

TECHNICAL MEMO

July 18, 2013

To: Prashant K. Gupta (Honeywell), John Morris (Honeywell)

From: Richard F. Carbonaro; Robert D. Mutch (Mutch Associates, LLC), James O'Loughlin (Parsons)

Subject: CO₂ Sparging Proof of Concept – 6 month post-sparge monitoring results, LCP Chemicals Site, Brunswick, GA

Mutch Associates, LLC, in collaboration with Parsons Corporation (Parsons), have prepared this technical memo describing the analytical results of the 6 month post-sparge monitoring for the CO₂ sparging Proof of Concept test conducted at the LCP Chemical Site in Brunswick, Georgia. The Proof of Concept test was conducted in accordance with the “Final Work Plan for CO₂ Sparging Proof of Concept Test, LCP Chemical Site, Brunswick, GA” (Mutch Associates, 2012) dated September 11, 2012. The Proof of Concept test was designed to evaluate the feasibility of CO₂ sparging to remediate a subsurface caustic brine pool (CBP) formed by historical production of industrial chemicals on the site. The purpose of the post-sparge sampling events is to assess changes in groundwater chemistry following CO₂ sparging, including the potential for rebound of pH and other constituents of concern.

This technical memo describes the results of the third and final post-sparge monitoring event that occurred on May 15, 2013. The first post-sparge monitoring event occurred approximately 1 week after the end of the sparging on November 26th – 28th, 2012. The second event occurred on February 4th and 5th of 2013.

Groundwater Sampling

A site plan showing the location of all wells within the Proof of Concept area is provided in Figure 1. In accordance with the work plan, five out of 13 monitoring wells were selected for rebound monitoring pending the outcome of pH and geochemistry results from the first post-sparging sampling round at one week. The wells selected were SW-1, MW-1C, MW-2C, MW-519B and MW-115C. These wells were sampled at 3 and 6 months post-sparging. SW-1 was selected to serve as a field duplicate for the 6 month sampling bringing the total number of samples to six. The distance from sparge wells to monitoring wells is shown on Table 1.

The five monitoring wells were purged and sampled using the low flow “Tubing-in-Screened-Interval” method, pursuant to US EPA Region IV Environmental Investigations Standard Operating Procedure (SOP) – October 2011. The guidance document *Groundwater Sampling Guidelines for Superfund and RCRA Project Managers* was also referenced for additional technical support. Per the method, the tubing intake was lowered to the middle of the screened interval of the well, and a peristaltic pump was used to purge the groundwater at a very low flow rate. Throughout the purge process, depths to

water measurements were collected to assess and maintain stable drawdown. A minimum one equipment volume was purged prior to stabilization parameters (pH, specific conductivity, dissolved oxygen, and turbidity) being collected. Although not considered stabilization parameters, temperature and oxidation reduction potential were also recorded. The field sampling logs are included as Appendix A to this report. Once the required parameters were stable for three consecutive readings, groundwater samples were collected for laboratory analysis as described in Table 3-2 of the Proof of Concept Report (Mutch Associates and Parsons, 2013). The groundwater samples were preserved on ice and submitted to TestAmerica Laboratories in Savannah, GA for analysis. Once the groundwater samples had been collected, approximately 900 mL of groundwater were pumped into a graduated cylinder and the specific gravity was determined using a hydrometer.

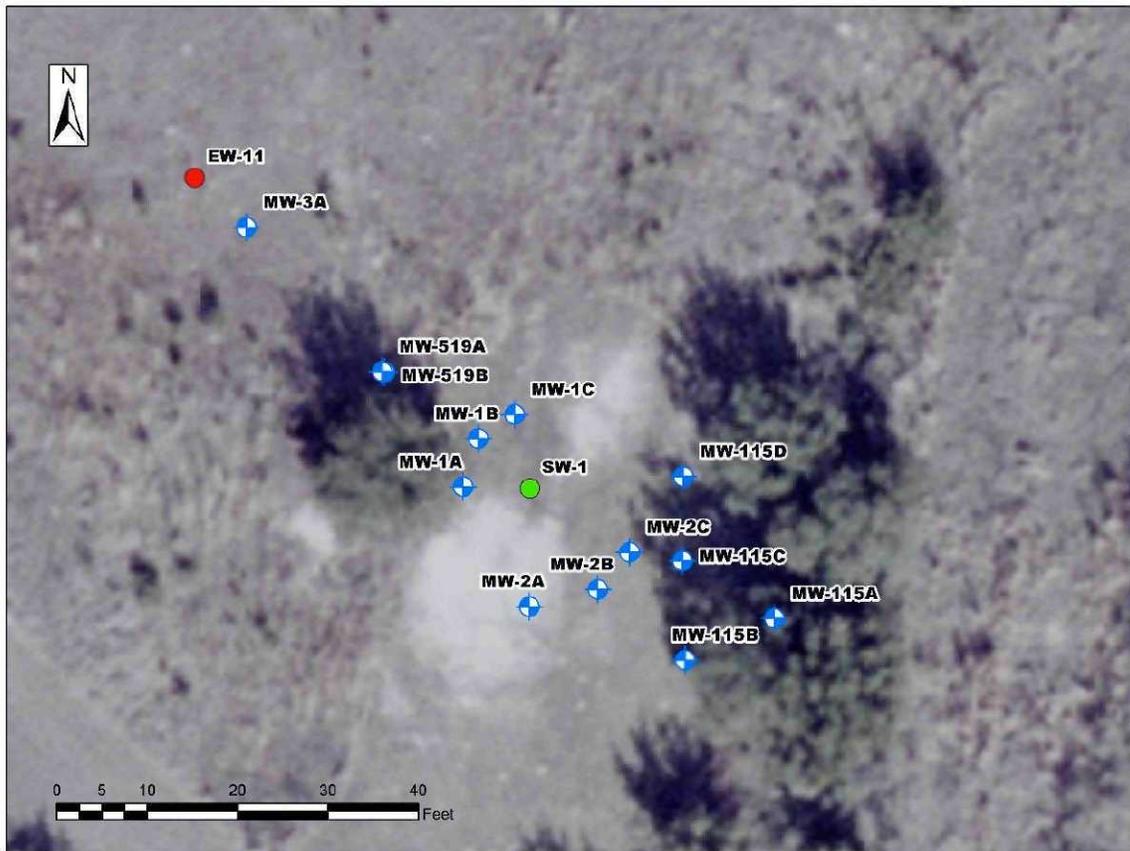


Figure 1: Proof of Concept Test Site Plan

Table 1: Summary of Deep Satilla Monitoring Wells and Inter-well Distances			
Monitoring Well	Distance from SW-1 (ft)	Distance from MW-1C (ft)	Screened Interval (ft)
MW-115C	18.7	24.6	40 – 42
MW-1C	8.4	0.0	45 – 50
MW-2C	13.1	19.9	45 – 50
MW-519B	20.6	15.1	42 – 48

Sampling Results

A summary of the results from the groundwater analysis is presented in Table 2. All of the analytical data from TestAmerica and the well purge/sampling logs are provided at the end of this Technical Memo.

