmed via resampling at 860 mg/L.

TDS concentrations in downgradient monitoring wells G54S and G57S that are generally consistent with those observed in groundwater prior to the GMF Pond being placed into service indicates that the GMF Pond is not the source of TDS SSIs in downgradient monitoring wells.

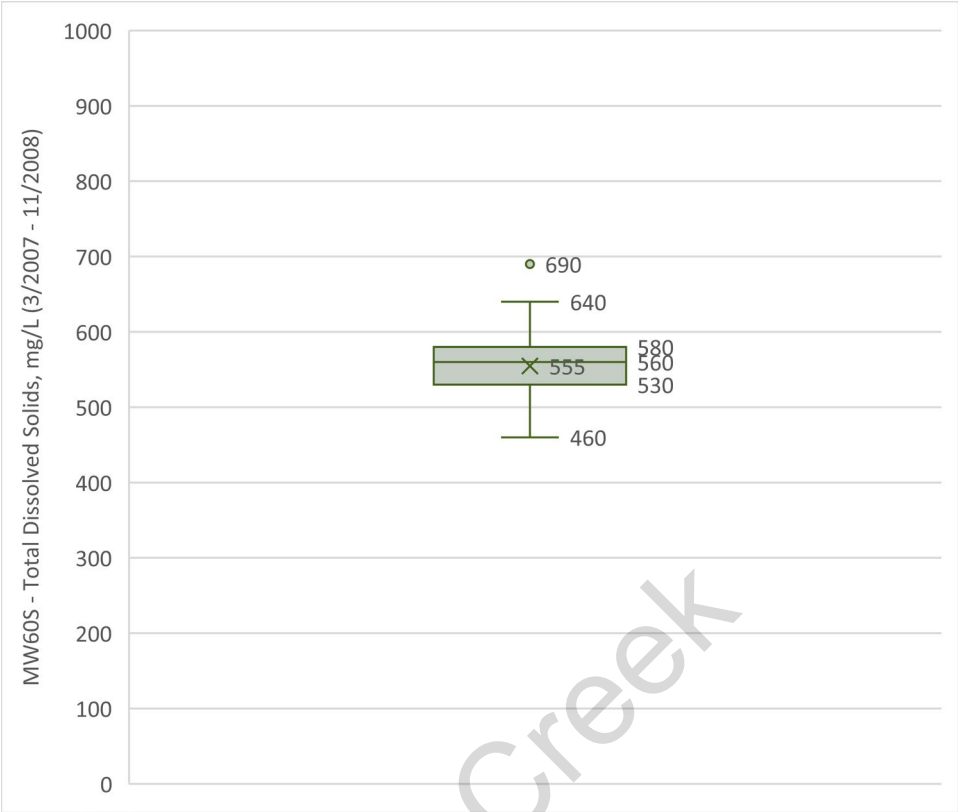


Figure 6. Box plot of TDS Concentrations Observed in Groundwater Samples Collected from MW60S Between March 2007 and November 2008.

LINE OF EVIDENCE #5: ELEVATED CONCENTRATIONS OF CHLORIDE IN REGIONAL BACKGROUND

Figure 7 below was modified from a bulletin released by the Illinois State Water Survey (ISWS) and the Prairie Research Institute, University of Illinois at Urbana-Champaign[5], and shows that there are multiple groundwater wells in Fulton and adjacent counties screened at a similar depth as G57S that have chloride concentrations of 20 mg/L to 30 mg/L, similar to the observed SSI concentration at G57S (23 mg/L).

[5] Kelly, W.R., Panno, S.V., Hackely, K., 2012, The Sources, Distribution, and Trends of Chloride in the Waters of Illinois; Illinois State Water Survey, Prairie Research Institute, University of Illinois at Urbana-Champaign, Bulletin B-74.

