Florida HEALTH

Florida Onsite Sewage Nitrogen Reduction Strategies Study

Task C.15 Tracer Test No. 3

May 2014



In association with:



Otis Environmental Consultants, LLC



Florida Onsite Sewage Nitrogen Reduction Strategies Study

TASK C.15 PROGRESS REPORT

Tracer Test No. 3

Prepared for:

Florida Department of Health Division of Disease Control and Health Protection Bureau of Environmental Health Onsite Sewage Programs 4042 Bald Cypress Way Bin #A-08 Tallahassee, FL 32399-1713

FDOH Contract CORCL

May 2014

Prepared by:



In Association With:





S&GW Test Facility Test Area 3 Tracer Test

1.0 Background

Task C of the Florida Onsite Sewage Nitrogen Reduction Strategies Study includes monitoring at field sites in Florida to evaluate nitrogen reduction in soil and groundwater, to assess groundwater impacts from various onsite wastewater systems, and to provide data for parameter estimation, verification, and validation of models developed in Task D. Controlled pilot-scale testing was conducted at the GCREC soil and groundwater (S&GW) test facility to characterize nitrogen fate and transport under a variety of typical operating conditions presented previously in Task C.16 and C.17 documents. The Task C objectives, monitoring framework, sample frequency and duration, and analytical methods to be used at the GCREC S&GW test facility site have been documented in previous reports.

2.0 Purpose

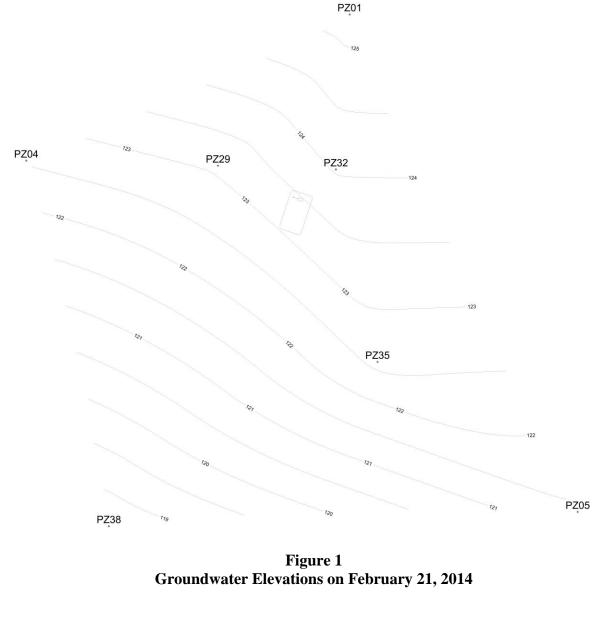
This memo documents the Test Area 3 (TA3) tracer test that was conducted at the GCREC S&GW test facility which commenced February 17, 2014. The most direct method for groundwater velocity determination was used which consisted of introducing a tracer at one point in the flow field and observing its arrival at other points. The test was conducted to assess expected travel direction, times and uniformity of flow.

3.0 Materials and Methods

The tracer test was conducted at the GCREC S&GW test facility located at the University of Florida, Gulf Coast Research and Education Center (GCREC) in southeast Hillsborough County, Florida. The specially designed pilot-scale test areas are representative of typical mounded onsite sewage treatment and disposal systems and enable controlled testing and evaluation of nitrogen reduction in soil and groundwater. Each test area consists of an above ground mound system to which effluent is dosed. Septic tank effluent (STE) is delivered to TA3 via a pressure dosed mound with a drip dispersal system at a design hydraulic loading rate of 32.6 L/m²-day (0.8 gal/ft²-day). The source of the influent wastewater is the septic tank effluent from the existing onsite wastewater system serving the GCREC. Details of the design and construction of the S&GW test facility were presented previously in Task C.6, C.7, C.8, C10, C.11, C.12, A.15 and A.17 documents.

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Throughout the S&GW test facility monitoring and sampling study period, from June 2012 through December 2013, the approximate direction of the groundwater flow was determined for TA3. Figure 1 depicts the groundwater elevations measured on February 21, 2014 in piezometers surrounding the site. The groundwater elevations have been found to fluctuate due to periods of dry weather and/or heavy precipitation; however, routine monitoring of the groundwater elevations indicates that the general flow-path does not change significantly.

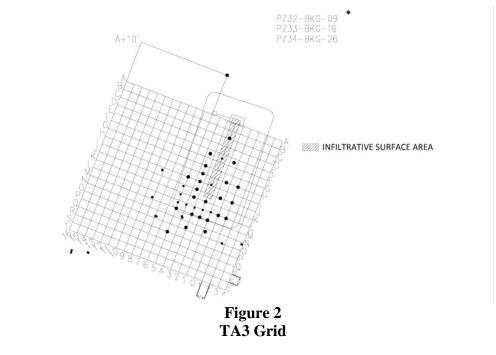


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3.1 Experimental Location and Design

