2018 Annual Groundwater Monitoring and Corrective Action Report Addendum No. 1

Ottumwa Generating Station – Ash Pond
Ottumwa, Iowa

Prepared for:

Alliant Energy

SCS ENGINEERS

25222072.00 | May 4, 2022

2830 Dairy Drive
Madison, WI 53718-6751
608-224-2830

Table of Contents

Section Page

1.0 Introduction.....1

Tables

Table 1 Groundwater Monitoring Well Network
Table 2 Groundwater Elevation Summary
Table 3 Horizontal Gradients and Flow Velocities
Table 4 Groundwater Analytical Results Summary - 2018
Table 5 2018 Groundwater Field Data Summary

Figures

Figure 1 Site Location Map
Figure 2 Site Plan and Monitoring Well Location
Figure 3 Shallow Potentiometric Surface, April 18, 2018
Figure 4 Shallow Potentiometric Surface, October 16, 2018

Appendices

Appendix A Regional Hydrogeologic Information
Appendix B Boring Logs and Well Construction Documentation
Appendix C Historical Monitoring Results
Appendix D Statistical Evaluation

I:\25222072.00\Deliverables\2018 Fed Annual Report Addendum - OGS AP\220504_Annual CCR GW Report OGS AP_2018 Add 1_Final.docx

1.0 INTRODUCTION

This 2018 Annual Groundwater Monitoring and Corrective Action Report Addendum (Addendum) was prepared to support compliance with the groundwater monitoring requirements of the Coal Combustion Residuals (CCR) Rule [40 CFR 257.50-107]. The original 2018 Annual Groundwater Monitoring and Corrective Report (Annual Report) was completed on January 31, 2019 to fulfill the requirements of 40 CFR 257.90(e).

The 2018 Annual Report and this Addendum cover the period of groundwater monitoring from January 1, 2018, through December 31, 2018.

This Addendum includes the following tables, figures, and appendix materials to support the information in the original 2018 Annual Report:

- Table 1 – Groundwater Monitoring Well Network
- Table 2 – Groundwater Elevation Summary
- Table 3 – Horizontal Gradients and Flow Velocities
- Table 4 – Groundwater Analytical Results Summary - 2018
- Table 5 – 2018 Groundwater Field Data Summary
- Figure 1 – Site Location Map
- Figure 2 – Site Plan and Monitoring Well Location
- Figure 3 – Shallow Potentiometric Surface, April 18, 2018
- Figure 4 – Shallow Potentiometric Surface, October 16, 2018
- Appendix A – Regional Hydrogeologic Information
- Appendix B – Boring Logs and Well Construction Documentation
- Appendix C – Historical Monitoring Results
- Appendix D – Statistical Evaluation

Tables

1 Groundwater Monitoring Well Network
2 Groundwater Elevation Summary
3 Horizontal Gradients and Flow Velocities
4 Groundwater Analytical Results Summary - 2018
5 2018 Groundwater Field Data Summary

Table 1. Groundwater Monitoring Well Network
Ottumwa Generating Station - Ash Pond / SCS Engineers Project #25222072.00

Monitoring Well	Location in Monitoring Network	Role in Monitoring Network
MW-301	Upgradient	Background
MW-302	Downgradient	Compliance
MW-303	Downgradient	Compliance
MW-304	Downgradient	Compliance
MW-305	Downgradient	Compliance
MW-306	Downgradient	Compliance

Created by: MDB Date: 12/17/2021
Last revision by: JAO Date: 3/22/2022
Checked by: KLG Date: 3/28/2022

\\Mad-fs01\data\Projects\25222072.00\Deliverables\2018 Fed Annual Report Addendum - OGS AP\Tables\[Table 1_GW Monitoring Well Network.xlsx]GW Summary

Table 2. Groundwater Elevations - CCR Rule Monitoring Well Networks
IPL - Ottumwa Generating Station / SCS Engineers Project #25222072.00

Ground Water or Surface Water Elevation in feet above mean sea level (amsl)									
Well Number	**MW-301**	**MW-302**	**MW-303**	**MW-304**	**MW-305**	**MW-306**	**MW-307**	**MW-308**	**MW-309**
Top of Well Casing Elevation / Surface Water Reference Elevation (feet amsl)	686.63	673.90	661.07	682.84	683.91	683.47	657.56	655.39	654.94
Screen Length (ft)	10.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Total Depth (ft from top of casing)	17.0	25.8	17.5	52.3	51.5	36.6	28.0	25.0	27.5
Top of Well Screen Elevation (ft)	679.63	653.10	648.57	635.54	637.41	651.87	634.56	635.39	632.44
Measurement Date									
April 26, 2016	682.80	655.63	652.42	655.37	661.67	670.86	NI	NI	NI
June 23, 2016	682.58	655.65	652.89	656.53	662.36	670.64	NI	NI	NI
August 9, 2016	682.27	655.52	651.76	653.79	660.78	670.35	NI	NI	NI
October 26-27, 2016	682.04	655.67	652.17	655.03	661.37	670.21	NI	NI	NI
January 18-19, 2017	681.67	655.46	651.74	654.50	660.87	669.89	648.81	647.42	646.66
April 19-20, 2017	682.15	656.35	654.57	657.48	663.27	670.69	653.62	651.09	650.16
June 20-21, 2017	681.91	655.65	652.42	654.75	661.26	669.94	649.85	648.26	647.60
August 21-23, 2017	681.28	655.13	650.58	652.39	659.00	668.77	645.78	643.12	641.82
November 8, 2017	681.54	655.40	651.34	653.03	659.76	669.04	647.37	644.99	644.20
April 18, 2018	681.53	655.71	652.47	655.55	660.99	668.92	649.66	647.91	647.65
May 30, 2018	NM	NM	NM	NM	NM	NM	652.45	651.05	650.98
June 28, 2018	NM	NM	NM	NM	NM	NM	652.87	651.43	651.47
July 18, 2018	NM	NM	NM	NM	NM	NM	652.27	650.67	650.69
August 14-15, 2018	680.91	656.05	652.57	656.35	661.56	668.66	NM	NM	NM
August 29, 2018	681.09	655.89	655.07	657.82	NM	NM	NM	NM	NM
October 16, 2018	682.50	656.91	656.17	658.20	663.37	670.24	654.13	NM	651.61
Bottom of Well Elevation (ft)	669.63	648.10	643.57	630.54	632.41	646.87	629.56	630.39	627.44

Notes:
NM = not measured
NI = not installed

Created by: NDK Date: 1/15/2018
Last rev. by: JAO Date: 3/22/2022
Checked by: KLG Date: 3/28/2022

\\Mad-fs01\data\Projects\25222072.00\Deliverables\2018 Fed Annual Report Addendum - OGS AP\Tables\[Table 2_GW Elevation Summary.

Table 3. Horizontal Gradients and Flow Velocity
Ottumwa Generating Station - Main Ash Pond /
SCS Engineers Project #25222072.00
January - December 2018

	Shallow				
Sampling Dates	**h1 (ft)**	**h2 (ft)**	**Δl (ft)**	**Δh/Δl (ft/ft)**	**V (ft/d)**
4/18/2018	665.00	652.47	867	0.01	0.10
4/18/2018	668.92	650.00	430	0.04	0.31
10/16/2018	670.00	656.17	1109	0.01	0.09
10/16/2018	670.24	654.13	482	0.03	0.24

	Well	**K Values (cm/sec)**	**K Values (ft/d)**
Upgradient Well	MW-301	4.6E-03	13
Shallow Wells	MW-302	3.2E-03	9.1
	MW-303	1.2E-04	0.35
	MW-304	3.5E-04	0.98
	MW-305	2.5E-03	7.1
	MW-306	2.8E-03	8.1
	Geometric Mean	1.0E-03	2.8

Assumed Unconsolidated Porosity, n
0.40

Note: Geometric mean calculations do not include upgradient well MW-301
Note: Two gradients were measured to account for variation across the site

Groundwater flow velocity equation: V = [K*(Δh/Δl)] / n

ft = feet
ft/d = feet per day
K = hydraulic conductivity
n = effective porosity
V = groundwater flow velocity
h1, h2 = point interpreted groundwater elevation
Δl = distance between location 1 and 2
Δh/Δl = hydraulic gradient

Created by: NDK Date: 3/30/2022
Last revision by: JAO Date: 4/11/2022
Checked by: NDK Date: 4/18/2022

Table 4. Groundwater Analytical Results Summary - CCR program - Detection Monitoring
Ottumwa Generating Station - Ash Pond / SCS Engineers Project #25222072.00

Parameter Name	UPL Method	UPL	GPS	Background Wells			Compliance Wells														
				MW-301			MW-302			MW-303			MW-304			MW-305			MW-306		
				4/18/2018	8/14/2018, 8/29/2018 ^	10/16/2018, 1/8/2019 ^^	4/18/2018	8/14/2018, 8/29/2018 ^	10/16/2018, 1/8/2019 ^^	4/18/2018	8/14/2018, 8/29/2018 ^	10/16/2018, 1/8/2019 ^^	4/18/2018	8/14/2018, 8/29/2018 ^	10/16/2018, 1/8/2019 ^^	4/18/2018	8/15/2018	10/16/2018, 1/9/2019 ^^	4/18/2018	8/15/2018	10/16/2018, 1/8/2019 ^^
Appendix III																					
Boron, ug/L	P	820		480	735	410	1,200	1,240	1,100	987	1,010	549	991	1,000	930	886	911	835	919	915	862
Calcium, mg/L	P	78.7		63.0	72.5	47.2	177	185	146	212	213	195	131	138	123	97.6	102.0	96.2	74.1	78.9	80.0
Chloride, mg/L	P	86.8		63.4	63.1	33.9	246	259	214	198	64.8	57	400	375	410	289	265	281	54.4	58.2	83.3
Fluoride, mg/L	P	0.484		0.22	0.27	0.3	0.26	0.26	0.24	0.22	0.31	0.24	0.92	1.00	1.0	0.40	0.44	0.40	0.11 J	0.13 J	<0.19
Field pH, Std. Units	P	6.87		6.41	6.26	6.27	6.47	6.76	6.37	6.63	6.83	6.66	6.9	7.34	6.86	6.9	7.21	6.86	6.42	6.74	6.42
Sulfate, mg/L	P	199		186	181	164	899	847	785	328	164	389	198	185	184	147	139	129	289	275	285
Total Dissolved Solids, mg/L	P	628		514	532	392	1,690	1,840	1,400	1,300	832	1,150	1,300	3,680	1,180	1,070	1,060	1,070	805	840	884
Appendix IV																					
Antimony, ug/L	P*	0.22	6	<0.026	0.20 J	<0.078	<0.026	<0.15	0.26 J,B	0.098 J	0.16 J	0.2 J,B	<0.026	0.19 J	<0.078	0.089 J	<0.15	0.096 J,B	0.094 J	<0.15	0.10 J,B
Arsenic, ug/L	P*	0.53	10	0.074 J	0.29 J	0.16 J	0.16 J	0.30 J	1.9	0.43 J	0.60 J	0.55 J	0.68 J	1.3	0.96 J	0.51 J	0.72 J	0.66 J	0.38 J	0.65 J	0.60 J
Barium, ug/L	P	68.8	2,000	31.6	44.5	28.1	17.7	18.3	28.9	69.5	77.3	95.2	88.5	87.4	91	116	118	125	48.2	51.6	56.0
Beryllium, ug/L	DQ	DQ	4	<0.012	0.14 J	<0.089	<0.012	<0.12	0.22 J	0.017 J	<0.12	<0.089	0.026 J	0.21 J	<0.089	<0.012	<0.12	<0.089	<0.012	<0.12	<0.089
Cadmium, ug/L	NP*	0.12	5	0.023 J	0.16 J	<0.033	0.22 J	0.21 J	0.67	0.44 J	0.36 J	0.24 J	<0.018	0.17 J	0.07 J	0.054 J	0.086 J	0.044 J	0.88	0.76	0.96
Chromium, ug/L	P	1.07	100	<0.054	0.25 J	0.11 J,B	0.46 J	0.48 J	1.6	0.12 J	0.19 J	0.15 J,B	2.0	5.9	1.4	0.26 J	0.41 J	0.3 J,B	0.37 J	0.70 J	0.46 J,B
Cobalt, ug/L	NP	4.1	6	0.46 J	1.4	0.36 J,B	0.90 J	1.50	4.0	2.1	2.2	1.7 B	0.39 J	0.92 J	0.45 J,B	14.5	15.6	17.2	4.8	5.5	6.4
Fluoride, mg/L	P	0.48	4	0.22	0.27	0.3	0.26	0.26	0.24	0.22	0.31	0.24	0.92	1.00	1.0	0.40	0.44	0.40	0.11 J	0.13 J	<0.19
Lead, ug/L	NP*	0.10	15	0.041 J	0.18 J	<0.13	0.098 J	0.12 J	3.9	0.069 J	0.13 J	<0.13	0.37 J	0.81 J	0.66 J	0.12 J	0.31 J	<0.13	0.040 J	0.20 J	<0.13
Lithium, ug/L	P	34.2	40	19.1	26.5	19.4	7.5 J	6.9 J	8.6 J	<4.6	6.9 J	<4.6	<4.6	<4.6	<4.6	<4.6	<4.6	<4.6	<4.6	<4.6	<4.6
Mercury, ug/L	DQ	DQ	2	<0.090	<0.083	<0.090 ^^	0.096 J	<0.083	<0.090 ^^	<0.090	<0.083	<0.090 ^^	<0.090	<0.083	<0.090 ^^	<0.090	<0.090	<0.090 ^^	<0.090	<0.083	<0.090 ^^
Molybdenum, ug/L	P	1.74	100	0.67 J	1.3	0.72 J	0.59 J	0.54 J	<0.57	0.61 J	0.98 J	5.5	2.0	2.4	1.9	7.1	6.5	7.3	5.7	4.7	5.1
Selenium, ug/L	P	8.55	50	4.3	6.3	3.4	<0.086	<0.16	0.84 J,B	0.23 J	0.35 J	0.37 J,B	<0.086	0.50 J	0.26 J,B	0.12 J	0.36 J	0.33 J,B	<0.086	0.21 J	0.22 J,B
Thallium, ug/L	NP*	0.14	2	<0.036	0.16 J	<0.099	<0.036	<0.14	0.16 J	<0.036	<0.14	<0.099	<0.036	0.15 J	<0.099	0.32 J	0.33 J	0.33 J	0.083 J	<0.14	0.12 J
Radium 226/228 Combined, pCi/L	P	2.15	5	0.513	1.19	1.7	0.746	1.12	1.7	0.529	1.82	1.68	2.08	3.74	1.25	0.676	1.33	1.32	0.305	0.985	1.34

4.4 Blue shaded cell indicates the compliance well result exceeds the UPL (background) and the Limit of Quantitation (LOQ).

30.8 Yellow highlighted cell indicates the compliance well result exceeds the GPS.

Abbreviations:
UPL = Upper Prediction Limit
NA = Not Analyzed
P = Parametric UPL with 1-of-2 retesting
GPS = Groundwater Protection Standard
DQ = Double Quantification Rule (not detected in background)
NP = Nonparametric UPL (highest background value)
LOD = Limit of Detection
LOQ = Limit of Quantitation
J = Estimated concentration at or above the LOD and below the LOQ.
B = Analyte was detected in the associated Method Blank.

* = UPL is below the LOQ for background sampling. For compliance wells, only results confirmed above the LOQ are evaluated as potential SSIs above background.
^ = During the August 2018 sampling event, samples for chloride, fluoride, sulfate, and total dissolved solids at MW-301, MW-302, MW-303, and MW-304 were received by the lab above the required temperature. The wells were resampled for these parameters on 8/29/2018.
^^ = During the October 2018 sampling event, samples were not analyzed for mercury due a laboratory error. The wells were resampled for mercury on 1/8/2019.

Notes:
1. An individual result above the UPL or GPS does not constitute a statistically significant increase (SSI) above background or statistically significant level above the GPS. See the accompanying letter text for identification of statistically significant results.
2. GPS is the United States Environmental Protection Agency (US EPA) Maximum Contamination Level (MCL), if established; otherwise, the values are from 40 CFR 257.95(h)(2).
3. Interwell UPLs calculated based on results from background well MW-301.

Created by: NDK Date: 5/1/2018
Last revision by: NDK Date: 3/30/2022
Checked by: MDB Date: 3/30/2022

I:\25222072.00\Deliverables\2018 Fed Annual Report Addendum - OGS AP\Tables\[Table 4 _CCR GW 2018 Screening Summary_OGS-2204.xlsx]Table

Table 5. 2018 Groundwater Field Data Summary
Ottumwa Generating Station - Ash Pond
SCS Engineers Project #25222072.00

Well	Sample Date	Groundwater Elevation (feet)	Field Temperature (deg C)	Field pH (Std. Units)	Oxygen, Dissolved (mg/L)	Field Specific Conductance (umhos/cm)	Field Oxidation Potential (mV)	Turbidity (NTU)
MW-301	4/18/2018	681.53	7.2	6.41	6.52	770	105.5	0.66
	8/14/2018	680.91	20.4	6.26	3.18	867	-55.5	0.52
	8/29/2018	681.09	20.6	6.31	4.71	781	--	0.63
	10/16/2018	682.5	16.6	6.27	4.12	599	119.7	2.91
MW-302	4/18/2018	655.71	10.7	6.47	0.2	2248	82.6	2.41
	8/14/2018	656.05	14.3	6.76	0.17	2304	-336.6	4.01
	8/29/2018	655.89	14.6	6.77	0.23	2357	--	1.42
	10/16/2018	656.91	14.1	6.37	0.26	1912	114.2	88.24
MW-303	4/18/2018	652.47	8.2	6.63	0.17	1862	3.2	3.69
	8/14/2018	652.57	17.2	6.83	0.19	1833	-307.9	1.51
	8/29/2018	655.07	18.7	7.03	1.92	1161	--	10.13
	10/16/2018	656.17	17.1	6.66	0.29	1573	32.8	5.99
MW-304	4/18/2018	655.55	12.8	6.9	0.15	2141	137.5	39.29
	8/15/2018	656.35	15.1	7.34	0.21	2085	35.5	81.42
	8/29/2018	657.82	13.7	7.22	0.16	2123	--	55.94
	10/16/2018	658.2	13.5	6.86	0.11	2058	-114.5	17.12
MW-305	4/18/2018	660.99	12.8	6.9	0.15	1840	-32.7	7.37
	8/15/2018	661.56	14.8	7.21	0.18	1832	31	14.9
	10/16/2018	663.37	13.9	6.86	0.09	1836	-26.8	6.96
MW-306	4/18/2018	668.92	13.1	6.42	0.14	1228	14.2	0.59
	8/15/2018	668.66	14.6	6.74	0.15	1271	22.8	3.95
	10/16/2018	670.24	13.4	6.42	0.08	1340	13.3	7.07

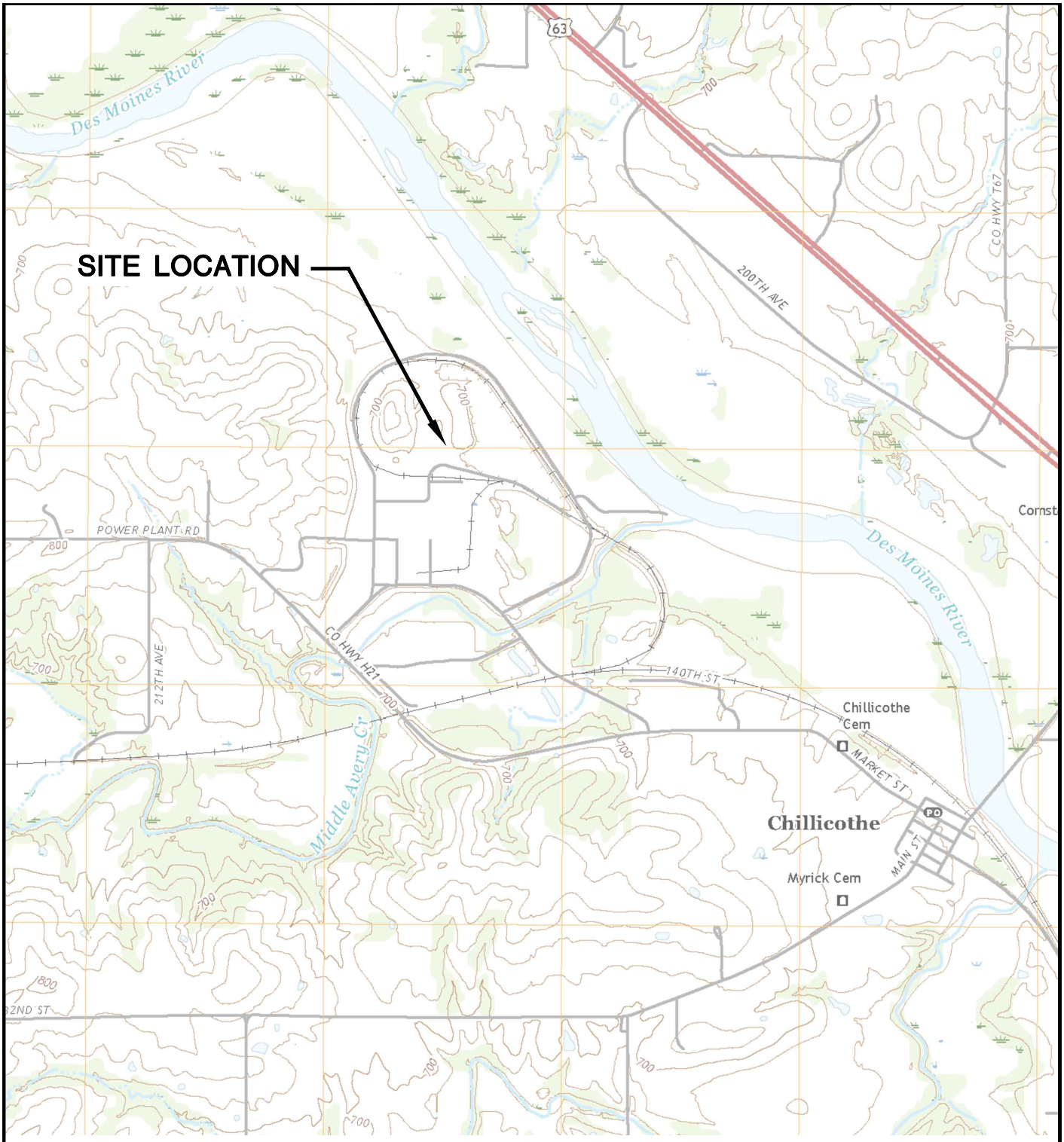
Notes:
-- = Not Measured

Created by: JAO Date: 3/23/2022
Last revision by: JAO Date: 3/23/2022
Checked by: KLG Date: 3/28/2022

\\Mad-fs01\data\Projects\25222072.00\Deliverables\2018 Fed Annual Report Addendum - OGS AP\Tables\[Table 5_Field_Parameters.xlsx]Sheet1

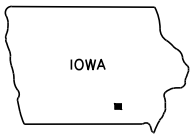
Figures

1 Site Location Map
2 Site Plan and Monitoring Well Location
3 Shallow Potentiometric Surface, April 18, 2018
4 Shallow Potentiometric Surface, October 16, 2018



N

CHILLICOTHE QUADRANGLE
IOWA–WAPELLO CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
2018
SCALE: 1" = 2,000'



CLIENT	INTERSTATE POWER AND LIGHT CO. 20775 POWER PLANT ROAD OTTUMWA, IA 52501	SITE	ALLIANT ENERGY OTTUMWA GENERATING STATION OTTUMWA, IOWA

SITE LOCATION MAP

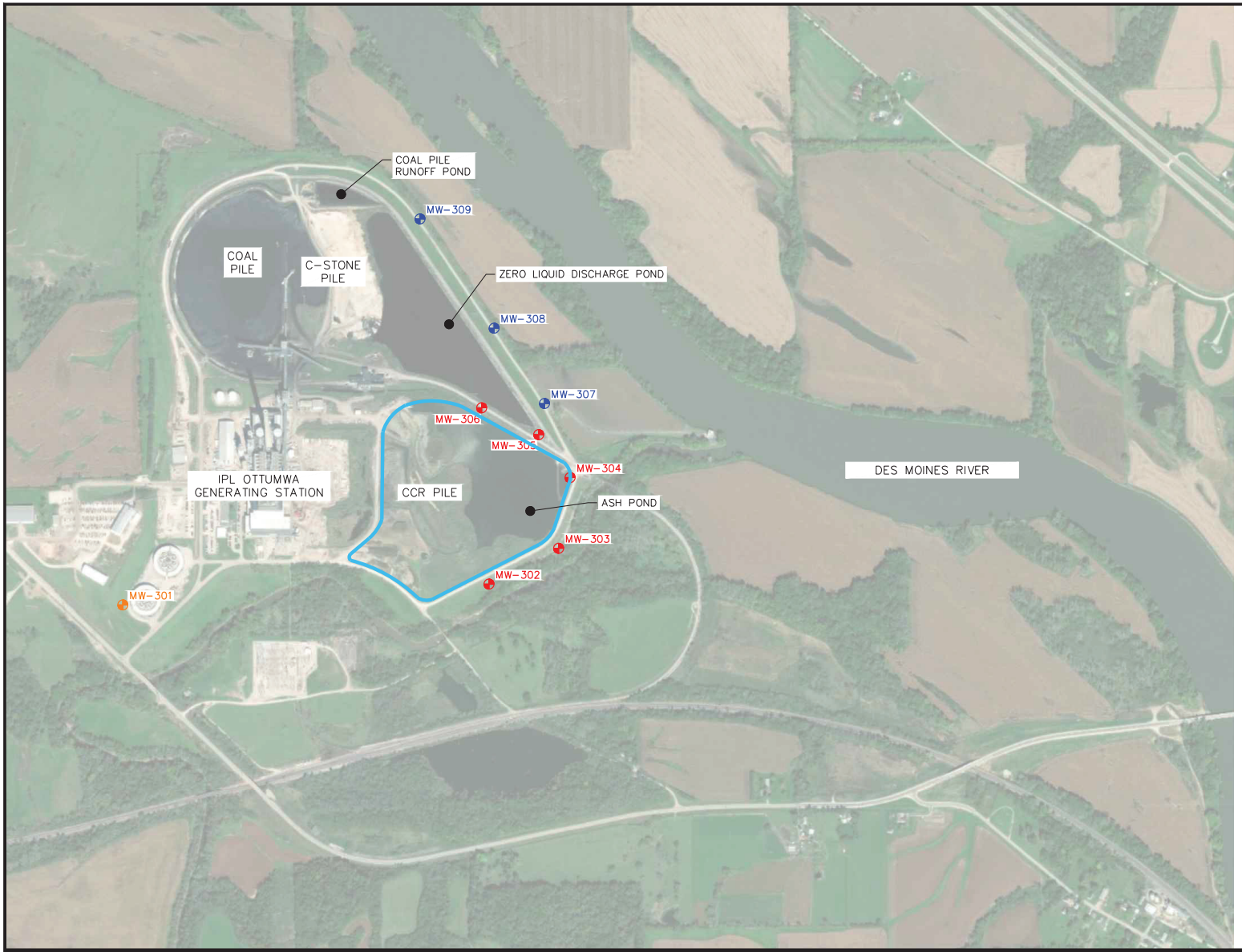
PROJECT NO.	25219072.00	DRAWN BY:	BSS
DRAWN:	11/15/2019	CHECKED BY:	MDB
REVISED:	01/10/2020	APPROVED BY:	TK 01/30/2020

ENGINEER

SCS ENGINEERS
2830 DAIRY DRIVE MADISON, WI 53718-6751
PHONE: (608) 224-2830

FIGURE 1

I:\25219072.00\Drawings\CCR 2019 Annual Report\Site Location Map.dwg, 1/30/2020 3:51:43 PM



LEGEND

- CCR UNIT
- CCR ZLDP MONITORING WELL
- CCR ASH POND MONITORING WELL
- CCR BACKGROUND MONITORING WELL

NOTES:

1. 2014 AERIAL PHOTOGRAPH SOURCES: ESRI, DIGITALGLOBE, GEOEYE, I-CUBED, USDA FSA, USGS, AEX, GETMAPPING, AEROGRID, IGN, IGP, SWISSTOPO, AND THE GIS USER COMMUNITY.
2. CCR UNIT LIMITS ARE APPROXIMATE.
3. MONITORING WELLS MW-301, MW-302, AND MW-304, WERE INSTALLED BY CASCADE DRILLING, LLP. UNDER THE SUPERVISION OF SCS ENGINEERS FROM NOVEMBER 11-12, 2015.
4. MONITORING WELLS MW-303 AND MW-305 WERE INSTALLED BY CASCADE DRILLING LLP. UNDER THE SUPERVISION OF SCS ENGINEERS ON DECEMBER 7-8, 2015.
5. MONITORING WELLS MW-307, MW-308, AND MW-309 WERE INSTALLED BY CASCADE DRILLING, LLP. UNDER THE SUPERVISION OF SCS ENGINEERS FROM OCTOBER 25-27, 2016.
6. THE BACKGROUND MONITORING WELL FOR THE OGS ASH POND IS MW-301.