Table 2: Summary of field and lab results from the 6 month post-sparge monitoring event

	SW-1	SW-1 (FD)	MW-1C	MW-2C	MW-519B	MW-115C
pH (field)	6.54	---	8.57	8.84	7.24	11.24
Hg (µg/L)	4.5	3.8	53	46	28	180
As (µg/L)	< 20	< 20	< 200	< 200	< 200	220
Cr (µg/L)	69	69	330	180	340	140
V (µg/L)	130	140	780	690	470	1,600
Si (mg/L)	61	60	57	75	46	2,000
TDS (mg/L)	16,000	13,000	43,000	30,000	44,000	31,000
Specific gravity	1.012	---	1.030	1.022	1.032	1.026

FD indicates sample was a field duplicate

A comparison of these results to the pre-sparge and post-sparge monitoring events is shown in Table 3 for pH. Results for mercury, arsenic and chromium are presented in Table 3.

Table 3: Comparison of mercury, arsenic and chromium results from the three post-sparge monitoring events

Mercury, Hg (µg/L)	Pre-sparge	Post-sparge		
		1 week	3 months	6 months
SW-1	110	11	4.4	4.5
MW-1C	110	21	44	53
MW-2C	110	33 top / 64.5 mid	41	46
MW-519B	120	89 top / 99 mid	68	28
MW-115C	120	110	110	180
Arsenic, As (µg/L)				
SW-1	-	45	9.5	< 20
MW-1C	320	120	23	5.6
MW-2C	260	26 top / 44 mid	24	18
MW-519B	390	130 top / 170 mid	120	< 20
MW-115C	280	98	180	210
Chromium, Cr (µg/L)				
SW-1	-	200	110	69
MW-1C	500	320	420	310
MW-2C	370	300 top / 320 mid	290	160
MW-519B	610	390 top / 380 mid	440	330
MW-115C	340	340	340	140

Changes in pH

Results for pre- and post-sparge pH are shown in Figure 2. Pre-sparge pH results are shown for the low-flow sampling event (performed by Parsons on October 2 - 3, 2012), and for the initial measurement from the continuous pH monitoring (performed by Mutch Associates on October 29, 2012). Note that only a continuous monitoring sample is available for SW-1. In general, the two pre-sparge pH readings are within 0.5 units of one another. Pre-sparge pH values ranged between 11.2 and 12.3 for deep Satilla wells. Post-sparge monitoring results are shown after 1 week, 3 months and 6 months. Results for 1 week are shown for both the low-flow sampling event (performed by Parsons on November 26 - 28, 2012), and continuous pH monitoring (performed by Mutch Associates on November 28, 2012). Filled squares shown on Figure 2 indicate the pH values found when sampling was performed at the top of the well screen during the 1 week post sparge sampling.

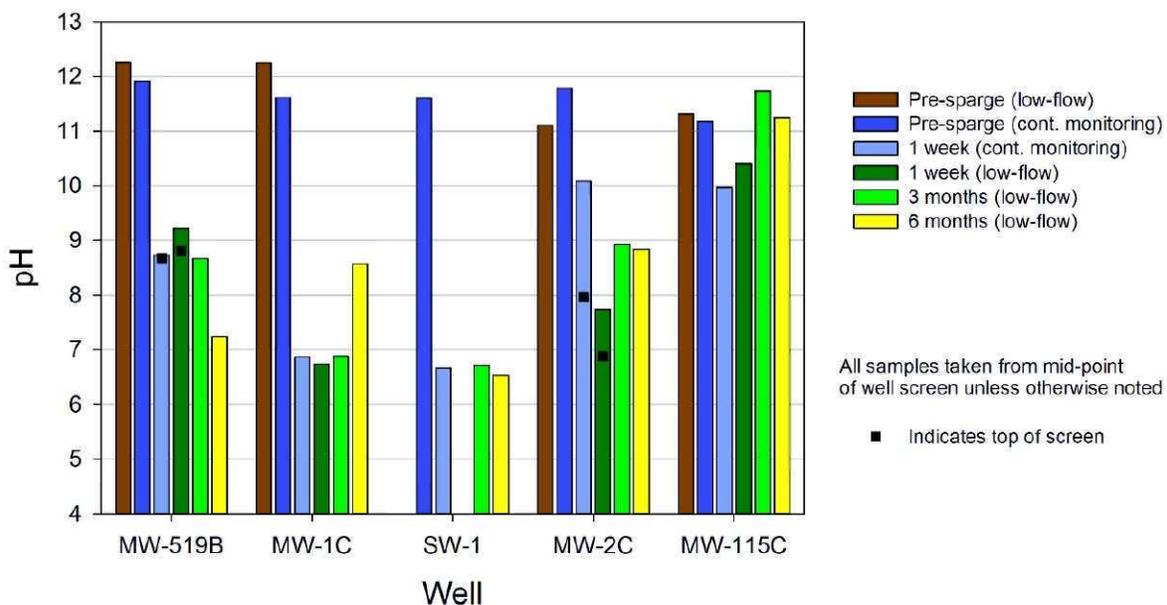


Figure 2: Summary of pH results from pre- and post-sparge monitoring.

Key observations from the post-sparge pH monitoring include:

- SW-1 has remained below 7.0 over the entire 6 month post-sparge monitoring period.
- MW-1C stayed below 7.0 through the 3 month sampling, but increased to 8.57 at the 6 month sampling
- MW-519B (24.6 ft from MW-1C) has trended downward from 8.73 (continuous monitoring) to 7.24 at the 6 month sampling
- MW-2C (19.9 ft from MW-1C) has stayed relatively constant over the 6 month post-sparge period; currently the pH is 8.84
- MW-115C (15.1 ft from MW-1C) increased after the 1 week sampling from 10.20 to 11.73 and 11.24 at 3 and 6 months, respectively. This well is outside of the 20-foot sparging radius of influence (ROI) determined from the 1 week post-sparge pH data (Mutch Associates and Parsons, 2013).

Overall, the monitoring results show that pH has remained low during the 6 month period after the Proof of Concept Test. Increases in pH in selected wells (i.e. MW-1C) have been balanced by decreases in nearby wells (i.e. MW-519B) within the 20-foot ROI. All wells within the 20-foot ROI have stayed below pH 9.0 up to 6 months after the Proof of Concept Test.