A 0.61 m (2 ft) by 0.61 m (2 ft) sampling grid for groundwater screening was developed downgradient of TA3. Transect lines A through T are parallel to the northern edge of the mound and increase (higher letter identification) moving southward from the mound. Transect lines 4' through 16 (numbered from east to west) are perpendicular to the northern edge of the mound. Groundwater monitoring points were installed in November 2011, March 2012, May 2012, and October 2012 with additional wells installed specifically for the tracer test in October 2013 (Figure 2). Standpipe piezometers were installed using either hand or drilling methods. Standpipe piezometers consist of either 0.02 m (3/4 in), 0.03 m (1 in), or 0.05 m (2 in) diameter Schedule 40 PVC with 0.31 m (1 ft), 0.76 m (2.5 ft), 1.52 m (5 ft), or 3.05 m (10 ft) long, 0.025 cm (0.010 in) slotted well screen and Schedule 40 riser extending to the ground surface (refer to the Task C QAPP and Task C.10/C.11/C.12 Progress Report for additional detail). Environmental Drilling Service, Inc. installed twenty-four additional TA3 wells October 28th and 29th, 2013 using a Geoprobe[™] rig. The new standpipe piezometers consist of 0.025 m (1 in) diameter PVC with 1.52 m (5 ft) long 0.025 cm (0.010 in) Schedule 40 well screens and Schedule 40 riser extending to the ground surface. The target bottom of casing for all new wells was 37 m (121.5 ft) above mean sea level based on NGVD 1929. A complete list of all TA3 installed monitoring devices is included in Appendix A.



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PAGE 2-3 HAZEN AND SAWYER, P.C. The tracer loading rate was designed to be the same loading as during the S&GW test facility study period which used the maximum allowable loading rate for sandy soils of 32.6 L/m^2 -day (0.8 gal/ft²-day) resulting in a daily flow of 121 liters/day (32 gal/day) over the 0.61 m (2 ft) by 6.1 m (20 ft) infiltrative area. The tracer solution was prepared in the STE dose tank, and the dose pump that was used throughout the S&GW test facility study period was used to deliver the tracer solution to the three STE dose areas (TA1, TA3, and TA5). All three test areas were dosed tracer solution to ensure that the hydraulic loading was consistent with the study period; however only TA3 was monitored and results reported herein.

The drip emitters discharge at a rate of 2.3 liters/hr (0.6 gal/hr). The test areas continued to receive a 15 minute dose, 6 times per day. The STE dose tank was emptied of wastewater, and 1136 liters (300 gal) of tracer solution was prepared using clean water within the STE dose tank, which was enough volume to dose the test areas for approximately three days at the design loading rate.

3.2 Tracer Solution and Standards

Tracers are usually chemical or radioactive compounds that flow in a fluid phase without altering the transport properties of the phase. Bromide (Br⁻) was chosen as the most appropriate tracer as it is conservative, and thus representative of the water movement through soil (although some diffusion from mobile to immobile water may occur). A target bromide concentration of 1,000 ppm was selected to ensure detection of the tracer in downgradient locations. The tracer solution was prepared by mixing granular potassium bromide (KBr) with clean water. To prevent density profiles, the solution was mixed onsite. A submersible pump to which a PVC stirring tree was attached was placed inside the STE dose tank to ensure that the solution was mixed during the experiment.

Nine bromide detection probes were used during the test. Six submersible water quality sensor dataloggers (AquiStar TempHion smart sensors) were installed within various wells to continuously record the bromide concentration. Two additional sensor dataloggers were used over a short period during the test. In addition, a bromide ion selective electrode (Cole Palmer model EW-27502-05) connected to a pH/mV meter (Oakton Ion 6+) was used to analyze pumped samples. Six bromide standards (ranging from 10 ppm to 10,000 ppm) were prepared prior to the start of the tracer test. The standards were used to create a calibration curve to which the ISE probe and datalogging sensors could be calibrated. The bromide standards were prepared using standard dilution as shown in Table 1. The standards were sent to an independent and fully NELAC certified analytical laboratory

(Southern Analytical Laboratory) for analyses (see Table 2), the laboratory report is provided in Appendix B. After the standards were prepared, each was measured with the ISE probe daily. The resulting readings (in mV) on February 17, 2014 for the standards are shown in Table 2, and the calibration curve associated with the standards is illustrated in Figure 3 using the laboratory reported value for the standards.

The laboratory value for Br concentration was significantly less than the target concentration. Standard concentrations were prepared and checked several times and results were routinely the same, lab results indicated less bromide in solution than the target concentration of the standard. The potassium bromide used for the test was not analytical grade, and it is suspected that this was the reason that target concentrations were not met. Laboratory values for Br concentration were therefore used throughout the study for calibration of probes and sensors.

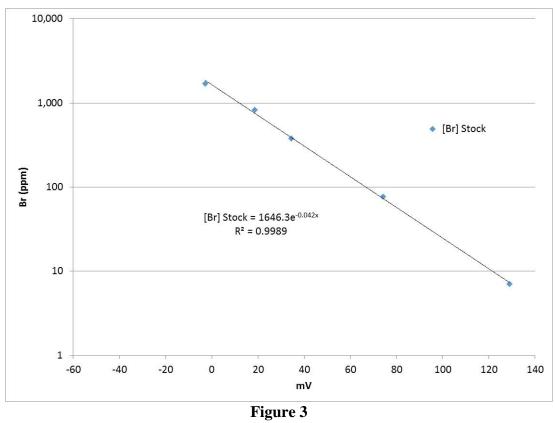
Table 1. Stock preparation method

CONCENTRATION	DILUTION	PREPARATION						
10,000 ppm = A	1:1	14.8 g of KBr in 1,000 mL						
2,000 ppm	1:5	100 mL of A plus 400 mL DI in 500 mL flask						
1,000 ppm	1:10	50 mL of A plus 450 mL DI in 500 mL flask						
500 ppm	1:20	25 mL of A plus 475 mL DI in 500 mL flask						
100 ppm	1:100	5 mL of A plus 495 mL DI in 500 mL flask						
50 ppm	1:200	2.5 mL of A plus 497.5 mL DI in 500 mL flask						
10 ppm	1:1000	0.5 mL of A plus 499.5 mL DI in 500 mL flask						