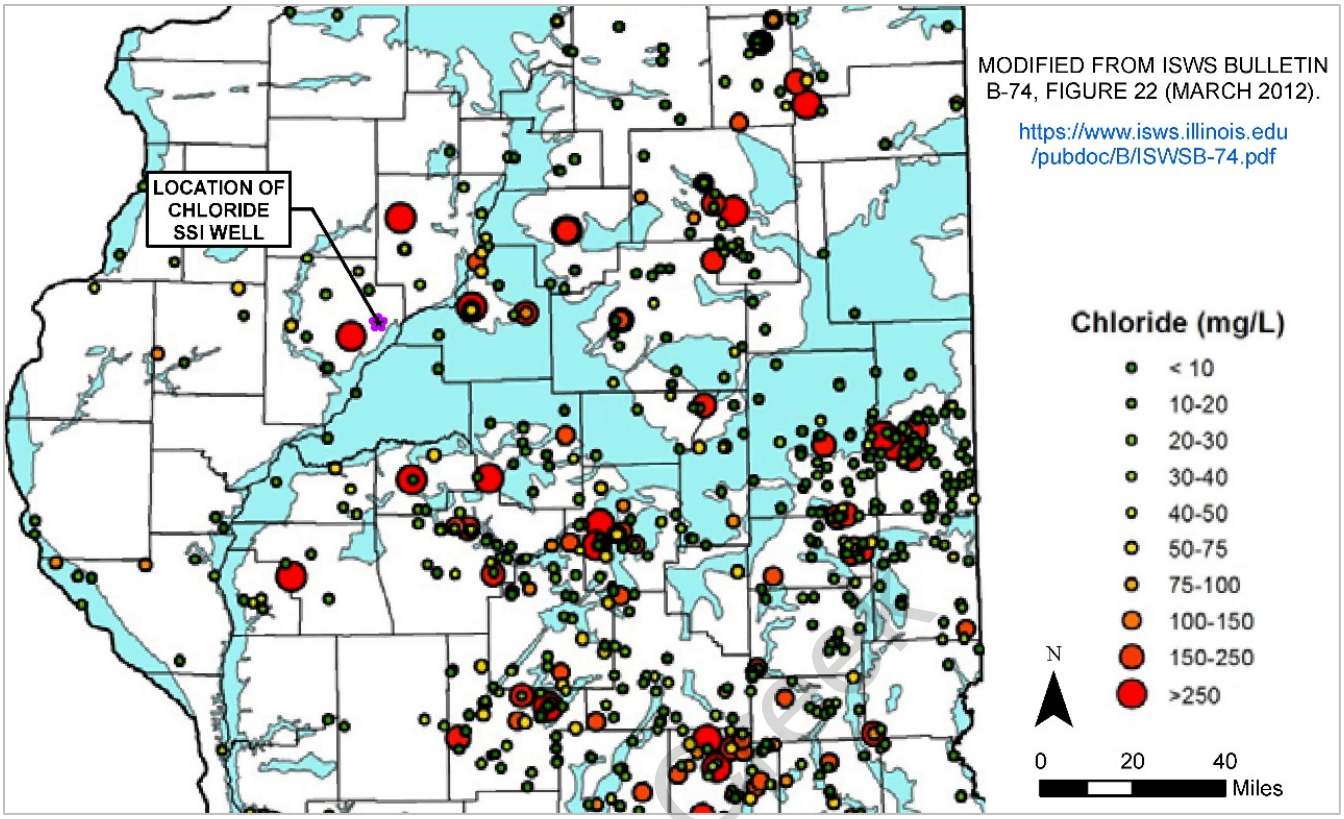


Figure 7. Chloride Concentrations in Wells 50 Feet Deep or Less Open to Quaternary-Age Sand and Gravel Aquifers. Locations of significant Quaternary-age sand and gravel aquifers indicated by light blue shading.

The similarity of observed chloride concentrations in groundwater throughout the region to the concentration observed in G57S indicates that the SSI determined at G57S is due to the natural variability of regional chloride concentrations in groundwater, and not due to the GMF Pond.

LINE OF EVIDENCE #6: CONCENTRATIONS OF BORON, A COMMON INDICATOR FOR CCR IMPACTS TO GROUNDWATER, IN THE DOWNGRADIENT WELLS ARE STABLE AND NEAR OR BELOW CONCENTRATIONS IN THE BACKGROUND WELLS

Boron is a common indicator of CCR impacts to groundwater due to its leachability from CCR and mobility in groundwater. If a constituent other than boron is identified as an SSI but boron is not also identified as elevated over background, it is unlikely that leakage from the CCR unit is the source of the SSI. Concentrations of boron downgradient from the GMF Pond are below concentrations in background (and the upper prediction limit [UPL]).

Maximum boron concentrations measured in groundwater at downgradient wells between 2015 and 2019 range from 0.027 mg/L to 0.059 mg/L, below the UPL of 0.07 mg/L. A time series plot for boron is provided in Figure 8 and box plots are shown in Figure 9.

The time series plot and box plots demonstrate the following observations:

- All boron concentrations in downgradient wells are below the UPL of 0.07 mg/L, determined from background monitoring wells G02S, G50S, and G51S.
- There is little variability over time in the results at each well, as shown by the height of the box plots. The upper and lower lines of the boxes are the 25th and 75th quartiles, the closer these two lines are to each other, the lower the overall variability is for that location.

Mann-Kendall trend analysis tests were performed (Attachment A1) to determine if concentrations at each well are increasing, decreasing or stable (i.e., no statistically significant upward or downward trend). If the Mann-Kendall test did not identify a trend, the coefficient of variation (CV) was calculated (Attachment A2) to determine if the concentrations are too variable to identify a trend (i.e., CV greater than or equal to 1).