N

800 0 800

SCALE: 1" = 800'

PROJECT NO.	25222072.00	DRAWN BY:	KP
DRAWN:	04/06/2022	CHECKED BY:	NDK
REVISED:	04/06/2022	APPROVED BY:	TK 05/03/2022

ENGINEER: SCS ENGINEERS
2830 DAIRY DRIVE MADISON, WI 53718-6751
PHONE: (608) 224-2830

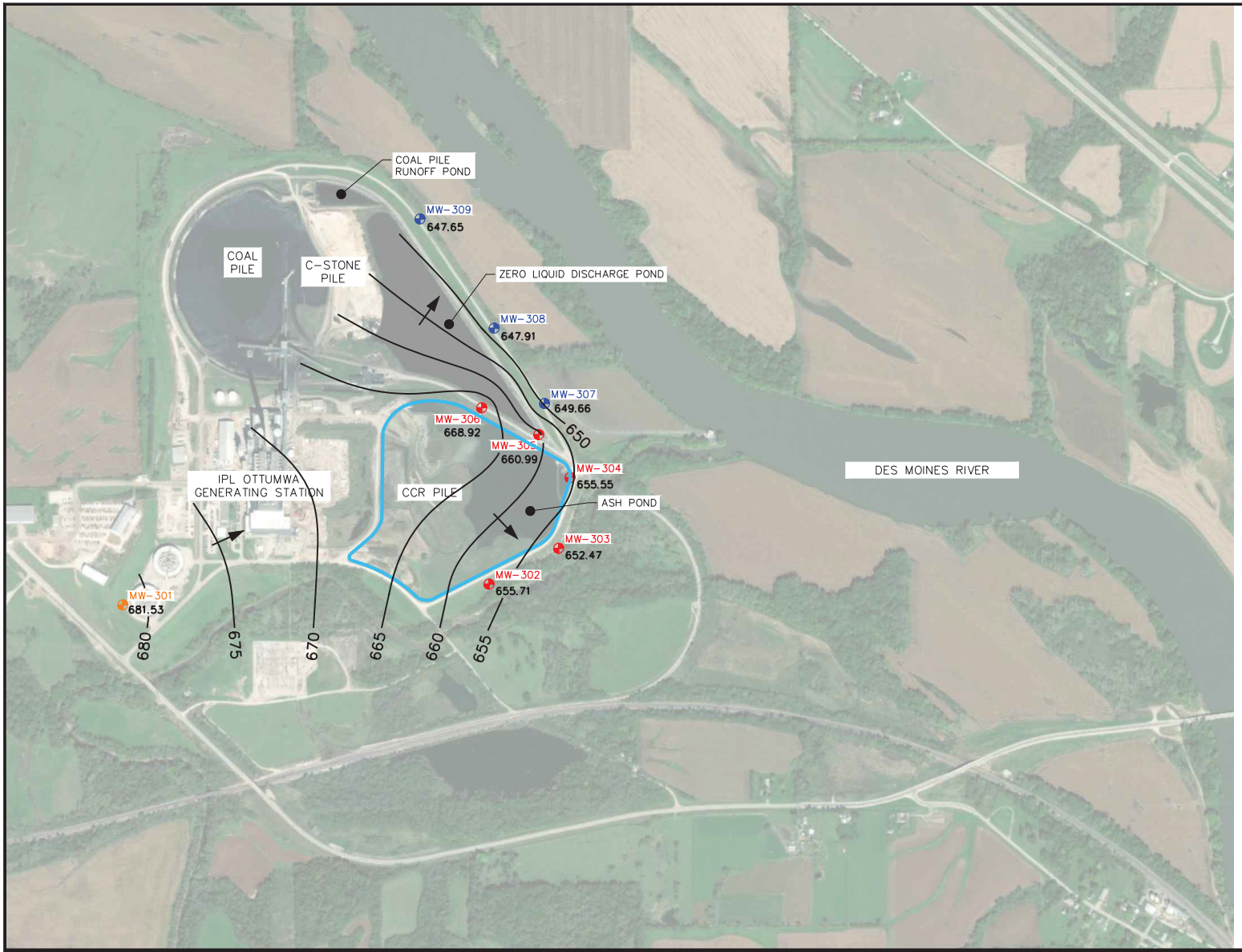
CLIENT: INTERSTATE POWER AND LIGHT CO.
20775 POWER PLANT ROAD
OTTUMWA, IA 52501

SITE: ALLIANT ENERGY
OTTUMWA GENERATING STATION
OTTUMWA, IOWA

SITE PLAN AND MONITORING WELL LOCATIONS-ASH POND

FIGURE 2

I:\25222072.00\Drawings\Potentiometric Surface Ash Pond.dwg, 4/8/2022 8:21:24 AM



LEGEND

- CCR UNIT
- CCR ZLDP MONITORING WELL
- CCR ASH POND MONITORING WELL
- CCR BACKGROUND MONITORING WELL
- 682.15 — POTENTIOMETRIC ELEVATION AT WELL (APRIL 18, 2018)
- POTENTIOMETRIC SURFACE CONTOUR
- APPROXIMATE GROUNDWATER FLOW DIRECTION

NOTE:

1. THE BACKGROUND MONITORING WELL FOR THE OGS ASH POND IS MW-301.

N

800 0 800

SCALE: 1" = 800'

PROJECT NO.	25222072.00	DRAWN BY:	KP
DRAWN:	04/06/2022	CHECKED BY:	NDK
REVISED:	04/06/2022	APPROVED BY:	TK 05/03/2022

ENGINEER: SCS ENGINEERS
2830 DAIRY DRIVE MADISON, WI 53718-6751
PHONE: (608) 224-2830

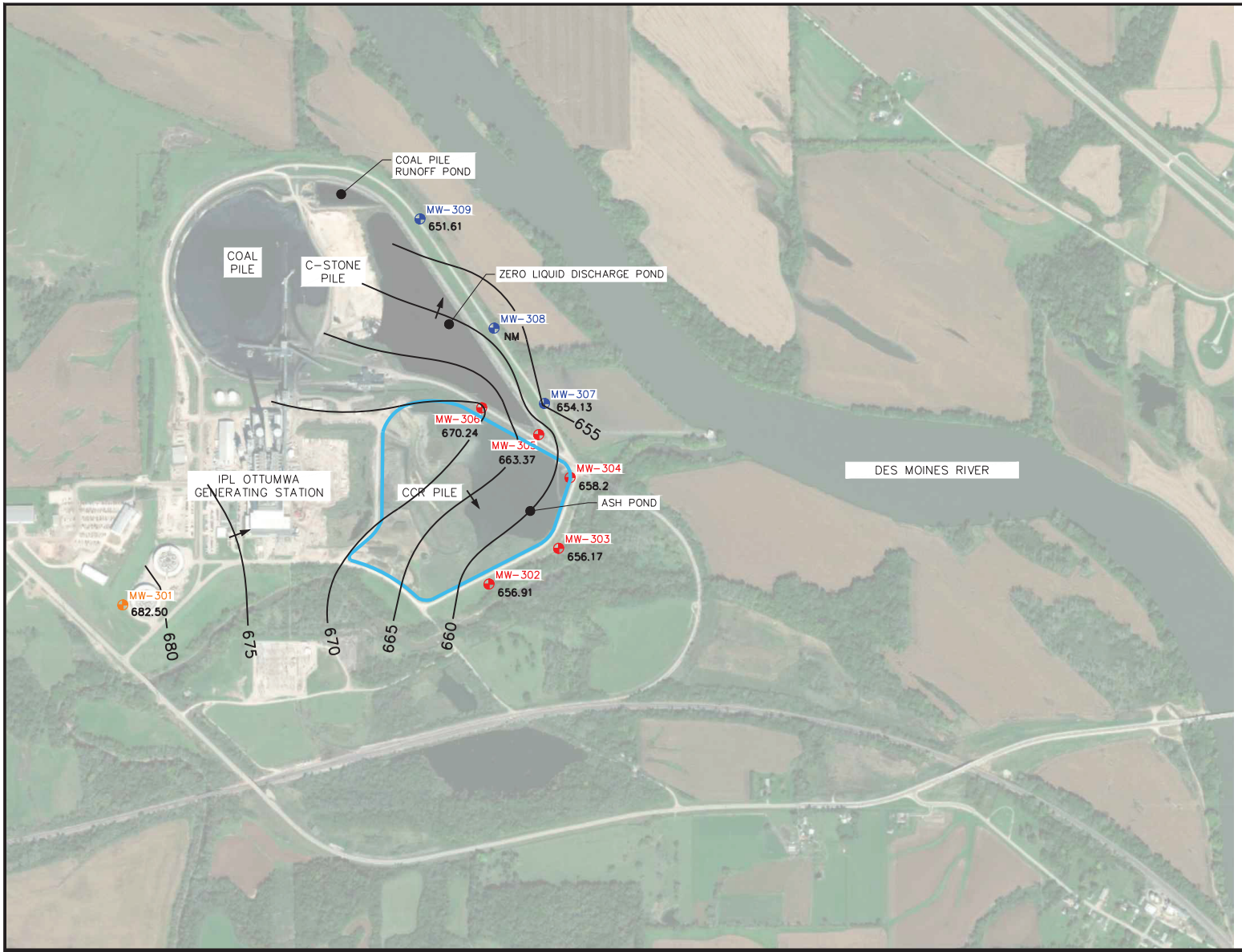
CLIENT: INTERSTATE POWER AND LIGHT CO.
20775 POWER PLANT ROAD
OTTUMWA, IA 52501

SITE: ALLIANT ENERGY
OTTUMWA GENERATING STATION
OTTUMWA, IOWA

SHALLOW POTENTIOMETRIC SURFACE
APRIL 18, 2018

FIGURE 3

I:\25222072.00\Drawings\Potentiometric Surface Ash Pond.dwg, 4/8/2022 8:21:52 AM



LEGEND

- CCR UNIT
- CCR ZLDP MONITORING WELL
- CCR ASH POND MONITORING WELL
- CCR BACKGROUND MONITORING WELL
- 682.15 — POTENTIOMETRIC ELEVATION AT WELL (OCTOBER 16, 2018)
- NM — NOT MEASURED
- POTENTIOMETRIC SURFACE CONTOUR
- APPROXIMATE GROUNDWATER FLOW DIRECTION

NOTE:

1. THE BACKGROUND MONITORING WELL FOR THE OGS ASH POND IS MW-301.

N

800 0 800

SCALE: 1" = 800'

PROJECT NO.	25222072.00	DRAWN BY:	KP
DRAWN:	04/06/2022	CHECKED BY:	NDK
REVISED:	04/06/2022	APPROVED BY:	TK 05/03/2022

ENGINEER: SCS ENGINEERS
2830 DAIRY DRIVE MADISON, WI 53718-6751
PHONE: (608) 224-2830

CLIENT: INTERSTATE POWER AND LIGHT CO.
20775 POWER PLANT ROAD
OTTUMWA, IA 52501

SITE: ALLIANT ENERGY
OTTUMWA GENERATING STATION
OTTUMWA, IOWA

SHALLOW POTENTIOMETRIC SURFACE
OCTOBER 16, 2018

FIGURE 4

I:\25222072.00\Drawings\Potentiometric Surface Ash Pond.dwg, 4/8/2022 8:21:57 AM

Appendix A

Regional Hydrogeologic Information

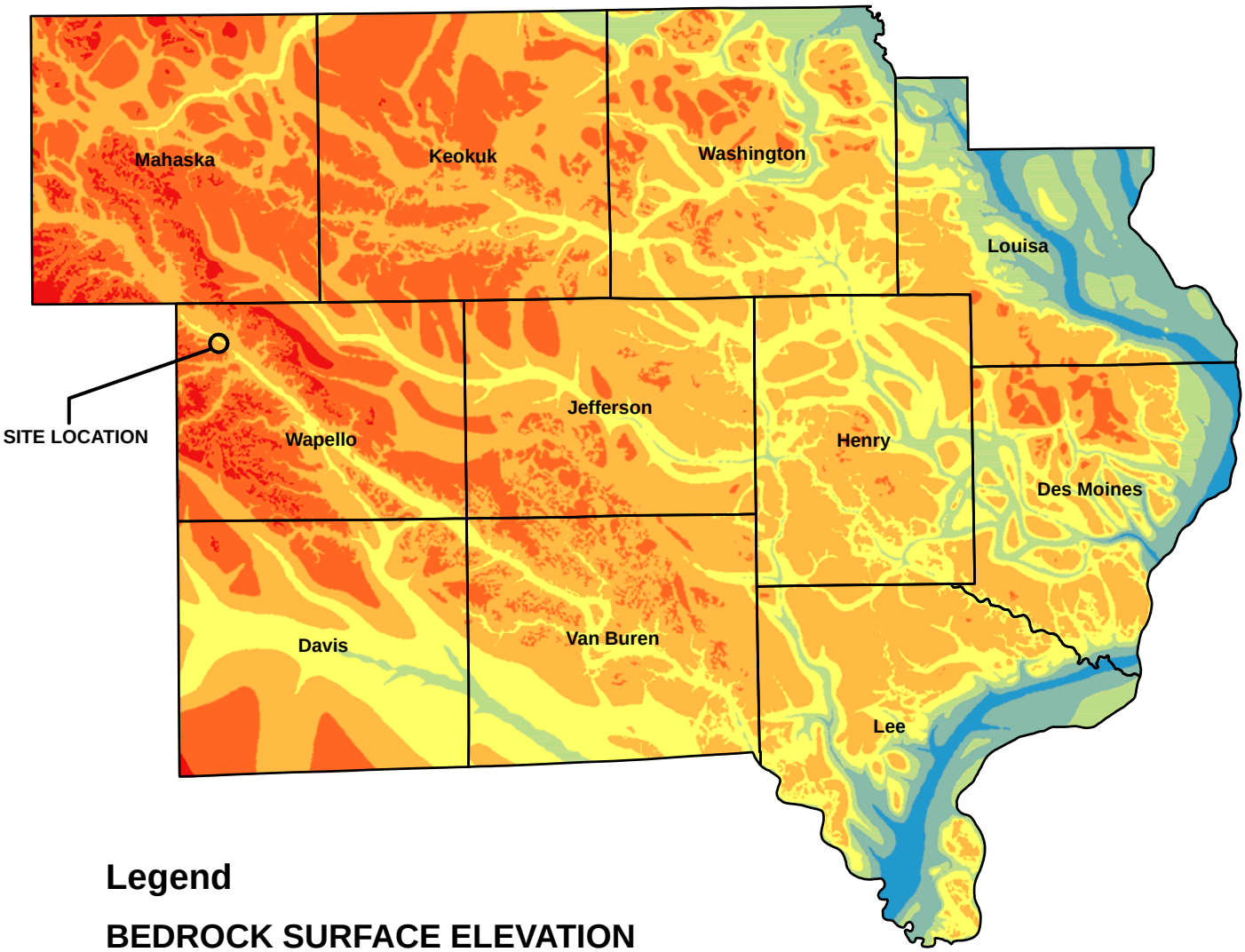
Table OGS-2. Regional Hydrogeologic Stratigraphy
Ottumwa Midland Landfill / SCS Engineers Project #25215053.01

Age of Rocks	Hydrogeologic Unit	General Thickness (feet)	Name of Rock Unit*	Type of Rock
Quaternary (0-1 million years old)	Surficial Aquifers • Alluvial • Buried-Channel • Drift	0 to 320	Undifferentiated	• Sand, gravel, silt, and clay • Sand, gravel, silt, and clay • Till (sandy, pebbly clay), sand, and silt
Pennsylvanian (180 to 310 million years old)	Aquiclude	0 to 370	Undifferentiated	• Shale, sandstone, limestone, and coal
Mississippian (310 to 345 million years old	Mississippian Aquifer • Upper	0 to 600	St. Louis Spergen	• Limestone and sandstone • Limestone
	• Lower		Warsaw Keokuk Burlington Hampton Starrs Cave	• Shale and dolomite • Dolomite, limestone, and shale • Dolomite and limestone • Limestone and dolomite • Limestone
	Aquiclude	0 to 425	Prospect Hill McCraney	• Siltstone • Limestone
Devonian (345 to 400 million years old)			Yellow Spring Lime Creek	• Shale, dolomite, and siltstone • Dolomite and shale
	Devonian Aquifer	110 to 420	Cedar Valley Wapsipinicon	• Limestone and dolomite • Dolomite, limestone, shale, and gypsum
Silurian (400 to 425 million years old)		0 to 105	Undifferentiated	• Dolomite
Ordovician (425 to 500 million years old)	Aquiclude	150 to 600	Maquoketa Galena Decorah Platteville	• Dolomite and shale • Dolomite and chert • Limestone and shale • Limestone, shale, and sandstone
	Cambrian-Ordovician aquifer	750 to 1,110	St. Peter Prairie du Chien	• Sandstone • Dolomite and sandstone
Cambrian (500 to 600 million years old)			Jordan St. Lawrence	• Sandstone • Dolomite
	Not considered an aquifer in southeast Iowa	450 to 750+	Franconia Galesville Eau Claire Mt. Simon	• Shale, siltstone, and sandstone • Sandstone • Sandstone, shale, and dolomite • Sandstone
Precambrian (600 million to 2 billion + years old)				• Sandstone, igneous rocks, and metamorphic rocks

*This nomenclature and classification of rock units in this report are those of the Iowa Geological Survey and do not necessarily coincide with those accepted by the U.S. Geological Survey.

Source: "Water Resources of Southeast Iowa," Iowa Geologic Survey Water Atlas No. 4.

I:\25215053\Reports\Report 1 - OML\Table_Regional_Hydrogeologic_Stratigraphy.doc



Legend

BEDROCK SURFACE ELEVATION

ELEVATION ABOVE MEAN SEA LEVEL IN FEET

- BELOW 300
- 300 TO 400
- 400 TO 500
- 500 TO 600
- 600 TO 700
- 700 TO 800
- 800 TO 900

N

0 5 10 20 Miles

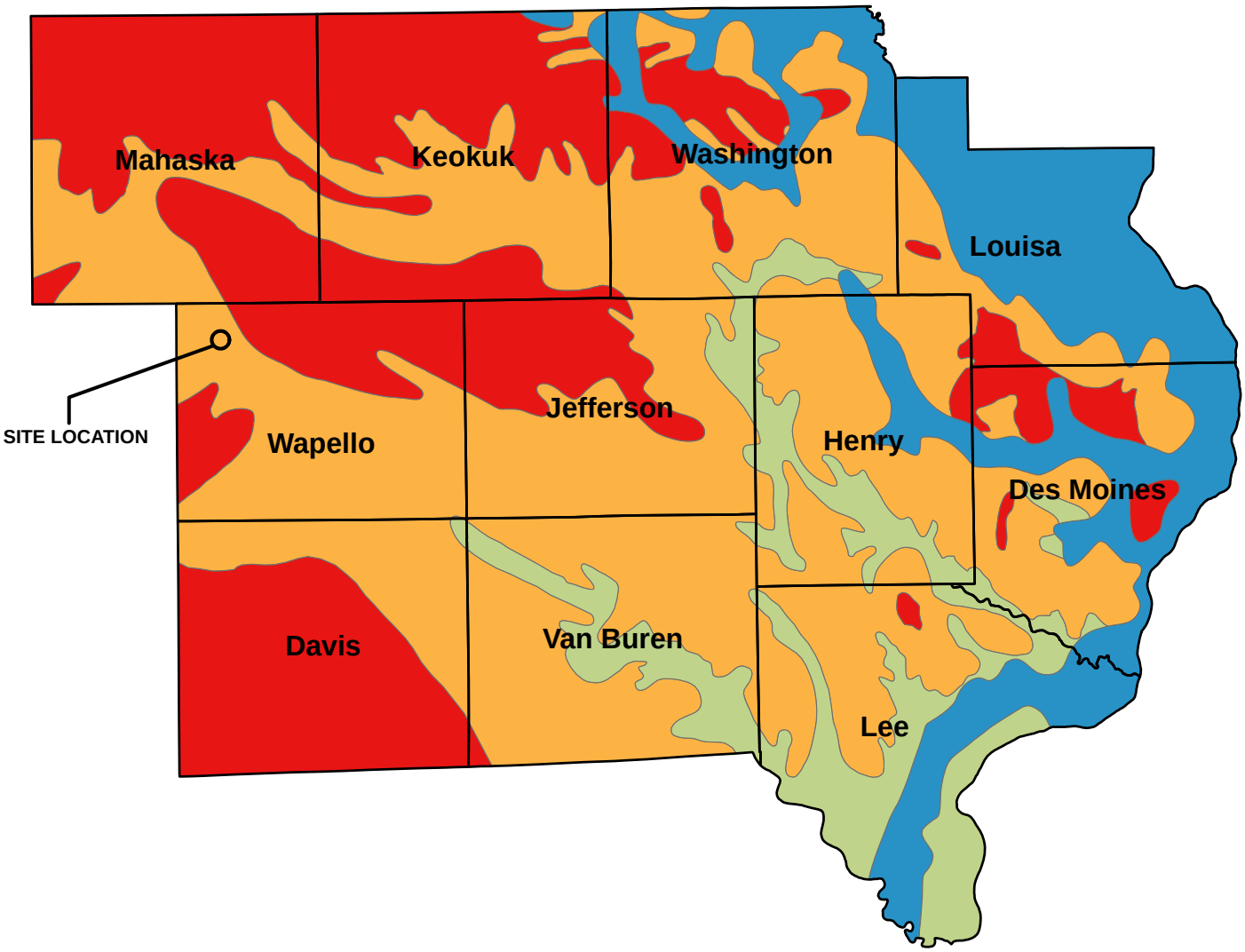
MAP DATA DERIVED FROM IOWA GEOLOGICAL AND WATER SURVEY
IOWA BEDROCK SURFACE ELEVATION AS OBTAINED
FROM IOWA NATURAL RESOURCES
GEOGRAPHIC INFORMATION SYSTEMS LIBRARY

CLIENT	INTERSTATE POWER AND LIGHT CO. 20775 POWER PLANT ROAD OTTUMWA, IA 52501	SITE	OTTUMWA GENERATING STATION OTTUMWA, IOWA	SE IOWA REGIONAL BEDROCK SURFACE ELEVATION

PROJECT NO.	25215053.03	DRAWN BY:	JB	ENGINEER	FIGURE
DRAWN:	07/29/13	CHECKED BY:	MDB		
REVISED:	05/29/15	APPROVED BY:	TK 05/03/2022		

SCS ENGINEERS
2830 DAIRY DRIVE MADISON, WI 53718-6751
PHONE: (608) 224-2830 FAX: (608) 224-2839

I:\25215053\Drawings\OGS\ArcMAP\OML-BEDROCK TOPO 8.5X11 portrait.mxd



Legend

MISSISSIPIAN AQUIFER POTENTIOMETRIC SURFACE

ELEVATION ABOVE MEAN SEA LEVEL IN FEET

- MISSISSIPPIAN NOT PRESENT
- 550
- 650
- 750

N

0 5 10 20 Miles

MAP DATA DERIVED FROM IOWA GEOLOGICAL AND WATER SURVEY
MISSISSIPIAN AQUIFER POTENTIOMETRIC SURFACE ELEVATION AS OBTAINED
FROM IOWA NATURAL RESOURCES
GEOGRAPHIC INFORMATION SYSTEMS LIBRARY

CLIENT	INTERSTATE POWER AND LIGHT CO. 20775 POWER PLANT ROAD OTTUMWA, IA 52501	SITE	OTTUMWA GENERATING STATION OTTUMWA, IOWA

SE IOWA
REGIONAL MISSISSIPIAN AQUIFER
POTENTIOMETRIC SURFACE ELEVATION

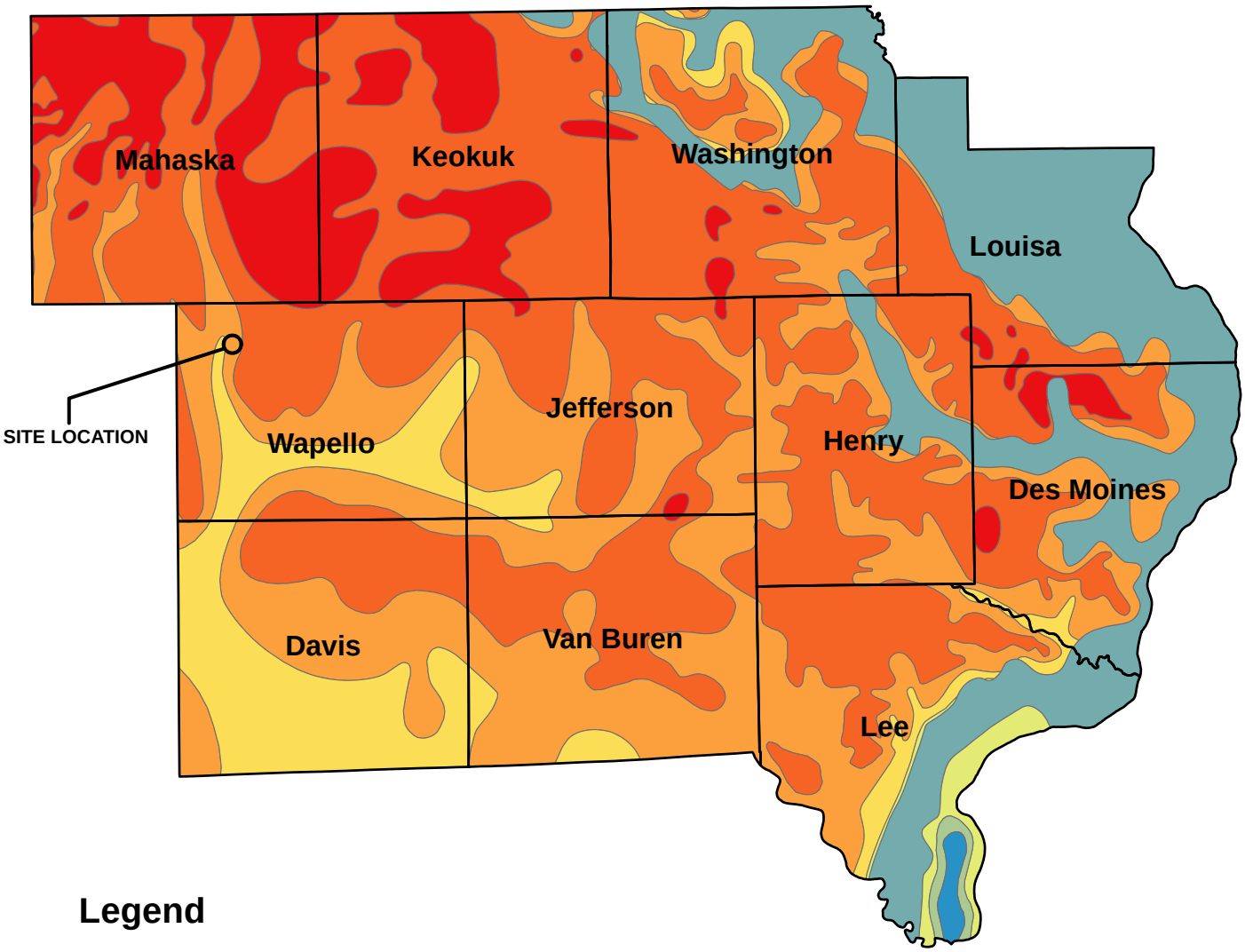
PROJECT NO.	25215053.03	DRAWN BY:	JB
DRAWN:	07/29/13	CHECKED BY:	MDB
REVISED:	05/29/15	APPROVED BY:	TK 05/03/2022

ENGINEER

SCS ENGINEERS
2830 DAIRY DRIVE MADISON, WI 53718-6751
PHONE: (608) 224-2830 FAX: (608) 224-2839

FIGURE

I:\25215053\Drawings\OGS\ArcMAP\OML-MISSISS POTENT 8.5X11 portrait.mxd



Legend

MISSISSIPIAN AQUIFER ELEVATION

ELEVATION ABOVE MEAN SEA LEVEL IN FEET

- MISSISSIPPIAN NOT PRESENT
- 150
- 250
- 350
- 450
- 550
- 650
- 750

N

0 5 10 20 Miles

MAP DATA DERIVED FROM IOWA GEOLOGICAL AND WATER SURVEY
MISSISSIPPIAN AQUIFER SURFACE ELEVATION AS OBTAINED
FROM IOWA NATURAL RESOURCES
GEOGRAPHIC INFORMATION SYSTEMS LIBRARY

CLIENT	INTERSTATE POWER AND LIGHT CO. 20775 POWER PLANT ROAD OTTUMWA, IA 52501	SITE	OTTUMWA GENERATING STATION OTTUMWA, IOWA	SE IOWA REGIONAL MISSISSIPIAN AQUIFER SURFACE ELEVATION

PROJECT NO.	25215053.03	DRAWN BY:	JB	ENGINEER	FIGURE
DRAWN:	07/29/13	CHECKED BY:	MDB		
REVISED:	05/29/15	APPROVED BY:	TK 05/03/2022		

SCS ENGINEERS
2830 DAIRY DRIVE MADISON, WI 53718-6751
PHONE: (608) 224-2830 FAX: (608) 224-2839

I:\25215053\Drawings\OGS\ArcMAP\OML-MISSISS TOPO 8.5X11 portrait.mxd

Appendix B

Boring Logs and Well Construction Documentation

SCS ENGINEERS
Environmental Consultants and Contractors

SOIL BORING LOG INFORMATION

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☐ Other ☐

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
IPL- Ottumwa Generating Station SCS#: 25215135.40		MW-301

Boring Drilled By: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
Todd Schmalfeld Cascade Drilling	11/10/2015	11/10/2015	4-1/4 hollow stem auger

Unique Well No.	DNR Well ID No.	Common Well Name	Final Static Water Level	Surface Elevation	Borehole Diameter
		MW-301	Feet	684.3 Feet	8.5 in

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☒
State Plane 400,077 N, 1,899,709 E S/C/N
NW 1/4 of SW 1/4 of Section 26, T 73 N, R 15 W
Lat ° ' "
Long ° ' "
Local Grid Location ☐ N Feet ☐ S ☐ E Feet ☐ W

Facility ID	County	Civil Town/City/ or Village
	Wapello	Ottumwa

Sample Number and Type	Sample Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			1	TOPSOIL.	TOPSOIL									
			2	SANDY SILT WITH GRAVEL, gray (7.5YR 6/1), gravel is fine.										
			3											
			4		ML									
S1	10	woh 1 3 9	5							W				
			6											
			7	WEATHERED SANDSTONE, very weak, light gray matrix (10YR 7/1), scondary color very dark gray 910YR 3/1), massive.										
S2	13	24 50	8							W				
			9											
			10											
S3	5	50	11		SANDSTONE					W				
			12											
S4	6	50	13							W				
			14											
S5	4	50	15							W				
				Endo of Boring at 15 feet bgs.										

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature	Firm	
for Kyle Kramer	SCS Engineers 2830 Dairy Drive Madison, WI 53718	Tel: (608) 224-2830 Fax:

SCS ENGINEERS
Environmental Consultants and Contractors

SOIL BORING LOG INFORMATION

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☐ Other ☐

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
IPL- Ottumwa Generating Station SCS#: 25215135.40		MW-302

Boring Drilled By: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
Todd Schmalfeld Cascade Drilling	11/10/2015	11/10/2015	4-1/4 hollow stem auger

Unique Well No.	DNR Well ID No.	Common Well Name	Final Static Water Level	Surface Elevation	Borehole Diameter
		MW-302	Feet	671.6 Feet	8.5 in

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☒
State Plane 400,267 N, 1,902,625 E S/C/N
NE 1/4 of SE 1/4 of Section 26, T 73 N, R 15 W
Lat ° ' "
Long ° ' "
Local Grid Location ☐ N ☐ E Feet ☐ S Feet ☐ W

Facility ID	County	Civil Town/City/ or Village
	Wapello	Ottumwa

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			1	TOPSOIL.	TOPSOIL									
			2	LEAN CLAY WITH SAND, dark gray (10YR 4/1).										
			3											
			4											
			5											
			6											
			7		CL									
			8											
			9											
			10											
S1	19	1 4 5 7	11							M				
			12											
S2	19	2 4 7 11	13							M				
			14	LEAN CLAY WITH SAND, very dark gray (5Y 3/1).										
			15		CL									
			16											

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature for Kyle Kramer
Firm SCS Engineers
2830 Dairy Drive Madison, WI 53718
Tel: (608) 224-2830
Fax:

Boring Number MW-302 Page 2 of 2

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
S3	24	2 3 9 9	17	POORLY GRADED SAND, olive yellow (2.5Y 6/6).	SP					M				
			18	LEAN CLAY, dark grayish brown (10YR 4/2).	CL									
S4	24	4 4 4 4	19	POORLY GRADED GRAVEL, fine.	GP					W				saturation @ 18 ft bgs.
			20	LEAN CLAY, brownish yellow (10YR 6/8).	CL									
S5	15	2 3 3 6	21	POORLY GRADED GRAVEL WITH CLAY, gray (10YR 5/1), fine.	GP-GC					W				
			22											
S6	24	3 4 8 9	23							W				
			24	POORLY GRADED SAND, gray (10YR 5/1), medium grained.	SP									
			25											
S7	24	4 3 6 8	26							W				
			27											
			28	Same as above, but brown (10YR 5/3).										
S8	24	7 8 11 9	29	POORLY GRADED SAND, gray (10YR 5/1), fine grained, (weathered bedrock?).	SP					W				
			30	Medium grained.										
S9	23	5 14 33 50/.4	31							W				
			32											
			33											
S10	12	12 50/.3	34							W				
			35	POORLY GRADED SAND, olive yellow (2.5Y 7/1), fine grained, (weathered bedrock?).	SP									
S11	3	50/.3	36							W				
			37	End of Boring at 37 feet bgs.										

SCS ENGINEERS
Environmental Consultants and Contractors

SOIL BORING LOG INFORMATION

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☐ Other ☐

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
IPL- Ottumwa Generating Station SCS#: 25215135.40		MW-303

Boring Drilled By: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
Todd Schmalfeld Cascade Drilling	12/8/2015	12/8/2015	4-1/4 hollow stem auger

Unique Well No.	DNR Well ID No.	Common Well Name	Final Static Water Level	Surface Elevation	Borehole Diameter
		MW-303	Feet	659.0 Feet	8.5 in

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☒
State Plane 400,583 N, 1,903,215 E S/C/N
NE 1/4 of SE 1/4 of Section 26, T 73 N, R 15 W
Lat ___ ° ___ ' ___ "
Long ___ ° ___ ' ___ "
Local Grid Location ☐ N ☐ E Feet ☐ S Feet ☐ W

Facility ID	County	Civil Town/City/ or Village
	Wapello	Ottumwa

Sample Number and Type	Sample Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			1–8	FILL, boring location was cleared to 9' bgs by hydrovac, then back filled.	FILL									
S1	1	50	9–12	WEATHERED SANDSTONE, medium grained, brown (10YR 5/4).	SANDSTONE					W				
S2	NR		13–14											
				End of Boring at 14.5 ft bgs.										

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature for Kyle Kramer
Firm SCS Engineers
2830 Dairy Drive Madison, WI 53718
Tel: (608) 224-2830
Fax:

SCS ENGINEERS
Environmental Consultants and Contractors

SOIL BORING LOG INFORMATION

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☐ Other ☐

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
IPL- Ottumwa Generating Station SCS#: 25215135.40		MW-304

Boring Drilled By: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
Todd Schmalfeld Cascade Drilling	11/11/2015	11/11/2015	4-1/4 hollow stem auger

Unique Well No.	DNR Well ID No.	Common Well Name	Final Static Water Level	Surface Elevation	Borehole Diameter
		MW-304	Feet	680.1 Feet	8.5 in

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☒
State Plane 401,152 N, 1,903,287 E S/C/N
SE 1/4 of NE 1/4 of Section 26, T 73 N, R 15 W
Lat ° ' "
Long ° ' "
Local Grid Location ☐ N Feet ☐ S ☐ E Feet ☐ W

Facility ID	County	Civil Town/City/ or Village
	Wapello	Ottumwa

Sample Number and Type	Sample Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			1	TOPSOIL.	TOPSOIL									
			2	FAT CLAY, black (10YR 2/1).										
			3											
			4											
			5											
			6											
			7		CH									
			8											
			9											
			10											
S1	23	4 5 4 5	11							M				
			12											
			13	FAT CLAY, yellowish brown (10YR 5/4).										
S2	19.5	4 4 5 5	14		CH					M				
			15	FAT CLAY, yellowish brown (10YR 3/4).										
			16		CH									

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature for Kyle Kramer

Firm SCS Engineers
2830 Dairy Drive Madison, WI 53718

Tel: (608) 224-2830
Fax:

Boring Number MW-304

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
S3	12	3 3 4 5	17	FAT CLAY, yellowish brown (10YR 3/4). *(continued)*						M				
S4	22	4 3 7 12	18 19							M				
S5	23	2 7 8 9	20 21							M				
S6	23	3 4 8 6	22 23 24							M				
S7	23	5 11 15 11	25 26		CH					M				
S8	15	4 4 5 6	27 28 29							M				
S9	18	4 6 9 9	30 31							M				
S10	24	4 6 7 6	32 33 34							M				
S11	16	2 2 4 6	35 36	FAT CLAY, DARK OLIVE BROWN (2.5Y 3/3).						M				
S12	24	4 3 5 5	37 38 39		CH					M				
S13	18	2 3 3 3	40 41							M				
			42											

Boring Number MW-304 Page 3 of 3

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Soil Properties: Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			43	FAT CLAY, DARK OLIVE BROWN (2.5Y 3/3). *(continued)*	CH									
S14	24	3 4 9 14	44	SANDY SILT, very dark gray.	ML					W				
				POORLY GRADED SAND, medium grained, gray (5Y 6/1), (weathered bedrock).										
			45											
S16	15	30 50/.4	46							W				
			47											
			48		SP									
S17	5	33 50/.2	49							W				
			50											
S18		50/.4	51							W				
			52	End of Boring at 52 feet bgs.										