DI = deionized water

Dilution factor expressed as: volume of analyte: total volume

		SAL Laboratory
Bromide Stock	Target Br Concentration	Reported Br Concentration
(mV)	(ppm)	(ppm)
128.8	10	7.1
74.2	100	77
34.5	500	380
18.5	1,000	830
-2.8	2,000	1,700



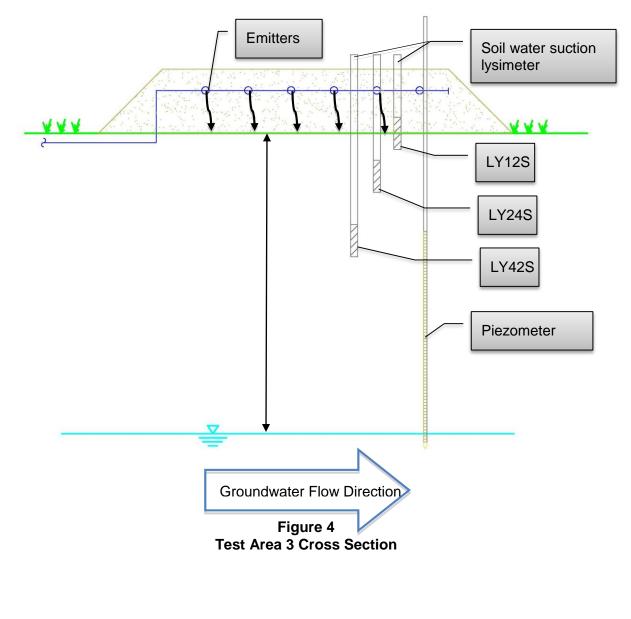
Bromide calibration curve – ISE probe

3.3 Pumped Sample Analysis

Two types of monitoring devices were used during the tracer test: soil water suction lysimeters and groundwater piezometers, shown in Figure 4. The suction lysimeters have a 0.05 m (1.9 in) diameter, 0.23 m (9 in) long porous ceramic cup (Soil Moisture Equipment Corp. part number 0653X07-B01M3). Soil moisture samples from the three TA3 southern suction lysimeters (center of the cup located 0.3, 0.6 and 1.07 meters (12, 24 and 42 in) below the infiltrative surface were collected using a peristaltic pump and dedicated 0.006 m (0.25 in) diameter linear low density polyethylene tubing. A vacuum of 50 kPA (7.25 psi) was applied to the suction lysimeters for one hour prior to collecting the soil water.

Groundwater samples were also collected using 0.006 m (0.25 in) diameter dedicated linear low density polyethylene tubing and a peristaltic pump. During the groundwater sample collection, a very low flow rate was used to minimize flow into the well during sampling. At the start of the test, the groundwater elevation was approximately 2.13 m (7

ft) below natural grade. For both monitoring devices, the tubing was first purged (approximately 100 mL), and then water was collected in a 100 mL beaker. A 10 mL sample was taken from the beaker using a pipette and placed in a 50 mL beaker, and 2 mL of 5M NaNO₃ ion strength adjustment solution (ISA) was added to each sample. A bromide ISE probe connected to a pH/mV meter or ion meter was used to measure the mV of the tracer solution. In addition, the concentration of the bromide solution in the STE dose tank was measured prior to and during the tracer test to ensure proper mixing of the solution.



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3.4 Submersible Sensors

The six AquiStar[™] submersible water quality sensor dataloggers were initially calibrated and installed within the test area 3 wells at grid locations G3.5, I2, I3.5, I5, K3.5, and the test area 5 outlet tee. The sensors were connected to an INW supplied junction box which was connected to an INW VZCOM device. The INW VZCOM device transmitted the six sensor readings at 5-minute intervals to the INW server accessed through the website www.myinwdata.com. The sensors were set to record the bromide concentration at 15-minute intervals within the sensor's internal data logger. Following detection in the pumped samples, the sensors were moved to the well grid locations within the anticipated peak concentration flow path.

4.0 Results

4.1 Bromide Tracer Solution

The tracer test was started at the GCREC S&GW test facility on February 17, 2014. Bromide tracer solution samples collected from the STE dose tank were sent for analyses in a NELAC certified laboratory (Appendix B) to confirm the bromide concentration as summarized in Table 3. The average bromide concentration of the tracer dose solution was 763 ppm. Tank samples analyzed in the field using the bromide ISE sometimes differed considerably from the laboratory results. Although the ISE probe was calibrated daily, it was not temperature compensating, and it is believed that changes in temperature were the cause of the differences. The laboratory results are therefore the most accurate.

	Time Sample	Laboratory Result
Date	Collected	Bromide Concentration (ppm)
2/17/2014	14:45	770
2/17/2014	15:05	730
2/17/2014	19:00	780
2/18/2014	7:06	750
2/18/2014	11:55	780
2/18/2014	15:05	760
2/19/2014	7:20	800
2/20/2014	12:23	750
2/20/2014	17:15	750
Average		763

On February 21st, the tracer solution tank was completely empty (after 97 hours of dosing). Following the tracer dosing, the tank was filled with septic tank effluent (STE), and STE was then dosed continuously to the test area at the same loading rate as the tracer solution.

4.2 Unsaturated Zone Transport

Soil moisture samples from the three TA3 southern suction lysimeters LY12S, LY24S, and LY42S center of the cup located at 0.3, 0.6 and 1.07 meters (12, 24 and 42 in) below the infiltrative surface respectively provides an opportunity to evaluate the unsaturated zone travel time. Figure 5 depicts the breakthrough curves generated for these three locations which are summarized in Table 4.