Boron concentrations are stable in background and downgradient wells. Table 2 provides summary statistics, including variability and trend per well. Stable boron concentrations in downgradient monitoring wells below background concentrations demonstrate that the GMF Pond is not the source of CCR constituents detected in the downgradient monitoring wells.

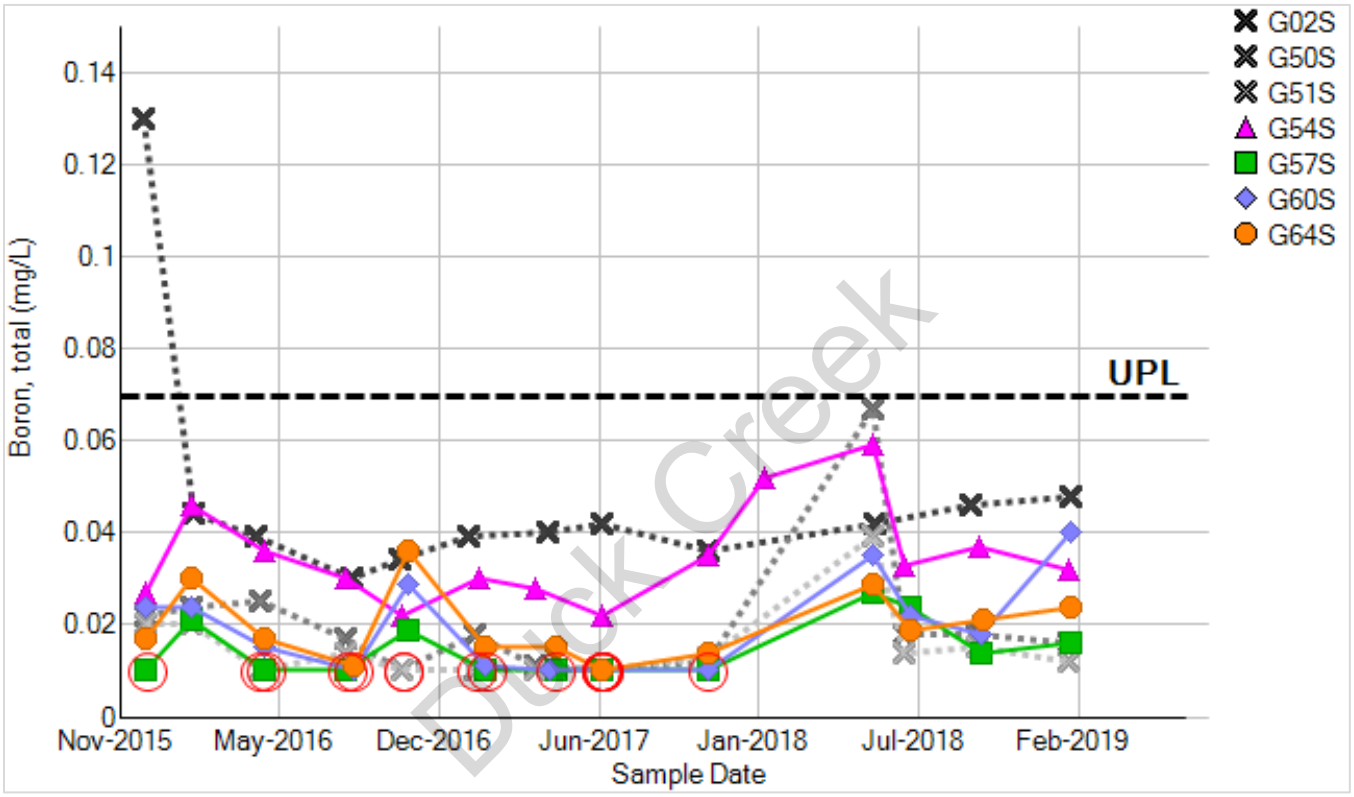


Figure 8. Boron Time Series.