SCS ENGINEERS
Environmental Consultants and Contractors

SOIL BORING LOG INFORMATION

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☐ Other ☐

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
IPL- Ottumwa Generating Station SCS#: 25215135.40		MW-305

Boring Drilled By: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
Todd Schmalfeld Cascade Drilling	12/7/2015	12/8/2015	4-1/4 hollow stem auger

Unique Well No.	DNR Well ID No.	Common Well Name	Final Static Water Level	Surface Elevation	Borehole Diameter
		MW-305	Feet	681.5 Feet	8.5 in

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☒
State Plane 401,473 N, 1,903,023 E S/C/N
SE 1/4 of NE 1/4 of Section 26, T 73 N, R 15 W
Lat ° ' "
Long ° ' "
Local Grid Location ☐ N ☐ E Feet ☐ S Feet ☐ W

Facility ID	County	Civil Town/City/ or Village
	Wapello	Ottumwa

Sample Number and Type	Sample Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			1	TOPSOIL	TOPSOIL									
				GRAVEL	GP									
			2	FAT CLAY										
			3											
			4											
			5											
			6											
			7											
			8											
			9		CH									
			10	FAT CLAY, very dark grayish brown (10YR 3/2).										
S1	18	3 6 9 11	11							W				
			12											
			13	same as above except, brown (10YR 4/3).										
S2	22	3 7 14 22	14							W				
			15											
			16											

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature for Kyle Kramer
Firm SCS Engineers
2830 Dairy Drive Madison, WI 53718
Tel: (608) 224-2830
Fax:

Boring Number MW-305 Page 2 of 3

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
S3	22	5 15 14 15	17	FAT CLAY *(continued)*										
S4	20	3 5 13 15	18 19 20		CH									
S5	24	4 5 7 11	21 22	FAT CLAY WITH SILT, dark gray (10YR 4/1).						M				
S6	20	7 11 15 20	23 24	same as above except, very dark brown (10YR 2/2).						M				
S7	24	4 8 11 12	25 26 27	same as above except, very dark gray (10YR 3/1).	CH					M				
S8	24	8 12 16 21	28 29							M				
S9	13	4 4 7 12	30 31 32							M				
S10	24	5 6 9	33 34	LEAN CLAY, very dark brown (10YR 2/2).						W				
S11	24	4 4 5 7	35 36 37		CL					W				
S12	22	2 2 3 5	38 39 40	same as above except, very dark grayish brown (10YR 3/2).						W				
S13	6	3 9 11	41 42	POORLY GRADED SANDY GRAVEL, fine, brown (10YR 4/3).	GPS					W				water @ 41.0 ft bgs.

Boring Number MW-305 Page 3 of 3

Sample Number and Type	Sample Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Standard Penetration	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/ Comments
S14	22	23 50	43	POORLY GRADED SAND, medium grained, yellowish brown (10YR 5/4), (weathered bedrock). *(continued)*	SP					S				
			44											
			45											
S15	6	5 10 50	46		SP					S				
			47											
			48											
S16	6	50	49							S				
			50	End of Boring at 50 ft bgs.										

SCS ENGINEERS
Environmental Consultants and Contractors

SOIL BORING LOG INFORMATION

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☐ Other ☐

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
IPL- Ottumwa Generating Station SCS#: 25215135.40		MW-306

Boring Drilled By: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
Todd Schmalfeld Cascade Drilling	11/12/2015	11/12/2015	4-1/4 hollow stem auger

Unique Well No.	DNR Well ID No.	Common Well Name	Final Static Water Level	Surface Elevation	Borehole Diameter
		MW-306	Feet	681.1 Feet	8.5 in

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☒
State Plane 401,666 N, 1,902,629 E S/C/N
SE 1/4 of NE 1/4 of Section 26, T 73 N, R 15 W
Lat ° ' "
Long ° ' "
Local Grid Location ☐ N Feet ☐ S ☐ E Feet ☐ W

Facility ID	County	Civil Town/City/ or Village
	Wapello	Ottumwa

Sample Number and Type	Sample Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			1	TOPSOIL.	TOPSOIL									
			1	FAT CLAY, dark olive brown (2.5Y 3/3).										
			2											
			3											
			4											
			5											
			6											
			7		CH									
			8											
			9											
			10											
S1	18	3 6 9 11	11							M				
			12											
			13	FAT CLAY, gray (10YR 5/1).										
S2	22	5 6 7 9	14							M				
			15		CH									
			16											

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature for Kyle Kramer

Firm SCS Engineers
2830 Dairy Drive Madison, WI 53718

Tel: (608) 224-2830
Fax:

Boring Number MW-306 Page 2 of 2

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
S3	22	5 10 10 14	17	FAT CLAY, gray (10YR 5/1). *(continued)* FAT CLAY, gray (10YR 5/1).	CH					M				
			18	FAT CLAY, dark olive brown (2.5Y 3/3).										
S4	13	5 8 14 17	19							M				
			20											
S5	15	5 6 13 16	21							W				
			22		CH									
			23											
S6	15	3 5 7 9	24							W				
			25											
S7	22	2 5 7 11	26	POORLY GRADED SAND, very dark grayish brown (10YR 3/2), medium to coarse grained, (weathered bedrock?).						W				
			27											
S8	NR	7 3 4 3	28							W				
			29											
			30		SP									
S9	18	1 1 2 2	31							W				
			32											
			33											
S10	13	WOR	34							W				
				End of Boring at 34.5 feet bgs.										

SCS ENGINEERS
Environmental Consultants and Contractors

SOIL BORING LOG INFORMATION

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☐ Other ☐

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
IPL-Ottumwa Generating Station SCS#: 25216148.00		MW-307

Boring Drilled By: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
Mike Mueller Cascade Drilling	10/25/2016	10/25/2016	HSA

Unique Well No.	DNR Well ID No.	Common Well Name	Final Static Water Level	Surface Elevation	Borehole Diameter
		MW-307	Feet	655.1 Feet	8.5 in

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☒
State Plane 401,707 N, 1,903,070 E S/C/N
NE 1/4 of SE 1/4 of Section 26, T 73 N, R 15 W
Lat ° ' "
Long ° ' "
Local Grid Location ☐ N ☐ E Feet ☐ S Feet ☐ W

Facility ID	County	Civil Town/City/ or Village
	Wapello	Ottumwa

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			1	POORLY GRADED SAND WITH GRAVEL, tan, fine to coarse sand and gravel, (construction fill sand to fill in hydrovac hole cleared to 8.5 ft bgs).	SP									
			2											
			3											
			4											
			5											
			6											
			7											water level 6.5 ft bgs.
			8											
			9											
S1	24	2 2 3 2	10							W				
			11	LEAN CLAY, dark yellowish brown (10YR 4/4), slightly dense.	CL									
			12											
			13											
S2	14	4 1 4 4	14							W				
			15											

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature	Firm	Tel: (608) 224-2830
	SCS Engineers 2830 Dairy Drive Madison, WI 53711	Fax:

Boring Number MW-307 Page 2 of 2

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			16	LEAN CLAY, dark yellowish brown (10YR 4/4), slightly dense. *(continued)*	CL									
S3	24	1 2 2 4	16	SILT, dark yellowish brown (10YR 3/4), fine to medium sand.						W				
			17											
			18		ML									
S4	17	3 3 3	19							W				Bedrock @19.5 ft bgs.
			20	SANDSTONE, dark brown (10YR 3/3),										
S5	5	50/0.5	21							W				More competent @20.5' -24.5' bgs.
			22											
			23											
			24											
			25	more weathered.										
			26											
			27											
S6	1	100	28	Same as above except, gray (10YR 6/1).										
				End of boring at 28 ft bgs.										

SCS ENGINEERS
Environmental Consultants and Contractors

SOIL BORING LOG INFORMATION

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☐ Other ☐

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
IPL-Ottumwa Generating Station SCS#: 25216148.00		MW-308

Boring Drilled By: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
Mike Mueller Cascade Drilling	10/25/2016	10/25/2016	HSA

Unique Well No.	DNR Well ID No.	Common Well Name	Final Static Water Level	Surface Elevation	Borehole Diameter
		MW-308	Feet	652.9 Feet	8.5 in

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☒
State Plane 402,312 N, 1,902,665 E S/C/N
NE 1/4 of SE 1/4 of Section 26, T 73 N, R 15 W
Lat ___ ° ___ ' ___ "
Long ___ ° ___ ' ___ "
Local Grid Location ☐ N ☐ E Feet ☐ S Feet ☐ W

Facility ID	County	Civil Town/City/ or Village
	Wapello	Ottumwa

Sample Number and Type	Sample Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			1–9	POORLY GRADED SAND WITH GRAVEL, tan, fine to coarse sand and gravel, (construction fill sand to fill in hydrovac hole cleared to 9.5 ft bgs).	SP									water @ 6.5 ft bgs.
S1	24	19 4 2 2	10–12	LEAN CLAY, brown (10YR 4/3), dense.	CL					W				
S2	13	1 2 2 2	13–14	SILT, brown (10YR 4/3), some clay.	ML					W				
			15											

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature

Firm SCS Engineers
2830 Dairy Drive Madison, WI 53711

Tel: (608) 224-2830
Fax:

Boring Number MW-308 Page 2 of 2

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			16	SILT, brown (10YR 4/3), some clay. *(continued)*	ML									
S3	18	1 2 1 3		SILTY SAND, brown (10YR 4/3).	SM					W				
			17	POORLY GRADED SAND, brown (10YR 4/3), fine grained.	SP									
			18											
S4	13	4 12 13 3		WELL GRADED SAND AND GRAVEL, dark grayish brown (10YR 3/2), fine to coarse grained, (weathered bedrock).	SW					W				
			19	SANDSTONE, dark grayish brown (10YR 4/2), weathered bedrock.										
S5	6	12 26 50/0.4	20	Same as above except, brown (10YR 4/3).						W				
			21											
			22											
			23											
			24	Same as above except, dark grayish brown (10YR 4/2).										
S6	4	50/0.4	25							W				
				End of boring at 25 ft bgs.										

SCS ENGINEERS
Environmental Consultants and Contractors

SOIL BORING LOG INFORMATION

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☐ Other ☐

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
IPL-Ottumwa Generating Station SCS#: 25216148.00		MW-309

Boring Drilled By: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
Mike Mueller Cascade Drilling	10/27/2016	10/27/2016	HSA

Unique Well No.	DNR Well ID No.	Common Well Name	Final Static Water Level	Surface Elevation	Borehole Diameter
		MW-309	Feet	652.5 Feet	8.5 in

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☒
State Plane 403,189 N, 1,902,070 E S/C/N
NE 1/4 of SE 1/4 of Section 26, T 73 N, R 15 W
Lat ° ' "
Long ° ' "
Local Grid Location ☐ N ☐ E Feet ☐ S Feet ☐ W

Facility ID	County	Civil Town/City/ or Village
	Wapello	Ottumwa

Sample Number and Type	Sample Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			1–9	Hydrovac borehole to 10 ft bgs.										
S1		3 3 6 7	10–11	LEAN CLAY, very dark grayish brown (10YR 3/2), trace sand.	CL					W				
S2		2 2 2 2	12–14							W				
			15											

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature

Firm SCS Engineers
2830 Dairy Drive Madison, WI 53711

Tel: (608) 224-2830
Fax:

SCS ENGINEERS
Environmental Consultants and Contractors

SOIL BORING LOG INFORMATION SUPPLEMENT
Form 4400-122A

Boring Number MW-309

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
S3		1 1 1 1	16	SILTY SAND, very dark grayish brown (10YR 3/2), fine to medium grained.						W				
			17		SM									
S4		3 5 4 6	18 19							W				
				POORLY GRADED SAND, yellowish brown (10YR 5/4), coarse grained.										
			20		SP									
S5		2 3 7 50	21							W				
			22	WEATHERED SANDSTONE.										
			23											
			24											
S6			25							W				
			26											
			27											
				End of boring at 27.5 ft bgs.										

SCS ENGINEERS
Environmental Consultants and Contractors

SOIL BORING LOG INFORMATION

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☐ Other ☐

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
IPL-Ottumwa Generating Station SCS#: 25216148.00		B-309X

Boring Drilled By: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
Mike Mueller Cascade Drilling	10/26/2016	10/26/2016	HSA

Unique Well No.	DNR Well ID No.	Common Well Name	Final Static Water Level	Surface Elevation	Borehole Diameter
			Feet	Feet	8.5 in

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☒
State Plane N, E S/C/N
NE 1/4 of SE 1/4 of Section 26, T 73 N, R 15 W
Lat ° ' "
Long ° ' "
Local Grid Location ☐ N Feet ☐ S ☐ E Feet ☐ W

Facility ID	County	Civil Town/City/ or Village
	Wapello	Ottumwa

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			1–15	POORLY GRADED SAND WITH GRAVEL, tan, fine to coarse sand and gravel, (construction fill sand to fill in hydrovac hole cleared to 9 ft bgs).	SP									Water at 6.5 ft bgs
S1	12	1 3 3 4	9–12	LEAN CLAY, dark brown (10YR 3/3), medium dense.	CL					W				
S2	18	3 3 3 3	13–15	SILT, dark brown (10YR 3/3), some clay.	ML					W				

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature

Firm SCS Engineers
2830 Dairy Drive Madison, WI 53711
Tel: (608) 224-2830
Fax:

Boring Number B-309X

Sample Number and Type	Sample Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Standard Penetration	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/ Comments
			16	SILT, dark brown (10YR 3/3), some clay. *(continued)*	ML									
S3	20	3 3 3 2	17	POORLY GRADED SAND, very dark grayish brown (10YR 3/2), fine grained.	SP					W				
			18	SILT, dark brown (10YR 3/3).	ML									
S4	15	1 17 50/0.2	19	POORLY GRADED SAND, brown (10YR 4/3).	SP					W				Bedrock at18.5 ft bgs
S5	6	50/0.3	20	WEATHERED SANDSTONE, grayish brown (10YR 5/2).						W				
			21											
			22											
			23											
			24											
			25											
			26											
				End of boring at 26.5 ft bgs.										

Print Form

IOWA DEPARTMENT OF NATURAL RESOURCES

MONITORING WELL/PIEZOMETER CONSTRUCTION DOCUMENTATION FORM

Disposal Site Name: IPL - Ottumwa Generating Station Permit No.:

Well or Piezometer No: MW-301

Dates Started: 11/10/15 Date Completed: 11/10/15

A. SURVEYED LOCATIONS AND ELEVATIONS

Locations (± 0.5 ft):

Specify corner of site: SE of Parcel 003052640340000

Distance & direction along boundary: 106' W

Distance & direction from boundary to wall: 306' N

Elevations (± 0.01 ft MSL):

Ground Surface: 684.28

Top of protective casing: 687.12

Top of well casing: 686.63

Benchmark elevation:

Benchmark description:

B. SOIL BORING INFORMATION

Name & Address of Construction Company:
Cascade Drilling, LP
301 Alderson St
Schofield, WI 54476

Name of Driller: Todd Schmalfeld

Drilling Method: HSA

Drilling Fluid: NA

Bore Hole Diameter: 8 inch

Soil Sampling Method: Spoon

Depth of Boring: 15 ft

C. MONITORING WELL INSTALLATION

Casing material: PVC sch 40

Length of casing: 4 ft

Outside casing diameter: 2.38"

Inside casing diameter: 2"

Casing joint type: threaded

Casing/screen joint type: threaded

Screen material: PVC

Screen opening size: 0.010"

Screen length: 10 ft

Depth of well: 14 ft

Filter Pack:

Material: Red Flint

Grain size: #40

Volume: 4 cu. ft.

Seal (minimum 3 ft length above filter pack):

Material: 3/8 inch bentonite chips

Placement method: Gravity

Volume: 8 cu. ft.

Backfill (if different from seal):

Material:

Placement method:

Volume:

Surface seal design:

Material of protective casing: Steel 6 inch

Material of grout between protective casing and well casing: sand

Protective cap:

Material: Steel, vented

Vented: ☐ Yes ☐ No Locking: ☑ Yes ☐ No

Well Cap:

Material: PVC

Vented: ☐ Yes ☑ No

D. GROUNDWATER MEASURMENT (± 0.01 ft below top of inner well casing)

Water level: 3.09 ft Stabilization Time: <5 minutes

Well development method: Surged with block and pumped to reduce turbidity. 435 gallons pumped.

Average depth of frostline: 3.5'

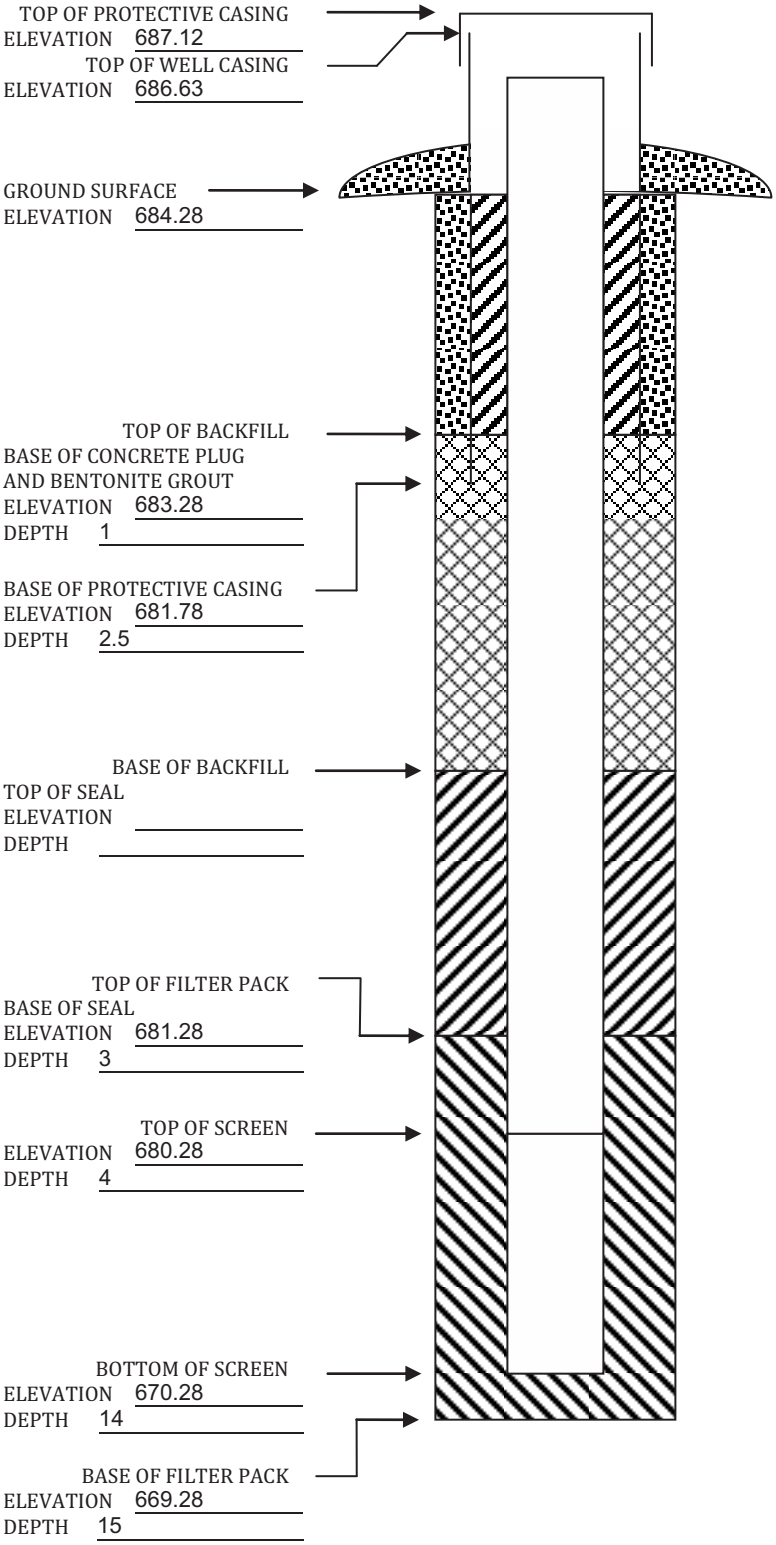
Attachments: Driller's log. Pipe schedules and grouting schedules. 8 ½x11 inch map showing locations of all monitoring wells and piezometers.

Please mail completed for to: Iowa Department of Natural Resources, Land Quality Bureau, 502 E 9th St, Des Moines IA 50319-0034.

Questions? Call or Email: Nina Koger, Environmental Engineer Sr., 515-281-8986, Nina.Koger@dnr.iowa.gov

ELEVATIONS: ± 0.01 ft MSL
DEPTHS: ± 0.1 ft FROM GROUND SURFACE

SPACE TO ATTACH ENTIRE SOIL BORING LOG
(SHOW SCREENED INTERVAL AND FILTER PACK INTERVAL.)



Print Form

IOWA DEPARTMENT OF NATURAL RESOURCES

MONITORING WELL/PIEZOMETER CONSTRUCTION DOCUMENTATION FORM

Disposal Site Name: IPL - Ottumwa Generating Station Permit No.:

Well or Piezometer No: MW-302

Dates Started: 11/10/15 Date Completed: 11/11/15

A. SURVEYED LOCATIONS AND ELEVATIONS

Locations (± 0.5 ft):

Specify corner of site: NW of Parcel 003052630215000

Distance & direction along boundary: 844' NE

Distance & direction from boundary to wall: 4.5' S

Elevations (± 0.01 ft MSL):

Ground Surface: 671.55

Top of protective casing: 674.39

Top of well casing: 673.90

Benchmark elevation:

Benchmark description:

B. SOIL BORING INFORMATION

Name & Address of Construction Company:
Cascade Drilling, LP
301 Alderson St
Schofield, WI 54476

Name of Driller: Todd Schmalfeld

Drilling Method: HSA

Drilling Fluid: NA

Bore Hole Diameter: 8 inch

Soil Sampling Method: Spoon

Depth of Boring: 24 ft

C. MONITORING WELL INSTALLATION

Casing material: PVC sch 40

Length of casing: 13 ft

Outside casing diameter: 2.38"

Inside casing diameter: 2"

Casing joint type: threaded

Casing/screen joint type: threaded

Screen material: PVC

Screen opening size: 0.010

Screen length: 10 ft

Depth of well: 23 ft

Filter Pack:

Material: Red Flint

Grain size: #40

Volume: 3.5 cu. ft

Seal (minimum 3 ft length above filter pack):

Material: 3/8" bentonite chips

Placement method: Gravity

Volume: 2.6 cu. ft

Backfill (if different from seal):

Material: 3/8" bentonite chips

Placement method: Gravity

Volume: 1 cu. ft.

Surface seal design:

Material of protective casing: Steel

Material of grout between protective casing and well casing: sand

Protective cap:

Material: Steel, vented

Vented: ☐ Yes ☐ No Locking: ☑ Yes ☐ No

Well Cap:

Material: PVC

Vented: ☐ Yes ☑ No

D. GROUNDWATER MEASURMENT (± 0.01 ft below top of inner well casing)

Water level: 18.19 Stabilization Time: < 5 min

Well development method: Surged with block and pumped to remove turbidity. 183 gallons purged

Average depth of frostline: 3.5'

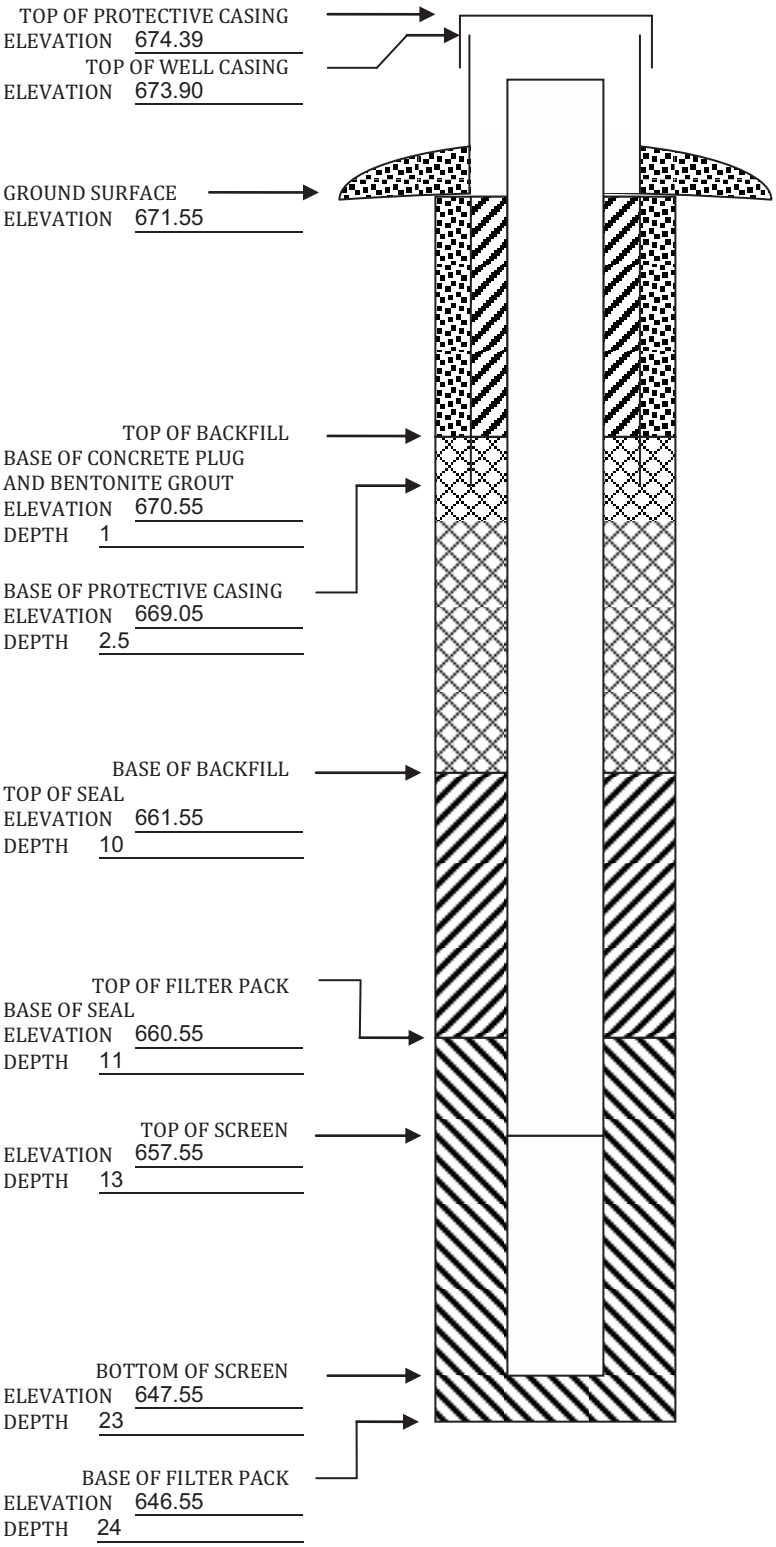
Attachments: Driller's log. Pipe schedules and grouting schedules. 8 ½x11 inch map showing locations of all monitoring wells and piezometers.

Please mail completed for to: Iowa Department of Natural Resources, Land Quality Bureau, 502 E 9th St, Des Moines IA 50319-0034.

Questions? Call or Email: Nina Koger, Environmental Engineer Sr., 515-281-8986, Nina.Koger@dnr.iowa.gov

ELEVATIONS: ± 0.01 ft MSL
DEPTHS: ± 0.1 ft FROM GROUND SURFACE

SPACE TO ATTACH ENTIRE SOIL BORING LOG
(SHOW SCREENED INTERVAL AND FILTER PACK INTERVAL.)



Print Form

IOWA DEPARTMENT OF NATURAL RESOURCES

MONITORING WELL/PIEZOMETER CONSTRUCTION DOCUMENTATION FORM

Disposal Site Name: IPL - Ottumwa Generating Station Permit No.:

Well or Piezometer No: MW-303

Dates Started: 12/8/15 Date Completed: 12/8/15

A. SURVEYED LOCATIONS AND ELEVATIONS

Locations (± 0.5 ft):

Specify corner of site: SE of parcel 003052630207000

Distance & direction along boundary: 181' NW

Distance & direction from boundary to wall: 0

Elevations (± 0.01 ft MSL):

Ground Surface: 658.95

Top of protective casing: 661.67

Top of well casing: 661.07

Benchmark elevation:

Benchmark description:

B. SOIL BORING INFORMATION

Name & Address of Construction Company:
Cascade Drilling, LP
301 Alderson St
Schofield, WI 54476

Name of Driller: Todd Schmalfeld

Drilling Method: HSA

Drilling Fluid: NA

Bore Hole Diameter: 8 inch

Soil Sampling Method: Spoon

Depth of Boring: 14.5 ft

C. MONITORING WELL INSTALLATION

Casing material: PVC sch 80

Length of casing: 3 ft

Outside casing diameter: 2.38"

Inside casing diameter: 2"

Casing joint type: threaded

Casing/screen joint type: threaded

Screen material: PVC

Screen opening size: 0.010

Screen length: 10 ft

Depth of well: 14 ft

Filter Pack:

Material: Red Flint

Grain size: #40

Volume: 7.5 cu. ft.

Seal (minimum 3 ft length above filter pack):

Material: 3/8" bentonite chips

Placement method: Gravity

Volume: 10 cu. ft.

Backfill (if different from seal):

Material:

Placement method:

Volume:

Surface seal design:

Material of protective casing: Steel 6 inch

Material of grout between protective casing and well casing: sand

Protective cap:

Material: Steel, vented

Vented: ☐ Yes ☐ No Locking: ☑ Yes ☐ No

Well Cap:

Material: PVC

Vented: ☐ Yes ☑ No

D. GROUNDWATER MEASURMENT (± 0.01 ft below top of inner well casing)

Water level: 7.71' Stabilization Time: ~ 1 day (bails dry)

Well development method: Bailed dry 3 times to reduce turbidity

Average depth of frostline: 3.5'

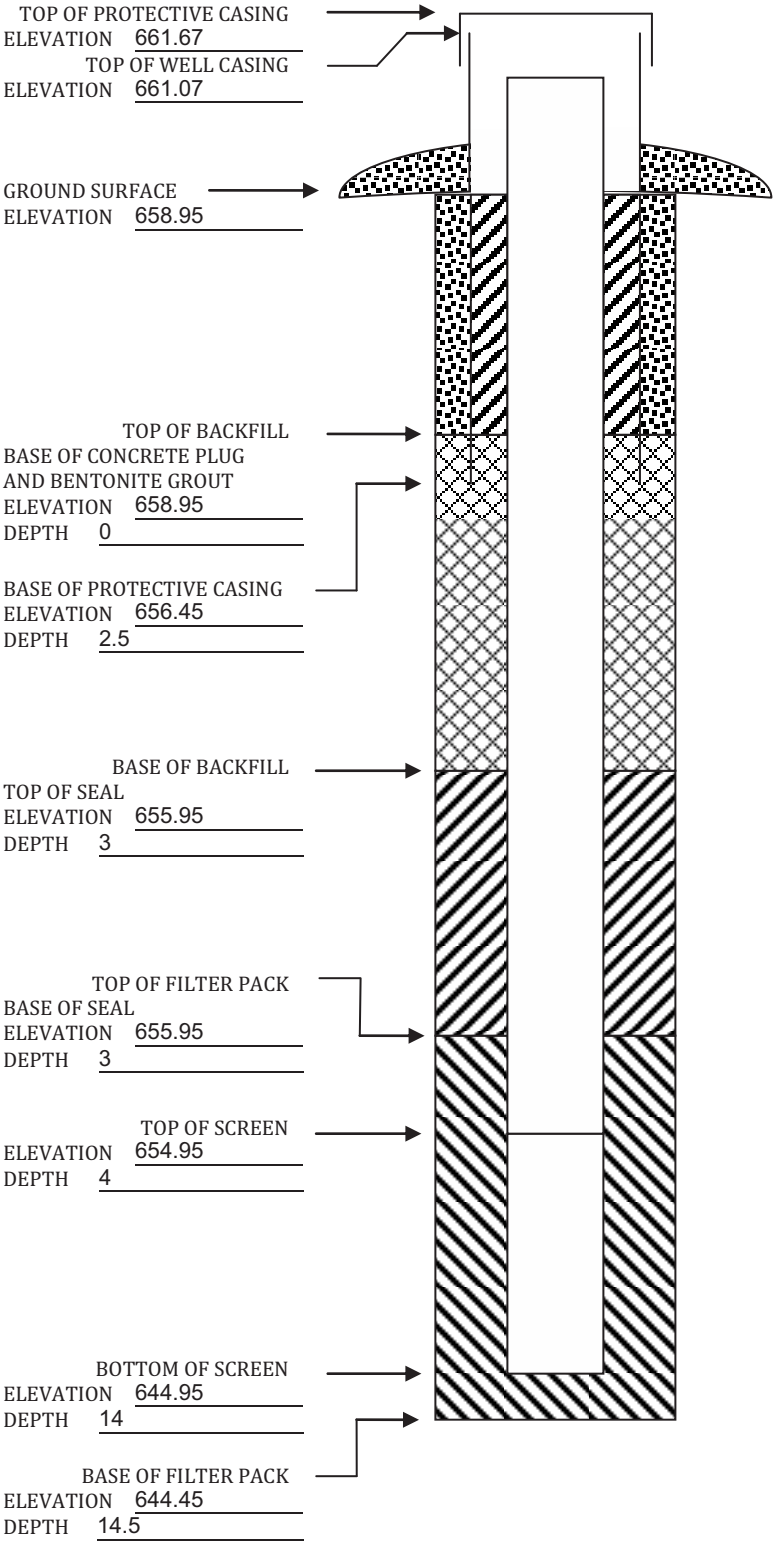
Attachments: Driller's log. Pipe schedules and grouting schedules. 8 ½x11 inch map showing locations of all monitoring wells and piezometers.

Please mail completed for to: Iowa Department of Natural Resources, Land Quality Bureau, 502 E 9th St, Des Moines IA 50319-0034.

Questions? Call or Email: Nina Koger, Environmental Engineer Sr., 515-281-8986, Nina.Koger@dnr.iowa.gov

ELEVATIONS: ± 0.01 ft MSL
DEPTHS: ± 0.1 ft FROM GROUND SURFACE

SPACE TO ATTACH ENTIRE SOIL BORING LOG
(SHOW SCREENED INTERVAL AND FILTER PACK INTERVAL.)