The shallowest lysimeter (LY12S) is located at the mound sand and native soil interface which is 0.3 m (12 in) below the infiltrative surface. The maximum or peak concentration of bromide in LY12S (580 ppm Br) occurred 5.8 days (138 hours) after initial input of bromide. The lysimeter located 0.3 m (12 in) into the native soil (LY24S) peak bromide concentration (590 ppm Br) occurred 162 hours after initial input of bromide. The deepest lysimeter 0.76 m (30 in) into the native soil (LY42S) peak bromide concentration (395 ppm Br) occurred 257 hours after initial input of bromide. The average velocity (Va) can be expressed using the equation:

$$Va = \frac{L}{t}$$

Where *L* is the distance traveled and *t* is the time of travel. Based on the average peak bromide unsaturated zone travel time obtained during this test, the estimated unsaturated zone flow rate would be 0.081 m/day (0.265 ft/day) below the infiltrative surface.

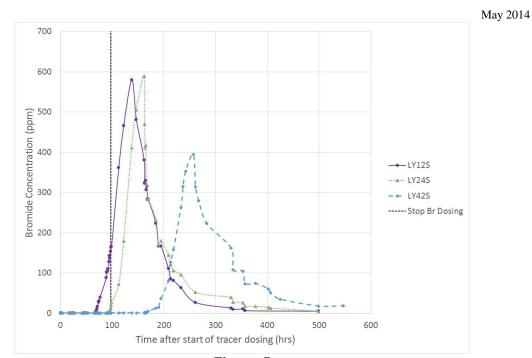


Figure 5 Test Area 3 Unsaturated Zone Breakthrough Curves

Table 4: Unsaturated Zone Travel Time							
		Distance	Time since start Br-		Velocity	Velocity	
		(L)	(t)		conc	(Va)	(Va)
		m	hours	days	ppm	m/day	ft/day
	Br start		69.2	2.9	5.8	0.106	0.347
LY12S	Br peak	0.3	138.3	5.8	580.0	0.053	0.174
	Br end		334.0	13.9	9.3	0.022	0.072
	Br start		95.0	4.0	5.2	0.154	0.505
LY24S	Br peak	0.6	162.0	6.8	590.0	0.090	0.296
	Br end		402.1	16.8	14.6	0.036	0.119
	Br start		169.7	7.1	4.7	0.151	0.495
LY42S	Br peak	1.07	257.2	10.7	394.7	0.100	0.327
	Br end		498.9	20.8	17.9	0.051	0.168
	Br start					0.11-0.15	0.35-0.51
Range	Br peak			0.05-0.10	0.17-0.33		
	Br end			0.02-0.05	0.07-0.17		
Average	(based on pe	eak Br)				0.081	0.265

Table A. II . 7 -. . .

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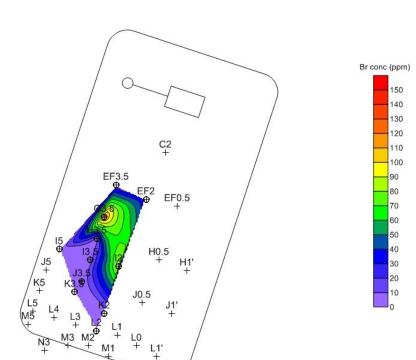
PAGE 2-10 HAZEN AND SAWYER, P.C.

4.3 Groundwater Transport

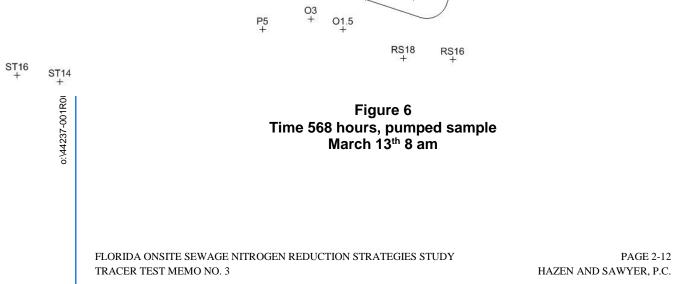
Pumped samples were collected starting with the closest well to the test area and continuing with those placed further away. The sampling interval was initially daily. To allow for a better visualization of the pumped data collected at the site, the mapping program **Surfer** was utilized for each sample event. **Surfer** is a grid-based mapping program that interpolates irregularly spaced XYZ data into a regularly spaced grid. Although there are several methods used in Surfer to fill in areas where data is missing, the Natural Neighbor method output gave the most informative graphs for determining the general peak bromide concentration flow direction (Appendix C, Figures C-1 through C-27). Although these graphs illustrate bromide movement, the areas without monitoring wells represent results from Surfer that are not well supported by field data. Nonetheless, the Surfer graphs in Appendix C depict the general flow path and bromide concentrations.

The graphs for time 568 hours (Figure 6) and time 1171 hours (Figure 7) are presented here to illustrate the general flow path for the peak bromide concentration (Figure 8) which follows approximately grid locations $G3.5 \rightarrow I5$.