The Proof of Concept monitoring wells are arranged along a line oriented N-45°W (northwest) (Figure 1). This is approximately the direction of groundwater flow according to the natural hydraulic gradient. Thus, water within the Satilla has the potential to move slowly from MW-115C to MW-1C to MW-519B. The potential movement of groundwater in the northwest direction is supported by the changes in pH over the course of the 6 month post-sparge monitoring period. Specifically, the increase in pH observed in MW-115C is possibly the result of untreated water entering the well screen from upgradient, the increase in MW-1C the result of movement of water from near MW-115C, and the decrease in MW-519B the result of movement of water that was formerly near MW-1C.

Changes in Mercury Concentrations

Pre- and post-sparge mercury concentrations are shown in Figure 3. Filled squares shown on Figure 3 indicate mercury results from sampling that was performed at the top of the well screen during the 1 week post-sparge sampling. Key observations from the post-sparge mercury concentrations include:

- SW-1 showed the lowest dissolved mercury concentrations after 1 week (11 µg/L), and has decreased to 4.4 and 4.5 µg/L at 3 and 6 months respectively.
- MW-1C has risen from 21 µg/L at the 1 week sampling to 53 µg/L at the 6 month sampling, concomitant with an increase in pH from 6.74 to 8.57
- MW-519B has shown a decrease from 99 µg/L to 28 µg/L at the 6 month sampling concomitant with a decrease in pH from 9.22 to 7.24.
- MW-2C has decreased slightly from 64.5 to 46 µg/L over the 6 month period.
- MW-115C did not change appreciably from pre-sparge (120 µg/L) through the 3 month post-sparge (110 µg/L). At 6 months post-sparge, concentrations increased to 180 µg/L.

Changes in mercury concentrations over the 6 month period closely mirror changes in pH discussed earlier. Decreases in pH are generally accompanied by decreases in dissolved mercury and vice versa. The relationship between mercury concentrations and pH is further illustrated in Figure 4. Data from the pre-sparge and post-sparge monitoring events from deep Satilla wells are shown. Data from the 1 week post-sparge monitoring (green circles and squares) show a curvilinear relationship where decreases in pH are reflected in decreases in mercury concentrations. A non-linear regression of these data (solid line) is provided for reference.

Data collected from the 3 and 6 month sampling events generally fall below the line formed by the pre-sparge and 1 week post-sparge data (Figure 4). This indicates a gradual lowering of dissolved mercury concentrations over time at a given pH. This effect appears after 3 months (blue circles, Figure 4) and is sustained through 6 months (grey circles, Figure 4).

Percent removals of mercury in individual monitoring wells are inversely proportional to pH. The largest percent removal of mercury from pre-sparge to post-sparge was 96% in SW-1. The average percent removal among the four deep Satilla wells within the radius of influence was 71%.

MW-115C is outside of the sparging ROI and did not experience a significant lowering of mercury at any time during the post-sparge monitoring period. Prior to the 6 month sampling, mercury concentrations were steady at 110 to 120 µg/L. As discussed earlier, changes in pH from 3 to 6 months suggest groundwater may be traveling to MW-115C from upgradient. This water may have slightly different water quality which resulted in an increase in MW-115C dissolved mercury 180 µg/L at 6 months.

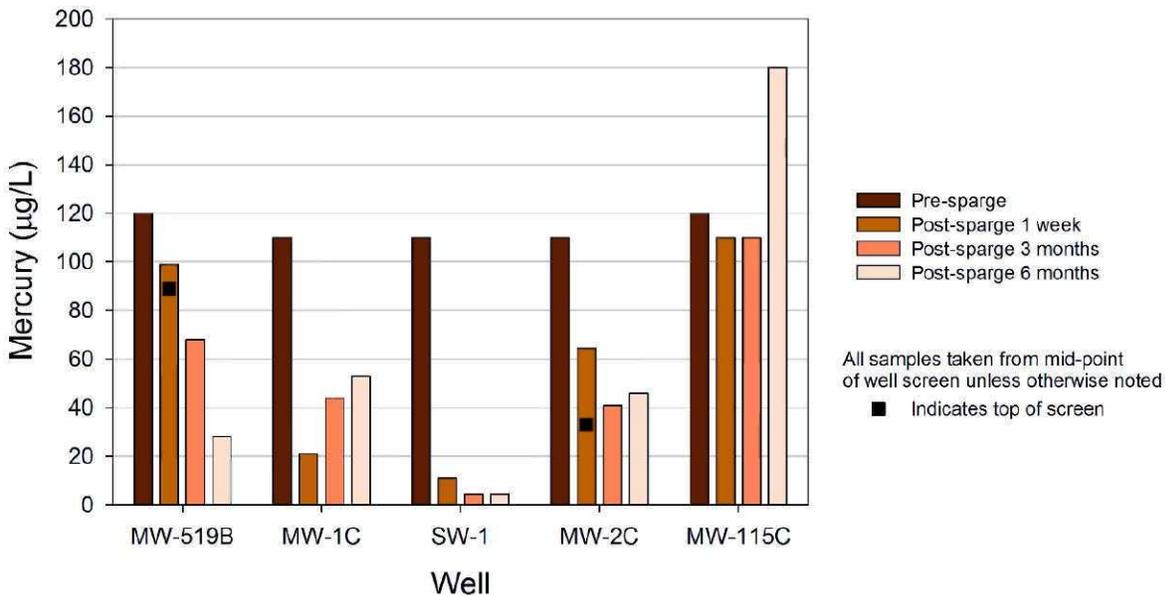


Figure 3: Summary of mercury results from pre- and post-sparge monitoring.

Arsenic and Chromium

The three deep Satilla monitoring wells within the sparging ROI (MW-1C, MW-2C and MW-519B) all showed large decreases in arsenic concentrations from pre- to post-sparge. Deep Satilla arsenic concentrations within the Proof of Concept test area were between 260 and 390 µg/L prior to CO₂ sparging. At 6 months post-sparge, concentrations in deep Satilla wells within the sparging ROI were all less than 20 µg/L. These wells have also shown decreases in arsenic concentrations over time from 1 week to 6 months. As a result, the average percent removal of these wells has increased from 67% (1 week) to 84% (3 months) to 96% (6 months)¹.