Print Form

IOWA DEPARTMENT OF NATURAL RESOURCES

MONITORING WELL/PIEZOMETER CONSTRUCTION DOCUMENTATION FORM

Disposal Site Name: IPL - Ottumwa Generating Station Permit No.:

Well or Piezometer No: MW-304

Dates Started: 11/11/15 Date Completed: 11/12/15

A. SURVEYED LOCATIONS AND ELEVATIONS

Locations (± 0.5 ft):

Specify corner of site: SE of Parcel 003052620200000

Distance & direction along boundary: 502' W

Distance & direction from boundary to wall: 44' N

Elevations (± 0.01 ft MSL):

Ground Surface: 680.09

Top of protective casing: 683.36

Top of well casing: 682.84

Benchmark elevation:

Benchmark description:

B. SOIL BORING INFORMATION

Name & Address of Construction Company:
Cascade Drilling, LP
301 Alderson St
Schofield, WI 54476

Name of Driller: Todd Schmalfeld

Drilling Method: HSA

Drilling Fluid: NA

Bore Hole Diameter: 8 inch

Soil Sampling Method: Spoon

Depth of Boring: 52 ft

C. MONITORING WELL INSTALLATION

Casing material: PVC sch 40

Length of casing: 40 ft

Outside casing diameter: 2.38"

Inside casing diameter: 2"

Casing joint type: threaded

Casing/screen joint type: threaded

Screen material: PVC

Screen opening size: 0.010"

Screen length: 5 ft

Depth of well: 50 ft

Filter Pack:

Material: Red Flint

Grain size: #40

Volume: 2 cu. ft.

Seal (minimum 3 ft length above filter pack):

Material: 3/8" bentonite chips

Placement method: gravity

Volume: .3 cu. ft.

Backfill (if different from seal):

Material: AquaGuard Grout

Placement method: tremie

Volume: 75 gallons

Surface seal design:

Material of protective casing: Steel

Material of grout between protective casing and well casing: sand

Protective cap:

Material: Steel, vented

Vented: ☐ Yes ☐ No Locking: ☑ Yes ☐ No

Well Cap:

Material: PVC

Vented: ☐ Yes ☑ No

D. GROUNDWATER MEASURMENT (± 0.01 ft below top of inner well casing)

Water level: 24.5 ft Stabilization Time: ~1 day (bails dry)

Well development method: bailed dry 3 times to reduce turbidity

Average depth of frostline: 3.5'

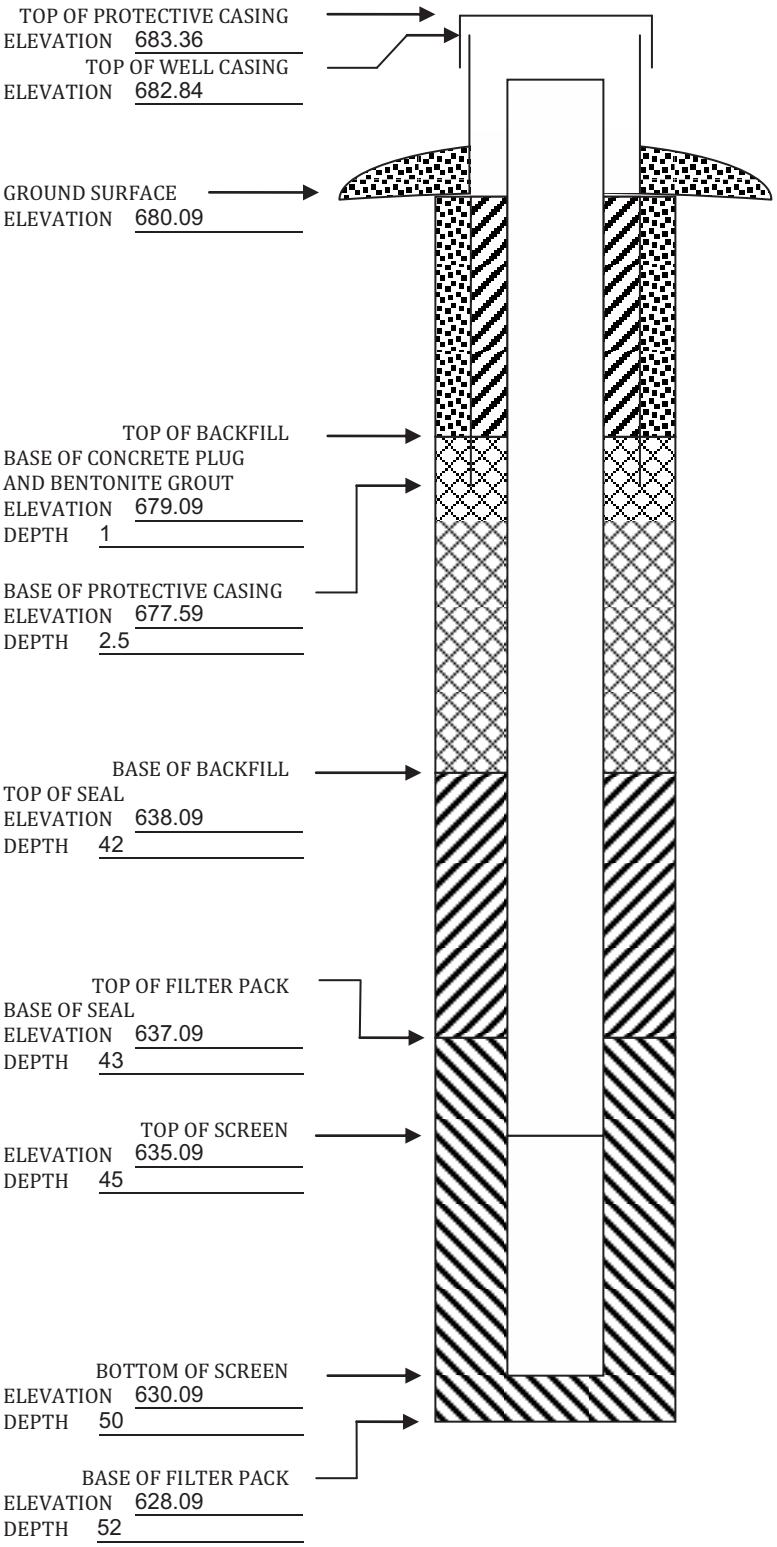
Attachments: Driller's log. Pipe schedules and grouting schedules. 8 ½x11 inch map showing locations of all monitoring wells and piezometers.

Please mail completed for to: Iowa Department of Natural Resources, Land Quality Bureau, 502 E 9th St, Des Moines IA 50319-0034.

Questions? Call or Email: Nina Koger, Environmental Engineer Sr., 515-281-8986, Nina.Koger@dnr.iowa.gov

ELEVATIONS: ± 0.01 ft MSL
DEPTHS: ± 0.1 ft FROM GROUND SURFACE

SPACE TO ATTACH ENTIRE SOIL BORING LOG
(SHOW SCREENED INTERVAL AND FILTER PACK INTERVAL.)



Print Form

IOWA DEPARTMENT OF NATURAL RESOURCES

MONITORING WELL/PIEZOMETER CONSTRUCTION DOCUMENTATION FORM

Disposal Site Name: IPL - Ottumwa Generating Station Permit No.:

Well or Piezometer No: MW-305

Dates Started: 12/7/15 Date Completed: 12/8/15

A. SURVEYED LOCATIONS AND ELEVATIONS

Locations (± 0.5 ft):

Specify corner of site: SW of Parcel 003052620200000

Distance & direction along boundary: 539' E

Distance & direction from boundary to wall: 404' N

Elevations (± 0.01 ft MSL):

Ground Surface: 681.54

Top of protective casing: 684.53

Top of well casing: 683.91

Benchmark elevation:

Benchmark description:

B. SOIL BORING INFORMATION

Name & Address of Construction Company:
Cascade Drilling, LP
301 Alderson St
Schofield, WI 54476

Name of Driller: Todd Schmalfeld

Drilling Method: HSA

Drilling Fluid: NA

Bore Hole Diameter: 8 inch

Soil Sampling Method: Spoon

Depth of Boring: 50 ft

C. MONITORING WELL INSTALLATION

Casing material: PVC sch 80

Length of casing: 44 ft

Outside casing diameter: 2.38"

Inside casing diameter: 2"

Casing joint type: threaded

Casing/screen joint type: threaded

Screen material: PVC

Screen opening size: 0.010

Screen length: 5 ft

Depth of well: 49 ft

Filter Pack:

Material: Red Flint

Grain size: #40

Volume: 2 cu. ft.

Seal (minimum 3 ft length above filter pack):

Material: 3/8" bentonite chips

Placement method: gravity

Volume: .3 cu. ft.

Backfill (if different from seal):

Material: AquaGuard grou

Placement method: tremie

Volume: 80 gallons

Surface seal design:

Material of protective casing: Steel

Material of grout between protective casing and well casing: sand

Protective cap:

Material: Steel, vented

Vented: ☐ Yes ☐ No Locking: ☑ Yes ☐ No

Well Cap:

Material: PVC

Vented: ☐ Yes ☑ No

D. GROUNDWATER MEASURMENT (± 0.01 ft below top of inner well casing)

Water level: 22.02 Stabilization Time: < 5 min

Well development method: Surged with block and pumped to reduce turbidity

Average depth of frostline: 3.5'

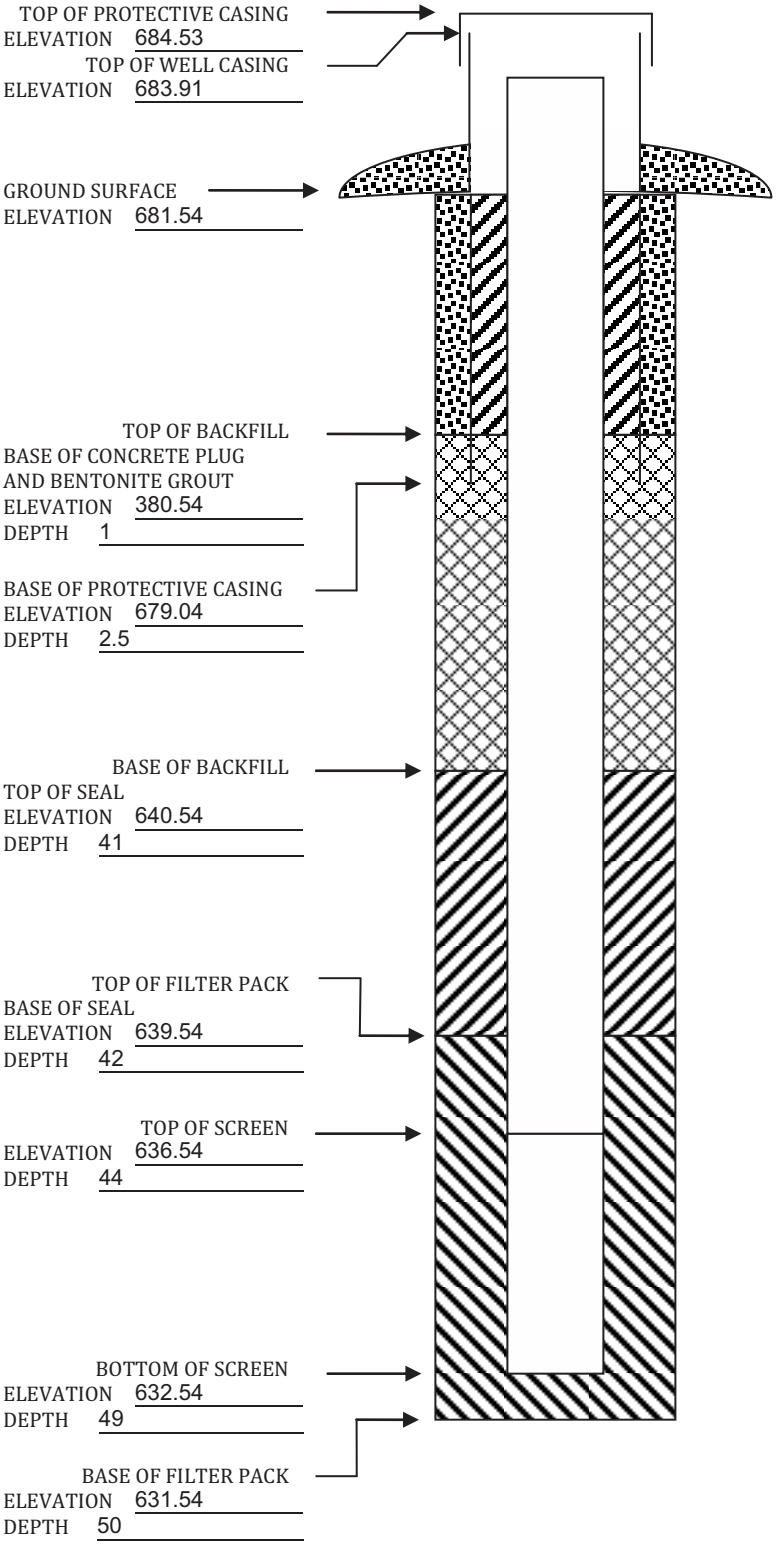
Attachments: Driller's log. Pipe schedules and grouting schedules. 8 ½x11 inch map showing locations of all monitoring wells and piezometers.

Please mail completed for to: Iowa Department of Natural Resources, Land Quality Bureau, 502 E 9th St, Des Moines IA 50319-0034.

Questions? Call or Email: Nina Koger, Environmental Engineer Sr., 515-281-8986, Nina.Koger@dnr.iowa.gov

ELEVATIONS: ± 0.01 ft MSL
DEPTHS: ± 0.1 ft FROM GROUND SURFACE

SPACE TO ATTACH ENTIRE SOIL BORING LOG
(SHOW SCREENED INTERVAL AND FILTER PACK INTERVAL.)



Print Form

IOWA DEPARTMENT OF NATURAL RESOURCES

MONITORING WELL/PIEZOMETER CONSTRUCTION DOCUMENTATION FORM

Disposal Site Name: IPL - Ottumwa Generating Station Permit No.:

Well or Piezometer No: MW-306

Dates Started: 11/12/15 Date Completed: 11/12/15

A. SURVEYED LOCATIONS AND ELEVATIONS

Locations (± 0.5 ft):

Specify corner of site: NW of Parcel 003052620200000

Distance & direction along boundary: 137.5' E

Distance & direction from boundary to wall: 321' S

Elevations (± 0.01 ft MSL):

Ground Surface: 681.05

Top of protective casing: 683.98

Top of well casing: 683.47

Benchmark elevation:

Benchmark description:

B. SOIL BORING INFORMATION

Name & Address of Construction Company:
Cascade Drilling, LP
301 Alderson St
Schofield, WI 54476

Name of Driller: Todd Schmalfeld

Drilling Method: HSA

Drilling Fluid: NA

Bore Hole Diameter: 8 inch

Soil Sampling Method: Spoon

Depth of Boring: 34.5 ft

C. MONITORING WELL INSTALLATION

Casing material: PVC sch 80

Length of casing: 29 ft

Outside casing diameter: 2.38"

Inside casing diameter: 2"

Casing joint type: threaded

Casing/screen joint type: threaded

Screen material: PVC

Screen opening size: 0.010"

Screen length: 5 ft

Depth of well: 34 ft

Filter Pack:

Material: Red Flint

Grain size: #40

Volume: 2 cu. ft.

Seal (minimum 3 ft length above filter pack):

Material: 3/8" bentonite chips

Placement method: Gravity

Volume: 10.5 cu. ft.

Backfill (if different from seal):

Material:

Placement method:

Volume:

Surface seal design:

Material of protective casing: Steel

Material of grout between protective casing and well casing: sand

Protective cap:

Material: Steel, vented

Vented: ☐ Yes ☐ No Locking: ☑ Yes ☐ No

Well Cap:

Material: PVC

Vented: ☐ Yes ☑ No

D. GROUNDWATER MEASURMENT (± 0.01 ft below top of inner well casing)

Water level: 12.96' Stabilization Time: < 5 min

Well development method: Surged with block and pumped. 193 gallons purged.

Average depth of frostline: 3.5'

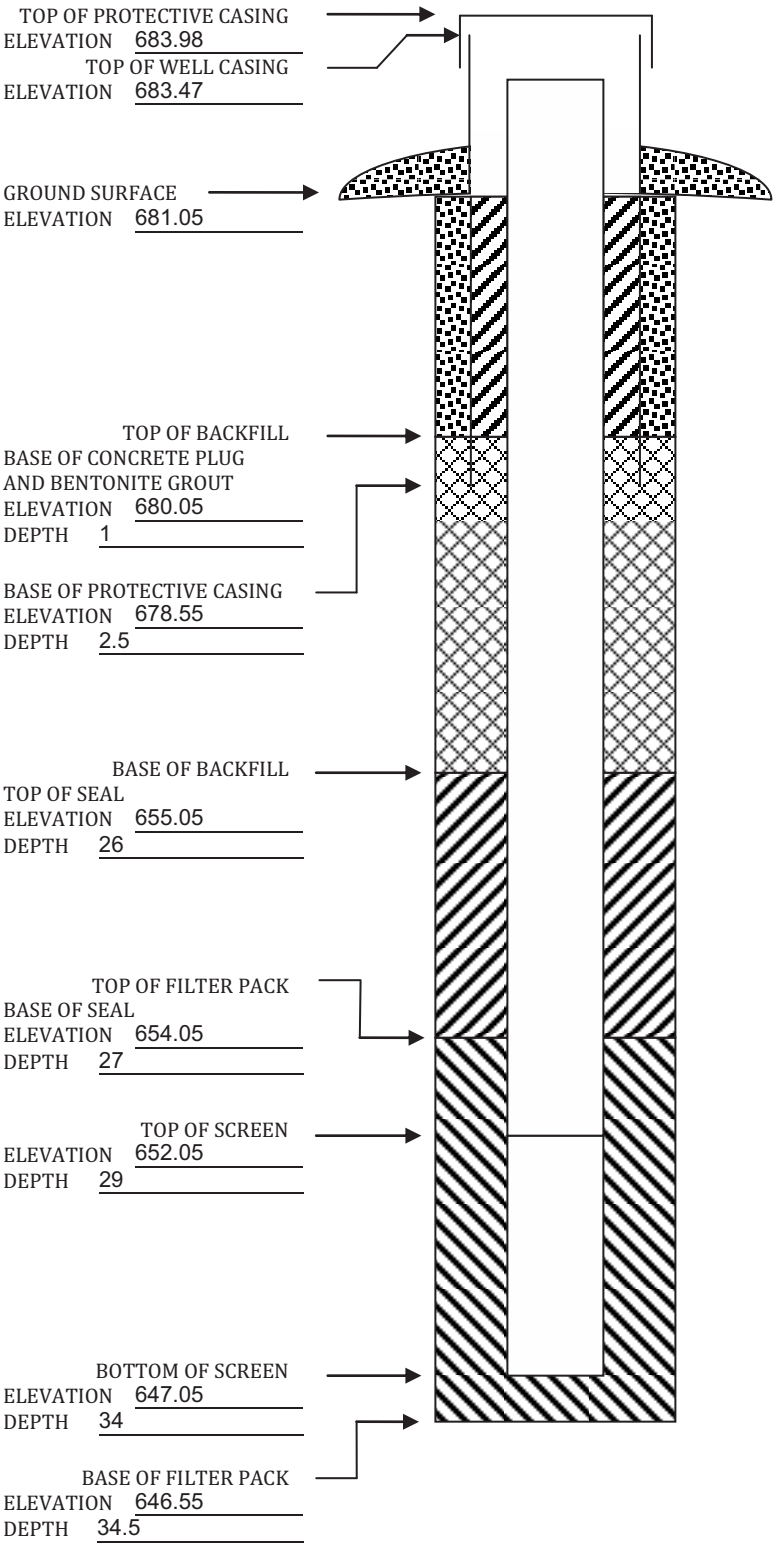
Attachments: Driller's log. Pipe schedules and grouting schedules. 8 ½x11 inch map showing locations of all monitoring wells and piezometers.

Please mail completed for to: Iowa Department of Natural Resources, Land Quality Bureau, 502 E 9th St, Des Moines IA 50319-0034.

Questions? Call or Email: Nina Koger, Environmental Engineer Sr., 515-281-8986, Nina.Koger@dnr.iowa.gov

ELEVATIONS: ± 0.01 ft MSL
DEPTHS: ± 0.1 ft FROM GROUND SURFACE

SPACE TO ATTACH ENTIRE SOIL BORING LOG
(SHOW SCREENED INTERVAL AND FILTER PACK INTERVAL.)



Print Form

IOWA DEPARTMENT OF NATURAL RESOURCES

MONITORING WELL/PIEZOMETER CONSTRUCTION DOCUMENTATION FORM

Disposal Site Name: IPL - Ottumwa Generating Station Permit No.:

Well or Piezometer No: MW-307

Dates Started: 10/25/16 Date Completed: 10/25/16

A. SURVEYED LOCATIONS AND ELEVATIONS

Locations (± 0.5 ft):

Specify corner of site: NE of Parcel 003052620200000

Distance & direction along boundary: 683' W

Distance & direction from boundary to wall: 296' S

Elevations (± 0.01 ft MSL):

Ground Surface: 655.08

Top of protective casing: 657.58

Top of well casing: 657.56

Benchmark elevation:

Benchmark description:

B. SOIL BORING INFORMATION

Name & Address of Construction Company:
Cascade Drilling, LP
301 Alderson St
Schofield, WI 54476

Name of Driller: Mike Mueller

Drilling Method: HSA

Drilling Fluid: NA

Bore Hole Diameter: 8 inch

Soil Sampling Method: Spoon

Depth of Boring: 28 ft

C. MONITORING WELL INSTALLATION

Casing material: PVC sch 40

Length of casing: 22 ft

Outside casing diameter: 2.38"

Inside casing diameter: 2"

Casing joint type: threaded

Casing/screen joint type: threaded

Screen material: PVC

Screen opening size: 0.010"

Screen length: 5 ft

Depth of well: 27 ft

Filter Pack:

Material: Red Flint

Grain size: #40

Volume: 200 lbs

Seal (minimum 3 ft length above filter pack):

Material: 3/8 inch bentonite chips

Placement method: Gravity

Volume: 250 lbs

Backfill (if different from seal):

Material:

Placement method:

Volume:

Surface seal design:

Material of protective casing: Steel 6 inch

Material of grout between protective casing and well casing: sand

Protective cap:

Material: Steel, vented

Vented: ☑ Yes ☐ No Locking: ☐ Yes ☐ No

Well Cap:

Material: PVC

Vented: ☐ Yes ☑ No

D. GROUNDWATER MEASURMENT (± 0.01 ft below top of inner well casing)

Water level: 8.12 Stabilization Time: 5 minutes

Well development method: surged with bailer and pumped

Average depth of frostline: 3.5'

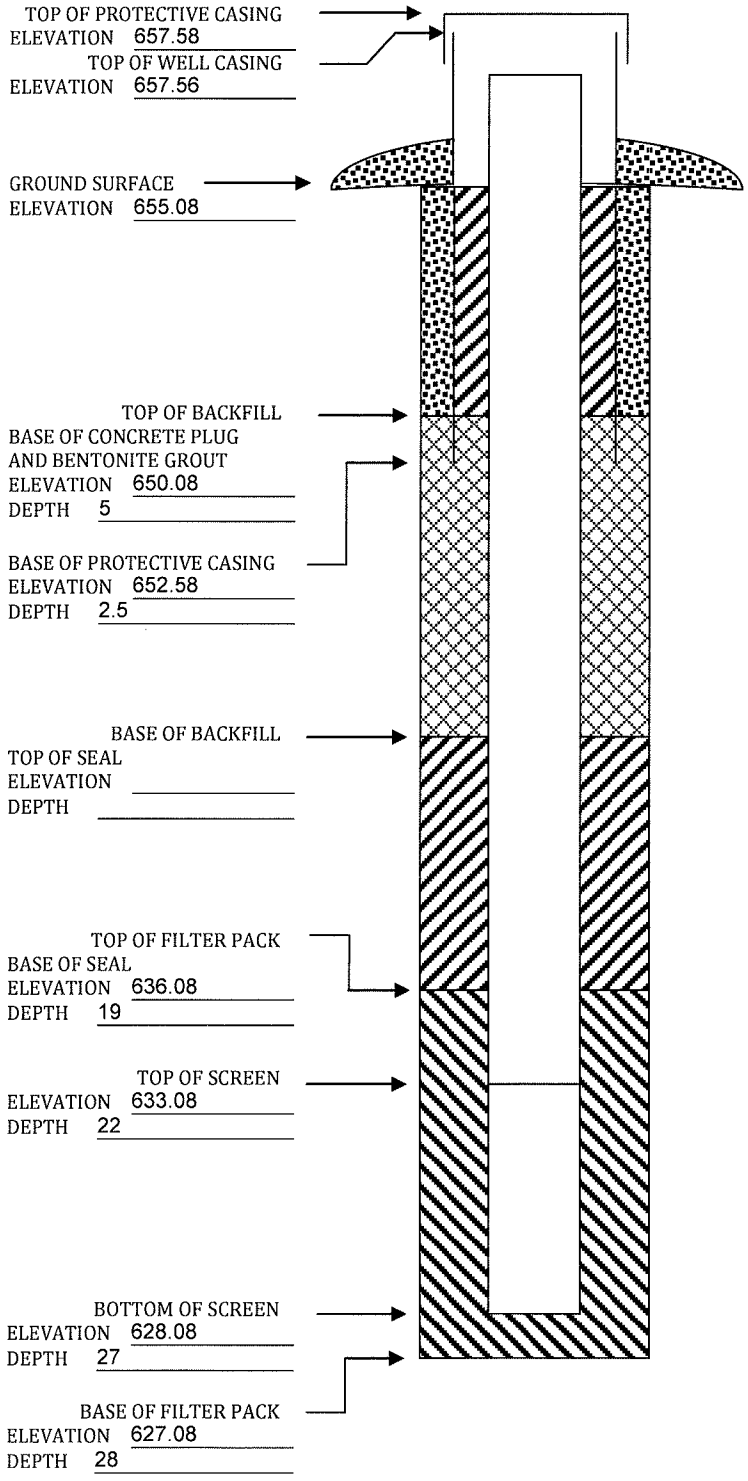
Attachments: Driller's log. Pipe schedules and grouting schedules. 8 ½x11 inch map showing locations of all monitoring wells and piezometers.

Please mail completed for to: Iowa Department of Natural Resources, Land Quality Bureau, 502 E 9th St, Des Moines IA 50319-0034.

Questions? Call or Email: Nina Koger, Environmental Engineer Sr., 515-281-8986, Nina.Koger@dnr.iowa.gov

ELEVATIONS: ± 0.01 ft MSL
DEPTHS: ± 0.1 ft FROM GROUND SURFACE

SPACE TO ATTACH ENTIRE SOIL BORING LOG
(SHOW SCREENED INTERVAL AND FILTER PACK INTERVAL.)



Print Form

IOWA DEPARTMENT OF NATURAL RESOURCES

MONITORING WELL/PIEZOMETER CONSTRUCTION DOCUMENTATION FORM

Disposal Site Name: IPL - Ottumwa Generating Station Permit No.:

Well or Piezometer No: MW-308

Dates Started: 10/26/16 Date Completed: 10/26/16

A. SURVEYED LOCATIONS AND ELEVATIONS

Locations (± 0.5 ft):

Specify corner of site: SW of Parcel 0030502620203000

Distance & direction along boundary: 158' E

Distance & direction from boundary to wall: 417' N

Elevations (± 0.01 ft MSL):

Ground Surface: 652.87

Top of protective casing: 655.23

Top of well casing: 655.39

Benchmark elevation:

Benchmark description:

B. SOIL BORING INFORMATION

Name & Address of Construction Company:
Cascade Drilling, LP
301 Alderson St
Schofield, WI 54476

Name of Driller: Mike Mueller

Drilling Method: HSA

Drilling Fluid: NA

Bore Hole Diameter: 8 inch

Soil Sampling Method: Spoon

Depth of Boring: 25 ft

C. MONITORING WELL INSTALLATION

Casing material: PVC sch 40

Length of casing: 19 ft

Outside casing diameter: 2.38"

Inside casing diameter: 2"

Casing joint type: threaded

Casing/screen joint type: threaded

Screen material: PVC

Screen opening size: 0.010"

Screen length: 5 ft

Depth of well: 24 ft

Filter Pack:

Material: Red Flint

Grain size: #40

Volume: 200 lbs

Seal (minimum 3 ft length above filter pack):

Material: 3/8 inch bentonite chips

Placement method: Gravity

Volume: 200 lbs

Backfill (if different from seal):

Material:

Placement method:

Volume:

Surface seal design:

Material of protective casing: Steel 6 inch

Material of grout between protective casing and well casing: sand

Protective cap:

Material: Steel, vented

Vented: ☑ Yes ☐ No Locking: ☐ Yes ☐ No

Well Cap:

Material: PVC

Vented: ☐ Yes ☑ No

D. GROUNDWATER MEASURMENT (± 0.01 ft below top of inner well casing)

Water level: 9.85 Stabilization Time: 5 minutes

Well development method: surged with bailer and pumped

Average depth of frostline: 3.5'

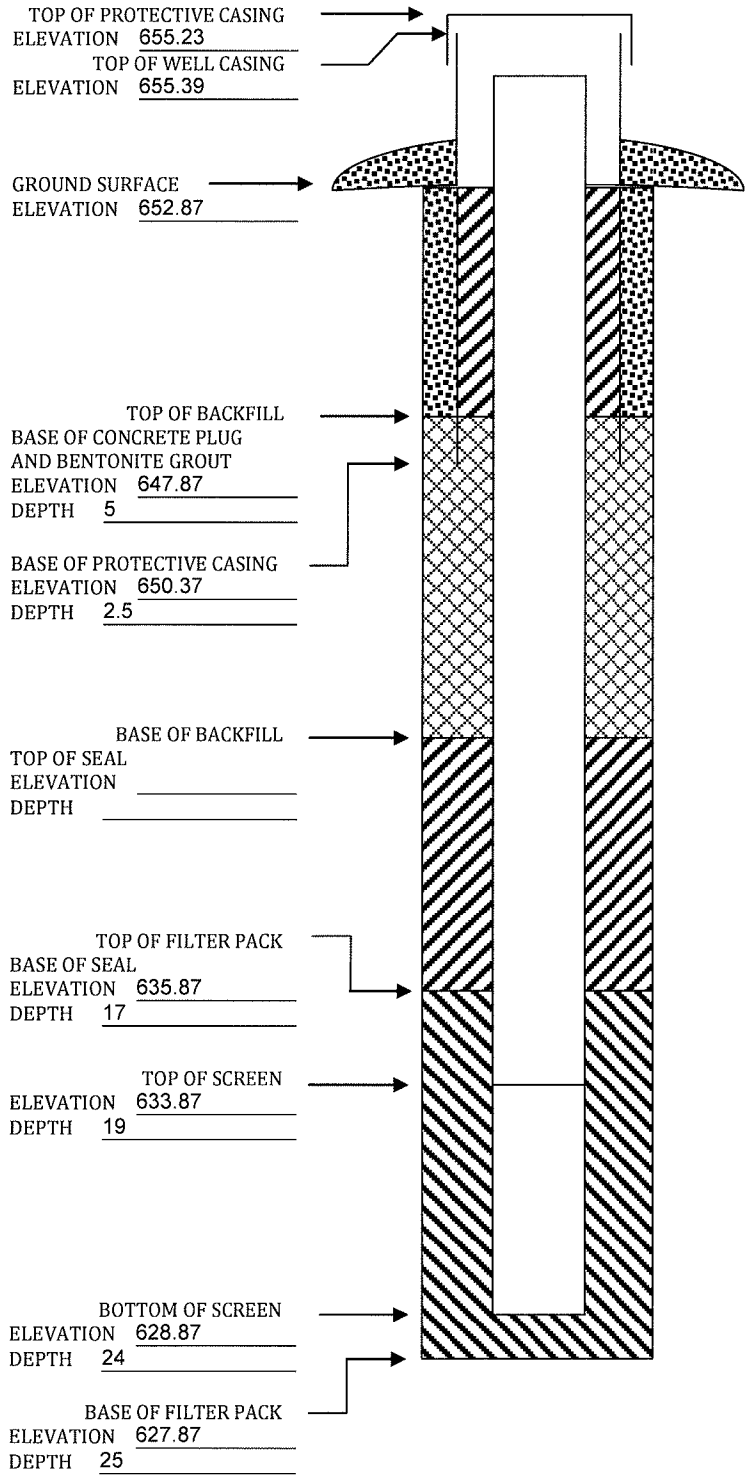
Attachments: Driller's log. Pipe schedules and grouting schedules. 8 ½x11 inch map showing locations of all monitoring wells and piezometers.

Please mail completed for to: Iowa Department of Natural Resources, Land Quality Bureau, 502 E 9th St, Des Moines IA 50319-0034.

Questions? Call or Email: Nina Koger, Environmental Engineer Sr., 515-281-8986, Nina.Koger@dnr.iowa.gov

ELEVATIONS: ± 0.01 ft MSL
DEPTHS: ± 0.1 ft FROM GROUND SURFACE

SPACE TO ATTACH ENTIRE SOIL BORING LOG
(SHOW SCREENED INTERVAL AND FILTER PACK INTERVAL.)