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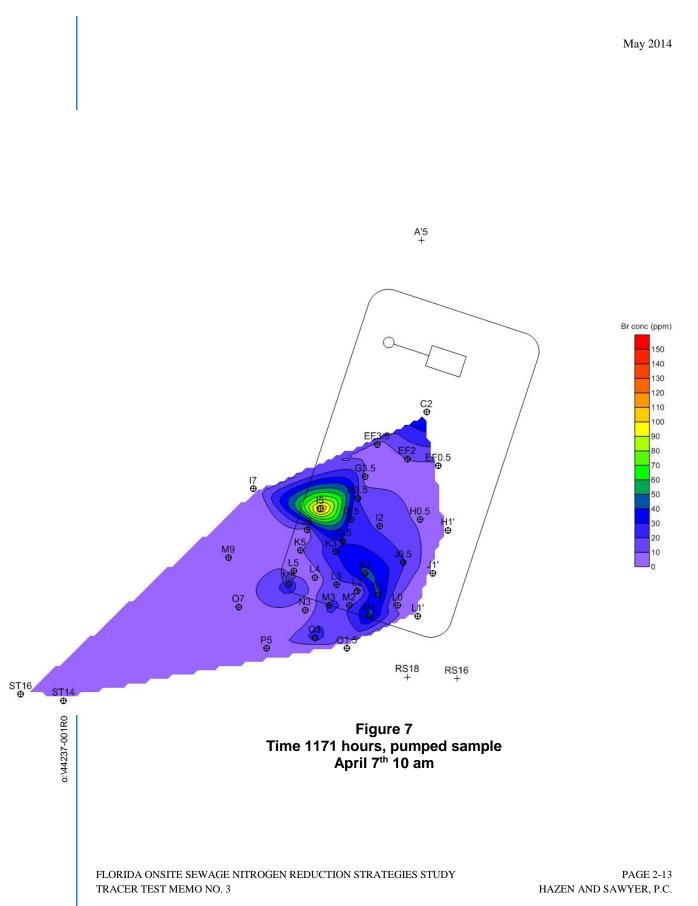


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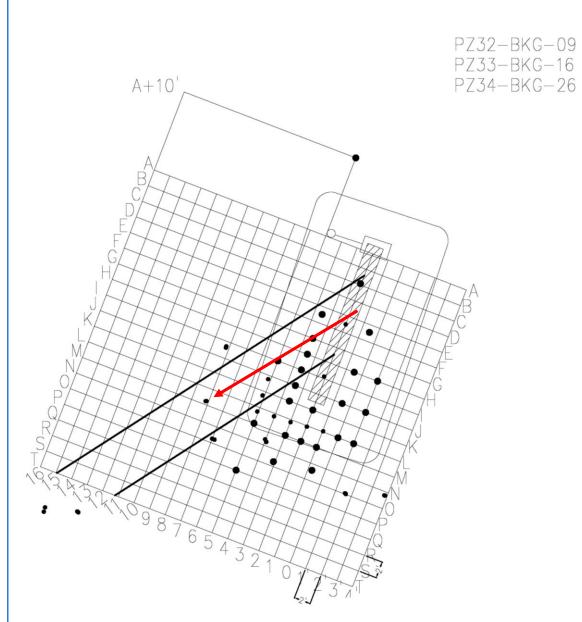
M9 +

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PZ32 +



PZ32 +



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Figure 8
Approximate peak bromide concentration flow direction

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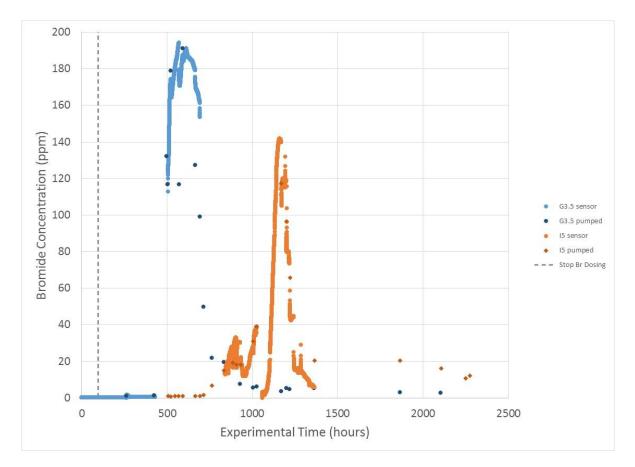


Figure 9 Test Area 3 Groundwater Breakthrough Curves

4.4 Groundwater Velocity and Hydraulic Conductivity Estimations

Various analytical methods are available for calculating the average interstitial velocity of groundwater flow. One approach in calculating the horizontal velocity is the empirical method where the distance is divided by the time of peak concentration occurrence (Table

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4). During the 112-day period of bromide monitoring, the bromide plume moved horizontally away from the dosing area a distance of over 3 m (10 ft). Table 5 shows the calculated linear velocity in the area where the peak bromide concentrations were measured. The peak-to-peak tracer travel time between wellpoints G3.5 and I5 was 24.562 days. Using this travel time, the average groundwater seepage velocity immediately downgradient of the infiltrative surface was 1.5 m (4.96 ft) in 24.562 days, or approximately 0.0616 m/day (0.2019 ft/day) which is less than the velocity determined from tracer test No. 2 (median 0.0914 m/d) which was also conducted at GCREC.

Peak to Peak Well Ids	L, distance	t, Peak-to-peak tracer travel time	Velocity (m/day)	Velocity (ft/day)					
	(m (ft))	(days)	(,))	(
EF3.5→I5	2.34 (7.67)	19.806	0.1181	0.3873					
G3.5→ I5	1.51 (4.96)	24.562	0.0616	0.2019					
H3.5→ I5	1.10 (3.60)	18.806	0.0584	0.1914					
I3.5→ I5	0.91 (3.00)	14.024	0.0652	0.2139					
Median			0.0634	0.2079					
Range			0.058 – 0.118	0.191 – 0.387					
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Table 5. Groundwater Velocity using Empirical Method

¹Peak flow path generally follows G3.5 \rightarrow I5 direction

Huang (1991) presented an approach for one-dimensional tracer models using analytical solutions and the tracer breakthrough curve to calculate the average velocity. The following equations, developed by Huang (1991), were used to compare the peak G3.5 and I5 concentrations and travel time.