Total chromium concentrations in deep Satilla monitoring wells have also decreased from pre- to post-sparge. Deep Satilla chromium concentrations within the Proof of Concept test area were between 340 and 610 µg/L prior to CO₂ sparging. After 6 months post-sparge, concentrations in deep Satilla wells

¹ The percent removal for arsenic at 6 months was calculated by assuming “U qualified” concentrations are one-half the reporting limit.

within the sparging ROI were between 69 and 310 $\mu\text{g/L}$. The average percent removal in these wells at 6 months was 47%. These wells have also shown decreases in chromium concentration over time from 1 week to 6 months. Most notable is SW-1 which decreased from 200 to 69 $\mu\text{g/L}$ after 6 months.

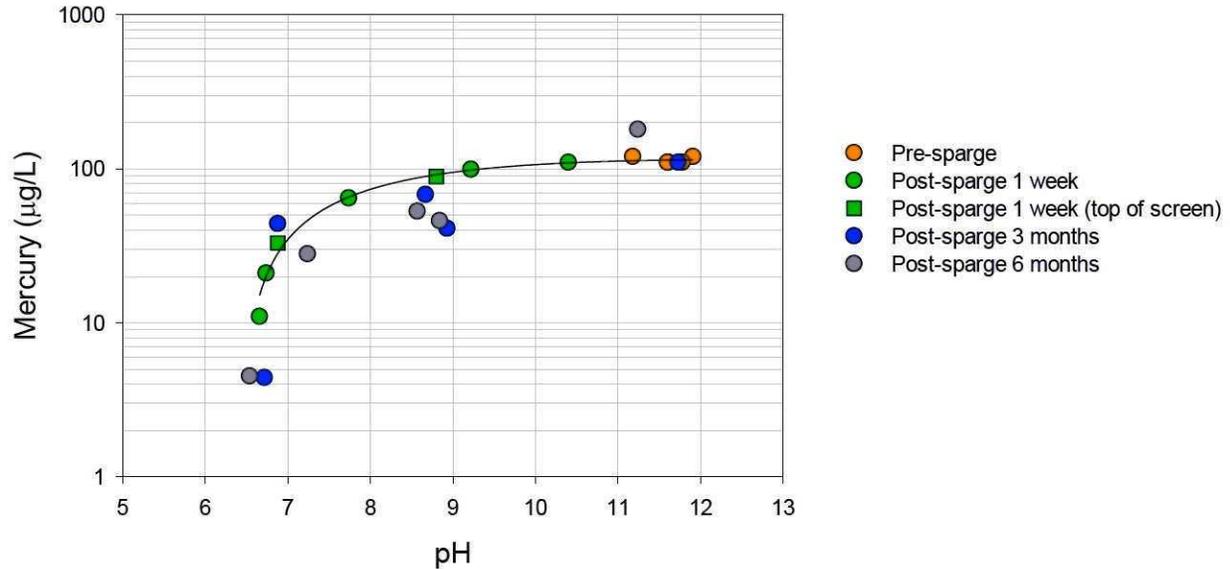


Figure 4: Relationship between mercury and pH in deep Satilla wells sampled as part of the Proof of Concept test. Curved line is an inverse cubic fit to the pre-sparge and 1 week post-sparge data.

Conclusions

The key conclusions drawn from the post-sparging monitoring are the following:

- Overall, pH has remained low during the 6 month period after the Proof of Concept Test. All wells within the 20-foot ROI have stayed below pH 9.0 through the 6 month sampling.
- Increases in pH in selected wells (i.e. MW-1C) have been balanced by decreases in nearby wells (i.e. MW-519B) within the 20-foot ROI.
- Changes in mercury concentrations over the 6 month period closely mirror changes in pH. Decreases in pH are generally accompanied by decreases in dissolved mercury and vice versa.
- Mercury, arsenic and chromium show a gradual lowering of dissolved concentrations over time at a given pH.

		Field Sample ID	MW-519B-051513		SW-1-051513		SW-1#2-051513		MW-1C-051513		MW-2C-051513		EQB-051513		MW-115C-051513	
		Location	MW-519B		SW-1		SW-1#2		MW-1C		MW-2C		Equipment Blank		MW-115C	
		Sample Date	5/15/2013		5/15/2013		5/15/2013		5/15/2013		5/15/2013		5/15/2013		5/15/2013	
		SDG	680-90380-1		680-90380-1		680-90380-1		680-90380-1		680-90380-1		680-90380-1		680-90380-1	
		Matrix	WATER		WATER		WATER									
		Sample Purpose	Regular sample		Equipment blank		Regular sample									
		Sample Type	Ground Water		Blank water		Ground Water									
Method	Parameter Name	Units														
SM2320B	ALKALINITY, CARBONATE (AS CaCO ₃)	mg/L	61		25	U	25	U	410		410		5	U	4,000	
SM2320B	BICARBONATE ALKALINITY (AS CaCO ₃)	mg/L	8,100		4,000		4,100		6,500		4,300		5	U	1,000	
SM2320B	TOTAL ALKALINITY	mg/L	8,200		4,000		4,100		6,900		4,800		5	U	5,100	
SM2540C	TOTAL DISSOLVED SOLIDS	mg/L	44,000		16,000		13,000		43,000		30,000		14		31,000	
SM3500-FeD	FERROUS IRON	µg/L	2,600	HF	6,700	HF	6,700	HF	1,400	HF	1,100	HF	36	J HF	1,700	HF
SM4500S2-F	SULFIDE	mg/L	27		10	U	10	U	24		27		1	U	6.3	
SM5310B	DISSOLVED ORGANIC CARBON	mg/L	350		220		170		280		760		0.67	J	1,400	
SM5310B	TOTAL ORGANIC CARBON	mg/L	340		180		180		340		910		1	U	1,400	
SW6010	ALUMINUM	mg/L	0.2	U	0.12	J	0.12	J	0.2	U	0.2	U	0.01	U	0.2	U
SW6010	ANTIMONY	mg/L	0.015	J	0.0081	J	0.014	J	0.013	J	0.023		0.02	U	0.015	J
SW6010	ARSENIC	mg/L	0.02	U	0.02	U	0.02	U	0.056	J	0.018	J	0.02	U	0.21	
SW6010	BARIUM	mg/L	0.140		0.160		0.160		0.076		0.085		0.01	U	0.017	
SW6010	BERYLLIUM	mg/L	0.003	J	0.003	J	0.003	J	0.0033	J	0.0027	J	0.004	U	0.0017	J
SW6010	CADMIUM	mg/L	0.0024	J	0.005	U	0.005	U	0.0022	J	0.005	U	0.005	U	0.005	U
SW6010	CALCIUM	mg/L	13		18		18		8.2		11		0.5	U	0.63	
SW6010	CHROMIUM	mg/L	0.330		0.069		0.069		0.310		0.16		0.01	U	0.14	
SW6010	COBALT	mg/L	0.01	U	0.01	U	0.01	U								
SW6010	COPPER	mg/L	0.078	J	0.02	U	0.002	J	0.0083	J	0.0036	J	0.01	U	0.0035	J
SW6010	IRON	mg/L	2.4		7.3		7.4		0.98		0.51		0.1	U	0.89	
SW6010	LEAD	mg/L	0.011		0.012		0.0065	J	0.0076	J	0.0085	J	0.01	U	0.012	
SW6010	MAGNESIUM	mg/L	9.3		12		12		3.8		5.2		0.5	U	0.036	J
SW6010	MANGANESE	mg/L	0.12		0.078		0.078		0.021		0.043		0.01	U	0.065	J
SW6010	NICKEL	mg/L	0.017	J	0.0045	J	0.0044	J	0.023	J	0.014	J	0.04	U	0.027	J
SW6010	POTASSIUM	mg/L	69		11		12		50		23		1	U	11	
SW6010	RESPIRABLE QUARTZ	mg/L	46		61		60		57		75		0.5	U	2,000	
SW6010	SELENIUM	mg/L	0.02	U	0.02	U	0.02	U	0.02	U	0.02	J	0.02	U	0.02	U
SW6010	SILVER	mg/L	0.01	U	0.01	U	0.01	U								
SW6010	SODIUM	mg/L	16,000		5,800		5,800		15,000		11,000		0.68	J	13,000	
SW6010	THALLIUM	mg/L	0.025	U	0.025	U	0.025	U								
SW6010	VANADIUM	mg/L	0.46		0.130		0.140		0.730		0.630		0.01	U	1.5	
SW6010	ZINC	mg/L	0.02	U	0.02	U	0.020	U	0.0087	J	0.020	U	0.02	U	0.02	
SW7470	MERCURY	µg/L	28		4.5		3.8		53		46		0.2	U	180	
SW9040	pH	S.U.	8.34	H	8.08	H	8.1	H	8.6	H	8.76	H	6.74	H	10.4	H
SW9056	CHLORIDE	mg/L	20,000		6,400		6400		19,000		14,000		5	U	16,000	
SW9056	SULFATE	mg/L	1,200		240	U	250	U	1,200		720		5	U	930	