Print Form

IOWA DEPARTMENT OF NATURAL RESOURCES

MONITORING WELL/PIEZOMETER CONSTRUCTION DOCUMENTATION FORM

Disposal Site Name: IPL - Ottumwa Generating Station Permit No.:

Well or Piezometer No: MW-309

Dates Started: 10/27/16 Date Completed: 10/27/16

A. SURVEYED LOCATIONS AND ELEVATIONS

Locations (± 0.5 ft):

Specify corner of site: NE of Parcel 003052620204000

Distance & direction along boundary: 480' W

Distance & direction from boundary to wall: 438' S

Elevations (± 0.01 ft MSL):

Ground Surface: 652.45

Top of protective casing: 654.97

Top of well casing: 654.94

Benchmark elevation:

Benchmark description:

B. SOIL BORING INFORMATION

Name & Address of Construction Company:
Cascade Drilling, LP
301 Alderson St
Schofield, WI 54476

Name of Driller: Mike Mueller

Drilling Method: HSA

Drilling Fluid: NA

Bore Hole Diameter: 8 inch

Soil Sampling Method: Spoon

Depth of Boring: 27.5 ft

C. MONITORING WELL INSTALLATION

Casing material: PVC sch 40

Length of casing: 21.5 ft

Outside casing diameter: 2.38"

Inside casing diameter: 2"

Casing joint type: threaded

Casing/screen joint type: threaded

Screen material: PVC

Screen opening size: 0.010"

Screen length: 5 ft

Depth of well: 26.5 ft

Filter Pack:

Material: Red Flint

Grain size: #40

Volume: 200 lbs

Seal (minimum 3 ft length above filter pack):

Material: 3/8 inch bentonite chips

Placement method: Gravity

Volume: 600 lbs

Backfill (if different from seal):

Material:

Placement method:

Volume:

Surface seal design:

Material of protective casing: Steel 6 inch

Material of grout between protective casing and well casing: sand

Protective cap:

Material: Steel, vented

Vented: ☑ Yes ☐ No Locking: ☐ Yes ☐ No

Well Cap:

Material: PVC

Vented: ☐ Yes ☑ No

D. GROUNDWATER MEASURMENT (± 0.01 ft below top of inner well casing)

Water level: 9.87 Stabilization Time: 5 minutes

Well development method: surged with bailer and pumped

Average depth of frostline: 3.5'

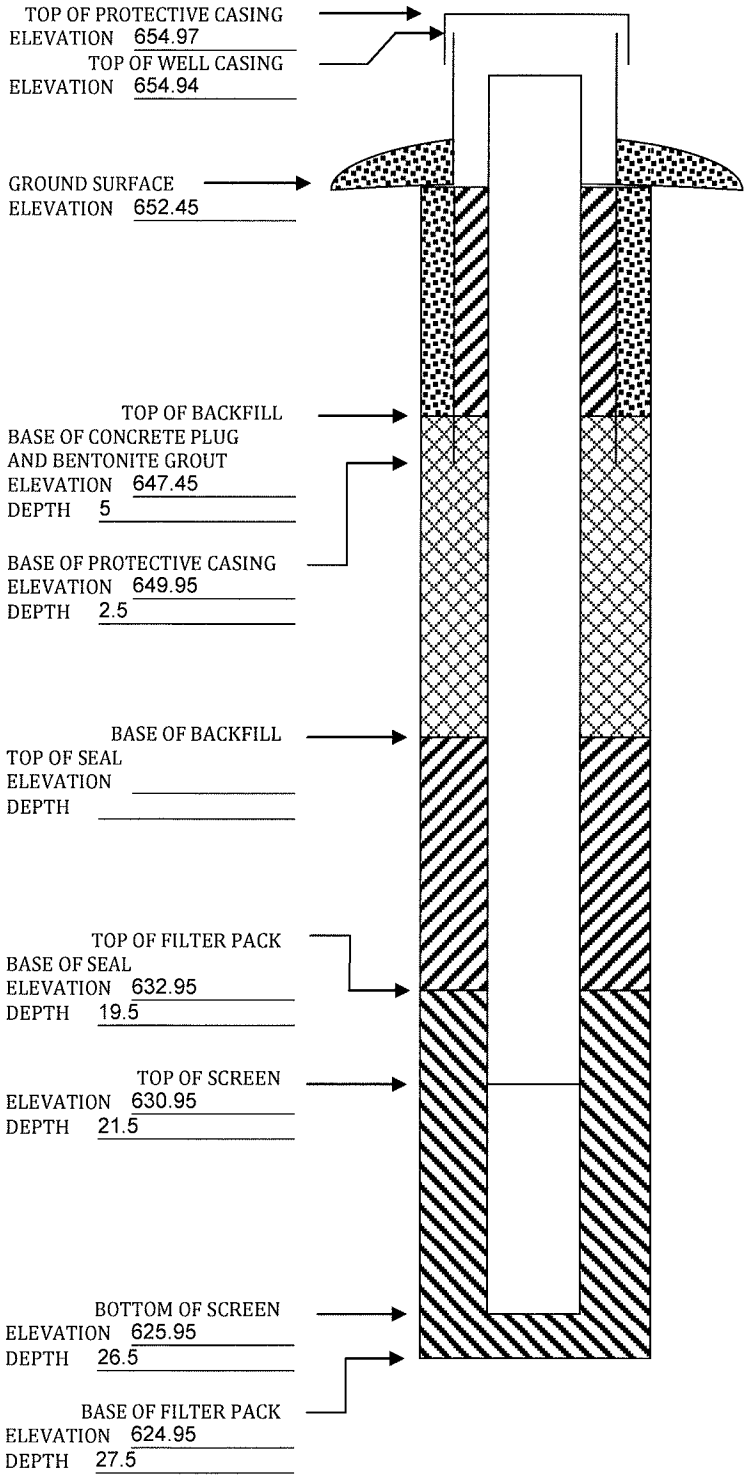
Attachments: Driller's log. Pipe schedules and grouting schedules. 8 ½x11 inch map showing locations of all monitoring wells and piezometers.

Please mail completed for to: Iowa Department of Natural Resources, Land Quality Bureau, 502 E 9th St, Des Moines IA 50319-0034.

Questions? Call or Email: Nina Koger, Environmental Engineer Sr., 515-281-8986, Nina.Koger@dnr.iowa.gov

ELEVATIONS: ± 0.01 ft MSL
DEPTHS: ± 0.1 ft FROM GROUND SURFACE

SPACE TO ATTACH ENTIRE SOIL BORING LOG
(SHOW SCREENED INTERVAL AND FILTER PACK INTERVAL.)



Appendix C

Historical Monitoring Results

Single Location

Name: IPL - Ottumwa Generating Station

Location ID:	MW-301				
Number of Sampling Dates:	4				
Parameter Name	**Units**	**4/18/2018**	**8/14/2018**	**8/29/2018**	**10/16/2018**
Boron	ug/L	480	735	--	410
Calcium	mg/L	63	72.5	--	47.2
Chloride	mg/L	63.4	--	63.1	33.9
Fluoride	mg/L	0.22	--	0.27	0.3
Field pH	Std. Units	6.41	6.26	6.31	6.27
Sulfate	mg/L	186	--	181	164
Total Dissolved Solids	mg/L	514	--	532	392
Antimony	ug/L	<0.026	0.2	--	<0.078
Arsenic	ug/L	0.074	0.29	--	0.16
Barium	ug/L	31.6	44.5	--	28.1
Beryllium	ug/L	<0.012	0.14	--	<0.089
Cadmium	ug/L	0.023	0.16	--	<0.033
Chromium	ug/L	<0.054	0.25	--	0.11
Cobalt	ug/L	0.46	1.4	--	0.36
Lead	ug/L	0.041	0.18	--	<0.13
Lithium	ug/L	19.1	26.5	--	19.4
Mercury	ug/L	<0.09	<0.083	--	--
Molybdenum	ug/L	0.67	1.3	--	0.72
Selenium	ug/L	4.3	6.3	--	3.4
Thallium	ug/L	<0.036	0.16	--	<0.099
Total Radium	pCi/L	0.513	1.19	--	1.16
Radium-226	pCi/L	0.145	0.417	--	0.529
Radium-228	pCi/L	0.368	0.773	--	0.627
Field Specific Conductance	umhos/cm	770	867	781	599
Field Temperature	deg C	7.2	20.4	20.6	16.6
Groundwater Elevation	feet	681.53	680.91	681.09	682.5
Oxygen, Dissolved	mg/L	6.52	3.18	4.71	4.12
Turbidity	NTU	0.66	0.52	0.63	2.91
pH at 25 Degrees C	Std. Units	6.6	--	6.5	6.6
Field Oxidation Potential	millivolts	105.5	-55.5	--	119.7

Single Location

Name: IPL - Ottumwa Generating Station

Location ID:	MW-302				
Number of Sampling Dates:	4				
Parameter Name	**Units**	**4/18/2018**	**8/14/2018**	**8/29/2018**	**10/16/2018**
Boron	ug/L	1200	1240	--	1100
Calcium	mg/L	177	185	--	146
Chloride	mg/L	246	--	259	214
Fluoride	mg/L	0.26	--	0.26	0.24
Field pH	Std. Units	6.47	6.76	6.77	6.37
Sulfate	mg/L	899	--	847	785
Total Dissolved Solids	mg/L	1690	--	1840	1400
Antimony	ug/L	<0.026	<0.15	--	0.26
Arsenic	ug/L	0.16	0.3	--	1.9
Barium	ug/L	17.7	18.3	--	28.9
Beryllium	ug/L	<0.012	<0.12	--	0.22
Cadmium	ug/L	0.22	0.21	--	0.67
Chromium	ug/L	0.46	0.48	--	1.6
Cobalt	ug/L	0.9	1.5	--	4
Lead	ug/L	0.098	0.12	--	3.9
Lithium	ug/L	7.5	6.9	--	8.6
Mercury	ug/L	0.096	<0.083	--	--
Molybdenum	ug/L	0.59	0.54	--	<0.57
Selenium	ug/L	<0.086	<0.16	--	0.84
Thallium	ug/L	<0.036	<0.14	--	0.16
Total Radium	pCi/L	0.746	1.12	--	0.299
Radium-226	pCi/L	0.251	0.624	--	0.191
Radium-228	pCi/L	0.495	0.499	--	0.108
Field Specific Conductance	umhos/cm	2248	2304	2357	1912
Field Temperature	deg C	10.7	14.3	14.6	14.1
Groundwater Elevation	feet	655.71	656.05	655.89	656.91
Oxygen, Dissolved	mg/L	0.2	0.17	0.23	0.26
Turbidity	NTU	2.41	4.01	1.42	88.24
pH at 25 Degrees C	Std. Units	6.7	--	6.7	6.6
Field Oxidation Potential	millivolts	82.6	-336.6	--	114.2

Single Location

Name: IPL - Ottumwa Generating Station

Location ID:	MW-303				
Number of Sampling Dates:	4				
Parameter Name	**Units**	**4/18/2018**	**8/14/2018**	**8/29/2018**	**10/16/2018**
Boron	ug/L	987	1010	--	549
Calcium	mg/L	212	213	--	195
Chloride	mg/L	198	--	64.8	57
Fluoride	mg/L	0.22	--	0.31	0.24
Field pH	Std. Units	6.63	6.83	7.03	6.66
Sulfate	mg/L	328	--	164	389
Total Dissolved Solids	mg/L	1300	--	832	1150
Antimony	ug/L	0.098	0.16	--	0.2
Arsenic	ug/L	0.43	0.6	--	0.55
Barium	ug/L	69.5	77.3	--	95.2
Beryllium	ug/L	0.017	<0.12	--	<0.089
Cadmium	ug/L	0.44	0.36	--	0.24
Chromium	ug/L	0.12	0.19	--	0.15
Cobalt	ug/L	2.1	2.2	--	1.7
Lead	ug/L	0.069	0.13	--	<0.13
Lithium	ug/L	<4.6	6.9	--	<4.6
Mercury	ug/L	<0.09	<0.083	--	--
Molybdenum	ug/L	0.61	0.98	--	5.5
Selenium	ug/L	0.23	0.35	--	0.37
Thallium	ug/L	<0.036	<0.14	--	<0.099
Total Radium	pCi/L	0.529	1.82	--	2.04
Radium-226	pCi/L	-0.088	1.02	--	0.478
Radium-228	pCi/L	0.529	0.799	--	1.56
Field Specific Conductance	umhos/cm	1862	1833	1161	1573
Field Temperature	deg C	8.2	17.2	18.7	17.1
Groundwater Elevation	feet	652.47	652.57	655.07	656.17
Oxygen, Dissolved	mg/L	0.17	0.19	1.92	0.29
Turbidity	NTU	3.69	1.51	10.13	5.99
pH at 25 Degrees C	Std. Units	6.9	--	7.1	6.9
Field Oxidation Potential	millivolts	3.2	-307.9	--	32.8

Single Location

Name: IPL - Ottumwa Generating Station

Location ID:	MW-304				
Number of Sampling Dates:	4				
Parameter Name	**Units**	**4/18/2018**	**8/15/2018**	**8/29/2018**	**10/16/2018**
Boron	ug/L	991	1000	--	930
Calcium	mg/L	131	138	--	123
Chloride	mg/L	400	--	375	410
Fluoride	mg/L	0.92	--	1	1
Field pH	Std. Units	6.9	7.34	7.22	6.86
Sulfate	mg/L	198	--	185	184
Total Dissolved Solids	mg/L	1300	--	3680	1180
Antimony	ug/L	<0.026	0.19	--	<0.078
Arsenic	ug/L	0.68	1.3	--	0.96
Barium	ug/L	88.5	87.4	--	91
Beryllium	ug/L	0.026	0.21	--	<0.089
Cadmium	ug/L	<0.018	0.17	--	0.073
Chromium	ug/L	2	5.9	--	1.4
Cobalt	ug/L	0.39	0.92	--	0.45
Lead	ug/L	0.37	0.81	--	0.66
Lithium	ug/L	<4.6	<4.6	--	<4.6
Mercury	ug/L	<0.09	<0.083	--	--
Molybdenum	ug/L	2	2.4	--	1.9
Selenium	ug/L	<0.086	0.5	--	0.26
Thallium	ug/L	<0.036	0.15	--	<0.099
Total Radium	pCi/L	2.08	3.74	--	2.76
Radium-226	pCi/L	1.22	1.78	--	1.21
Radium-228	pCi/L	0.862	1.96	--	1.55
Field Specific Conductance	umhos/cm	2141	2085	2123	2058
Field Temperature	deg C	12.8	15.1	13.7	13.5
Groundwater Elevation	feet	655.55	656.35	657.82	658.2
Oxygen, Dissolved	mg/L	0.15	0.21	0.16	0.11
Turbidity	NTU	39.29	81.42	55.94	17.12
pH at 25 Degrees C	Std. Units	7	--	7.1	7
Field Oxidation Potential	millivolts	137.5	35.5	--	-114.5

Single Location

Name: IPL - Ottumwa Generating Station

Location ID:	MW-305			
Number of Sampling Dates:	3			
Parameter Name	**Units**	**4/18/2018**	**8/15/2018**	**10/16/2018**
Boron	ug/L	886	911	835
Calcium	mg/L	97.6	102	96.2
Chloride	mg/L	289	265	281
Fluoride	mg/L	0.4	0.44	0.4
Field pH	Std. Units	6.9	7.21	6.86
Sulfate	mg/L	147	139	129
Total Dissolved Solids	mg/L	1070	1060	1070
Antimony	ug/L	0.089	<0.15	0.096
Arsenic	ug/L	0.51	0.72	0.66
Barium	ug/L	116	118	125
Beryllium	ug/L	<0.012	<0.12	<0.089
Cadmium	ug/L	0.054	0.086	0.044
Chromium	ug/L	0.26	0.41	0.3
Cobalt	ug/L	14.5	15.6	17.2
Lead	ug/L	0.12	0.31	<0.13
Lithium	ug/L	<4.6	<4.6	<4.6
Mercury	ug/L	<0.09	<0.09	--
Molybdenum	ug/L	7.1	6.5	7.3
Selenium	ug/L	0.12	0.36	0.33
Thallium	ug/L	0.32	0.33	0.33
Total Radium	pCi/L	0.676	1.33	1.56
Radium-226	pCi/L	0.278	0.96	0.635
Radium-228	pCi/L	0.398	0.366	0.921
Field Specific Conductance	umhos/cm	1840	1832	1836
Field Temperature	deg C	12.8	14.8	13.9
Groundwater Elevation	feet	660.99	661.56	663.37
Oxygen, Dissolved	mg/L	0.15	0.18	0.09
Turbidity	NTU	7.37	14.9	6.96
pH at 25 Degrees C	Std. Units	7.3	7	7.1
Field Oxidation Potential	millivolts	-32.7	31	-26.8

Single Location

Name: IPL - Ottumwa Generating Station

Location ID:	MW-306			
Number of Sampling Dates:	3			
Parameter Name	**Units**	**4/18/2018**	**8/15/2018**	**10/16/2018**
Boron	ug/L	919	915	862
Calcium	mg/L	74.1	78.9	80
Chloride	mg/L	54.4	58.2	83.3
Fluoride	mg/L	0.11	0.13	<0.19
Field pH	Std. Units	6.42	6.74	6.42
Sulfate	mg/L	289	275	285
Total Dissolved Solids	mg/L	805	840	884
Antimony	ug/L	0.094	<0.15	0.1
Arsenic	ug/L	0.38	0.65	0.6
Barium	ug/L	48.2	51.6	56
Beryllium	ug/L	<0.012	<0.12	<0.089
Cadmium	ug/L	0.88	0.76	0.96
Chromium	ug/L	0.37	0.7	0.46
Cobalt	ug/L	4.8	5.5	6.4
Lead	ug/L	0.04	0.2	<0.13
Lithium	ug/L	<4.6	<4.6	<4.6
Mercury	ug/L	<0.09	<0.083	--
Molybdenum	ug/L	5.7	4.7	5.1
Selenium	ug/L	<0.086	0.21	0.22
Thallium	ug/L	0.083	<0.14	0.12
Total Radium	pCi/L	0.305	0.985	0.693
Radium-226	pCi/L	0.305	0.482	0.263
Radium-228	pCi/L	-0.109	0.503	0.43
Field Specific Conductance	umhos/cm	1228	1271	1340
Field Temperature	deg C	13.1	14.6	13.4
Groundwater Elevation	feet	668.92	668.66	670.24
Oxygen, Dissolved	mg/L	0.14	0.15	0.08
Turbidity	NTU	0.59	3.95	7.07
pH at 25 Degrees C	Std. Units	6.9	6.6	6.7
Field Oxidation Potential	millivolts	14.2	22.8	13.3

Appendix D

Statistical Evaluation

APPENDIX D – STATISTICAL EVALUATION

2018 Annual Report Addendum
Ottumwa Generating Station Ash Pond

Statistical evaluation completed in 2018 included the following:

- Calculation of upper prediction limits (UPLs) for Appendix III parameters
- Calculation of UPLS for Appendix IV parameters

These evaluations were completed in accordance with 40 CFR 257.93(f)(3) using an interwell prediction interval procedure, and in accordance with the statistical methods described in the Sampling and Analysis Plan for the monitoring system.

These evaluations are documented in the following attachments:

- Statistical Procedures Summary Table, November 2017 Event, Appendix III Parameters
- Chemstat Workbook for Appendix III UPL Calculations
- Statistical Procedures Summary Table, April 2018 Event, Appendix IV Parameters
- Chemstat Workbook for Appendix IV UPL Calculations

UPLs calculated from the background monitoring data from upgradient well MW-301 were applied to subsequent monitoring events in 2018.

SCC/REO

I:\25222072.00\Deliverables\2018 Fed Annual Report Addendum - OGS AP\Appendix D - Statistical Evaluation\2018_OGS Addendum_stats_cover page.docx

Site Name: Ottumwa Generating Station
Sampling Event: November 2017
Project Number: 25216072

Background Evaluation
Non-Detects: None
Potential outliers:

App III Parameters	Original # of Background Samples	Background % ND	Outliers	Keep Outliers?	Removed Outliers	# of Background Samples for UPL Calculation	Normality Test Results	Data Transformations or Adjustments	Statistical Method for UPL Calculation	UPL	Sample Exceeds Limit?	Resample Exceeds Limit?	SSI?
B	9	0.0%	2 @ 95%, 0 @ 99%	Yes	-	9	Normal		Parametric UPL with 1-of-2 Resampling	820	Yes	Not sampled	Yes
Ca	9	0.0%	No	-	-	9	Normal		Parametric UPL with 1-of-2 Resampling	78.7	Yes	Not sampled	Yes
Cl	9	0.0%	No	-	-	9	Normal		Parametric UPL with 1-of-2 Resampling	86.8	Yes	Not sampled	Yes
F	9	0.0%	No	-	-	9	Normal		Parametric UPL with 1-of-2 Resampling	0.484	Yes	Not sampled	Yes
pH	9	0.0%	No	-	-	9	Normal		Parametric UPL with 1-of-2 Resampling	6.87	Yes	Not sampled	Yes
SO4	9	0.0%	No	-	-	9	Normal		Parametric UPL with 1-of-2 Resampling	199	Yes	Not sampled	Yes
TDS	9	0.0%	No	-	-	9	Normal		Parametric UPL with 1-of-2 Resampling	628	Yes	Not sampled	Yes

Prepared by: NK
Checked by: SC

I:\25222072.00\Deliverables\2018 Fed Annual Report Addendum - OGS AP\Appendix D - Statistical Evaluation\[OGS_Nov2017_StatsProcedures.xlsx]ProcedureNotes

Basic Statistics

Parameter: Boron

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

Total Measurements	14
Total Non-Detects	0 (0%)
Pooled Mean	766.214
Pooled Std Dev	245.105
Compliance Meas.	5
Compliance Mean	1047.2
Compliance Std Dev	171.425
Background Meas.	9
Background Mean	610.111
Background Std Dev	78.5564

Background Locations

There is 1 background location

Location	Meas.	Non-Detects	% ND	Total
MW-301	9	0	0	5491

Location	Mean	Std Dev	Std Err	Rank Sum	Rank Mean
MW-301	610.111	78.5564	0	45	5

Compliance Locations

There are 5 compliance location

Location	Obs.	Non-Detects	% ND	Total
MW-302	1	0	0	1320
MW-303	1	0	0	1070
MW-306	1	0	0	881
MW-304	1	0	0	1040
MW-305	1	0	0	925

Location	Mean	Std Dev	Dif From Bkg	Std Err	Rank Sum	Rank Mean
MW-302	1320	0	709.889	82.8057	14	14
MW-303	1070	0	459.889	82.8057	13	13
MW-306	881	0	270.889	82.8057	10	10
MW-304	1040	0	429.889	82.8057	12	12
MW-305	925	0	314.889	82.8057	11	11

Analysis of Variance Statistics

SS Wells	731625
SS Total	780994

Kruskal-Wallis Statistics

Non-Detect Rank	0
Background Rank Sum	45
Background Rank Mean	5
H Statistic	9.57143
H Adjusted for Ties	9.57143

Basic Statistics

Parameter: Calcium

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

Total Measurements	14
Total Non-Detects	0 (0%)
Pooled Mean	94.2429
Pooled Std Dev	53.3483
Compliance Meas.	5
Compliance Mean	145.12
Compliance Std Dev	64.5867
Background Meas.	9
Background Mean	65.9778
Background Std Dev	4.74415

Background Locations

There is 1 background location

Location	Meas.	Non-Detects	% ND	Total
MW-301	9	0	0	593.8

Location	Mean	Std Dev	Std Err	Rank Sum	Rank Mean
MW-301	65.9778	4.74415	0	46	5.11111

Compliance Locations

There are 5 compliance location

Location	Obs.	Non-Detects	% ND	Total
MW-302	1	0	0	183
MW-303	1	0	0	234
MW-304	1	0	0	136
MW-306	1	0	0	73.1
MW-305	1	0	0	99.5

Location	Mean	Std Dev	Dif From Bkg	Std Err	Rank Sum	Rank Mean
MW-302	183	0	117.022	5.00077	13	13
MW-303	234	0	168.022	5.00077	14	14
MW-304	136	0	70.0222	5.00077	12	12
MW-306	73.1	0	7.12222	5.00077	9	9
MW-305	99.5	0	33.5222	5.00077	11	11

Analysis of Variance Statistics

SS Wells	36818.4
SS Total	36998.5

Kruskal-Wallis Statistics

Non-Detect Rank	0
Background Rank Sum	46
Background Rank Mean	5.11111
H Statistic	9.06349
H Adjusted for Ties	9.06349

Basic Statistics

Parameter: Chloride

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

Total Measurements	14
Total Non-Detects	0 (0%)
Pooled Mean	128.414
Pooled Std Dev	112.831
Compliance Meas.	5
Compliance Mean	237.68
Compliance Std Dev	134.383
Background Meas.	9
Background Mean	67.7111
Background Std Dev	7.12854

Background Locations

There is 1 background location

Location	Meas.	Non-Detects	% ND	Total
MW-301	9	0	0	609.4

Location	Mean	Std Dev	Std Err	Rank Sum	Rank Mean
MW-301	67.7111	7.12854	0	54	6

Compliance Locations

There are 5 compliance location

Location	Obs.	Non-Detects	% ND	Total
MW-302	1	0	0	254
MW-303	1	0	0	185
MW-305	1	0	0	282
MW-306	1	0	0	50.4
MW-304	1	0	0	417

Location	Mean	Std Dev	Dif From Bkg	Std Err	Rank Sum	Rank Mean
MW-302	254	0	186.289	7.51414	12	12
MW-303	185	0	117.289	7.51414	11	11
MW-305	282	0	214.289	7.51414	13	13
MW-306	50.4	0	-17.3111	7.51414	1	1
MW-304	417	0	349.289	7.51414	14	14

Analysis of Variance Statistics

SS Wells	165094
SS Total	165501

Kruskal-Wallis Statistics

Non-Detect Rank	0
Background Rank Sum	54
Background Rank Mean	6
H Statistic	9.57143
H Adjusted for Ties	9.57143

Basic Statistics

Parameter: Field pH

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

Total Measurements	14
Total Non-Detects	0 (0%)
Pooled Mean	6.47
Pooled Std Dev	0.293467
Compliance Meas.	5
Compliance Mean	6.73
Compliance Std Dev	0.254067
Background Meas.	9
Background Mean	6.32556
Background Std Dev	0.204824

Background Locations

There is 1 background location

Location	Meas.	Non-Detects	% ND	Total
MW-301	9	0	0	56.93

Location	Mean	Std Dev	Std Err	Rank Sum	Rank Mean
MW-301	6.32556	0.204824	0	49	5.44444

Compliance Locations

There are 5 compliance location

Location	Obs.	Non-Detects	% ND	Total
MW-302	1	0	0	6.55
MW-303	1	0	0	6.6
MW-304	1	0	0	7
MW-306	1	0	0	6.49
MW-305	1	0	0	7.01

Location	Mean	Std Dev	Dif From Bkg	Std Err	Rank Sum	Rank Mean
MW-302	6.55	0	0.224444	0.215903	10	10
MW-303	6.6	0	0.274444	0.215903	11	11
MW-304	7	0	0.674444	0.215903	13	13
MW-306	6.49	0	0.164444	0.215903	8	8
MW-305	7.01	0	0.684444	0.215903	14	14

Analysis of Variance Statistics

SS Wells	0.783978
SS Total	1.1196

Kruskal-Wallis Statistics

Non-Detect Rank	0
Background Rank Sum	49
Background Rank Mean	5.44444
H Statistic	7.3873
H Adjusted for Ties	7.3873

Basic Statistics

Parameter: Fluoride

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

Total Measurements	14
Total Non-Detects	0 (0%)
Pooled Mean	0.305
Pooled Std Dev	0.208465
Compliance Meas.	5
Compliance Mean	0.372
Compliance Std Dev	0.345644
Background Meas.	9
Background Mean	0.267778
Background Std Dev	0.0807431

Background Locations

There is 1 background location

Location	Meas.	Non-Detects	% ND	Total
MW-301	9	0	0	2.41

Location	Mean	Std Dev	Std Err	Rank Sum	Rank Mean
MW-301	0.267778	0.0807431	0	70	7.77778

Compliance Locations

There are 5 compliance location

Location	Obs.	Non-Detects	% ND	Total
MW-302	1	0	0	0.2
MW-303	1	0	0	0.19
MW-306	1	0	0	0.11
MW-304	1	0	0	0.96
MW-305	1	0	0	0.4

Location	Mean	Std Dev	Dif From Bkg	Std Err	Rank Sum	Rank Mean
MW-302	0.2	0	-0.0677778	0.0851107	5	5
MW-303	0.19	0	-0.0777778	0.0851107	3	3
MW-306	0.11	0	-0.157778	0.0851107	1	1
MW-304	0.96	0	0.692222	0.0851107	14	14
MW-305	0.4	0	0.132222	0.0851107	12	12

Analysis of Variance Statistics

SS Wells	0.512794
SS Total	0.56495

Kruskal-Wallis Statistics

Non-Detect Rank	0
Background Rank Sum	70
Background Rank Mean	7.77778
H Statistic	7.53968
H Adjusted for Ties	7.53968

Basic Statistics

Parameter: Sulfate

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

Total Measurements	14
Total Non-Detects	0 (0%)
Pooled Mean	231.571
Pooled Std Dev	169.097
Compliance Meas.	5
Compliance Mean	348
Compliance Std Dev	257.457
Background Meas.	9
Background Mean	166.889
Background Std Dev	11.9838

Background Locations

There is 1 background location

Location	Meas.	Non-Detects	% ND	Total
MW-301	9	0	0	1502

Location	Mean	Std Dev	Std Err	Rank Sum	Rank Mean
MW-301	166.889	11.9838	0	54	6

Compliance Locations

There are 5 compliance location

Location	Obs.	Non-Detects	% ND	Total
MW-302	1	0	0	786
MW-303	1	0	0	348
MW-306	1	0	0	274
MW-304	1	0	0	194
MW-305	1	0	0	138

Location	Mean	Std Dev	Dif From Bkg	Std Err	Rank Sum	Rank Mean
MW-302	786	0	619.111	12.632	14	14
MW-303	348	0	181.111	12.632	13	13
MW-306	274	0	107.111	12.632	12	12
MW-304	194	0	27.1111	12.632	11	11
MW-305	138	0	-28.8889	12.632	1	1

Analysis of Variance Statistics

SS Wells	370569
SS Total	371717

Kruskal-Wallis Statistics

Non-Detect Rank	0
Background Rank Sum	54
Background Rank Mean	6
H Statistic	9.57143
H Adjusted for Ties	9.57143

Basic Statistics

Parameter: Total Dissolved Solids

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

Total Measurements	14
Total Non-Detects	0 (0%)
Pooled Mean	763.143
Pooled Std Dev	380.784
Compliance Meas.	5
Compliance Mean	1198.6
Compliance Std Dev	315.166
Background Meas.	9
Background Mean	521.222
Background Std Dev	39.9806

Background Locations

There is 1 background location

Location	Meas.	Non-Detects	% ND	Total
MW-301	9	0	0	4691

Location	Mean	Std Dev	Std Err	Rank Sum	Rank Mean
MW-301	521.222	39.9806	0	45	5

Compliance Locations

There are 5 compliance location

Location	Obs.	Non-Detects	% ND	Total
MW-302	1	0	0	1620
MW-303	1	0	0	1290
MW-306	1	0	0	773
MW-304	1	0	0	1270
MW-305	1	0	0	1040

Location	Mean	Std Dev	Dif From Bkg	Std Err	Rank Sum	Rank Mean
MW-302	1620	0	1098.78	42.1432	14	14
MW-303	1290	0	768.778	42.1432	13	13
MW-306	773	0	251.778	42.1432	10	10
MW-304	1270	0	748.778	42.1432	12	12
MW-305	1040	0	518.778	42.1432	11	11

Analysis of Variance Statistics

SS Wells	1.87216e+006
SS Total	1.88495e+006

Kruskal-Wallis Statistics

Non-Detect Rank	0
Background Rank Sum	45
Background Rank Mean	5
H Statistic	9.57143
H Adjusted for Ties	9.57143

Dixon's Test for Outliers

Parameter: Boron

Background Locations

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

For 9 Measurements...
5% Level of Significance

Iteration	Highest	Lowest	Critical	Outlier
1	0.570093	0.455621	0.512	779
2	0.402174	0.583333	0.554	488
3	0.402174	0.0978261	0.507	None

Loc.	Date	Conc.	Outlier
MW-301	4/26/2016	574	FALSE
	6/23/2016	612	FALSE
	8/10/2016	597	FALSE
	10/26/2016	620	FALSE
	1/18/2017	599	FALSE
	4/19/2017	565	FALSE
	6/20/2017	657	FALSE
	8/22/2017	**779**	**TRUE**
	11/8/2017	**488**	**TRUE**

Dixon's Test for Outliers

Parameter: Boron

Background Locations

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

For 9 Measurements...
1% Level of Significance

Iteration	Highest	Lowest	Critical	Outlier
1	0.570093	0.455621	0.635	None

Loc.	Date	Conc.	Outlier
MW-301	4/26/2016	574	FALSE
	6/23/2016	612	FALSE
	8/10/2016	597	FALSE
	10/26/2016	620	FALSE
	1/18/2017	599	FALSE
	4/19/2017	565	FALSE
	6/20/2017	657	FALSE
	8/22/2017	779	FALSE
	11/8/2017	488	FALSE

Dixon's Test for Outliers

Parameter: Calcium

Background Locations

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

For 9 Measurements...
5% Level of Significance

Iteration	Highest	Lowest	Critical	Outlier
1	0.174603	0.174603	0.512	None

Loc.	Date	Conc.	Outlier
MW-301	4/26/2016	66.9	FALSE
	6/23/2016	62.5	FALSE
	8/10/2016	65.6	FALSE
	10/26/2016	71.9	FALSE
	1/18/2017	74.1	FALSE
	4/19/2017	61.5	FALSE
	6/20/2017	59.3	FALSE
	8/22/2017	66.8	FALSE
	11/8/2017	65.2	FALSE

Dixon's Test for Outliers

Parameter: Chloride

Background Locations

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

For 9 Measurements...
5% Level of Significance

Iteration	Highest	Lowest	Critical	Outlier
1	0.169697	0.26738	0.512	None

Loc.	Date	Conc.	Outlier
MW-301	4/26/2016	63.4	FALSE
	6/23/2016	66.9	FALSE
	8/10/2016	73.3	FALSE
	10/26/2016	76.3	FALSE
	1/18/2017	71.6	FALSE
	4/19/2017	54.8	FALSE
	6/20/2017	69.8	FALSE
	8/22/2017	73.5	FALSE
	11/8/2017	59.8	FALSE

Dixon's Test for Outliers

Parameter: Field pH

Background Locations

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

For 9 Measurements...
5% Level of Significance

Iteration	Highest	Lowest	Critical	Outlier
1	0.178571	0.0416667	0.512	None

Loc.	Date	Conc.	Outlier
MW-301	4/26/2016	6.54	FALSE
	6/23/2016	6.06	FALSE
	8/10/2016	6.08	FALSE
	10/26/2016	6.26	FALSE
	1/18/2017	6.47	FALSE
	4/19/2017	6.64	FALSE
	6/20/2017	6.31	FALSE
	8/22/2017	6.16	FALSE
	11/8/2017	6.41	FALSE