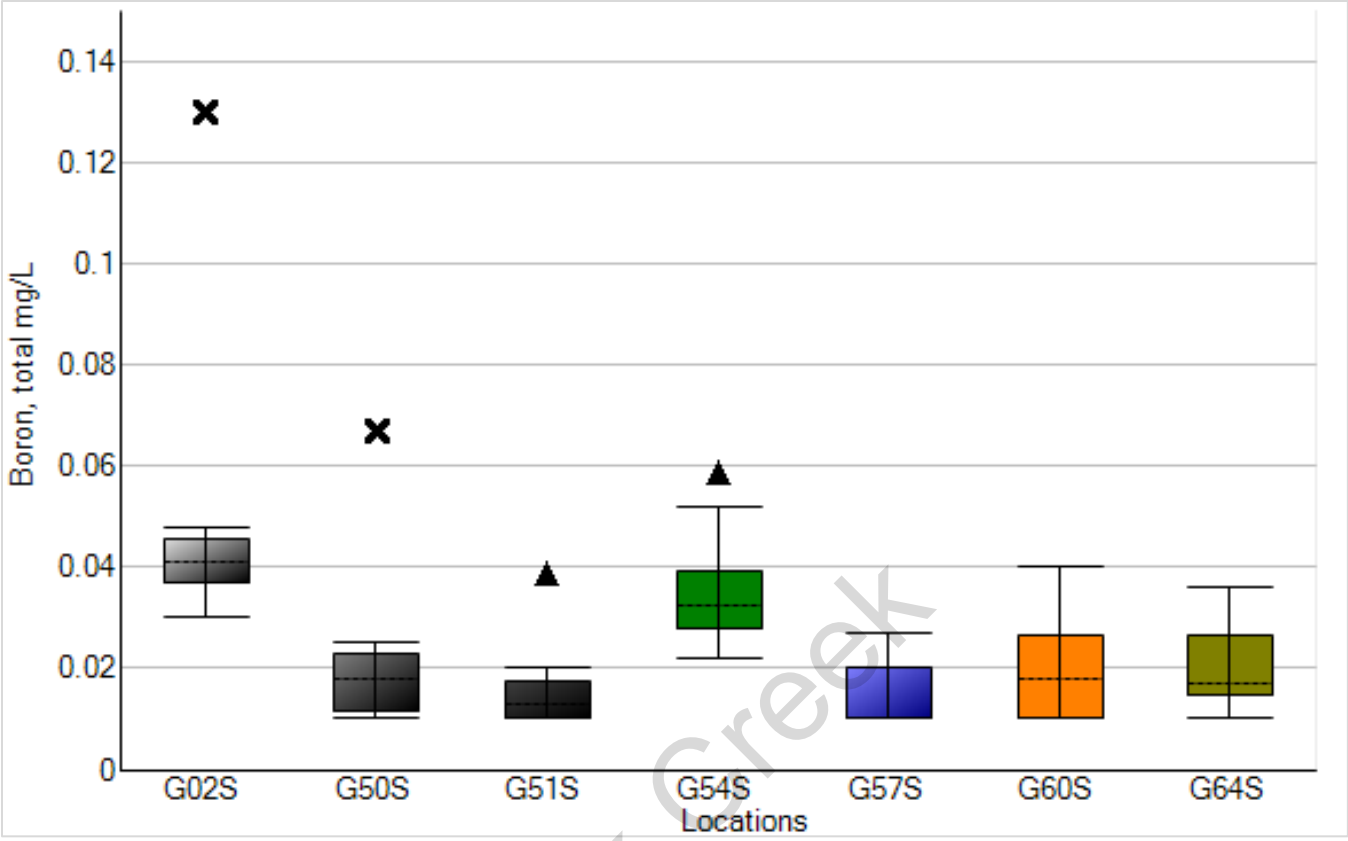


Figure 9. Boron Box Plots.

Monitoring Well	Boron (mg/L) Minimum	Maximum	Median	Standard Deviation	Trend	CV
G02S	0.030	0.13	0.041	0.026	stable	0.56
G50S	<0.010	0.067	0.018	0.015	stable	0.72
G51S	<0.010	0.039	0.013	0.008	stable	0.53
G54S	0.022	0.059	0.033	0.011	stable	0.31
G57S	<0.010	0.027	0.01	0.006	stable	0.42
G60S	<0.010	0.040	0.018	0.010	stable	0.51
G64S	<0.010	0.036	0.017	0.008	stable	0.40

Table 2. Minimum, Maximum, Median, Standard Deviation, Trend, and Coefficient of Variation of Boron in Groundwater.

Based on these six lines of evidence, it has been demonstrated that the Duck Creek GMF Pond is not the source of the calcium SSIs at G54S, G57S, G60S, and G64S; the chloride SSI at G57S; the sulfate SSI at G60S; and the TDS SSIs at G54S, G57S, and G60S.

This information serves as the written alternate source demonstration prepared in accordance with 40 C.F.R. § 257.94(e)(2) that the SSIs observed during the detection monitoring program were not due to the CCR unit. Therefore, an assessment monitoring program is not required and the Duck Creek GMF Pond will remain in detection monitoring.