Analytical Data from 6-month Post Sparge Monitoring Event

Analytical Lab was TestAmerica Savannah (5102 LaRoche Avenue, Savannah, GA 31404)

- Qualifiers:**
- U Indicates the analyte was analyzed for but not detected.
 - J Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.
 - H Sample was prepped or analyzed beyond the specified holding time
 - HF Field parameter with a holding time of 15 minutes

Groundwater Sampling Logs

GROUNDWATER SAMPLING LOG

SITE NAME: LCP Chemical Site	SITE LOCATION: Brunswick, GA
WELL NO: MW-1C	SAMPLE ID: MW-1C DATE: 5/15/2013

PURGING DATA

WELL DIAMETER (inches): 2	TUBING DIAMETER (inches): 1/4	WELL SCREEN INTERVAL DEPTH(ft btoc): 48.5 to 53.5	STATIC DEPTH TO WATER (ft btoc): 9.40	PURGE PUMP TYPE OR BAILER: PP
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Tubing-in-Screen Interval purge: 1 EQUIPMENT VOL. = (TUBING CAPACITY X TUBING LENGTH) + FLOW CELL VOLUME
 = s (0.0026 gallons/foot X 54 feet) + 0.13 gallons = **0.27 gallons**

INITIAL PUMP OR TUBING DEPTH IN WELL (ft btoc): 50.5	FINAL PUMP OR TUBING DEPTH IN WELL (ft btoc): 50.5	PURGING INITIATED AT: 0848	PURGING ENDED AT: 0951	TOTAL VOLUME PURGED (gallons): ~1.7
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TIME	VOLUME PURGED (gallons)	CUMUL. VOLUME PURGED (gallons)	PURGE RATE (gpm)	DEPTH TO WATER (feet btoc)	pH (standard units)	TEMP. (°C)	SP COND. (mS/cm)	DISSOLVED OXYGEN (% saturation)	TURBIDITY (NTUs)	ORP (mV)	SP Gravity (sg)
0910	0.5	0.5	0.02	9.65	8.46	21.48	56.02	6.4	8.02	-185.5	
0918	0.25	0.75	0.03	9.65	8.53	21.45	56.71	7.1	7.12	-189.9	
0928	0.25	1.0	0.03	9.67	8.56	21.76	57.36	6.8	5.48	-193.8	
0938	0.35	1.35	0.04	9.67	8.57	21.75	57.81	6.5	5.30	-195.6	
0950	0.35	1.7	0.03	9.66	8.57	21.81	58.03	6.2	4.76	-197.6	1.030

WELL CAPACITY (Gallons Per Foot): 0.75" = 0.02; 1" = 0.04; 1.25" = 0.06; 2" = 0.16; 3" = 0.37; 4" = 0.65; 5" = 1.02; 6" = 1.47; 12" = 5.88
TUBING INSIDE DIA. CAPACITY (Gal./Ft.): 1/8" = 0.0006; 3/16" = 0.0014; 1/4" = 0.0026; 5/16" = 0.004; 3/8" = 0.006; 1/2" = 0.010; 5/8" = 0.016
BTOC = Below top of casing – feet below top of casing which includes above grade riser

PURGING EQUIPMENT CODES: B = Bailer; BP = Bladder Pump; ESP = Electric Submersible Pump; PP = Peristaltic Pump; O = Other (Specify)

SAMPLING DATA

SAMPLED BY (PRINT) / AFFILIATION: Christine Jaynes/Parsons	SAMPLER(S) SIGNATURE(S): 	SAMPLING INITIATED AT: 1029	SAMPLING ENDED AT: 1056
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PUMP OR TUBING DEPTH IN WELL (feet): 50.5	TUBING MATERIAL CODE: Teflon-lined PE	FIELD-FILTERED: Yes SM 4500 Sulfide FILTER SIZE: 0.45 µm Filtration Equipment Type: In-line filter
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FIELD DECONTAMINATION: PUMP Y No TUBING Yes No (replaced)	DUPLICATE: No
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SAMPLE CONTAINER SPECIFICATION				SAMPLE PRESERVATION			INTENDED ANALYSIS AND/OR METHOD	SAMPLING EQUIPMENT CODE	Additional Comments
SAMPLE ID CODE	# CONTAINERS	MATERIAL CODE	VOLUME	PRESERVATIVE USED	TOTAL VOL ADDED IN FIELD (mL)	FINAL pH			
MW-1C	1	PE	250mL	HNO3	--	--	6010B TAL Metals/ 7470A Hg	APP	
MW-1C	1	PE	125mL	--	--	--	3500 FE/ 9040B pH	APP	
MW-1C	1	PE	250mL	--	--	--	6010B Dissolved Silica	APP	
MW-1C	1	PE	125mL	--	--	--	9056A_28D Chloride & Sulfate	APP	
MW-1C	1	AG	125mL	--	--	--	SM 5310 DOC	APP	
MW-1C	2	PE	250mL	NaOH Zinc Acetate	--	--	SM4500 Sulfide	APP	Field-Filtered
MW-1C	1	PE	500mL	--	--	--	2540C TDS	APP	
MW-1C	1	PE	250mL	--	--	--	2320B Alkalinity	APP	
MW-1C	1	AG	125mL	HCl	--	--	SM5310 TOC	APP	

REMARKS: Per SOP, parameters stable prior to sample collection. Purge water clear brown, sulfur-like odor. Minimal black resin noted in the bucket and tubing.