Dixon's Test for Outliers

Parameter: Fluoride

Background Locations

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

For 9 Measurements...
5% Level of Significance

Iteration	Highest	Lowest	Critical	Outlier
1	0.416667	0.176471	0.512	None

Loc.	Date	Conc.	Outlier
MW-301	4/26/2016	0.22	FALSE
	6/23/2016	0.2 J	FALSE
	8/10/2016	0.44	FALSE
	10/26/2016	0.27	FALSE
	1/18/2017	0.17 J	FALSE
	4/19/2017	0.24	FALSE
	6/20/2017	0.26	FALSE
	8/22/2017	0.34	FALSE
	11/8/2017	0.27	FALSE

Dixon's Test for Outliers

Parameter: Sulfate

Background Locations

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

For 9 Measurements...
5% Level of Significance

Iteration	Highest	Lowest	Critical	Outlier
1	0.363636	0.25	0.512	None

Loc.	Date	Conc.	Outlier
MW-301	4/26/2016	150	FALSE
	6/23/2016	157	FALSE
	8/10/2016	159	FALSE
	10/26/2016	169	FALSE
	1/18/2017	171	FALSE
	4/19/2017	190	FALSE
	6/20/2017	166	FALSE
	8/22/2017	162	FALSE
	11/8/2017	178	FALSE

Dixon's Test for Outliers

Parameter: Total Dissolved Solids

Background Locations

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

For 9 Measurements...
5% Level of Significance

Iteration	Highest	Lowest	Critical	Outlier
1	0.22093	0.385321	0.512	None

Loc.	Date	Conc.	Outlier
MW-301	4/26/2016	500	FALSE
	6/23/2016	531	FALSE
	8/10/2016	576	FALSE
	10/26/2016	545	FALSE
	1/18/2017	545	FALSE
	4/19/2017	499	FALSE
	6/20/2017	490	FALSE
	8/22/2017	557	FALSE
	11/8/2017	448	FALSE

Shapiro-Wilks Test of Normality

Parameter: Boron

Background Locations

Normality Test of Residuals

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

K = 4 for 9 measurements

i	x(i)	x(n-i+1)	x(n-1+1)-x(i)	a(n-i+1)	b(i)
1	-122.111	168.889	291	0.5888	171.341
2	-45.1111	46.8889	92	0.3244	29.8448
3	-36.1111	9.88889	46	0.1976	9.0896
4	-13.1111	1.88889	15	0.0947	1.4205
5	-11.1111	-11.1111	0		
6	1.88889	-13.1111	-15		
7	9.88889	-36.1111	-46		
8	46.8889	-45.1111	-92		
9	168.889	-122.111	-291		

Sum of b values = 211.696
Sample Standard Deviation = 78.5564
W Statistic = 0.907759

5% Critical value of 0.829 is less than 0.907759
Data is normally distributed at 95% level of significance

1% Critical value of 0.764 is less than 0.907759
Data is normally distributed at 99% level of significance

Shapiro-Wilks Test of Normality

Parameter: Calcium

Background Locations

Normality Test of Residuals

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

K = 4 for 9 measurements

i	x(i)	x(n-i+1)	x(n-1+1)-x(i)	a(n-i+1)	b(i)
1	-6.67778	8.12222	14.8	0.5888	8.71424
2	-4.47778	5.92222	10.4	0.3244	3.37376
3	-3.47778	0.922222	4.4	0.1976	0.86944
4	-0.777778	0.822222	1.6	0.0947	0.15152
5	-0.377778	-0.377778	0		
6	0.822222	-0.777778	-1.6		
7	0.922222	-3.47778	-4.4		
8	5.92222	-4.47778	-10.4		
9	8.12222	-6.67778	-14.8		

Sum of b values = 13.109
Sample Standard Deviation = 4.74415
W Statistic = 0.954399

5% Critical value of 0.829 is less than 0.954399
Data is normally distributed at 95% level of significance

1% Critical value of 0.764 is less than 0.954399
Data is normally distributed at 99% level of significance

Shapiro-Wilks Test of Normality

Parameter: Chloride

Background Locations

Normality Test of Residuals

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

K = 4 for 9 measurements

i	x(i)	x(n-i+1)	x(n-1+1)-x(i)	a(n-i+1)	b(i)
1	-12.9111	8.58889	21.5	0.5888	12.6592
2	-7.91111	5.78889	13.7	0.3244	4.44428
3	-4.31111	5.58889	9.9	0.1976	1.95624
4	-0.811111	3.88889	4.7	0.0947	0.44509
5	2.08889	2.08889	0		
6	3.88889	-0.811111	-4.7		
7	5.58889	-4.31111	-9.9		
8	5.78889	-7.91111	-13.7		
9	8.58889	-12.9111	-21.5		

Sum of b values = 19.5048
Sample Standard Deviation = 7.12854
W Statistic = 0.935819

5% Critical value of 0.829 is less than 0.935819
Data is normally distributed at 95% level of significance

1% Critical value of 0.764 is less than 0.935819
Data is normally distributed at 99% level of significance

Shapiro-Wilks Test of Normality

Parameter: Field pH

Background Locations

Normality Test of Residuals

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

K = 4 for 9 measurements

i	x(i)	x(n-i+1)	x(n-1+1)-x(i)	a(n-i+1)	b(i)
1	-0.265556	0.314444	0.58	0.5888	0.341504
2	-0.245556	0.214444	0.46	0.3244	0.149224
3	-0.165556	0.144444	0.31	0.1976	0.061256
4	-0.0655556	0.0844444	0.15	0.0947	0.014205
5	-0.0155556	-0.0155556	0		
6	0.0844444	-0.0655556	-0.15		
7	0.144444	-0.165556	-0.31		
8	0.214444	-0.245556	-0.46		
9	0.314444	-0.265556	-0.58		

Sum of b values = 0.566189
Sample Standard Deviation = 0.204824
W Statistic = 0.955151

5% Critical value of 0.829 is less than 0.955151
Data is normally distributed at 95% level of significance

1% Critical value of 0.764 is less than 0.955151
Data is normally distributed at 99% level of significance

Shapiro-Wilks Test of Normality

Parameter: Fluoride

Background Locations

Normality Test of Residuals

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

K = 4 for 9 measurements

i	x(i)	x(n-i+1)	x(n-1+1)-x(i)	a(n-i+1)	b(i)
1	-0.0977778	0.172222	0.27	0.5888	0.158976
2	-0.0677778	0.0722222	0.14	0.3244	0.045416
3	-0.0477778	0.00222222	0.05	0.1976	0.00988
4	-0.0277778	0.00222222	0.03	0.0947	0.002841
5	-0.00777778	-0.00777778	0		
6	0.00222222	-0.0277778	-0.03		
7	0.00222222	-0.0477778	-0.05		
8	0.0722222	-0.0677778	-0.14		
9	0.172222	-0.0977778	-0.27		

Sum of b values = 0.217113
Sample Standard Deviation = 0.0807431
W Statistic = 0.903797

5% Critical value of 0.829 is less than 0.903797
Data is normally distributed at 95% level of significance

1% Critical value of 0.764 is less than 0.903797
Data is normally distributed at 99% level of significance

Shapiro-Wilks Test of Normality

Parameter: Sulfate

Background Locations

Normality Test of Residuals

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

K = 4 for 9 measurements

i	x(i)	x(n-i+1)	x(n-1+1)-x(i)	a(n-i+1)	b(i)
1	-16.8889	23.1111	40	0.5888	23.552
2	-9.88889	11.1111	21	0.3244	6.8124
3	-7.88889	4.11111	12	0.1976	2.3712
4	-4.88889	2.11111	7	0.0947	0.6629
5	-0.888889	-0.888889	0		
6	2.11111	-4.88889	-7		
7	4.11111	-7.88889	-12		
8	11.1111	-9.88889	-21		
9	23.1111	-16.8889	-40		

Sum of b values = 33.3985
Sample Standard Deviation = 11.9838
W Statistic = 0.970903

5% Critical value of 0.829 is less than 0.970903
Data is normally distributed at 95% level of significance

1% Critical value of 0.764 is less than 0.970903
Data is normally distributed at 99% level of significance

Shapiro-Wilks Test of Normality

Parameter: Total Dissolved Solids

Background Locations

Normality Test of Residuals

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

K = 4 for 9 measurements

i	x(i)	x(n-i+1)	x(n-1+1)-x(i)	a(n-i+1)	b(i)
1	-73.2222	54.7778	128	0.5888	75.3664
2	-31.2222	35.7778	67	0.3244	21.7348
3	-22.2222	23.7778	46	0.1976	9.0896
4	-21.2222	23.7778	45	0.0947	4.2615
5	9.77778	9.77778	0		
6	23.7778	-21.2222	-45		
7	23.7778	-22.2222	-46		
8	35.7778	-31.2222	-67		
9	54.7778	-73.2222	-128		

Sum of b values = 110.452
Sample Standard Deviation = 39.9806
W Statistic = 0.95403

5% Critical value of 0.829 is less than 0.95403
Data is normally distributed at 95% level of significance

1% Critical value of 0.764 is less than 0.95403
Data is normally distributed at 99% level of significance

Parametric Prediction Limit with Resampling
Inter-Well Comparison.

Background date range: 1/1/2000 to 1/16/2018

1 of 2 Resampling Plan
Two Sampling Events per Year

Originating Sampling Event Date is 11/8/2017

Indicator Parameters
Total Dissolved Solids
Fluoride
Sulfate
Chloride
Boron
Calcium
Field pH
There are 7 parameters.

5 Compliance Wells Analyzed.
MW-305
MW-304
MW-306
MW-303
MW-302

Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Per-constituent, per-evaluation false positive rate:
0.00714286 = 0.10/(7 * 2)
Alpha 0.00714286 approximated by 0.00667

Total Dissolved Solids
Background Observations: 9
Background Mean: 521.222
Background Std. Dev: 39.9806
K(5, 9, 0.00667) = 2.675
PL = 521.222 + (2.675 * 39.9806) = 628.17

Well	Date	Value	Resample	Exceedance
MW-302	11/8/2017	1620	FALSE	TRUE
MW-303	11/8/2017	1290	FALSE	TRUE
MW-306	11/8/2017	773	FALSE	TRUE
MW-304	11/8/2017	1270	FALSE	TRUE
MW-305	11/8/2017	1040	FALSE	TRUE

Fluoride
Background Observations: 9

Background Mean: 0.267778
Background Std. Dev: 0.0807431
K(5, 9, 0.00667) = 2.675
PL = 0.267778 + (2.675 * 0.0807431) = 0.483766

Well	Date	Value	Resample	Exceedance
MW-302	11/8/2017	0.2 J	FALSE	FALSE
MW-303	11/8/2017	0.19 J	FALSE	FALSE
MW-306	11/8/2017	0.11 J	FALSE	FALSE
MW-304	**11/8/2017**	**0.96**	**FALSE**	**TRUE**
MW-305	11/8/2017	0.4	FALSE	FALSE

Sulfate

Background Observations: 9
Background Mean: 166.889
Background Std. Dev: 11.9838
K(5, 9, 0.00667) = 2.675
PL = 166.889 + (2.675 * 11.9838) = 198.946

Well	Date	Value	Resample	Exceedance
MW-302	**11/8/2017**	**786**	**FALSE**	**TRUE**
MW-303	**11/8/2017**	**348**	**FALSE**	**TRUE**
MW-306	**11/8/2017**	**274**	**FALSE**	**TRUE**
MW-304	11/8/2017	194	FALSE	FALSE
MW-305	11/8/2017	138	FALSE	FALSE

Chloride

Background Observations: 9
Background Mean: 67.7111
Background Std. Dev: 7.12854
K(5, 9, 0.00667) = 2.675
PL = 67.7111 + (2.675 * 7.12854) = 86.78

Well	Date	Value	Resample	Exceedance
MW-302	**11/8/2017**	**254**	**FALSE**	**TRUE**
MW-303	**11/8/2017**	**185**	**FALSE**	**TRUE**
MW-305	**11/8/2017**	**282**	**FALSE**	**TRUE**
MW-306	11/8/2017	50.4	FALSE	FALSE
MW-304	**11/8/2017**	**417**	**FALSE**	**TRUE**

Boron

Background Observations: 9
Background Mean: 610.111
Background Std. Dev: 78.5564
K(5, 9, 0.00667) = 2.675
PL = 610.111 + (2.675 * 78.5564) = 820.25

Well	Date	Value	Resample	Exceedance
MW-302	**11/8/2017**	**1320**	**FALSE**	**TRUE**
MW-303	**11/8/2017**	**1070**	**FALSE**	**TRUE**
MW-306	**11/8/2017**	**881**	**FALSE**	**TRUE**
MW-304	**11/8/2017**	**1040**	**FALSE**	**TRUE**
MW-305	**11/8/2017**	**925**	**FALSE**	**TRUE**

Calcium

Background Observations: 9
Background Mean: 65.9778
Background Std. Dev: 4.74415
K(5, 9, 0.00667) = 2.675
PL = 65.9778 + (2.675 * 4.74415) = 78.6684

Well	Date	Value	Resample	Exceedance
MW-302	**11/8/2017**	**183**	**FALSE**	**TRUE**
MW-303	**11/8/2017**	**234**	**FALSE**	**TRUE**
MW-304	**11/8/2017**	**136**	**FALSE**	**TRUE**
MW-306	11/8/2017	73.1	FALSE	FALSE
MW-305	**11/8/2017**	**99.5**	**FALSE**	**TRUE**

Field pH

Background Observations: 9
Background Mean: 6.32556
Background Std. Dev: 0.204824
K(5, 9, 0.00667) = 2.675
PL = 6.32556 + (2.675 * 0.204824) = 6.87346

Well	Date	Value	Resample	Exceedance
MW-302	11/8/2017	6.55	FALSE	FALSE
MW-303	11/8/2017	6.6	FALSE	FALSE
MW-304	**11/8/2017**	**7**	**FALSE**	**TRUE**
MW-306	11/8/2017	6.49	FALSE	FALSE

MW-305	11/8/2017	7.01	FALSE	TRUE

Site Name: Ottumwa Generating Station
Sampling Event: Apr-18
Project Number: 25216072

App VI Parameters	Original # of Background Samples	Background % ND	Outliers	Keep Outliers?	Removed Outliers	Updated Background % ND	# of Background Samples for UPL Calculation	Normality Test Results	Data Transformations or Adjustments	Statistical Method for UPL Calculation	UPL	GPS	UPL> GPS	
Antimony	8	37.50%	No	-	-	37.50%	8	Normal	Cohen's adjustment	Parametric UPL with 1-of-2 Resampling	0.22*	6	0	No
Arsenic	8	0%	No	-	-	0%	8	Normal		Parametric UPL with 1-of-2 Resampling	0.53*	10	0	No
Barium	8	0%	No	-	-	0%	8	Normal		Parametric UPL with 1-of-2 Resampling	68.8	2000	0	No
Beryllium	8	100%	No	-	-	100%	8	Not Test 100% ND		Double Qualification	DQ	4	0	No
Cadmium	8	37.50%	1	Yes	-	37.50%	8	Not Normal not Normal wwith NL transform		Non- Parametric Test	0.12*	5	0	No
Chromium	8	12.50%	No	-	-	12.50%	8	Normal	replace ND with 1/2 Detection limit	Parametric UPL with 1-of-2 Resampling	1.07	100	0	No
Cobalt	8	0%	No	-	-	0%	8	Normal @99%, Normal , not @95%		Non- Parametric Test (chosen to be more conservative than parametric for this data set)	4.1	6	0	No
F- same as AppIII cal.	9	see appendix III GPS calculation for UPL									0.484	4	0	No
lead	8	62.50%	No	-	-	62.50%	8	Not Tested - ND>50%		Non- Parametric Test	0.1*	15	0	No
lithium	8	0%	No	-	-	0%	8	Normal		Parametric UPL with 1-of-2 Resampling	34.2	40	0	No
mercury	8	100%	No	-	-		8	Not Test 100% ND		Double Qualification	DQ	2	0	No
molybdenum	8	0%	No	-	-	0%	8	Normal		Parametric UPL with 1-of-2 Resampling	1.74	100	0	No
selenium	8	0%	No	-	-	0%	8	Normal		Parametric UPL with 1-of-2 Resampling	8.55	50	0	No
thallium	8	75%	No	-	-	75%	8	Not Tested - ND>50%		Non- Parametric Test	0.14*	2	0	No
radium combined 266/228	8	0%	No	-	-	0%	8	Nomal		Parametric UPL with 1-of-2 Resampling	2.15	5	0	No

	Initial Review	Final Review
Prepared by:	NK	NDK 2/13/2019
Checked by:	SC	SCC 9/1/2019

* UPL is below the limit of Quantification (LOQ) for background sampling for compliance wells, only results confirmed above the LOQ will be evaluated as potential SSIs above the background.

Dixon's Test for Outliers

Parameter: Antimony

Background Locations

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

For 10 Measurements...
5% Level of Significance

Iteration	Highest	Lowest	Critical	Outlier
1	0.402299	0	0.477	None

Loc.	Date	Conc.	Outlier
MW-301	4/26/2016	ND<0.058 U	FALSE
	6/23/2016	0.13 J	FALSE
	8/10/2016	0.12 J	FALSE
	10/26/2016	ND<0.058 U	FALSE
	1/18/2017	0.11 J	FALSE
	4/19/2017	ND<0.026 U	FALSE
	6/20/2017	0.054 J	FALSE
	8/21/2017	0.063 J	FALSE
	4/16/2018	ND<0.026 U	FALSE
	8/14/2018	0.2 J	FALSE

Basic Statistics

Parameter: Antimony

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

Total Measurements	20
Total Non-Detects	9 (45%)
Pooled Mean	0.0989
Pooled Std Dev	0.0560328
Compliance Meas.	10
Compliance Mean	0.1133
Compliance Std Dev	0.0563167
Background Meas.	10
Background Mean	0.0845
Background Std Dev	0.0547342

Background Locations

There is 1 background location

Location	Meas.	Non-Detects	% ND	Total
MW-301	10	4	40	0.845

Location	Mean	Std Dev	Std Err	Rank Sum	Rank Mean
MW-301	0.0845	0.0547342	0	109	10.9

Compliance Locations

There are 5 compliance location

Location	Obs.	Non-Detects	% ND	Total
MW-302	2	2	100	0.176
MW-303	2	0	0	0.258
MW-304	2	1	50	0.216
MW-305	2	1	50	0.239
MW-306	2	1	50	0.244

Location	Mean	Std Dev	Dif From Bkg	Std Err	Rank Sum	Rank Mean
MW-302	0.088	0.0876812	0.0035	0.047861	10	5
MW-303	0.129	0.0438406	0.0445	0.047861	32	16
MW-304	0.108	0.115966	0.0235	0.047861	24	12
MW-305	0.1195	0.0431335	0.035	0.047861	17	8.5
MW-306	0.122	0.039598	0.0375	0.047861	18	9

Analysis of Variance Statistics

SS Wells	0.0062048
SS Total	0.0596538

Kruskal-Wallis Statistics

Non-Detect Rank	5
Background Rank Sum	109
Background Rank Mean	10.9
H Statistic	3.98857
H Adjusted for Ties	4.38413

Basic Statistics

Parameter: Arsenic

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

Total Measurements	20
Total Non-Detects	0 (0%)
Pooled Mean	0.3997
Pooled Std Dev	0.287647
Compliance Meas.	10
Compliance Mean	0.573
Compliance Std Dev	0.311807
Background Meas.	10
Background Mean	0.2264
Background Std Dev	0.103498

Background Locations

There is 1 background location

Location	Meas.	Non-Detects	% ND	Total
MW-301	10	0	0	2.264

Location	Mean	Std Dev	Std Err	Rank Sum	Rank Mean
MW-301	0.2264	0.103498	0	63	6.3

Compliance Locations

There are 5 compliance location

Location	Obs.	Non-Detects	% ND	Total
MW-302	2	0	0	0.46
MW-303	2	0	0	1.03
MW-304	2	0	0	1.98
MW-305	2	0	0	1.23
MW-306	2	0	0	1.03

Location	Mean	Std Dev	Dif From Bkg	Std Err	Rank Sum	Rank Mean
MW-302	0.23	0.0989949	0.0036	0.126156	15	7.5
MW-303	0.515	0.120208	0.2886	0.126156	30	15
MW-304	0.99	0.438406	0.7636	0.126156	38	19
MW-305	0.615	0.148492	0.3886	0.126156	34	17
MW-306	0.515	0.190919	0.2886	0.126156	30	15

Analysis of Variance Statistics

SS Wells	1.20072
SS Total	1.57207

Kruskal-Wallis Statistics

Non-Detect Rank	0
Background Rank Sum	63
Background Rank Mean	6.3
H Statistic	14.4114
H Adjusted for Ties	14.4114

Basic Statistics

Parameter: Barium

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

Total Measurements	20
Total Non-Detects	0 (0%)
Pooled Mean	57.17
Pooled Std Dev	27.9469
Compliance Meas.	10
Compliance Mean	69.25
Compliance Std Dev	35.4885
Background Meas.	10
Background Mean	45.09
Background Std Dev	8.07003

Background Locations

There is 1 background location

Location	Meas.	Non-Detects	% ND	Total
MW-301	10	0	0	450.9

Location	Mean	Std Dev	Std Err	Rank Sum	Rank Mean
MW-301	45.09	8.07003	0	82	8.2

Compliance Locations

There are 5 compliance location

Location	Obs.	Non-Detects	% ND	Total
MW-302	2	0	0	36
MW-303	2	0	0	146.8
MW-304	2	0	0	175.9
MW-305	2	0	0	234
MW-306	2	0	0	99.8

Location	Mean	Std Dev	Dif From Bkg	Std Err	Rank Sum	Rank Mean
MW-302	18	0.424264	-27.09	5.17596	3	1.5
MW-303	73.4	5.51543	28.31	5.17596	31	15.5
MW-304	87.95	0.777817	42.86	5.17596	35	17.5
MW-305	117	1.41421	71.91	5.17596	39	19.5
MW-306	49.9	2.40416	4.81	5.17596	20	10

Analysis of Variance Statistics

SS Wells	14214.4
SS Total	14839.6

Kruskal-Wallis Statistics

Non-Detect Rank	0
Background Rank Sum	82
Background Rank Mean	8.2
H Statistic	15.0114
H Adjusted for Ties	15.0114

Basic Statistics

Parameter: Beryllium

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

Total Measurements	20
Total Non-Detects	16 (80%)
Pooled Mean	0.06785
Pooled Std Dev	0.0576745
Compliance Meas.	10
Compliance Mean	0.0769
Compliance Std Dev	0.0698895
Background Meas.	10
Background Mean	0.0588
Background Std Dev	0.0442237

Background Locations

There is 1 background location

Location	Meas.	Non-Detects	% ND	Total
MW-301	10	9	90	0.588

Location	Mean	Std Dev	Std Err	Rank Sum	Rank Mean
MW-301	0.0588	0.0442237	0	95.5	9.55

Compliance Locations

There are 5 compliance location

Location	Obs.	Non-Detects	% ND	Total
MW-303	2	1	50	0.137
MW-304	2	0	0	0.236
MW-302	2	2	100	0.132
MW-305	2	2	100	0.132
MW-306	2	2	100	0.132

Location	Mean	Std Dev	Dif From Bkg	Std Err	Rank Sum	Rank Mean
MW-303	0.0685	0.072832	0.0097	0.0495682	25.5	12.75
MW-304	0.118	0.130108	0.0592	0.0495682	38	19
MW-302	0.066	0.0763675	0.0072	0.0495682	17	8.5
MW-305	0.066	0.0763675	0.0072	0.0495682	17	8.5
MW-306	0.066	0.0763675	0.0072	0.0495682	17	8.5

Analysis of Variance Statistics

SS Wells	0.00587045
SS Total	0.0632005

Kruskal-Wallis Statistics

Non-Detect Rank	8.5
Background Rank Sum	95.5
Background Rank Mean	9.55
H Statistic	5.36143
H Adjusted for Ties	10.9703

Basic Statistics

Parameter: Cadmium

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

Total Measurements	20
Total Non-Detects	4 (20%)
Pooled Mean	0.1871
Pooled Std Dev	0.246676
Compliance Meas.	10
Compliance Mean	0.3198
Compliance Std Dev	0.295243
Background Meas.	10
Background Mean	0.0544
Background Std Dev	0.0464667

Background Locations

There is 1 background location

Location	Meas.	Non-Detects	% ND	Total
MW-301	10	3	30	0.544

Location	Mean	Std Dev	Std Err	Rank Sum	Rank Mean
MW-301	0.0544	0.0464667	0	67.5	6.75

Compliance Locations

There are 5 compliance location

Location	Obs.	Non-Detects	% ND	Total
MW-303	2	0	0	0.8
MW-304	2	1	50	0.188
MW-302	2	0	0	0.43
MW-305	2	0	0	0.14
MW-306	2	0	0	1.64

Location	Mean	Std Dev	Dif From Bkg	Std Err	Rank Sum	Rank Mean
MW-303	0.4	0.0565685	0.3456	0.0423993	35	17.5
MW-304	0.094	0.10748	0.0396	0.0423993	16.5	8.25
MW-302	0.215	0.00707107	0.1606	0.0423993	31	15.5
MW-305	0.07	0.0226274	0.0156	0.0423993	21	10.5
MW-306	0.82	0.0848528	0.7656	0.0423993	39	19.5

Analysis of Variance Statistics

SS Wells	1.11419
SS Total	1.15613

Kruskal-Wallis Statistics

Non-Detect Rank	2.5
Background Rank Sum	67.5
Background Rank Mean	6.75
H Statistic	13.1643
H Adjusted for Ties	13.264

Basic Statistics

Parameter: Chromium

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

Total Measurements	20
Total Non-Detects	2 (10%)
Pooled Mean	0.7612
Pooled Std Dev	1.27456
Compliance Meas.	10
Compliance Mean	1.089
Compliance Std Dev	1.77344
Background Meas.	10
Background Mean	0.4334
Background Std Dev	0.213635

Background Locations

There is 1 background location

Location	Meas.	Non-Detects	% ND	Total
MW-301	10	2	20	4.334

Location	Mean	Std Dev	Std Err	Rank Sum	Rank Mean
MW-301	0.4334	0.213635	0	99	9.9

Compliance Locations

There are 5 compliance location

Location	Obs.	Non-Detects	% ND	Total
MW-303	2	0	0	0.31
MW-304	2	0	0	7.9
MW-302	2	0	0	0.94
MW-305	2	0	0	0.67
MW-306	2	0	0	1.07

Location	Mean	Std Dev	Dif From Bkg	Std Err	Rank Sum	Rank Mean
MW-303	0.155	0.0494975	-0.2784	0.58861	7	3.5
MW-304	3.95	2.75772	3.5166	0.58861	39	19.5
MW-302	0.47	0.0141421	0.0366	0.58861	23	11.5
MW-305	0.335	0.106066	-0.0984	0.58861	17	8.5
MW-306	0.535	0.233345	0.1016	0.58861	25	12.5

Analysis of Variance Statistics

SS Wells	22.7816
SS Total	30.8657

Kruskal-Wallis Statistics

Non-Detect Rank	1.5
Background Rank Sum	99
Background Rank Mean	9.9
H Statistic	8.04571
H Adjusted for Ties	8.05177

Basic Statistics

Parameter: Cobalt

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

Total Measurements	20
Total Non-Detects	0 (0%)
Pooled Mean	3.265
Pooled Std Dev	4.27125
Compliance Meas.	10
Compliance Mean	4.841
Compliance Std Dev	5.63576
Background Meas.	10
Background Mean	1.689
Background Std Dev	1.1104

Background Locations

There is 1 background location

Location	Meas.	Non-Detects	% ND	Total
MW-301	10	0	0	16.89

Location	Mean	Std Dev	Std Err	Rank Sum	Rank Mean
MW-301	1.689	1.1104	0	91	9.1

Compliance Locations

There are 5 compliance location

Location	Obs.	Non-Detects	% ND	Total
MW-303	2	0	0	4.3
MW-304	2	0	0	1.31
MW-302	2	0	0	2.4
MW-305	2	0	0	30.1
MW-306	2	0	0	10.3

Location	Mean	Std Dev	Dif From Bkg	Std Err	Rank Sum	Rank Mean
MW-303	2.15	0.0707107	0.461	0.725229	27	13.5
MW-304	0.655	0.374767	-1.034	0.725229	5	2.5
MW-302	1.2	0.424264	-0.489	0.725229	13	6.5
MW-305	15.05	0.777817	13.361	0.725229	39	19.5
MW-306	5.15	0.494975	3.461	0.725229	35	17.5

Analysis of Variance Statistics

SS Wells	334.356
SS Total	346.628

Kruskal-Wallis Statistics

Non-Detect Rank	0
Background Rank Sum	91
Background Rank Mean	9.1
H Statistic	13.0743
H Adjusted for Ties	13.0743

Basic Statistics

Parameter: Lead

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

Total Measurements	20
Total Non-Detects	5 (25%)
Pooled Mean	0.18235
Pooled Std Dev	0.171113
Compliance Meas.	10
Compliance Mean	0.2267
Compliance Std Dev	0.230178
Background Meas.	10
Background Mean	0.138
Background Std Dev	0.0667849

Background Locations

There is 1 background location

Location	Meas.	Non-Detects	% ND	Total
MW-301	10	5	50	1.38

Location	Mean	Std Dev	Std Err	Rank Sum	Rank Mean
MW-301	0.138	0.0667849	0	67	6.7

Compliance Locations

There are 5 compliance location

Location	Obs.	Non-Detects	% ND	Total
MW-303	2	0	0	0.199
MW-304	2	0	0	1.18
MW-302	2	0	0	0.218
MW-305	2	0	0	0.43
MW-306	2	0	0	0.24

Location	Mean	Std Dev	Dif From Bkg	Std Err	Rank Sum	Rank Mean
MW-303	0.0995	0.0431335	-0.0385	0.0853299	25	12.5
MW-304	0.59	0.311127	0.452	0.0853299	39	19.5
MW-302	0.109	0.0155563	-0.029	0.0853299	24	12
MW-305	0.215	0.13435	0.077	0.0853299	32	16
MW-306	0.12	0.113137	-0.018	0.0853299	23	11.5

Analysis of Variance Statistics

SS Wells	0.386422
SS Total	0.556317

Kruskal-Wallis Statistics

Non-Detect Rank	3
Background Rank Sum	67
Background Rank Mean	6.7
H Statistic	10.8971
H Adjusted for Ties	11.0635

Basic Statistics

Parameter: Lithium

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

Total Measurements	20
Total Non-Detects	7 (35%)
Pooled Mean	14.92
Pooled Std Dev	10.1248
Compliance Meas.	10
Compliance Mean	5.35
Compliance Std Dev	1.21861
Background Meas.	10
Background Mean	24.49
Background Std Dev	3.37752

Background Locations

There is 1 background location

Location	Meas.	Non-Detects	% ND	Total
MW-301	10	0	0	244.9

Location	Mean	Std Dev	Std Err	Rank Sum	Rank Mean
MW-301	24.49	3.37752	0	155	15.5

Compliance Locations

There are 5 compliance location

Location	Obs.	Non-Detects	% ND	Total
MW-303	2	1	50	11.5
MW-302	2	0	0	14.4
MW-304	2	2	100	9.2
MW-305	2	2	100	9.2
MW-306	2	2	100	9.2

Location	Mean	Std Dev	Dif From Bkg	Std Err	Rank Sum	Rank Mean
MW-303	5.75	1.62635	-18.74	2.1263	12	6
MW-302	7.2	0.424264	-17.29	2.1263	19	9.5
MW-304	4.6	0	-19.89	2.1263	8	4
MW-305	4.6	0	-19.89	2.1263	8	4
MW-306	4.6	0	-19.89	2.1263	8	4

Analysis of Variance Statistics

SS Wells	1842.24
SS Total	1947.73

Kruskal-Wallis Statistics

Non-Detect Rank	4
Background Rank Sum	155
Background Rank Mean	15.5
H Statistic	15.6
H Adjusted for Ties	16.2857

Dixon's Test for Outliers

Parameter: Chromium

Background Locations

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

For 8 Measurements...
5% Level of Significance

Iteration	Highest	Lowest	Critical	Outlier
1	0.25	0.230769	0.554	None

Loc.	Date	Conc.	Outlier
MW-301	4/26/2016	0.59 J	FALSE
	6/23/2016	0.74 J	FALSE
	8/10/2016	0.64 J	FALSE
	10/26/2016	ND<0.34 U	FALSE
	1/18/2017	0.59 J	FALSE
	4/19/2017	0.49 J	FALSE
	6/20/2017	0.25 J	FALSE
	8/21/2017	0.39 J	FALSE

Basic Statistics

Parameter: Mercury

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

Total Measurements	20
Total Non-Detects	19 (95%)
Pooled Mean	0.0692
Pooled Std Dev	0.0234422
Compliance Meas.	10
Compliance Mean	0.0878
Compliance Std Dev	0.00451664
Background Meas.	10
Background Mean	0.0506
Background Std Dev	0.0192596

Background Locations

There is 1 background location

Location	Meas.	Non-Detects	% ND	Total
MW-301	10	10	100	0.506

Location	Mean	Std Dev	Std Err	Rank Sum	Rank Mean
MW-301	0.0506	0.0192596	0	100	10

Compliance Locations

There are 5 compliance location

Location	Obs.	Non-Detects	% ND	Total
MW-303	2	2	100	0.173
MW-302	2	1	50	0.179
MW-304	2	2	100	0.173
MW-305	2	2	100	0.18
MW-306	2	2	100	0.173

Location	Mean	Std Dev	Dif From Bkg	Std Err	Rank Sum	Rank Mean
MW-303	0.0865	0.00494975	0.0359	0.0122411	20	10
MW-302	0.0895	0.00919239	0.0389	0.0122411	30	15
MW-304	0.0865	0.00494975	0.0359	0.0122411	20	10
MW-305	0.09	0	0.0394	0.0122411	20	10
MW-306	0.0865	0.00494975	0.0359	0.0122411	20	10