 $U_{max} = \frac{t_1 t_{max}}{t_{1-t_{max}}} ln \frac{C_1 \sqrt{t_1}}{C_{max} \sqrt{t_{max}}}$ $V = \sqrt{\frac{2U_{max} - t_{max}}{2U_{max} - t_1}} \frac{x}{t_{max}}$ $D = \frac{x^2 - V^2 t_{max}^2}{2t_{max}}$

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PAGE 2-16 HAZEN AND SAWYER, P.C. Where C_{max} is the max concentration and t_{max} is the time associated with C_{max} , C_1 is the concentration at time t_1 , x is the distance to the tracer dose point, V is the estimated average linear velocity, and D is the dispersion coefficient of the tracer. U_{max} is a calculated function relating tracer concentrations and travel times.

The tracer breakthrough and peak data for the G3.5 and I5 curves are summarized in Table 6. The estimated average horizontal groundwater linear velocity is 0.0639 m/day (0.2097 ft/day), which agrees well with the data in Table 5. The associated dispersion coefficient of the tracer for locations G3.5 and I5 are approximately 4.295 and 28.723 cm^2/day (0.0046 and 0.0309 ft²/day), respectively.

Well ID	t_1	C1	t_{max}	C_{max}	U _{max}	Х	V	D	
	Tracer	Tracer	Peak	Peak		dis-	Veloc-	Disper-	
	break-	break-	concentra-	bromide		tance	ity	sion coef-	
	through	through bro-	tion	concentra-		from	(m/day)	ficient	
	started	mide	occurred	tion		Row 2		(cm²/day)	
	(days after	concentra-	(days after	(ppm)		(m)			
	Bromide	tion	Bromide						
	dosed)	(ppm)	dosed)						
G3.5	17.72	1.29	23.74	194.30	361.0	1.545	0.0648	4.295	
15	31.77	6.92	48.30	141.90	299.9	3.088	0.0630	28.723	
Average							0.0639		

The saturated hydraulic conductivity, K_{sat} , can also be estimated from the tracer results using Darcy's law as follows:

$$v = \frac{K_{sat * gradient}}{n_e}$$
, solving for K_{sat}
 $K_{sat} = \frac{v * n_e}{gradient}$

where K_{sat} is the saturated hydraulic conductivity, and n_e is the effective porosity. Using the average groundwater velocity determined from the breakthrough curve data 0.0639 m/day (0.2096 ft/day), the average hydraulic gradient across the tracer test area (0.0157), and an estimated effective porosity of 33%; the estimated saturated hydraulic conductivity is 134.48 cm/day (4.4120 ft/day).

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5.0 Summary

Based on the average peak bromide unsaturated zone travel time obtained during this tracer test, the estimated unsaturated zone flow rate is 0.081 m/day (0.265 ft/day) below the infiltrative surface of TA3. Using the peak-to-peak travel time determined in this tracer test, the groundwater seepage velocity immediately downgradient of the infiltrative surface of TA3 was 1.51 m (4.96 ft) in 24.562 days, or approximately 0.0616 m/day (0.2019 ft/day) which is less than the velocity determined from tracer test No. 2 which was also conducted at GCREC. The results of the tracer testing will be used in evaluating the fate and transport of nitrogen at the soil and groundwater test facility. In addition, the data will be used in the development of the Task D models.

References

Huang, H., 1991. On a One-Dimensional Tracer Model. Ground Water 29 (1):18-20.



Appendix A: S&GW Test Facility TA3 Sample Identification

ID #	Sample Identification	Test Area	Grid Location	Elev NGVD 29	Revised Elev NGVD 29	Notes			
38	TA1-PZ-09-RS16	TA1	RS16	129.65	128.04				
39	TA1-PZ-16-RS16	TA1	RS16	129.72	128.00				
40	TA1-PZ-09-RS18	TA1	RS18	130.25	128.22				
41	TA1-PZ-16-RS18	TA1	RS18	130.25	128.25				
71	TA3-PAN-12-N	TA3	North						
72	TA3-OBS-N	TA3	North	131.20					
73	TA3-OBS-S	TA3	South	131.11					
74	TA3-SM-39-N	TA3	North	130.59					
75	TA3-SM-39-C	TA3	Center	130.60					
76	TA3-SM-39-S	TA3	South	130.57					
77	TA3-SM-BKG-S	TA3	South	129.32					
78	TA3-SM-BKG-E	TA3	East						
79	TA3-LY-24-C	TA3	Center	133.45					
80	TA3-LY-12-S	TA3	South	132.24					
81	TA3-LY-24-S	TA3	South	132.90					
82	TA3-LY-42-S	TA3	South	132.98					
83	TA3-T-6-C	TA3	Center	132.19					
84	TA3-T-12-C	TA3	Center	132.70					
85	TA3-T-24-C	TA3	Center	132.23					
86	TA3-T-36-C	TA3	Center	131.70					
87	TA3-T-42-C	TA3	Center	132.20					
88	TA3-T-6-S	TA3	South	132.19					
89	TA3-T-12-S	TA3	South	132.69					
90	TA3-T-24-S	TA3	South	132.22					
91	TA3-T-36-S	TA3	South	131.71					
92	TA3-T-42-S	TA3	South	132.21					