Attachments

Figure 1	Duck Creek GMF Pond (Unit ID: 203) Uppermost Aquifer Unit Groundwater Elevation Contour Map January 7, 2019
Figure 3	Coal Mine Coverage Area Near Duck Creek GMF Pond (Unit ID: 203)
Attachment A1	Mann-Kendall Trend Analyses
Attachment A2	Coefficient of Variation Evaluation

I, Eric J. Tlachac, a qualified professional engineer in good standing in the State of Illinois, certify that the information in this report is accurate as of the date of my signature below. The content of this report is not to be used for other than its intended purpose and meaning, or for extrapolations beyond the interpretations contained herein.

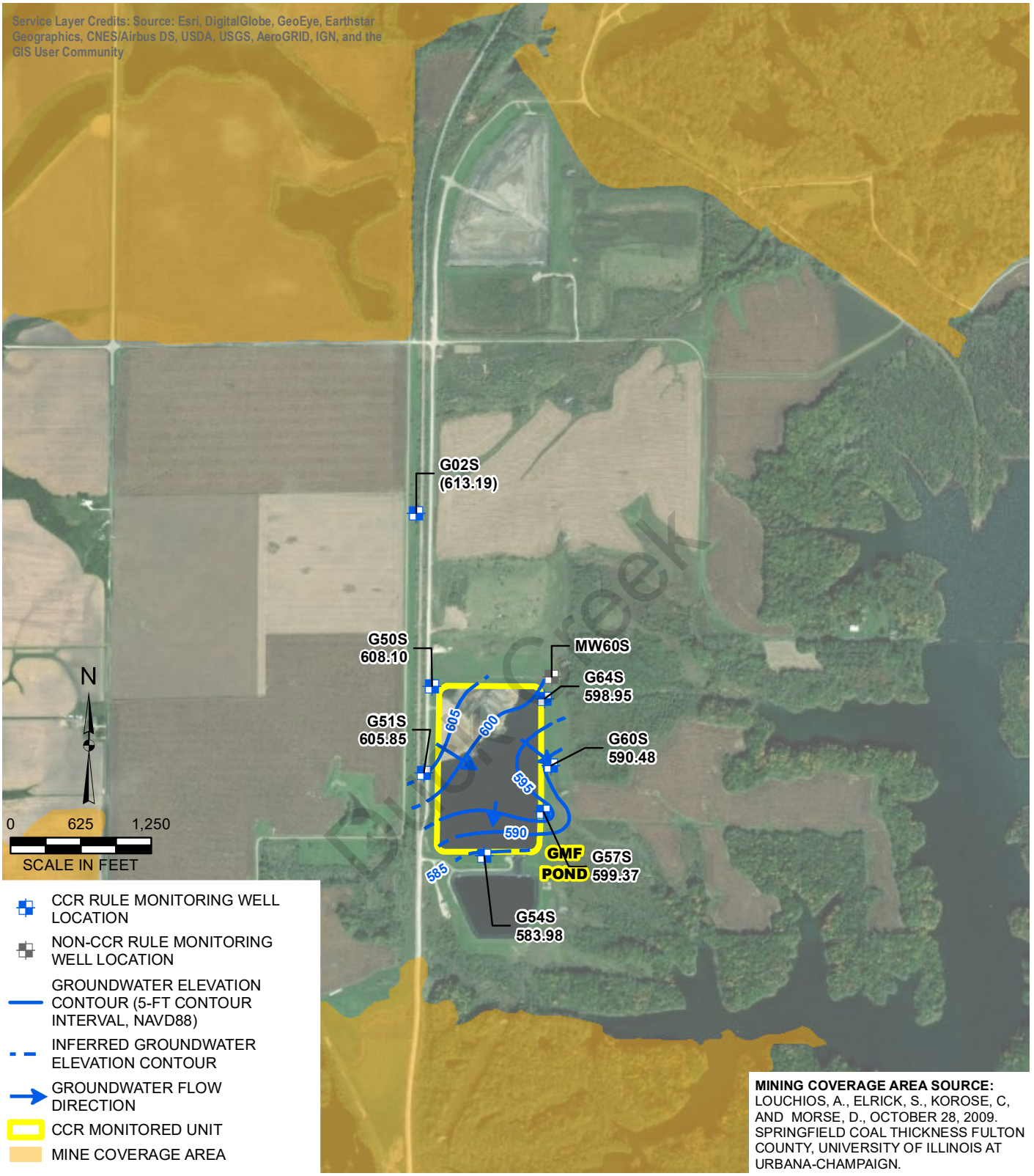
Eric J. Tlachac
Qualified Professional Engineer
062-063091
Illinois
O'Brien & Gere Engineers, Inc., a Ramboll Company
Date: October 14, 2019

I, Nicole M. Pagano, a professional geologist in good standing in the State of Illinois, certify that the information in this report is accurate as of the date of my signature below. The content of this report is not to be used for other than its intended purpose and meaning, or for extrapolations beyond the interpretations contained herein.