MATERIAL CODES: AG = Amber Glass; CG = Clear Glass; PE = Polyethylene; PP = Polypropylene; S = Silicone; T = Teflon; O = Other (Specify)

SAMPLING EQUIPMENT CODES: APP = After Peristaltic Pump; B = Bailer; BP = Bladder Pump; ESP = Electric Submersible Pump; RFPP = Reverse Flow Peristaltic Pump; SM = Straw Method (Tubing Gravity Drain); O = Other (Specify)

NOTES: Stabilization Criteria for Range of Variation of Last Three Consecutive Readings: pH: ± 0.1 unit Specific Conductance: ± 5% Dissolved Oxygen: all readings ≤ 10% saturation; optionally, ± 0.2 mg/L Turbidity: all readings ≤ 10 NTU; or ± 10%

GROUNDWATER SAMPLING LOG

SITE NAME: LCP Chemical Site	SITE LOCATION: Brunswick, GA
WELL NO: MW-2C	SAMPLE ID: MW-2C DATE: 5/15/2013

PURGING DATA

WELL DIAMETER (inches): 2	TUBING DIAMETER (inches): 1/4	WELL SCREEN INTERVAL DEPTH (ft btoc): 48 to 53	STATIC DEPTH TO WATER (ft btoc): 8.46	PURGE PUMP TYPE OR BAILER: PP
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Tubing-in-Screen-Interval purge: 1 EQUIPMENT VOL. = (TUBING CAPACITY X TUBING LENGTH) + FLOW CELL VOLUME
 = (0.0026 gallons/foot X 54 feet) + 0.13 gallons = **0.27 gallons**

INITIAL PUMP OR TUBING DEPTH IN WELL (feet btoc): 50.5	FINAL PUMP OR TUBING DEPTH IN WELL (feet btoc): 50.5	PURGING INITIATED AT: 1218	PURGING ENDED AT: 1436	TOTAL VOLUME PURGED (gallons): 2.6
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TIME	VOLUME PURGED (gallons)	CUMUL. VOLUME PURGED (gallons)	PURGE RATE (gpm)	DEPTH TO WATER (feet btoc)	pH (standard units)	TEMP. (°C)	SP COND. (mS/cm)	DISSOLVED OXYGEN (% saturation)	TURBIDITY (NTUs)	ORP (mV)	SP Gravity (sg)
1405	2.2	2.2	0.02	12.87	8.77	27.52	42.77	6.1	8.90	-391.7	
1418	0.15	2.35	0.01	12.84	8.82	27.70	42.94	5.8	7.07	-402.7	
1425	0.15	2.5	0.02	12.81	8.83	27.50	43.04	5.8	6.16	-404.5	
1435	0.1	2.6	0.01	12.73	8.84	27.77	43.17	5.9	6.07	-407.9	1.022

WELL CAPACITY (Gallons Per Foot): 0.75" = 0.02; 1" = 0.04; 1.25" = 0.06; 2" = 0.16; 3" = 0.37; 4" = 0.65; 5" = 1.02; 6" = 1.47; 12" = 5.88
TUBING INSIDE DIA. CAPACITY (Gal./Ft.): 1/8" = 0.0006; 3/16" = 0.0014; 1/4" = 0.0026; 5/16" = 0.004; 3/8" = 0.006; 1/2" = 0.010; 5/8" = 0.016
BTOC = Below top of casing – feet below top of casing which includes above grade riser

PURGING EQUIPMENT CODES: B = Bailer; BP = Bladder Pump; ESP = Electric Submersible Pump; PP = Peristaltic Pump; O = Other (Specify)

SAMPLING DATA

SAMPLED BY (PRINT) / AFFILIATION: Christine Jaynes/Parsons	SAMPLER(S) SIGNATURE(S): 	SAMPLING INITIATED AT: 1438	SAMPLING ENDED AT: 1516
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PUMP OR TUBING DEPTH IN WELL (feet): 53.5	TUBING MATERIAL CODE: Teflon-lined PE	FIELD-FILTERED: Yes/SM 4500 Sulfide FILTER SIZE: <u>0.45</u> µm Filtration Equipment Type: In-line filter
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FIELD DECONTAMINATION: PUMP Y No TUBING Y No (replaced)	DUPLICATE: No
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SAMPLE CONTAINER SPECIFICATION				SAMPLE PRESERVATION			INTENDED ANALYSIS AND/OR METHOD	SAMPLING EQUIPMENT CODE	Additional Comments
SAMPLE ID CODE	# CONTAINERS	MATERIAL CODE	VOLUME	PRESERVATIVE USED	TOTAL VOL ADDED IN FIELD (mL)	FINAL pH			
MW-2C-	2	PE	250mL	HNO3	--	--	6010B TAL Metals/7470A Hg Mercury	APP	
MW-2C-	2	PE	125mL	--	--	--	3500 FE/ 9040B pH	APP	
MW-2C-	2	PE	250mL	--	--	--	6010B Dissolved Silica	APP	
MW-2C-	2	PE	125mL	--	--	--	9056A_28D Chloride & Sulfate	APP	
MW-2C-	2	AG	125mL	--	--	--	SM 5310 DOC	APP	
MW-2C-	4	PE	250mL	NaOH Zinc Acetate	--	--	SM4500 Sulfide	APP	Field-Filtered
MW-2C-	2	PE	500mL	--	--	--	2540C TDS	APP	
MW-2C-	2	PE	250mL	--	--	--	2320B Alkalinity	APP	
MW-2C-	2	AG	125mL	HCl	--	--	SM5310 TOC	APP	

REMARKS: Per SOP, parameters stable prior to sample collection. > 1.5 hours for the water level to stabilize. Purge water clear, brown odor noted.