Analysis of Variance Statistics

SS Wells	0.0069448
SS Total	0.0104412

Kruskal-Wallis Statistics

Non-Detect Rank	10
Background Rank Sum	100
Background Rank Mean	10
H Statistic	1.28571
H Adjusted for Ties	9

Basic Statistics

Parameter: Molybdenum

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

Total Measurements	20
Total Non-Detects	0 (0%)
Pooled Mean	2.0385
Pooled Std Dev	2.12574
Compliance Meas.	10
Compliance Mean	3.112
Compliance Std Dev	2.62735
Background Meas.	10
Background Mean	0.965
Background Std Dev	0.275288

Background Locations

There is 1 background location

Location	Meas.	Non-Detects	% ND	Total
MW-301	10	0	0	9.65

Location	Mean	Std Dev	Std Err	Rank Sum	Rank Mean
MW-301	0.965	0.275288	0	87	8.7

Compliance Locations

There are 5 compliance location

Location	Obs.	Non-Detects	% ND	Total
MW-302	2	0	0	1.13
MW-303	2	0	0	1.59
MW-304	2	0	0	4.4
MW-305	2	0	0	13.6
MW-306	2	0	0	10.4

Location	Mean	Std Dev	Dif From Bkg	Std Err	Rank Sum	Rank Mean
MW-302	0.565	0.0353553	-0.4	0.254537	5	2.5
MW-303	0.795	0.26163	-0.17	0.254537	13	6.5
MW-304	2.2	0.282843	1.235	0.254537	31	15.5
MW-305	6.8	0.424264	5.835	0.254537	39	19.5
MW-306	5.2	0.707107	4.235	0.254537	35	17.5

Analysis of Variance Statistics

SS Wells	84.3451
SS Total	85.8569

Kruskal-Wallis Statistics

Non-Detect Rank	0
Background Rank Sum	87
Background Rank Mean	8.7
H Statistic	14.3543
H Adjusted for Ties	14.3543

Basic Statistics

Parameter: Selenium

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

Total Measurements	20
Total Non-Detects	4 (20%)
Pooled Mean	2.9144
Pooled Std Dev	2.84898
Compliance Meas.	10
Compliance Mean	0.2188
Compliance Std Dev	0.142421
Background Meas.	10
Background Mean	5.61
Background Std Dev	0.9837

Background Locations

There is 1 background location

Location	Meas.	Non-Detects	% ND	Total
MW-301	10	0	0	56.1

Location	Mean	Std Dev	Std Err	Rank Sum	Rank Mean
MW-301	5.61	0.9837	0	155	15.5

Compliance Locations

There are 5 compliance location

Location	Obs.	Non-Detects	% ND	Total
MW-302	2	2	100	0.246
MW-303	2	0	0	0.58
MW-304	2	1	50	0.586
MW-305	2	0	0	0.48
MW-306	2	1	50	0.296

Location	Mean	Std Dev	Dif From Bkg	Std Err	Rank Sum	Rank Mean
MW-302	0.123	0.0523259	-5.487	0.615553	5	2.5
MW-303	0.29	0.0848528	-5.32	0.615553	15	7.5
MW-304	0.293	0.292742	-5.317	0.615553	12.5	6.25
MW-305	0.24	0.169706	-5.37	0.615553	14	7
MW-306	0.148	0.0876812	-5.462	0.615553	8.5	4.25

Analysis of Variance Statistics

SS Wells	145.376
SS Total	154.217

Kruskal-Wallis Statistics

Non-Detect Rank	2.5
Background Rank Sum	155
Background Rank Mean	15.5
H Statistic	15.2786
H Adjusted for Ties	15.3943

Basic Statistics

Parameter: Thallium

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

Total Measurements	20
Total Non-Detects	13 (65%)
Pooled Mean	0.2175
Pooled Std Dev	0.186312
Compliance Meas.	10
Compliance Mean	0.1411
Compliance Std Dev	0.107644
Background Meas.	10
Background Mean	0.2939
Background Std Dev	0.220733

Background Locations

There is 1 background location

Location	Meas.	Non-Detects	% ND	Total
MW-301	10	7	70	2.939

Location	Mean	Std Dev	Std Err	Rank Sum	Rank Mean
MW-301	0.2939	0.220733	0	97	9.7

Compliance Locations

There are 5 compliance location

Location	Obs.	Non-Detects	% ND	Total
MW-302	2	2	100	0.176
MW-303	2	2	100	0.176
MW-304	2	1	50	0.186
MW-305	2	0	0	0.65
MW-306	2	1	50	0.223

Location	Mean	Std Dev	Dif From Bkg	Std Err	Rank Sum	Rank Mean
MW-302	0.088	0.0735391	-0.2059	0.140025	14	7
MW-303	0.088	0.0735391	-0.2059	0.140025	14	7
MW-304	0.093	0.0806102	-0.2009	0.140025	24	12
MW-305	0.325	0.00707107	0.0311	0.140025	39	19.5
MW-306	0.1115	0.0403051	-0.1824	0.140025	22	11

Analysis of Variance Statistics

SS Wells	0.202036
SS Total	0.659533

Kruskal-Wallis Statistics

Non-Detect Rank	7
Background Rank Sum	97
Background Rank Mean	9.7
H Statistic	6.35429
H Adjusted for Ties	8.74865

Basic Statistics

Parameter: Total Radium

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

Total Measurements	20
Total Non-Detects	0 (0%)
Pooled Mean	1.07585
Pooled Std Dev	0.801729
Compliance Meas.	10
Compliance Mean	1.3331
Compliance Std Dev	1.01296
Background Meas.	10
Background Mean	0.8186
Background Std Dev	0.428737

Background Locations

There is 1 background location

Location	Meas.	Non-Detects	% ND	Total
MW-301	10	0	0	8.186

Location	Mean	Std Dev	Std Err	Rank Sum	Rank Mean
MW-301	0.8186	0.428737	0	88	8.8

Compliance Locations

There are 5 compliance location

Location	Obs.	Non-Detects	% ND	Total
MW-302	2	0	0	1.866
MW-303	2	0	0	2.349
MW-306	2	0	0	1.29
MW-304	2	0	0	5.82
MW-305	2	0	0	2.006

Location	Mean	Std Dev	Dif From Bkg	Std Err	Rank Sum	Rank Mean
MW-302	0.933	0.264458	0.1144	0.433284	23	11.5
MW-303	1.1745	0.912875	0.3559	0.433284	23	11.5
MW-306	0.645	0.480833	-0.1736	0.433284	13	6.5
MW-304	2.91	1.1738	2.0914	0.433284	39	19.5
MW-305	1.003	0.462448	0.1844	0.433284	24	12

Analysis of Variance Statistics

SS Wells	7.83214
SS Total	12.2126

Kruskal-Wallis Statistics

Non-Detect Rank	0
Background Rank Sum	88
Background Rank Mean	8.8
H Statistic	6.61143
H Adjusted for Ties	6.61143

Shapiro-Wilks Test of Normality

Parameter: Antimony

Background Locations

Normality Test of Residuals

Original Data (Not Transformed)

Cohen's Adjustment

K = 4 for 8 measurements

i	x(i)	x(n-i+1)	x(n-1+1)-x(i)	a(n-i+1)	b(i)
1	-0.0377777	0.0662223	0.104	0.6052	0.0629408
2	-0.00977766	0.0562223	0.066	0.3164	0.0208824
3	-0.00577766	0.0462223	0.052	0.1743	0.0090636
4	-0.00577766	-0.000777661	0.005	0.0561	0.0002805
5	-0.000777661	-0.00577766	-0.005		
6	0.0462223	-0.00577766	-0.052		
7	0.0562223	-0.00977766	-0.066		
8	0.0662223	-0.0377777	-0.104		

Sum of b values = 0.0931673
Sample Standard Deviation = 0.0374049
W Statistic = 0.886283

5% Critical value of 0.818 is less than 0.886283
Data is normally distributed at 95% level of significance

1% Critical value of 0.749 is less than 0.886283
Data is normally distributed at 99% level of significance

Dixon's Test for Outliers

Parameter: Arsenic

Background Locations

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

For 8 Measurements...
5% Level of Significance

Iteration	Highest	Lowest	Critical	Outlier
1	0	0	0.554	None

Loc.	Date	Conc.	Outlier
MW-301	4/26/2016	0.38 J	FALSE
	6/23/2016	0.38 J	FALSE
	8/10/2016	0.26 J	FALSE
	10/26/2016	0.14 J	FALSE
	1/18/2017	0.23 J	FALSE
	4/19/2017	0.22 J	FALSE
	6/20/2017	0.15 J	FALSE
	8/21/2017	0.14 J	FALSE

Shapiro-Wilks Test of Normality

Parameter: Arsenic

Background Locations

Normality Test of Residuals

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

K = 4 for 8 measurements

i	x(i)	x(n-i+1)	x(n-1+1)-x(i)	a(n-i+1)	b(i)
1	-0.0975	0.1425	0.24	0.6052	0.145248
2	-0.0975	0.1425	0.24	0.3164	0.075936
3	-0.0875	0.0225	0.11	0.1743	0.019173
4	-0.0175	-0.0075	0.01	0.0561	0.000561
5	-0.0075	-0.0175	-0.01		
6	0.0225	-0.0875	-0.11		
7	0.1425	-0.0975	-0.24		
8	0.1425	-0.0975	-0.24		

Sum of b values = 0.240918
Sample Standard Deviation = 0.0986697
W Statistic = 0.851673

5% Critical value of 0.818 is less than 0.851673
Data is normally distributed at 95% level of significance

1% Critical value of 0.749 is less than 0.851673
Data is normally distributed at 99% level of significance

Dixon's Test for Outliers

Parameter: Barium

Background Locations

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

For 8 Measurements...
5% Level of Significance

Iteration	Highest	Lowest	Critical	Outlier
1	0.157233	0.247191	0.554	None

Loc.	Date	Conc.	Outlier
MW-301	4/26/2016	51.6	FALSE
	6/23/2016	55.8	FALSE
	8/10/2016	52.3	FALSE
	10/26/2016	53.3	FALSE
	1/18/2017	42.4	FALSE
	4/19/2017	35.5	FALSE
	6/20/2017	39.9	FALSE
	8/21/2017	44	FALSE

Shapiro-Wilks Test of Normality

Parameter: Barium

Background Locations

Normality Test of Residuals

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

K = 4 for 8 measurements

i	x(i)	x(n-i+1)	x(n-1+1)-x(i)	a(n-i+1)	b(i)
1	-11.35	8.95	20.3	0.6052	12.2856
2	-6.95	6.45	13.4	0.3164	4.23976
3	-4.45	5.45	9.9	0.1743	1.72557
4	-2.85	4.75	7.6	0.0561	0.42636
5	4.75	-2.85	-7.6		
6	5.45	-4.45	-9.9		
7	6.45	-6.95	-13.4		
8	8.95	-11.35	-20.3		

Sum of b values = 18.6772
Sample Standard Deviation = 7.35838
W Statistic = 0.920373

5% Critical value of 0.818 is less than 0.920373
Data is normally distributed at 95% level of significance

1% Critical value of 0.749 is less than 0.920373
Data is normally distributed at 99% level of significance

Dixon's Test for Outliers

Parameter: Beryllium

Background Locations

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

For 8 Measurements...
5% Level of Significance

Iteration	Highest	Lowest	Critical	Outlier
1	0	0	0.554	None

Loc.	Date	Conc.	Outlier
MW-301	4/26/2016	ND<0.08 U	FALSE
	6/23/2016	ND<0.08 U	FALSE
	8/10/2016	ND<0.08 U	FALSE
	10/26/2016	ND<0.08 U	FALSE
	1/18/2017	ND<0.08 U	FALSE
	4/19/2017	ND<0.012 U	FALSE
	6/20/2017	ND<0.012 U	FALSE
	8/21/2017	ND<0.012 U	FALSE

Dixon's Test for Outliers

Parameter: Cadmium

Background Locations

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

For 8 Measurements...
5% Level of Significance

Iteration	Highest	Lowest	Critical	Outlier
1	0.835165	0	0.554	0.12
2	0.4	0	0.507	None

Loc.	Date	Conc.	Outlier
MW-301	4/26/2016	ND<0.029 U	FALSE
	6/23/2016	ND<0.029 U	FALSE
	8/10/2016	**0.12 J**	**TRUE**
	10/26/2016	0.038 J	FALSE
	1/18/2017	ND<0.029 U	FALSE
	4/19/2017	0.035 J	FALSE
	6/20/2017	0.044 J	FALSE
	8/21/2017	0.037 J	FALSE

Dixon's Test for Outliers

Parameter: Cadmium

Background Locations

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

For 7 Measurements...
5% Level of Significance

Iteration	Highest	Lowest	Critical	Outlier
1	0.4	0	0.507	None

Loc.	Date	Conc.	Outlier
MW-301	4/26/2016	ND<0.029 U	FALSE
	6/23/2016	ND<0.029 U	FALSE
	10/26/2016	0.038 J	FALSE
	1/18/2017	ND<0.029 U	FALSE
	4/19/2017	0.035 J	FALSE
	6/20/2017	0.044 J	FALSE
	8/21/2017	0.037 J	FALSE

Shapiro-Wilks Test of Normality

Parameter: Cadmium

Background Locations

Normality Test of Residuals

Original Data (Not Transformed)

Cohen's Adjustment

K = 3 for 7 measurements

i	x(i)	x(n-i+1)	x(n-1+1)-x(i)	a(n-i+1)	b(i)
1	-0.00277591	0.0122241	0.015	0.6233	0.0093495
2	-0.00277591	0.00622409	0.009	0.3031	0.0027279
3	-0.00277591	0.00522409	0.008	0.1401	0.0011208
4	0.00322409	0.00322409	0		
5	0.00522409	-0.00277591	-0.008		
6	0.00622409	-0.00277591	-0.009		
7	0.0122241	-0.00277591	-0.015		

Sum of b values = 0.0131982
Sample Standard Deviation = 0.00576938
W Statistic = 0.872208

5% Critical value of 0.803 is less than 0.872208
Data is normally distributed at 95% level of significance

1% Critical value of 0.73 is less than 0.872208
Data is normally distributed at 99% level of significance

Shapiro-Wilks Test of Normality

Parameter: Chromium

Background Locations

Normality Test of Residuals

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

K = 4 for 8 measurements

i	x(i)	x(n-i+1)	x(n-1+1)-x(i)	a(n-i+1)	b(i)
1	-0.25375	0.23625	0.49	0.6052	0.296548
2	-0.16375	0.13625	0.3	0.3164	0.09492
3	-0.11375	0.08625	0.2	0.1743	0.03486
4	-0.01375	0.08625	0.1	0.0561	0.00561
5	0.08625	-0.01375	-0.1		
6	0.08625	-0.11375	-0.2		
7	0.13625	-0.16375	-0.3		
8	0.23625	-0.25375	-0.49		

Sum of b values = 0.431938
Sample Standard Deviation = 0.166299
W Statistic = 0.963752

5% Critical value of 0.818 is less than 0.963752
Data is normally distributed at 95% level of significance

1% Critical value of 0.749 is less than 0.963752
Data is normally distributed at 99% level of significance

Dixon's Test for Outliers

Parameter: Cobalt

Background Locations

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

For 8 Measurements...
5% Level of Significance

Iteration	Highest	Lowest	Critical	Outlier
1	0.319489	0.0046729	0.554	None

Loc.	Date	Conc.	Outlier
MW-301	4/26/2016	4.1	FALSE
	6/23/2016	3.1	FALSE
	8/10/2016	1.8	FALSE
	10/26/2016	1.8	FALSE
	1/18/2017	1.3	FALSE
	4/19/2017	0.97 J	FALSE
	6/20/2017	1 J	FALSE
	8/21/2017	0.96 J	FALSE

Shapiro-Wilks Test of Normality

Parameter: Cobalt

Background Locations

Normality Test of Residuals

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

K = 4 for 8 measurements

i	x(i)	x(n-i+1)	x(n-1+1)-x(i)	a(n-i+1)	b(i)
1	-0.91875	2.22125	3.14	0.6052	1.90033
2	-0.90875	1.22125	2.13	0.3164	0.673932
3	-0.87875	-0.07875	0.8	0.1743	0.13944
4	-0.57875	-0.07875	0.5	0.0561	0.02805
5	-0.07875	-0.57875	-0.5		
6	-0.07875	-0.87875	-0.8		
7	1.22125	-0.90875	-2.13		
8	2.22125	-0.91875	-3.14		

Sum of b values = 2.74175
Sample Standard Deviation = 1.14735
W Statistic = 0.815766

5% Critical value of 0.818 exceeds 0.815766
Evidence of non-normality at 95% level of significance

1% Critical value of 0.749 is less than 0.815766
Data is normally distributed at 99% level of significance

Shapiro-Wilks Test of Normality

Parameter: Cobalt

Background Locations

Normality Test of Residuals

Natural Logarithm Transformation

Non-Detects Replaced with Detection Limit

K = 4 for 8 measurements

i	x(i)	x(n-i+1)	x(n-1+1)-x(i)	a(n-i+1)	b(i)
1	-0.529453	0.922356	1.45181	0.6052	0.878635
2	-0.51909	0.642771	1.16186	0.3164	0.367613
3	-0.488631	0.099156	0.587787	0.1743	0.102451
4	-0.226266	0.099156	0.325422	0.0561	0.0182562
5	0.099156	-0.226266	-0.325422		
6	0.099156	-0.488631	-0.587787		
7	0.642771	-0.51909	-1.16186		
8	0.922356	-0.529453	-1.45181		

Sum of b values = 1.36696
Sample Standard Deviation = 0.550752
W Statistic = 0.880033

5% Critical value of 0.818 is less than 0.880033
Data is normally distributed at 95% level of significance

1% Critical value of 0.749 is less than 0.880033
Data is normally distributed at 99% level of significance

Dixon's Test for Outliers

Parameter: Lead

Background Locations

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

For 8 Measurements...
5% Level of Significance

Iteration	Highest	Lowest	Critical	Outlier
1	0	0.0780142	0.554	None

Loc.	Date	Conc.	Outlier
MW-301	4/26/2016	ND<0.19 U	FALSE
	6/23/2016	ND<0.19 U	FALSE
	8/10/2016	ND<0.19 U	FALSE
	10/26/2016	ND<0.19 U	FALSE
	1/18/2017	ND<0.19 U	FALSE
	4/19/2017	0.06 J	FALSE
	6/20/2017	0.1 J	FALSE
	8/21/2017	0.049 J	FALSE

Shapiro-Wilks Test of Normality

Parameter: Lead

Background Locations

Normality Test of Residuals

Original Data (Not Transformed)

Cohen's Adjustment

K = 4 for 8 measurements

i	x(i)	x(n-i+1)	x(n-1+1)-x(i)	a(n-i+1)	b(i)
1	-0.173567	-0.032567	0.141	0.6052	0.0853332
2	-0.162567	-0.032567	0.13	0.3164	0.041132
3	-0.122567	-0.032567	0.09	0.1743	0.015687
4	-0.032567	-0.032567	0	0.0561	0
5	-0.032567	-0.032567	0		
6	-0.032567	-0.122567	-0.09		
7	-0.032567	-0.162567	-0.13		
8	-0.032567	-0.173567	-0.141		

Sum of b values = 0.142152
Sample Standard Deviation = 0.0639094
W Statistic = 0.706773

5% Critical value of 0.818 exceeds 0.706773
Evidence of non-normality at 95% level of significance

1% Critical value of 0.749 exceeds 0.706773
Evidence of non-normality at 99% level of significance

Shapiro-Wilks Test of Normality

Parameter: Lead

Background Locations

Normality Test of Residuals

Natural Logarithm Transformation

Cohen's Adjustment

K = 4 for 8 measurements

i	x(i)	x(n-i+1)	x(n-1+1)-x(i)	a(n-i+1)	b(i)
1	-1.66984	-0.314632	1.3552	0.6052	0.820169
2	-1.46731	-0.314632	1.15268	0.3164	0.364708
3	-0.956486	-0.314632	0.641854	0.1743	0.111875
4	-0.314632	-0.314632	0	0.0561	0
5	-0.314632	-0.314632	0		
6	-0.314632	-0.956486	-0.641854		
7	-0.314632	-1.46731	-1.15268		
8	-0.314632	-1.66984	-1.3552		

Sum of b values = 1.29675
Sample Standard Deviation = 0.577818
W Statistic = 0.719504

5% Critical value of 0.818 exceeds 0.719504
Evidence of non-normality at 95% level of significance

1% Critical value of 0.749 exceeds 0.719504
Evidence of non-normality at 99% level of significance

Dixon's Test for Outliers

Parameter: Lithium

Background Locations

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

For 8 Measurements...
5% Level of Significance

Iteration	Highest	Lowest	Critical	Outlier
1	0.115942	0.217949	0.554	None

Loc.	Date	Conc.	Outlier
MW-301	4/26/2016	22.8	FALSE
	6/23/2016	28.7	FALSE
	8/10/2016	27.6	FALSE
	10/26/2016	25.5	FALSE
	1/18/2017	20.1	FALSE
	4/19/2017	21.8	FALSE
	6/20/2017	24.9	FALSE
	8/21/2017	27.9	FALSE

Shapiro-Wilks Test of Normality

Parameter: Lithium

Background Locations

Normality Test of Residuals

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

K = 4 for 8 measurements

i	x(i)	x(n-i+1)	x(n-1+1)-x(i)	a(n-i+1)	b(i)
1	-4.8125	3.7875	8.6	0.6052	5.20472
2	-3.1125	2.9875	6.1	0.3164	1.93004
3	-2.1125	2.6875	4.8	0.1743	0.83664
4	-0.0125	0.5875	0.6	0.0561	0.03366
5	0.5875	-0.0125	-0.6		
6	2.6875	-2.1125	-4.8		
7	2.9875	-3.1125	-6.1		
8	3.7875	-4.8125	-8.6		

Sum of b values = 8.00506
Sample Standard Deviation = 3.12018
W Statistic = 0.940311

5% Critical value of 0.818 is less than 0.940311
Data is normally distributed at 95% level of significance

1% Critical value of 0.749 is less than 0.940311
Data is normally distributed at 99% level of significance

Dixon's Test for Outliers

Parameter: Mercury

Background Locations

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

For 8 Measurements...
5% Level of Significance

Iteration	Highest	Lowest	Critical	Outlier
1	0	0	0.554	None

Loc.	Date	Conc.	Outlier
MW-301	4/26/2016	ND<0.039 U	FALSE
	6/23/2016	ND<0.039 U	FALSE
	8/10/2016	ND<0.039 U	FALSE
	10/26/2016	ND<0.039 U	FALSE
	1/18/2017	ND<0.039 U	FALSE
	4/19/2017	ND<0.046 U	FALSE
	6/20/2017	ND<0.046 U	FALSE
	8/21/2017	ND<0.046 U	FALSE

Dixon's Test for Outliers

Parameter: Molybdenum

Background Locations

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

For 8 Measurements...
5% Level of Significance

Iteration	Highest	Lowest	Critical	Outlier
1	0.185185	0.333333	0.554	None

Loc.	Date	Conc.	Outlier
MW-301	4/26/2016	1.2	FALSE
	6/23/2016	1.2	FALSE
	8/10/2016	0.89 J	FALSE
	10/26/2016	1	FALSE
	1/18/2017	0.76 J	FALSE
	4/19/2017	0.54 J	FALSE
	6/20/2017	0.79 J	FALSE
	8/21/2017	1.3	FALSE

Shapiro-Wilks Test of Normality

Parameter: Molybdenum

Background Locations

Normality Test of Residuals

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

K = 4 for 8 measurements

i	x(i)	x(n-i+1)	x(n-1+1)-x(i)	a(n-i+1)	b(i)
1	-0.42	0.34	0.76	0.6052	0.459952
2	-0.2	0.24	0.44	0.3164	0.139216
3	-0.17	0.24	0.41	0.1743	0.071463
4	-0.07	0.04	0.11	0.0561	0.006171
5	0.04	-0.07	-0.11		
6	0.24	-0.17	-0.41		
7	0.24	-0.2	-0.44		
8	0.34	-0.42	-0.76		

Sum of b values = 0.676802
Sample Standard Deviation = 0.26257
W Statistic = 0.949152

5% Critical value of 0.818 is less than 0.949152
Data is normally distributed at 95% level of significance

1% Critical value of 0.749 is less than 0.949152
Data is normally distributed at 99% level of significance

Dixon's Test for Outliers

Parameter: Selenium

Background Locations

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

For 8 Measurements...
5% Level of Significance

Iteration	Highest	Lowest	Critical	Outlier
1	0.28	0.217391	0.554	None

Loc.	Date	Conc.	Outlier
MW-301	4/26/2016	4.7	FALSE
	6/23/2016	5.4	FALSE
	8/10/2016	6.1	FALSE
	10/26/2016	6.5	FALSE
	1/18/2017	5.9	FALSE
	4/19/2017	4.2	FALSE
	6/20/2017	5.5	FALSE
	8/21/2017	7.2	FALSE

Shapiro-Wilks Test of Normality

Parameter: Selenium

Background Locations

Normality Test of Residuals

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

K = 4 for 8 measurements

i	x(i)	x(n-i+1)	x(n-1+1)-x(i)	a(n-i+1)	b(i)
1	-1.4875	1.5125	3	0.6052	1.8156
2	-0.9875	0.8125	1.8	0.3164	0.56952
3	-0.2875	0.4125	0.7	0.1743	0.12201
4	-0.1875	0.2125	0.4	0.0561	0.02244
5	0.2125	-0.1875	-0.4		
6	0.4125	-0.2875	-0.7		
7	0.8125	-0.9875	-1.8		
8	1.5125	-1.4875	-3		

Sum of b values = 2.52957
Sample Standard Deviation = 0.961305
W Statistic = 0.989175

5% Critical value of 0.818 is less than 0.989175
Data is normally distributed at 95% level of significance

1% Critical value of 0.749 is less than 0.989175
Data is normally distributed at 99% level of significance

Dixon's Test for Outliers

Parameter: Thallium

Background Locations

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

For 8 Measurements...
5% Level of Significance

Iteration	Highest	Lowest	Critical	Outlier
1	0	0.0668103	0.554	None

Loc.	Date	Conc.	Outlier
MW-301	4/26/2016	ND<0.5 U	FALSE
	6/23/2016	ND<0.5 U	FALSE
	8/10/2016	ND<0.5 U	FALSE
	10/26/2016	ND<0.5 U	FALSE
	1/18/2017	ND<0.5 U	FALSE
	4/19/2017	0.14 J	FALSE
	6/20/2017	ND<0.036 U	FALSE
	8/21/2017	0.067 J	FALSE

Shapiro-Wilks Test of Normality

Parameter: Thallium

Background Locations

Normality Test of Residuals

Original Data (Not Transformed)

Cohen's Adjustment

K = 4 for 8 measurements

i	x(i)	x(n-i+1)	x(n-1+1)-x(i)	a(n-i+1)	b(i)
1	-0.668121	-0.204121	0.464	0.6052	0.280813
2	-0.637121	-0.204121	0.433	0.3164	0.137001
3	-0.564121	-0.204121	0.36	0.1743	0.062748
4	-0.204121	-0.204121	0	0.0561	0
5	-0.204121	-0.204121	0		
6	-0.204121	-0.564121	-0.36		
7	-0.204121	-0.637121	-0.433		
8	-0.204121	-0.668121	-0.464		

Sum of b values = 0.480562
Sample Standard Deviation = 0.218723
W Statistic = 0.689622

5% Critical value of 0.818 exceeds 0.689622
Evidence of non-normality at 95% level of significance

1% Critical value of 0.749 exceeds 0.689622
Evidence of non-normality at 99% level of significance

Shapiro-Wilks Test of Normality

Parameter: Thallium

Background Locations

Normality Test of Residuals

Natural Logarithm Transformation

Cohen's Adjustment

K = 4 for 8 measurements

i	x(i)	x(n-i+1)	x(n-1+1)-x(i)	a(n-i+1)	b(i)
1	-3.34717	-0.716081	2.63109	0.6052	1.59234
2	-2.726	-0.716081	2.00992	0.3164	0.635937
3	-1.98905	-0.716081	1.27297	0.1743	0.221878
4	-0.716081	-0.716081	0	0.0561	0
5	-0.716081	-0.716081	0		
6	-0.716081	-1.98905	-1.27297		
7	-0.716081	-2.726	-2.00992		
8	-0.716081	-3.34717	-2.63109		

Sum of b values = 2.45015
Sample Standard Deviation = 1.08305
W Statistic = 0.731126

5% Critical value of 0.818 exceeds 0.731126
Evidence of non-normality at 95% level of significance

1% Critical value of 0.749 exceeds 0.731126
Evidence of non-normality at 99% level of significance

Dixon's Test for Outliers

Parameter: Total Radium

Background Locations

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

For 8 Measurements...
5% Level of Significance

Iteration	Highest	Lowest	Critical	Outlier
1	0.304762	0.334549	0.554	None

Loc.	Date	Conc.	Outlier
MW-301	4/26/2016	0.51	FALSE
	6/23/2016	0.614	FALSE
	8/10/2016	1.56	FALSE
	10/26/2016	1.24	FALSE
	1/18/2017	0.143	FALSE
	4/19/2017	0.631	FALSE
	6/20/2017	1.06	FALSE
	8/21/2017	0.725	FALSE

Shapiro-Wilks Test of Normality

Parameter: Total Radium

Background Locations

Normality Test of Residuals

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

K = 4 for 8 measurements

i	x(i)	x(n-i+1)	x(n-1+1)-x(i)	a(n-i+1)	b(i)
1	-0.667375	0.749625	1.417	0.6052	0.857568
2	-0.300375	0.429625	0.73	0.3164	0.230972
3	-0.196375	0.249625	0.446	0.1743	0.0777378
4	-0.179375	-0.085375	0.094	0.0561	0.0052734
5	-0.085375	-0.179375	-0.094		
6	0.249625	-0.196375	-0.446		
7	0.429625	-0.300375	-0.73		
8	0.749625	-0.667375	-1.417		

Sum of b values = 1.17155
Sample Standard Deviation = 0.450788
W Statistic = 0.964894

5% Critical value of 0.818 is less than 0.964894
Data is normally distributed at 95% level of significance

1% Critical value of 0.749 is less than 0.964894
Data is normally distributed at 99% level of significance

Non-Parametric Prediction Interval

Inter-Well Comparison

Parameter: Thallium

Original Data (Not Transformed)

Cohen's Adjustment

Not used. Used nonparametric max background detection = 0.14

Total Percent Non-Detects = 66.6667%
Number of comparisons = 5
Future Samples (k) = 5
Recent Dates = 1
Background Measurements (n) = 8
Maximum Background Value = 0.5
Confidence Level = 61.5%
False Positive Rate = 38.5%

Location	Date	Count	Mean	Significant
MW-302	8/14/2018	1	0.14	FALSE
MW-303	8/14/2018	1	0.14	FALSE
MW-304	8/14/2018	1	0.15	FALSE
MW-305	8/14/2018	1	0.33	FALSE
MW-306	8/14/2018	1	0.14	FALSE

Non-Parametric Prediction Interval

Inter-Well Comparison

Parameter: Lead

Original Data (Not Transformed)

Cohen's Adjustment

Not used. Used nonparametric max background detection = 0.10

Total Percent Non-Detects = 27.7778%
Number of comparisons = 5
Future Samples (k) = 5
Recent Dates = 1
Background Measurements (n) = 8
Maximum Background Value = 0.19
Confidence Level = 61.5%
False Positive Rate = 38.5%

Location	Date	Count	Mean	Significant
MW-303	8/14/2018	1	0.13	FALSE
MW-304	**8/14/2018**	**1**	**0.81**	**TRUE**
MW-302	8/14/2018	1	0.12	FALSE
MW-305	**8/14/2018**	**1**	**0.31**	**TRUE**
MW-306	**8/14/2018**	**1**	**0.2**	**TRUE**

Non-Parametric Prediction Interval

Inter-Well Comparison

Parameter: Lead

Original Data (Not Transformed)

Cohen's Adjustment

Duplicate--see previous page

Total Percent Non-Detects = 27.7778%
Number of comparisons = 5
Future Samples (k) = 5
Recent Dates = 1
Background Measurements (n) = 8
Maximum Background Value = 0.19
Confidence Level = 61.5%
False Positive Rate = 38.5%

Location	Date	Count	Mean	Significant
MW-303	8/14/2018	1	0.13	FALSE
MW-304	**8/14/2018**	**1**	**0.81**	**TRUE**
MW-302	8/14/2018	1	0.12	FALSE
MW-305	**8/14/2018**	**1**	**0.31**	**TRUE**
MW-306	**8/14/2018**	**1**	**0.2**	**TRUE**

Non-Parametric Prediction Interval

Inter-Well Comparison

Parameter: Beryllium

Original Data (Not Transformed)

Cohen's Adjustment

Not used - DQ applies. 100% ND in background

Total Percent Non-Detects = 83.3333%
Number of comparisons = 5
Future Samples (k) = 5
Recent Dates = 1
Background Measurements (n) = 8
Maximum Background Value = 0.08
Confidence Level = 61.5%
False Positive Rate = 38.5%

Location	Date	Count	Mean	Significant
MW-303	8/14/2018	1	0.12	TRUE
MW-304	8/14/2018	1	0.21	TRUE
MW-302	8/14/2018	1	0.12	TRUE
MW-305	8/14/2018	1	0.12	TRUE
MW-306	8/14/2018	1	0.12	TRUE

Parametric Prediction Limit with Resampling
Inter-Well Comparison.

Background date range: 1/1/2000 to 9/30/2017

1 of 2 Resampling Plan
Two Sampling Events per Year

Originating Sampling Event Date is 4/16/2018

Indicator Parameters
Cobalt
Chromium
Barium
Lithium
Beryllium
Molybdenum
Arsenic
Antimony
Lead
Mercury
Total Radium
Thallium
Selenium
Cadmium
There are 14 parameters.