Nicole M. Pagano
Professional Geologist
196-000750
O'Brien & Gere Engineers, Inc., a Ramboll Company
Date: October 14, 2019

Attachments

Figures



MINING COVERAGE AREA SOURCE:
LOUCHIOS, A., ELRICK, S., KOROSE, C, AND MORSE, D., OCTOBER 28, 2009. SPRINGFIELD COAL THICKNESS FULTON COUNTY, UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN.

DRAWN BY/DATE:
MPG
REVIEWED BY/DATE:
KLT
APPROVED BY/DATE:
NMP

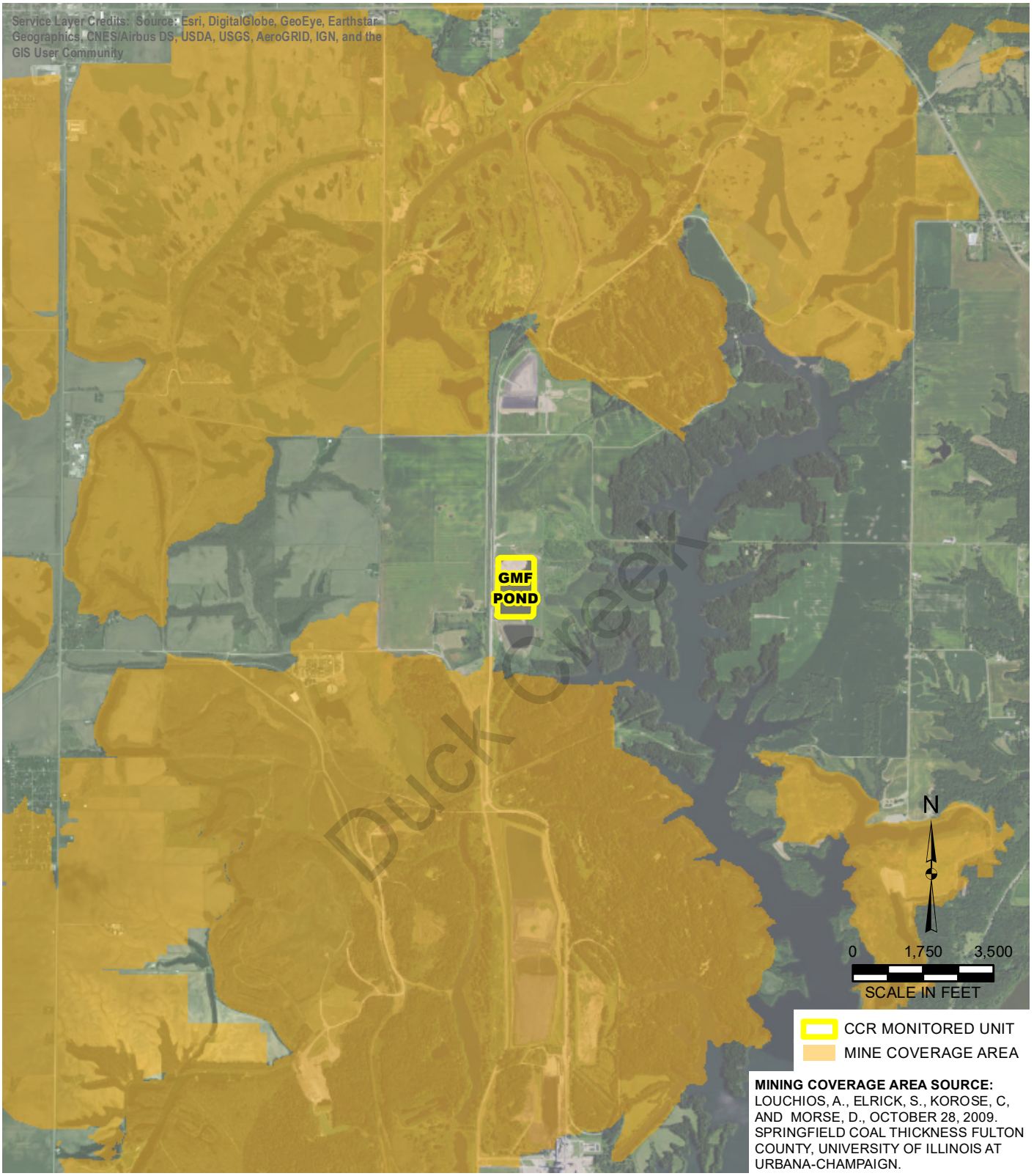
DUCK CREEK GMF POND (UNIT ID: 203)
UPPERMOST AQUIFER UNIT
GROUNDWATER ELEVATION CONTOUR MAP
JANUARY 7, 2019