MATERIAL CODES: AG = Amber Glass; CG = Clear Glass; PE = Polyethylene; PP = Polypropylene; S = Silicone; T = Teflon; O = Other (Specify)

SAMPLING EQUIPMENT CODES: APP = After Peristaltic Pump; B = Bailer; BP = Bladder Pump; ESP = Electric Submersible Pump; RFPF = Reverse Flow Peristaltic Pump; SM = Straw Method (Tubing Gravity Drain); O = Other (Specify)

NOTES: Stabilization Criteria for Range of Variation of Last Three Consecutive Readings: pH: ± 0.1 unit Specific Conductance: ± 5% Dissolved Oxygen: all readings ≤ 10% saturation; optionally, ± 0.2 mg/L Turbidity: all readings ≤ 10 NTU; or ± 10%

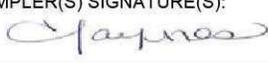
GROUNDWATER SAMPLING LOG

SITE NAME: LCP Chemical Site	SITE LOCATION: Brunswick, GA
WELL NO: SW-1	SAMPLE ID: SW-1 DATE: 5/15/2013

PURGING DATA

WELL DIAMETER (inches): 4	TUBING DIAMETER (inches): 1/4	WELL SCREEN INTERVAL DEPTH(ft btoc): 43 to 48	STATIC DEPTH TO WATER (ft btoc): 8.45	PURGE PUMP TYPE OR BAILER: PP							
Tubing-in-Screen-Interval purge: 1 EQUIPMENT VOL. = (TUBING CAPACITY X TUBING LENGTH) + FLOW CELL VOLUME = (0.0026 gallons/foot X 49 feet) + 0.13 gallons = 0.26 gallons											
INITIAL PUMP OR TUBING DEPTH IN WELL (feet btoc): 45.5	FINAL PUMP OR TUBING DEPTH IN WELL (feet btoc): 45.5	PURGING INITIATED AT: 1235	PURGING ENDED AT: 1432	TOTAL VOLUME PURGED (gallons): 4.70							
TIME	VOLUME PURGED (gallons)	CUMUL. VOLUME PURGED (gallons)	PURGE RATE (gpm)	DEPTH TO WATER (feet btoc)	pH (standard units)	TEMP. (°C)	SP COND. (mS/cm)	DISSOLVED OXYGEN (% saturation)	TURBIDITY (NTUs)	ORP (mV)	SP Gravity (sg)
1256	0.8	0.8	0.04	8.54	6.54	24.50	21.77	24.3	22.2	-77.0	
1307	0.45	1.25	0.04	8.53	6.54	24.61	21.95	18.8	19.1	-79.4	
1317	0.5	1.75	0.05	8.55	6.53	24.03	22.24	16.2	20.3	-82.0	
1323	0.35	2.15	0.06	8.55	6.53	24.00	22.36	14.9	21.9	-81.6	
1330	0.35	2.5	0.05	8.53	6.55	24.41	22.57	13.5	21.9	-80.5	
1341	0.5	3.0	0.05	8.53	6.57	24.57	22.92	11.7	24.1	-82.3	
1352	0.5	3.5	0.05	8.53	6.53	24.66	23.30	9.9	27.0	-80.5	
1358	0.4	3.9	0.07	8.53	6.54	24.81	23.62	9.1	32.4	-80.2	
1414	0.35	4.25	0.02	8.47	6.55	26.07	24.00	6.2	39.1	-76.1	
14.23	0.25	4.5	0.03	8.47	6.55	26.00	24.13	6.5	40.8	-79.2	
14.31	0.2	4.70	0.03	8.47	6.54	26.17	24.30	5.0	42.6	-77.6	1.012
WELL CAPACITY (Gallons Per Foot): 0.75" = 0.02; 1" = 0.04; 1.25" = 0.06; 2" = 0.16; 3" = 0.37; 4" = 0.65; 5" = 1.02; 6" = 1.47; 12" = 5.88 TUBING INSIDE DIA. CAPACITY (Gal./Ft.): 1/8" = 0.0006; 3/16" = 0.0014; 1/4" = 0.0026; 5/16" = 0.004; 3/8" = 0.006; 1/2" = 0.010; 5/8" = 0.016 BTOW = Below top of casing – feet below top of casing which includes above grade riser											
PURGING EQUIPMENT CODES: B = Bailer; BP = Bladder Pump; ESP = Electric Submersible Pump; PP = Peristaltic Pump; O = Other (Specify)											

SAMPLING DATA

SAMPLED BY (PRINT) / AFFILIATION: Christine Jaynes/Parsons				SAMPLER(S) SIGNATURE(S): 			SAMPLING INITIATED AT: 1449		SAMPLING ENDED AT: 1535	
PUMP OR TUBING DEPTH IN WELL (feet): 45.5				TUBING MATERIAL CODE: Teflon-lined PE			FIELD-FILTERED: Yes/SM 4500 Sulfide FILTER SIZE: <u>0.45</u> µm Filtration Equipment Type: In-line filter			
FIELD DECONTAMINATION: PUMP <input checked="" type="checkbox"/> Y <input type="checkbox"/> No				TUBING <input checked="" type="checkbox"/> Y <input type="checkbox"/> No (replaced)			DUPLICATE: <input checked="" type="checkbox"/> Yes			
SAMPLE CONTAINER SPECIFICATION				SAMPLE PRESERVATION			INTENDED ANALYSIS AND/OR METHOD		SAMPLING EQUIPMENT CODE	Additional Comments
SAMPLE ID CODE	# CONTAINERS	MATERIAL CODE	VOLUME	PRESERVATIVE USED	TOTAL VOL ADDED IN FIELD (mL)	FINAL pH				
SW-1	1	PE	250mL	HNO3	--	--	6010B TAL Metals/7470A Hg		APP	
SW-1	1	PE	125mL	--	--	--	3500 FE/ 9040B pH		APP	
SW-1	1	PE	250mL	--	--	--	6010B Dissolved Silica		APP	
SW-1	1	PE	125mL	--	--	--	9056A_28D Chloride & Sulfate		APP	
SW-1	1	AG	125mL	--	--	--	SM 5310 DOC		APP	
SW-1	2	PE	250mL	NaOH Zinc Acetate	--	--	SM4500 Sulfide		APP	Field-Filtered
SW-1	1	PE	500mL	--	--	--	2540C TDS		APP	
SW-1	1	PE	250mL	--	--	--	2320B Alkalinity		APP	
SW-1	1	AG	125mL	HCl	--	--	SM5310 TOC		APP	
REMARKS: Per SOP, parameters stable prior to sample collection; although turbidity > 10 NTU; turbidity +/- 10%. The decision was made to collect the sample as the turbidity was increasing and I did not want the turbidity to exceed 50 NTU. Purge water clear, light brown, no odor. It appeared that residual CO2 still remains as bubbles were present in the tubing, the bubbles decreased as the purge continued. Turbidity post sample collection was 31.3 NTU										
MATERIAL CODES: AG = Amber Glass; CG = Clear Glass; PE = Polyethylene; PP = Polypropylene; S = Silicone; T = Teflon; O = Other (Specify)										
SAMPLING EQUIPMENT CODES: APP = After Peristaltic Pump; B = Bailer; BP = Bladder Pump; ESP = Electric Submersible Pump; RFP = Reverse Flow Peristaltic Pump; SM = Straw Method (Tubing Gravity Drain); O = Other (Specify)										