 Table A.1

 S&GW Test Facility TA3 Sample Identification

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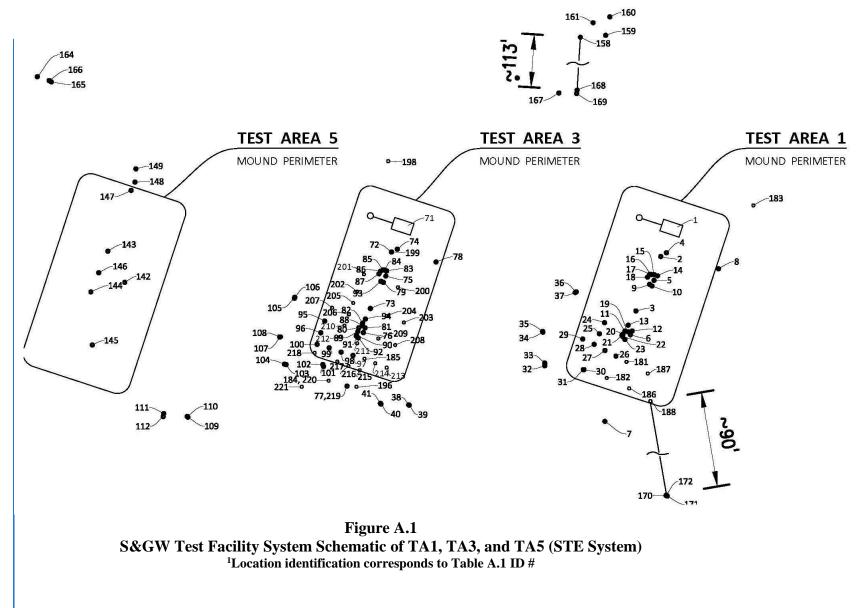
		-	0	Elev	Revised	
ID #	Sample Identification	Test Area	Grid Location	NGVD 29	Elev NGVD 29	Notes
93	TA3-PZ-11-EF2	TA3	EF2	133.82		
94	TA3-PZ-11-I2	TA3	12	133.54		
95	TA3-PZ-10-J5	TA3	J5	133.49	128.31	
96	TA3-PZ-10-K5	TA3	K5	133.49	128.46	
97	TA3-PZ-11-L2	TA3	L2	133.51	129.16	
98	TA3-PZ-11-L3	TA3	L3	133.51	129.02	
99	TA3-PZ-11-L4	TA3	L4	133.50	128.83	
100	TA3-PZ-10-L5	TA3	L5	133.49	128.53	
101	TA3-PZ-09-N3	TA3	N3	129.88	129.19	
102	TA3-PZ-16-N3	TA3	N3	129.89	129.26	
103	TA3-PZ-09-07	TA3	07	130.06	128.20	
104	TA3-PZ-16-O7	TA3	07	130.26	128.19	
105	TA3-PZ-09-I7	TA3	17	130.06	129.48	
106	TA3-PZ-16-I7	TA3	17	130.06	129.48	
107	TA3-PZ-09-M9	TA3	M9	130.18	129.60	
108	TA3-PZ-16-M9	TA3	M9	130.12	129.54	
109	TA3-PZ-09-ST14	TA3	ST14	129.88		
110	TA3-PZ-16-ST14	TA3	ST14	129.81		
111	TA3-PZ-09-ST16	TA3	ST16	129.54		
112	TA3-PZ-16-ST16	TA3	ST16	130.00		
167	PZ32-BKG-09	BKG		133.51		
168	PZ33-BKG-16	BKG		132.84		
169	PZ34-BKG-26	BKG		130.45		
184	PZ-44	TA3		131.82		
185	PZ-45	TA3		132.48		
198	TA3-PZ-BKG5	TA3	BKG5	131.36		New well installed Oct 2013
199	TA3-PZ-C2	TA3	C2	132.08		New well installed Oct 2013
200	TA3-PZ-EF0.5	TA3	EF0.5	131.24		New well installed Oct 2013
201	TA3-PZ-EF3.5	TA3	EF3.5	131.52		New well installed Oct 2013
202	TA3-PZ-G3.5	TA3	G3.5	131.05		New well installed Oct 2013
203	TA3-PZ-H1'	TA3	H1'	131.41		New well installed Oct 2013

Table A.1 S&GW Test Facility TA3 Sample Identification

FLORIDA DEPARTMENT OF HEALTH TRACER TEST MEMO NO. 3 PAGE A-2 HAZEN AND SAWYER, P.C.

ID #	Sample Identification	Test Area	Grid Location	Elev NGVD 29	Revised Elev NGVD 29	Notes
204	TA3-PZ-H0.5	TA3	H0.5	131.25		New well installed Oct 2013
205	TA3-PZ-H3.5	TA3	H3.5	131.04		New well installed Oct 2013
206	TA3-PZ-I3.5	TA3	13.5	131.49		New well installed Oct 2013
207	TA3-PZ-I5	TA3	15	130.90		New well installed Oct 2013
208	TA3-PZ-J1'	TA3	J1'	131.24		New well installed Oct 2013
209	TA3-PZ-J0.5	TA3	J0.5	131.34		New well installed Oct 2013
210	TA3-PZ-J3.5	TA3	J3.5	130.91		New well installed Oct 2013
211	TA3-PZ-K2	TA3	K2	131.46		New well installed Oct 2013
212	TA3-PZ-K3.5	TA3	K3.5	131.28		New well installed Oct 2013
213	TA3-PZ-L1'	TA3	L1'	131.52		New well installed Oct 2013
214	TA3-PZ-L0	TA3	L0	131.18		New well installed Oct 2013
215	TA3-PZ-M1	TA3	M1	131.54		New well installed Oct 2013
216	TA3-PZ-M2	TA3	M2	131.40		New well installed Oct 2013
217	TA3-PZ-M3	TA3	M3	131.34		New well installed Oct 2013
218	TA3-PZ-M5	TA3	M5	131.45		New well installed Oct 2013
219	TA3-PZ-O1.5	TA3	O1.5	131.16		New well installed Oct 2013
220	TA3-PZ-O3	TA3	O3	130.88		New well installed Oct 2013
221	TA3-PZ-P5	TA3	P5	129.28		New well installed Oct 2013