ALTERNATE SOURCE DEMONSTRATION
DUCK CREEK POWER STATION
CANTON, ILLINOIS

PROJECT NO: 72753

FIGURE NO: 1

Y:\Mapping\Projects\221285\MXD\Alt_Source_Dem\Figure 1_DuckCreekGMFP_GWC_1901_Mining.mxd Author: STOLZSD;



MINING COVERAGE AREA SOURCE:
LOUCHIOS, A., ELRICK, S., KOROSE, C, AND MORSE, D., OCTOBER 28, 2009. SPRINGFIELD COAL THICKNESS FULTON COUNTY, UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN.

DRAWN BY/DATE:
SDS 4/9/18
REVIEWED BY/DATE:
EJT 4/9/18
APPROVED BY/DATE:
NMP 4/9/18

COAL MINE COVERAGE AREA
NEAR DUCK CREEK GMF POND (UNIT ID: 203)

ALTERNATE SOURCE DEMONSTRATION
DUCK CREEK POWER STATION
CANTON, ILLINOIS

FIGURE NO: 3

Y:\Mapping\Projects\221228\MXD\Alt_Source_Dem\Figure 4_DuckCreekGMFP_Mining.mxd Author: stolzsd

Attachment A1

Mann-Kendall Trend Analyses

Duck Creek
Mann-Kendall Trend Analysis

User Supplied Information

Location ID:	**G02S**	**Parameter Code:**	**01022**
Location Class:		**Parameter:**	**B, tot**
Location Type:		**Units:**	**mg/L**
Confidence Level:	**95.00%**	**Period Length:**	**1 month(s)**
Date Range: 12/02/2015 to 06/30/2019		**Limit Name:**	
		Averaged:	**No**

Trend Analysis

Trend of the least squares straight line		
Slope (fitted to data):	-0.000022	mg/L per day
R-Squared error of fit:	0.097751	
Sen's Non-parametric estimate of the slope (One-Sided Test)		
Median Slope:	0.000006	mg/L per day
Lower Confidence Limit of Slope, M1:	-0.000010	mg/L per day
Upper Confidence Limit of Slope, M2+1:	0.000013	mg/L per day
Non-parametric Mann-Kendall Test for Trend		
S Statistic:	0.896	
Z test:	1.645	
At the 95.0 % Confidence Level (One-Sided Test):	None	

Duck Creek
Mann-Kendall Trend Analysis

User Supplied Information

Location ID:	**G50S**	**Parameter Code:**	**01022**
Location Class:		**Parameter:**	**B, tot**
Location Type:		**Units:**	**mg/L**
Confidence Level:	**95.00%**	**Period Length:**	**1 month(s)**
Date Range: 12/02/2015 to 06/30/2019		**Limit Name:**	
		Averaged:	**No**

Trend Analysis

Trend of the least squares straight line

Slope (fitted to data):	0.000006	mg/L per day
R-Squared error of fit:	0.024341	

Sen's Non-parametric estimate of the slope (One-Sided Test)

Median Slope:	-0.000004	mg/L per day
Lower Confidence Limit of Slope, M1:	-0.000018	mg/L per day
Upper Confidence Limit of Slope, M2+1:	0.000012	mg/L per day

Non-parametric Mann-Kendall Test for Trend

S Statistic:	-0.554
Z test:	1.645
At the 95.0 % Confidence Level (One-Sided Test):	None

Duck Creek
Mann-Kendall Trend Analysis

User Supplied Information

Location ID:	**G51S**	**Parameter Code:**	**01022**
Location Class:		**Parameter:**	**B, tot**
Location Type:		**Units:**	**mg/L**
Confidence Level:	**95.00%**	**Period Length:**	**1 month(s)**
Date Range: 12/02/2015 to 06/30/2019		**Limit Name:**	
		Averaged:	**No**

Trend Analysis

Trend of the least squares straight line

Slope (fitted to data):	0.000005	mg/L per day
R-Squared error of fit:	0.041674	

Sen's Non-parametric estimate of the slope (One-Sided Test)

Median Slope:	0.000000	mg/L per day
Lower Confidence Limit of Slope, M1:	-0.000007	mg/L per day
Upper Confidence Limit of Slope, M2+1:	0.000011	mg/L per day

Non-parametric Mann-Kendall Test for Trend

S Statistic:	0.187
Z test:	1.645
At the 95.0 % Confidence Level (One-Sided Test):	None