GROUNDWATER SAMPLING LOG

SITE NAME: LCP Chemical Site	SITE LOCATION: Brunswick, GA
WELL NO: MW-519B	SAMPLE ID: MW-519B DATE: 5/15/2013

PURGING DATA

WELL DIAMETER (inches): 2	TUBING DIAMETER (inches): 1/4	WELL SCREEN INTERVAL DEPTH (feet btoc): 42.55 to 47.55	STATIC DEPTH TO WATER (feet btoc): 8.18	PURGE PUMP TYPE OR BAILER: PP							
Tubing-in-Screen Interval Purge: 1 EQUIPMENT VOL. = (TUBING CAPACITY X TUBING LENGTH) + FLOW CELL VOLUME = (0.0026 gallons/foot X 48.55 feet) + 0.13 gallons = 0.26 gallons											
INITIAL PUMP OR TUBING DEPTH IN WELL (feet btoc): 45.05		FINAL PUMP OR TUBING DEPTH IN WELL (feet btoc): 45.05		PURGING INITIATED AT: 0755	PURGING ENDED AT: 0922	TOTAL VOLUME PURGED (gallons): 2.0					
TIME	VOLUME PURGED (gallons)	CUMUL. VOLUME PURGED (gallons)	PURGE RATE (gpm)	DEPTH TO WATER (feet btoc)	pH (standard units)	TEMP. (°C)	SP COND. (mS/cm)	DISSOLVED OXYGEN (% saturation)	TURBIDITY (NTUs)	ORP (mV)	SP Gravity (sg)
0850	1.25	1.25	0.02	10.6	7.34	22.66	57.10	12.7	8.76	-298.8	
0901	0.25	1.5	0.02	10.44	7.26	22.98	56.73	9.7	4.99	-352.0	
Water level fluctuation due to the pump not maintaining a constant RPM											
0913	0.25	1.75	0.02	10.53	7.22	23.02	57.89	8.7	2.56	-314.3	
0920	0.25	2.0	0.04	10.54	7.24	23.08	58.56	8.2	3.23	-330.1	1.032
WELL CAPACITY (Gallons Per Foot): 0.75" = 0.02; 1" = 0.04; 1.25" = 0.06; 2" = 0.16; 3" = 0.37; 4" = 0.65; 5" = 1.02; 6" = 1.47; 12" = 5.88 TUBING INSIDE DIA. CAPACITY (Gal./Ft.): 1/8" = 0.0006; 3/16" = 0.0014; 1/4" = 0.0026; 5/16" = 0.004; 3/8" = 0.006; 1/2" = 0.010; 5/8" = 0.016 BTOC = Below top of casing – feet below top of casing which includes above grade riser											
PURGING EQUIPMENT CODES: B = Bailer; BP = Bladder Pump; ESP = Electric Submersible Pump; PP = Peristaltic Pump; O = Other (Specify)											

SAMPLING DATA

SAMPLED BY (PRINT) / AFFILIATION: Christine Jaynes/Parsons				SAMPLER(S) SIGNATURE(S): 				SAMPLING INITIATED AT: 0931		SAMPLING ENDED AT: 1005	
PUMP OR TUBING DEPTH IN WELL (feet): 45.05				TUBING MATERIAL CODE: Teflon-lined PE				FIELD-FILTERED: Yes/SM 4500 Sulfide FILTER SIZE: 0.45 µm Filtration Equipment Type: In-line filter			
FIELD DECONTAMINATION: PUMP Y No				TUBING Y No (replaced)				DUPLICATE: No			
SAMPLE CONTAINER SPECIFICATION				SAMPLE PRESERVATION				INTENDED ANALYSIS AND/OR METHOD	SAMPLING EQUIPMENT CODE	Additional Comments	
SAMPLE ID CODE	# CONTAINERS	MATERIAL CODE	VOLUME	PRESERVATIVE USED	TOTAL VOL ADDED IN FIELD (mL)	FINAL pH					
MW-519B-	1	PE	250mL	HNO3	--	--	6010B TAL Metals/7470A Hg	APP			
MW-519B-	1	PE	125mL	--	--	--	3500 FE/ 9040B pH	APP			
MW-519B-	1	PE	250mL	--	--	--	6010B Dissolved Silica	APP			
MW-519B-	1	PE	125mL	--	--	--	9056A_28D Chloride & Sulfate	APP			
MW-519B-	1	AG	125mL	--	--	--	SM 5310 DOC	APP			
MW-519B-	2	PE	250mL	NaOH Zinc Acetate	--	--	SM4500 Sulfide	APP	Field-Filtered		
MW-519B-	1	PE	500mL	--	--	--	2540C TDS	APP			
MW-519B-	1	PE	250mL	--	--	--	2320B Alkalinity	APP			
MW-519B-	1	AG	125mL	HCl	--	--	SM5310 TOC	APP			
REMARKS: Per SOP, parameters stable prior to sample collection. Water level stabilized prior to collecting parameters. Purge water clear brown, sulfur-like odor. Black resin-like film noted in the bucket after the purge water had been dumped.											
MATERIAL CODES: AG = Amber Glass; CG = Clear Glass; PE = Polyethylene; PP = Polypropylene; S = Silicone; T = Teflon; O = Other (Specify)											
SAMPLING EQUIPMENT CODES: APP = After Peristaltic Pump; B = Bailer; BP = Bladder Pump; ESP = Electric Submersible Pump; RFPP = Reverse Flow Peristaltic Pump; SM = Straw Method (Tubing Gravity Drain); O = Other (Specify)											

NOTES: Stabilization Criteria for Range of Variation of Last Three Consecutive Readings: pH: ± 0.1 unit Specific Conductance: ± 5% Dissolved Oxygen: all readings ≤ 10% saturation; optionally, ± 0.2 mg/L Turbidity: all readings ≤ 10 NTU; or ± 10%