5 Compliance Wells Analyzed.
MW-306
MW-305
MW-302
MW-304
MW-303

Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Per-constituent, per-evaluation false positive rate:
0.00357143 = 0.10/(14 * 2)
Alpha 0.00357143 approximated by 0.003333

Cobalt
Background Observations: 8
Background Mean: 1.87875
Background Std. Dev: 1.14735
K(5, 8, 0.003333) = 3.22
PL = 1.87875 + (3.22 * 1.14735) = 5.57322

Not used. Used nonparametric max background value = 4.1

Well	Date	Value	Resample	Exceedance
MW-303	4/16/2018	2.1	FALSE	FALSE
MW-304	4/16/2018	0.39 J	FALSE	FALSE
MW-302	4/16/2018	0.9 J	FALSE	FALSE
MW-305	**4/16/2018**	**14.5**	**FALSE**	**TRUE**

MW-305	**8/14/2018**	**15.6**	**TRUE**	**TRUE**
MW-305 has required 1 resample exceedences				
MW-306	4/16/2018	4.8	FALSE	FALSE

Chromium

Background Observations: 8
Background Mean: 0.50375
Background Std. Dev: 0.166299
K(5, 8, 0.003333) = 3.22
PL = 0.50375 + (3.22 * 0.166299) = 1.03923

Well	Date	Value	Resample	Exceedance
MW-303	4/16/2018	0.12 J	FALSE	FALSE
MW-304	**4/16/2018**	**2**	**FALSE**	**TRUE**
MW-304	**8/14/2018**	**5.9**	**TRUE**	**TRUE**
MW-304 has required 1 resample exceedences				
MW-302	4/16/2018	0.46 J	FALSE	FALSE
MW-305	4/16/2018	0.26 J	FALSE	FALSE
MW-306	4/16/2018	0.37 J	FALSE	FALSE

Barium

Background Observations: 8
Background Mean: 46.85
Background Std. Dev: 7.35838
K(5, 8, 0.003333) = 3.22
PL = 46.85 + (3.22 * 7.35838) = 70.544

Well	Date	Value	Resample	Exceedance
MW-302	4/16/2018	17.7	FALSE	FALSE
MW-303	4/16/2018	69.5	FALSE	FALSE
MW-304	**4/16/2018**	**88.5**	**FALSE**	**TRUE**
MW-304	**8/14/2018**	**87.4**	**TRUE**	**TRUE**
MW-304 has required 1 resample exceedences				
MW-305	**4/16/2018**	**116**	**FALSE**	**TRUE**
MW-305	**8/14/2018**	**118**	**TRUE**	**TRUE**
MW-305 has required 1 resample exceedences				
MW-306	4/16/2018	48.2	FALSE	FALSE

Lithium

Background Observations: 8
Background Mean: 24.9125
Background Std. Dev: 3.12018

K(5, 8, 0.003333) = 3.22
PL = 24.9125 + (3.22 * 3.12018) = 34.9595

Well	Date	Value	Resample	Exceedance
MW-303	4/16/2018	ND<4.6 U	FALSE	FALSE
MW-302	4/16/2018	7.5 J	FALSE	FALSE
MW-304	4/16/2018	ND<4.6 U	FALSE	FALSE
MW-305	4/16/2018	ND<4.6 U	FALSE	FALSE
MW-306	4/16/2018	ND<4.6 U	FALSE	FALSE

Beryllium

Background Observations: 8
Background Mean: 0.0545
Background Std. Dev: 0.0351933
K(5, 8, 0.003333) = 3.22
PL = 0.0545 + (3.22 * 0.0351933) = 0.167823

Well	Date	Value	Resample	Exceedance
MW-303	4/16/2018	0.017 J	FALSE	FALSE
MW-304	4/16/2018	0.026 J	FALSE	FALSE
MW-302	4/16/2018	ND<0.012 U	FALSE	FALSE
MW-305	4/16/2018	ND<0.012 U	FALSE	FALSE
MW-306	4/16/2018	ND<0.012 U	FALSE	FALSE

Molybdenum

Background Observations: 8
Background Mean: 0.96
Background Std. Dev: 0.26257
K(5, 8, 0.003333) = 3.22
PL = 0.96 + (3.22 * 0.26257) = 1.80547

Well	Date	Value	Resample	Exceedance
MW-302	4/16/2018	0.59 J	FALSE	FALSE
MW-303	4/16/2018	0.61 J	FALSE	FALSE
MW-304	**4/16/2018**	**2**	**FALSE**	**TRUE**
MW-304	**8/14/2018**	**2.4**	**TRUE**	**TRUE**
MW-304 has required 1 resample exceedences				
MW-305	**4/16/2018**	**7.1**	**FALSE**	**TRUE**
MW-305	**8/14/2018**	**6.5**	**TRUE**	**TRUE**
MW-305 has required 1 resample exceedences				
MW-306	**4/16/2018**	**5.7**	**FALSE**	**TRUE**

MW-306	**8/14/2018**	**4.7**	**TRUE**	**TRUE**

MW-306 has required 1 resample exceedences

Arsenic

Background Observations: 8
Background Mean: 0.2375
Background Std. Dev: 0.0986697
K(5, 8, 0.003333) = 3.22
PL = 0.2375 + (3.22 * 0.0986697) = 0.555217

Well	Date	Value	Resample	Exceedance
MW-302	4/16/2018	0.16 J	FALSE	FALSE
MW-303	4/16/2018	0.43 J	FALSE	FALSE
MW-304	**4/16/2018**	**0.68 J**	**FALSE**	**TRUE**
MW-304	**8/14/2018**	**1.3**	**TRUE**	**TRUE**
MW-305	4/16/2018	0.51 J	FALSE	FALSE
MW-306	4/16/2018	0.38 J	FALSE	FALSE

MW-304 has required 1 resample exceedences

Antimony

Background Observations: 8
Background Mean: 0.077375
Background Std. Dev: 0.0374049
K(5, 8, 0.003333) = 3.22
PL = 0.077375 + (3.22 * 0.0374049) = 0.197819

Well	Date	Value	Resample	Exceedance
MW-302	4/16/2018	ND<0.026 U	FALSE	FALSE
MW-303	4/16/2018	0.098 J	FALSE	FALSE
MW-304	4/16/2018	ND<0.026 U	FALSE	FALSE
MW-305	4/16/2018	0.089 J	FALSE	FALSE
MW-306	4/16/2018	0.094 J	FALSE	FALSE

Lead

Background Observations: 8
Background Mean: 0.144875
Background Std. Dev: 0.0639094
K(5, 8, 0.003333) = 3.22
PL = 0.144875 + (3.22 * 0.0639094) = 0.350663

Well	Date	Value	Resample	Exceedance
MW-303	4/16/2018	0.069 J	FALSE	FALSE

MW-304	**4/16/2018**	**0.37 J**	**FALSE**	**TRUE**
MW-304	**8/14/2018**	**0.81 J**	**TRUE**	**TRUE**
MW-304 has required 1 resample exceedences				
MW-302	4/16/2018	0.098 J	FALSE	FALSE
MW-305	4/16/2018	0.12 J	FALSE	FALSE
MW-306	4/16/2018	0.04 J	FALSE	FALSE

Mercury

Background Observations: 8
Background Mean: 0.041625
Background Std. Dev: 0.00362284
K(5, 8, 0.003333) = 3.22
PL = 0.041625 + (3.22 * 0.00362284) = 0.0532906

Well	Date	Value	Resample	Exceedance
MW-303	**4/16/2018**	**ND<0.09 U**	**FALSE**	**TRUE**
MW-303	**8/14/2018**	**ND<0.083 U**	**TRUE**	**TRUE**
MW-303 has required 1 resample exceedences				
MW-302	**4/16/2018**	**0.096 J**	**FALSE**	**TRUE**
MW-302	**8/14/2018**	**ND<0.083 U**	**TRUE**	**TRUE**
MW-302 has required 1 resample exceedences				
MW-304	**4/16/2018**	**ND<0.09 U**	**FALSE**	**TRUE**
MW-304	**8/14/2018**	**ND<0.083 U**	**TRUE**	**TRUE**
MW-304 has required 1 resample exceedences				
MW-305	**4/16/2018**	**ND<0.09 U**	**FALSE**	**TRUE**
MW-305	**8/14/2018**	**ND<0.09 U**	**TRUE**	**TRUE**
MW-305 has required 1 resample exceedences				
MW-306	**4/16/2018**	**ND<0.09 U**	**FALSE**	**TRUE**
MW-306	**8/14/2018**	**ND<0.083 U**	**TRUE**	**TRUE**
MW-306 has required 1 resample exceedences				

Total Radium

Background Observations: 8
Background Mean: 0.810375
Background Std. Dev: 0.450788
K(5, 8, 0.003333) = 3.22
PL = 0.810375 + (3.22 * 0.450788) = 2.26191

Well	Date	Value	Resample	Exceedance
MW-302	4/16/2018	0.746	FALSE	FALSE
MW-303	4/16/2018	0.529	FALSE	FALSE
MW-306	4/16/2018	0.305	FALSE	FALSE
MW-304	4/16/2018	2.08	FALSE	FALSE

MW-305	4/16/2018	0.676	FALSE	FALSE

Thallium

Background Observations: 8
Background Mean: 0.342875
Background Std. Dev: 0.218723
K(5, 8, 0.003333) = 3.22
PL = 0.342875 + (3.22 * 0.218723) = 1.04716

Well	Date	Value	Resample	Exceedance
MW-302	4/16/2018	ND<0.036 U	FALSE	FALSE
MW-303	4/16/2018	ND<0.036 U	FALSE	FALSE
MW-304	4/16/2018	ND<0.036 U	FALSE	FALSE
MW-305	4/16/2018	0.32 J	FALSE	FALSE
MW-306	4/16/2018	0.083 J	FALSE	FALSE

Selenium

Background Observations: 8
Background Mean: 5.6875
Background Std. Dev: 0.961305
K(5, 8, 0.003333) = 3.22
PL = 5.6875 + (3.22 * 0.961305) = 8.7829

Well	Date	Value	Resample	Exceedance
MW-302	4/16/2018	ND<0.086 U	FALSE	FALSE
MW-303	4/16/2018	0.23 J	FALSE	FALSE
MW-304	4/16/2018	ND<0.086 U	FALSE	FALSE
MW-305	4/16/2018	0.12 J	FALSE	FALSE
MW-306	4/16/2018	ND<0.086 U	FALSE	FALSE

Cadmium

Background Observations: 7
Background Mean: 0.0344286
Background Std. Dev: 0.00576938
K(5, 7, 0.003333) = 3.605
PL = 0.0344286 + (3.605 * 0.00576938) = 0.0552272

Well	Date	Value	Resample	Exceedance
MW-303	**4/16/2018**	**0.44 J**	**FALSE**	**TRUE**
MW-303	**8/14/2018**	**0.36 J**	**TRUE**	**TRUE**

MW-303 has required 1 resample exceedences

MW-304	4/16/2018	ND<0.018 U	FALSE	FALSE
MW-302	**4/16/2018**	**0.22 J**	**FALSE**	**TRUE**
MW-302	**8/14/2018**	**0.21 J**	**TRUE**	**TRUE**
MW-302 has required 1 resample exceedences				
MW-305	4/16/2018	0.054 J	FALSE	FALSE
MW-306	**4/16/2018**	**0.88**	**FALSE**	**TRUE**
MW-306	**8/14/2018**	**0.76**	**TRUE**	**TRUE**
MW-306 has required 1 resample exceedences				

Parametric Prediction Limit with Resampling
Inter-Well Comparison.

Background date range: 1/1/2000 to 9/30/2017

1 of 2 Resampling Plan
Two Sampling Events per Year

Originating Sampling Event Date is 4/16/2018

Indicator Parameters
Cobalt
Chromium
Barium
Lithium
Beryllium
Molybdenum
Arsenic
Antimony
Lead
Mercury
Total Radium
Thallium
Selenium
Cadmium
There are 14 parameters.

5 Compliance Wells Analyzed.
MW-306
MW-305
MW-302
MW-304
MW-303

Original Data (Not Transformed)
Cohen's Adjustment

Per-constituent, per-evaluation false positive rate:
0.00357143 = 0.10/(14 * 2)
Alpha 0.00357143 approximated by 0.003333

Cobalt
Background Observations: 8
Background Mean: 1.855
Background Std. Dev: 1.16663
K(5, 8, 0.003333) = 3.22
PL = 1.855 + (3.22 * 1.16663) = 5.61156

Well	Date	Value	Resample	Exceedance
MW-303	4/16/2018	2.1	FALSE	FALSE
MW-304	4/16/2018	0.39 J	FALSE	FALSE
MW-302	4/16/2018	0.9 J	FALSE	FALSE
MW-305	**4/16/2018**	**14.5**	**FALSE**	**TRUE**

MW-305	**8/14/2018**	**15.6**	**TRUE**	**TRUE**
MW-305 has required 1 resample exceedences				
MW-306	4/16/2018	4.8	FALSE	FALSE

Chromium

Background Observations: 8
Background Mean: 0.490644
Background Std. Dev: 0.184357
K(5, 8, 0.003333) = 3.22
PL = 0.490644 + (3.22 * 0.184357) = 1.08427

Well	Date	Value	Resample	Exceedance
MW-303	4/16/2018	0.12 J	FALSE	FALSE
MW-304	**4/16/2018**	**2**	**FALSE**	**TRUE**
MW-304	**8/14/2018**	**5.9**	**TRUE**	**TRUE**
MW-304 has required 1 resample exceedences				
MW-302	4/16/2018	0.46 J	FALSE	FALSE
MW-305	4/16/2018	0.26 J	FALSE	FALSE
MW-306	4/16/2018	0.37 J	FALSE	FALSE

Barium

Background Observations: 8
Background Mean: 46.3664
Background Std. Dev: 8.76372
K(5, 8, 0.003333) = 3.22
PL = 46.3664 + (3.22 * 8.76372) = 74.5856

Well	Date	Value	Resample	Exceedance
MW-302	4/16/2018	17.7	FALSE	FALSE
MW-303	4/16/2018	69.5	FALSE	FALSE
MW-304	**4/16/2018**	**88.5**	**FALSE**	**TRUE**
MW-304	**8/14/2018**	**87.4**	**TRUE**	**TRUE**
MW-304 has required 1 resample exceedences				
MW-305	**4/16/2018**	**116**	**FALSE**	**TRUE**
MW-305	**8/14/2018**	**118**	**TRUE**	**TRUE**
MW-305 has required 1 resample exceedences				
MW-306	4/16/2018	48.2	FALSE	FALSE

Lithium

Background Observations: 8
Background Mean: 24.6574
Background Std. Dev: 4.01145

K(5, 8, 0.003333) = 3.22
PL = 24.6574 + (3.22 * 4.01145) = 37.5742

Well	Date	Value	Resample	Exceedance
MW-303	4/16/2018	ND<4.6 U	FALSE	FALSE
MW-302	4/16/2018	7.5 J	FALSE	FALSE
MW-304	4/16/2018	ND<4.6 U	FALSE	FALSE
MW-305	4/16/2018	ND<4.6 U	FALSE	FALSE
MW-306	4/16/2018	ND<4.6 U	FALSE	FALSE

Beryllium

Background Observations: 8
Background Mean: 0.178924
Background Std. Dev: 0.0987488
K(5, 8, 0.003333) = 3.22
PL = 0.178924 + (3.22 * 0.0987488) = 0.496895

Well	Date	Value	Resample	Exceedance
MW-303	4/16/2018	0.017 J	FALSE	FALSE
MW-304	4/16/2018	0.026 J	FALSE	FALSE
MW-302	4/16/2018	ND<0.012 U	FALSE	FALSE
MW-305	4/16/2018	ND<0.012 U	FALSE	FALSE
MW-306	4/16/2018	ND<0.012 U	FALSE	FALSE

Molybdenum

Background Observations: 8
Background Mean: 0.949681
Background Std. Dev: 0.280801
K(5, 8, 0.003333) = 3.22
PL = 0.949681 + (3.22 * 0.280801) = 1.85386

Well	Date	Value	Resample	Exceedance
MW-302	4/16/2018	0.59 J	FALSE	FALSE
MW-303	4/16/2018	0.61 J	FALSE	FALSE
MW-304	**4/16/2018**	**2**	**FALSE**	**TRUE**
MW-304	**8/14/2018**	**2.4**	**TRUE**	**TRUE**
MW-304 has required 1 resample exceedences				
MW-305	**4/16/2018**	**7.1**	**FALSE**	**TRUE**
MW-305	**8/14/2018**	**6.5**	**TRUE**	**TRUE**
MW-305 has required 1 resample exceedences				
MW-306	**4/16/2018**	**5.7**	**FALSE**	**TRUE**

MW-306	**8/14/2018**	**4.7**	**TRUE**	**TRUE**

MW-306 has required 1 resample exceedences

Arsenic

Background Observations: 8
Background Mean: 0.234778
Background Std. Dev: 0.101893
K(5, 8, 0.003333) = 3.22
PL = 0.234778 + (3.22 * 0.101893) = 0.562873

Well	Date	Value	Resample	Exceedance
MW-302	4/16/2018	0.16 J	FALSE	FALSE
MW-303	4/16/2018	0.43 J	FALSE	FALSE
MW-304	**4/16/2018**	**0.68 J**	**FALSE**	**TRUE**
MW-304	**8/14/2018**	**1.3**	**TRUE**	**TRUE**
MW-305	4/16/2018	0.51 J	FALSE	FALSE
MW-306	4/16/2018	0.38 J	FALSE	FALSE

MW-304 has required 1 resample exceedences

Antimony

Background Observations: 8
Background Mean: 0.0637777
Background Std. Dev: 0.0521036
K(5, 8, 0.003333) = 3.22
PL = 0.0637777 + (3.22 * 0.0521036) = 0.231551

Well	Date	Value	Resample	Exceedance
MW-302	4/16/2018	ND<0.026 U	FALSE	FALSE
MW-303	4/16/2018	0.098 J	FALSE	FALSE
MW-304	4/16/2018	ND<0.026 U	FALSE	FALSE
MW-305	4/16/2018	0.089 J	FALSE	FALSE
MW-306	4/16/2018	0.094 J	FALSE	FALSE

Lead

Background Observations: 8
Background Mean: 0.222567
Background Std. Dev: 0.138273
K(5, 8, 0.003333) = 3.22
PL = 0.222567 + (3.22 * 0.138273) = 0.667805

Well	Date	Value	Resample	Exceedance
MW-303	4/16/2018	0.069 J	FALSE	FALSE

MW-304	4/16/2018	0.37 J	FALSE	FALSE
MW-302	4/16/2018	0.098 J	FALSE	FALSE
MW-305	4/16/2018	0.12 J	FALSE	FALSE
MW-306	4/16/2018	0.04 J	FALSE	FALSE

Mercury

Background Observations: 8
Background Mean: 0.136655
Background Std. Dev: 0.0754205
K(5, 8, 0.003333) = 3.22
PL = 0.136655 + (3.22 * 0.0754205) = 0.379509

Well	Date	Value	Resample	Exceedance
MW-303	4/16/2018	ND<0.09 U	FALSE	FALSE
MW-302	4/16/2018	0.096 J	FALSE	FALSE
MW-304	4/16/2018	ND<0.09 U	FALSE	FALSE
MW-305	4/16/2018	ND<0.09 U	FALSE	FALSE
MW-306	4/16/2018	ND<0.09 U	FALSE	FALSE

Total Radium

Background Observations: 8
Background Mean: 0.800411
Background Std. Dev: 0.459657
K(5, 8, 0.003333) = 3.22
PL = 0.800411 + (3.22 * 0.459657) = 2.28051

Well	Date	Value	Resample	Exceedance
MW-302	4/16/2018	0.746	FALSE	FALSE
MW-303	4/16/2018	0.529	FALSE	FALSE
MW-306	4/16/2018	0.305	FALSE	FALSE
MW-304	4/16/2018	2.08	FALSE	FALSE
MW-305	4/16/2018	0.676	FALSE	FALSE

Thallium

Background Observations: 8
Background Mean: 0.704121
Background Std. Dev: 0.440866
K(5, 8, 0.003333) = 3.22
PL = 0.704121 + (3.22 * 0.440866) = 2.12371

Well	Date	Value	Resample	Exceedance

MW-302	4/16/2018	ND<0.036 U	FALSE	FALSE
MW-303	4/16/2018	ND<0.036 U	FALSE	FALSE
MW-304	4/16/2018	ND<0.036 U	FALSE	FALSE
MW-305	4/16/2018	0.32 J	FALSE	FALSE
MW-306	4/16/2018	0.083 J	FALSE	FALSE

Selenium

Background Observations: 8
Background Mean: 5.62859
Background Std. Dev: 1.12212
K(5, 8, 0.003333) = 3.22
PL = 5.62859 + (3.22 * 1.12212) = 9.24182

Well	Date	Value	Resample	Exceedance
MW-302	4/16/2018	ND<0.086 U	FALSE	FALSE
MW-303	4/16/2018	0.23 J	FALSE	FALSE
MW-304	4/16/2018	ND<0.086 U	FALSE	FALSE
MW-305	4/16/2018	0.12 J	FALSE	FALSE
MW-306	4/16/2018	ND<0.086 U	FALSE	FALSE

Cadmium

Background Observations: 7
Background Mean: 0.0317759
Background Std. Dev: 0.00888138
K(5, 7, 0.003333) = 3.605
PL = 0.0317759 + (3.605 * 0.00888138) = 0.0637933

Well	Date	Value	Resample	Exceedance
MW-303	**4/16/2018**	**0.44 J**	**FALSE**	**TRUE**
MW-303	**8/14/2018**	**0.36 J**	**TRUE**	**TRUE**
MW-303 has required 1 resample exceedences				
MW-304	4/16/2018	ND<0.018 U	FALSE	FALSE
MW-302	**4/16/2018**	**0.22 J**	**FALSE**	**TRUE**
MW-302	**8/14/2018**	**0.21 J**	**TRUE**	**TRUE**
MW-302 has required 1 resample exceedences				
MW-305	4/16/2018	0.054 J	FALSE	FALSE
MW-306	**4/16/2018**	**0.88**	**FALSE**	**TRUE**
MW-306	**8/14/2018**	**0.76**	**TRUE**	**TRUE**
MW-306 has required 1 resample exceedences				

Parametric Prediction Limit with Resampling
Inter-Well Comparison.

Background date range: 1/1/2000 to 9/30/2017

1 of 2 Resampling Plan
Two Sampling Events per Year

Originating Sampling Event Date is 4/16/2018

Indicator Parameters
Cobalt
Chromium
Barium
Lithium
Beryllium
Molybdenum
Arsenic
Antimony
Lead
Mercury
Total Radium
Thallium
Selenium
Cadmium
There are 14 parameters.

5 Compliance Wells Analyzed.
MW-306
MW-305
MW-302
MW-304
MW-303

Natural Logarithm Transformation
Non-Detects Replaced with Detection Limit

Per-constituent, per-evaluation false positive rate:
0.00357143 = 0.10/(14 * 2)
Alpha 0.00357143 approximated by 0.003333

Cobalt
Background Observations: 8
Background Mean: 0.488631
Background Std. Dev: 0.550752
K(5, 8, 0.003333) = 3.22
PL = 0.488631 + (3.22 * 0.550752) = 2.26205

Well	Date	Value	Resample	Exceedance
MW-303	4/16/2018	0.741937	FALSE	FALSE
MW-304	4/16/2018	-0.941609 J	FALSE	FALSE
MW-302	4/16/2018	-0.105361 J	FALSE	FALSE
MW-305	**4/16/2018**	**2.67415**	**FALSE**	**TRUE**

MW-305	**8/14/2018**	**2.74727**	**TRUE**	**TRUE**
MW-305 has required 1 resample exceedences				
MW-306	4/16/2018	1.56862	FALSE	FALSE

Chromium

Background Observations: 8
Background Mean: -0.74034
Background Std. Dev: 0.367023
K(5, 8, 0.003333) = 3.22
PL = -0.74034 + (3.22 * 0.367023) = 0.441473

Well	Date	Value	Resample	Exceedance
MW-303	4/16/2018	-2.12026 J	FALSE	FALSE
MW-304	**4/16/2018**	**0.693147**	**FALSE**	**TRUE**
MW-304	**8/14/2018**	**1.77495**	**TRUE**	**TRUE**
MW-304 has required 1 resample exceedences				
MW-302	4/16/2018	-0.776529 J	FALSE	FALSE
MW-305	4/16/2018	-1.34707 J	FALSE	FALSE
MW-306	4/16/2018	-0.994252 J	FALSE	FALSE

Barium

Background Observations: 8
Background Mean: 3.83568
Background Std. Dev: 0.162246
K(5, 8, 0.003333) = 3.22
PL = 3.83568 + (3.22 * 0.162246) = 4.35812

Well	Date	Value	Resample	Exceedance
MW-302	4/16/2018	2.87356	FALSE	FALSE
MW-303	4/16/2018	4.24133	FALSE	FALSE
MW-304	**4/16/2018**	**4.483**	**FALSE**	**TRUE**
MW-304	**8/14/2018**	**4.4705**	**TRUE**	**TRUE**
MW-304 has required 1 resample exceedences				
MW-305	**4/16/2018**	**4.75359**	**FALSE**	**TRUE**
MW-305	**8/14/2018**	**4.77068**	**TRUE**	**TRUE**
MW-305 has required 1 resample exceedences				
MW-306	4/16/2018	3.87536	FALSE	FALSE

Lithium

Background Observations: 8
Background Mean: 3.20828
Background Std. Dev: 0.128303

K(5, 8, 0.003333) = 3.22
PL = 3.20828 + (3.22 * 0.128303) = 3.62142

Well	Date	Value	Resample	Exceedance
MW-303	4/16/2018	ND<1.52606 U	FALSE	FALSE
MW-302	4/16/2018	2.0149 J	FALSE	FALSE
MW-304	4/16/2018	ND<1.52606 U	FALSE	FALSE
MW-305	4/16/2018	ND<1.52606 U	FALSE	FALSE
MW-306	4/16/2018	ND<1.52606 U	FALSE	FALSE

Beryllium

Background Observations: 8
Background Mean: -3.23715
Background Std. Dev: 0.981853
K(5, 8, 0.003333) = 3.22
PL = -3.23715 + (3.22 * 0.981853) = -0.0755824

Well	Date	Value	Resample	Exceedance
MW-303	4/16/2018	-4.07454 J	FALSE	FALSE
MW-304	4/16/2018	-3.64966 J	FALSE	FALSE
MW-302	4/16/2018	ND<-4.42285 U	FALSE	FALSE
MW-305	4/16/2018	ND<-4.42285 U	FALSE	FALSE
MW-306	4/16/2018	ND<-4.42285 U	FALSE	FALSE

Molybdenum

Background Observations: 8
Background Mean: -0.076984
Background Std. Dev: 0.295696
K(5, 8, 0.003333) = 3.22
PL = -0.076984 + (3.22 * 0.295696) = 0.875156

Well	Date	Value	Resample	Exceedance
MW-302	4/16/2018	-0.527633 J	FALSE	FALSE
MW-303	4/16/2018	-0.494296 J	FALSE	FALSE
MW-304	4/16/2018	0.693147	FALSE	FALSE
MW-305	**4/16/2018**	**1.96009**	**FALSE**	**TRUE**
MW-305	**8/14/2018**	**1.8718**	**TRUE**	**TRUE**
MW-305 has required 1 resample exceedences				
MW-306	**4/16/2018**	**1.74047**	**FALSE**	**TRUE**
MW-306	**8/14/2018**	**1.54756**	**TRUE**	**TRUE**
MW-306 has required 1 resample exceedences				

Arsenic

Background Observations: 8
Background Mean: -1.51192
Background Std. Dev: 0.411014
K(5, 8, 0.003333) = 3.22
PL = -1.51192 + (3.22 * 0.411014) = -0.188458

Well	Date	Value	Resample	Exceedance
MW-302	4/16/2018	-1.83258 J	FALSE	FALSE
MW-303	4/16/2018	-0.84397 J	FALSE	FALSE
MW-304	4/16/2018	-0.385662 J	FALSE	FALSE
MW-305	4/16/2018	-0.673345 J	FALSE	FALSE
MW-306	4/16/2018	-0.967584 J	FALSE	FALSE

Antimony

Background Observations: 8
Background Mean: -2.67443
Background Std. Dev: 0.535356
K(5, 8, 0.003333) = 3.22
PL = -2.67443 + (3.22 * 0.535356) = -0.950584

Well	Date	Value	Resample	Exceedance
MW-302	4/16/2018	ND<-3.64966 U	FALSE	FALSE
MW-303	4/16/2018	-2.32279 J	FALSE	FALSE
MW-304	4/16/2018	ND<-3.64966 U	FALSE	FALSE
MW-305	4/16/2018	-2.41912 J	FALSE	FALSE
MW-306	4/16/2018	-2.36446 J	FALSE	FALSE

Lead

Background Observations: 8
Background Mean: -2.05445
Background Std. Dev: 0.577818
K(5, 8, 0.003333) = 3.22
PL = -2.05445 + (3.22 * 0.577818) = -0.193873

Well	Date	Value	Resample	Exceedance
MW-303	4/16/2018	-2.67365 J	FALSE	FALSE
MW-304	4/16/2018	-0.994252 J	FALSE	FALSE
MW-302	4/16/2018	-2.32279 J	FALSE	FALSE

MW-305	4/16/2018	-2.12026 J	FALSE	FALSE
MW-306	4/16/2018	-3.21888 J	FALSE	FALSE

Mercury

Background Observations: 8
Background Mean: -3.18229
Background Std. Dev: 0.0854369
K(5, 8, 0.003333) = 3.22
PL = -3.18229 + (3.22 * 0.0854369) = -2.90718

Well	Date	Value	Resample	Exceedance
MW-303	**4/16/2018**	**ND<-2.40795 U**	**FALSE**	**TRUE**
MW-303	**8/14/2018**	**ND<-2.48891 U**	**TRUE**	**TRUE**
MW-303 has required 1 resample exceedences				
MW-302	**4/16/2018**	**-2.34341 J**	**FALSE**	**TRUE**
MW-302	**8/14/2018**	**ND<-2.48891 U**	**TRUE**	**TRUE**
MW-302 has required 1 resample exceedences				
MW-304	**4/16/2018**	**ND<-2.40795 U**	**FALSE**	**TRUE**
MW-304	**8/14/2018**	**ND<-2.48891 U**	**TRUE**	**TRUE**
MW-304 has required 1 resample exceedences				
MW-305	**4/16/2018**	**ND<-2.40795 U**	**FALSE**	**TRUE**
MW-305	**8/14/2018**	**ND<-2.40795 U**	**TRUE**	**TRUE**
MW-305 has required 1 resample exceedences				
MW-306	**4/16/2018**	**ND<-2.40795 U**	**FALSE**	**TRUE**
MW-306	**8/14/2018**	**ND<-2.48891 U**	**TRUE**	**TRUE**
MW-306 has required 1 resample exceedences				

Total Radium

Background Observations: 8
Background Mean: -0.396248
Background Std. Dev: 0.734917
K(5, 8, 0.003333) = 3.22
PL = -0.396248 + (3.22 * 0.734917) = 1.97019

Well	Date	Value	Resample	Exceedance
MW-302	4/16/2018	-0.29303	FALSE	FALSE
MW-303	4/16/2018	-0.636767	FALSE	FALSE
MW-306	4/16/2018	-1.18744	FALSE	FALSE
MW-304	4/16/2018	0.732368	FALSE	FALSE
MW-305	4/16/2018	-0.391562	FALSE	FALSE

Thallium

Background Observations: 8
Background Mean: -1.43239
Background Std. Dev: 1.08305
K(5, 8, 0.003333) = 3.22
PL = -1.43239 + (3.22 * 1.08305) = 2.05502

Well	Date	Value	Resample	Exceedance
MW-302	4/16/2018	ND<-3.32424 U	FALSE	FALSE
MW-303	4/16/2018	ND<-3.32424 U	FALSE	FALSE
MW-304	4/16/2018	ND<-3.32424 U	FALSE	FALSE
MW-305	4/16/2018	-1.13943 J	FALSE	FALSE
MW-306	4/16/2018	-2.48891 J	FALSE	FALSE

Selenium

Background Observations: 8
Background Mean: 1.72536
Background Std. Dev: 0.173394
K(5, 8, 0.003333) = 3.22
PL = 1.72536 + (3.22 * 0.173394) = 2.28369

Well	Date	Value	Resample	Exceedance
MW-302	4/16/2018	ND<-2.45341 U	FALSE	FALSE
MW-303	4/16/2018	-1.46968 J	FALSE	FALSE
MW-304	4/16/2018	ND<-2.45341 U	FALSE	FALSE
MW-305	4/16/2018	-2.12026 J	FALSE	FALSE
MW-306	4/16/2018	ND<-2.45341 U	FALSE	FALSE

Cadmium

Background Observations: 7
Background Mean: -3.38062
Background Std. Dev: 0.164691
K(5, 7, 0.003333) = 3.605
PL = -3.38062 + (3.605 * 0.164691) = -2.78691

Well	Date	Value	Resample	Exceedance
MW-303	**4/16/2018**	**-0.820981 J**	**FALSE**	**TRUE**
MW-303	**8/14/2018**	**-1.02165 J**	**TRUE**	**TRUE**
MW-303 has required 1 resample exceedences				
MW-304	4/16/2018	ND<-4.01738 U	FALSE	FALSE
MW-302	**4/16/2018**	**-1.51413 J**	**FALSE**	**TRUE**
MW-302	**8/14/2018**	**-1.56065 J**	**TRUE**	**TRUE**
MW-302 has required 1 resample exceedences				

MW-305	4/16/2018	-2.91877 J	FALSE	FALSE
MW-306	**4/16/2018**	**-0.127833**	**FALSE**	**TRUE**
MW-306	**8/14/2018**	**-0.274437**	**TRUE**	**TRUE**
MW-306 has required 1 resample exceedences				