Duck Creek
Mann-Kendall Trend Analysis

User Supplied Information

Location ID:	**G54S**	**Parameter Code:**	**01022**
Location Class:		**Parameter:**	**B, tot**
Location Type:		**Units:**	**mg/L**
Confidence Level:	**95.00%**	**Period Length:**	**1 month(s)**
Date Range: 12/02/2015 to 06/30/2019		**Limit Name:**	
		Averaged:	**No**

Trend Analysis

Trend of the least squares straight line		
Slope (fitted to data):	0.000008	mg/L per day
R-Squared error of fit:	0.077887	
Sen's Non-parametric estimate of the slope (One-Sided Test)		
Median Slope:	0.000006	mg/L per day
Lower Confidence Limit of Slope, M1:	-0.000008	mg/L per day
Upper Confidence Limit of Slope, M2+1:	0.000017	mg/L per day
Non-parametric Mann-Kendall Test for Trend		
S Statistic:	0.879	
Z test:	1.645	
At the 95.0 % Confidence Level (One-Sided Test):	None	

Duck Creek
Mann-Kendall Trend Analysis

User Supplied Information

Location ID:	**G57S**	**Parameter Code:**	**01022**
Location Class:		**Parameter:**	**B, tot**
Location Type:		**Units:**	**mg/L**
Confidence Level:	**95.00%**	**Period Length:**	**1 month(s)**
Date Range: 12/02/2015 to 06/30/2019		**Limit Name:**	
		Averaged:	**No**

Trend Analysis

Trend of the least squares straight line

Slope (fitted to data):	0.000009	mg/L per day
R-Squared error of fit:	0.173265	

Sen's Non-parametric estimate of the slope (One-Sided Test)

Median Slope:	0.000000	mg/L per day
Lower Confidence Limit of Slope, M1:	0.000000	mg/L per day
Upper Confidence Limit of Slope, M2+1:	0.000015	mg/L per day

Non-parametric Mann-Kendall Test for Trend

S Statistic:	1.068
Z test:	1.645
At the 95.0 % Confidence Level (One-Sided Test):	None

Duck Creek
Mann-Kendall Trend Analysis

User Supplied Information

Location ID:	**G60S**	**Parameter Code:**	**01022**
Location Class:		**Parameter:**	**B, tot**
Location Type:		**Units:**	**mg/L**
Confidence Level:	**95.00%**	**Period Length:**	**1 month(s)**
Date Range: 12/02/2015 to 06/30/2019		**Limit Name:**	
		Averaged:	**No**

Trend Analysis

Trend of the least squares straight line		
Slope (fitted to data):	0.000010	mg/L per day
R-Squared error of fit:	0.110581	
Sen's Non-parametric estimate of the slope (One-Sided Test)		
Median Slope:	0.000009	mg/L per day
Lower Confidence Limit of Slope, M1:	-0.000014	mg/L per day
Upper Confidence Limit of Slope, M2+1:	0.000020	mg/L per day
Non-parametric Mann-Kendall Test for Trend		
S Statistic:	0.368	
Z test:	1.645	
At the 95.0 % Confidence Level (One-Sided Test):	None	

Duck Creek
Mann-Kendall Trend Analysis

User Supplied Information

Location ID:	**G64S**	**Parameter Code:**	**01022**
Location Class:		**Parameter:**	**B, tot**
Location Type:		**Units:**	**mg/L**
Confidence Level:	**95.00%**	**Period Length:**	**1 month(s)**
Date Range: 12/02/2015 to 06/30/2019		**Limit Name:**	
		Averaged:	**No**

Trend Analysis

Trend of the least squares straight line

Slope (fitted to data):	0.000001	mg/L per day
R-Squared error of fit:	0.003330	

Sen's Non-parametric estimate of the slope (One-Sided Test)

Median Slope:	0.000002	mg/L per day
Lower Confidence Limit of Slope, M1:	-0.000010	mg/L per day
Upper Confidence Limit of Slope, M2+1:	0.000013	mg/L per day

Non-parametric Mann-Kendall Test for Trend

S Statistic:	0.184
Z test:	1.645
At the 95.0 % Confidence Level (One-Sided Test):	None

Attachment A2

Coefficient of Variation Evaluation

Duck Creek

Coefficient of Variation
Date Range: 12/02/2015 to 6/30/2019

Boron, total (mg/L)

Location	Count	Mean	Std Dev	% Non-Detects	CV
G02S	12	0.048	0.026	0.00	0.56
G50S	13	0.021	0.015	15.38	0.72
G51S	13	0.015	0.008	30.77	0.53
G54S	14	0.035	0.011	0.00	0.31
G57S	13	0.015	0.006	53.85	0.42
G60S	13	0.020	0.010	15.38	0.51
G64S	13	0.020	0.008	7.69	0.40

CV=Std Dev/ Mean