Table A.1 S&GW Test Facility TA3 Sample Identification



FLORIDA ONSITE SEWAGE NITROGEN REDUCTION STRATEGIES STUDY TRACER TEST MEMO NO. 3

PAGE A-4 HAZEN AND SAWYER, P.C.



Appendix B: Laboratory Results

FLORIDA ONSITE SEWAGE NITROGEN REDUCTION STRATEGIES STUDY TRACER TEST MEMO NO. 3

PAGE B-1 HAZEN AND SAWYER, P.C.

110 BAYVIEW BOULEVARD, OLDSMAR, FL 34677 813-855-1844 FAX 813-855-2218



February 25, 2014

Work Order: 1401927

Hazen and Sawyer 10002 Princess Palm Ave, Suite 200

Tampa, FL 33619

Project Name		Was	tewater					
Parameters	Units	Results *	Method	PQL	MDL	Prepared	Analyzed	ilution
Sample Description		BR-10-D						
Matrix		Water						
SAL Sample Number		1401927-01						
Date/Time Collected		02/19/14 08:58						
Collected by		Josephine Edeback	-Hirst					
Date/Time Received		02/19/14 15:30						
Inorganics								
Bromide	mg/L	7.1	EPA 300.0	0.20	0.022		02/24/14 15:4	8 1
Sample Description		BR-100-D						
Matrix		Water						
SAL Sample Number		1401927-02						
Date/Time Collected		02/19/14 08:59						
Collected by		Josephine Edeback	-Hirst					
Date/Time Received		02/19/14 15:30						
Inorganics								
Bromide	mg/L	77	EPA 300.0	2.0	0.22		02/24/14 15:5	8 10
Sample Description Matrix		BR-500-D Water						
SAL Sample Number		1401927-03						
Date/Time Collected		02/19/14 09:00	112					
Collected by		Josephine Edeback	-Hirst					
Date/Time Received		02/19/14 15:30						
Inorganics								
Bromide	mg/L	380	EPA 300.0	20	2.2		02/24/14 16:0	7 100
		BR-1000-D						
Sample Description								
Matrix		Water						
SAL Sample Number		1401927-04						
Date/Time Collected		02/19/14 08:59	11:					
Collected by Date/Time Received		Josephine Edeback	-mirst					
Date/ TITLE RECEIVED		02/19/14 15:30						
Inorganics								
Bromide	mg/L	830	EPA 300.0	20	2.2		02/24/14 16:1	7 100

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February 25, 2014

Work Order: 1401927

Hazen and Sawyer 10002 Princess Palm Ave, Suite 200

Tampa, FL 33619

Project Name		Was	stewater					
Parameters	Units	Results *	Method	PQL	MDL	Prepared	Analyzed	Dilution
Sample Description		BR-2000-D						
Matrix		Water						
SAL Sample Number		1401927-05						
Date/Time Collected		02/19/14 09:01						
Collected by		Josephine Edeback	k-Hirst					
Date/Time Received		02/19/14 15:30						
Inorganics								
Bromide	mg/L	1,700	EPA 300.0	20	2.2		02/24/14 16:2	26 100
Sample Description		Tank-1000						
Matrix		Water						
SAL Sample Number								
Date/Time Collected		1401927-06 02/19/14 07:20						
Collected by		Josephine Edeback	/ Uirct					
Date/Time Received		•						
		02/19/14 15:30						
Inorganics								
Bromide	mg/L	800	EPA 300.0	20	2.2		02/24/14 16:3	35 100
Sample Description		Tank-1000						
Matrix		Water						
SAL Sample Number		1401927-07						
Date/Time Collected		02/18/14 11:55						
Collected by		Josephine Edeback	-Hirst					
Date/Time Received		02/19/14 15:30						
Inorganics								
Bromide	mg/L	780	EPA 300.0	20	2.2		02/24/14 16:4	15 100
	ing/L	100		20	2.2		02/24/14 10	10 100
Sample Description		Tank-1000						
Matrix		Water						
SAL Sample Number		1401927-08						
Date/Time Collected		02/17/14 19:00						
Collected by		Josephine Edeback	c-Hirst					
Date/Time Received		02/19/14 15:30						
Inorganics								

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February 25, 2014

Work Order: 1401927

Hazen and Sawyer 10002 Princess Palm Ave, Suite 200

Tampa, FL 33619

Project Name		Was	stewater					
Parameters	Units	Results *	Method	PQL	MDL	Prepared	Analyzed D	ilution
Sample Description		K3.5						
Matrix		Water						
SAL Sample Number		1401927-09						
Date/Time Collected		02/17/14 10:23						
Collected by		Josephine Edeback	-Hirst					
Date/Time Received		02/19/14 15:30						
Inorganics								
Bromide	mg/L	0.62	EPA 300.0	0.20	0.022		02/24/14 17:03	31
Sample Description		Tank						
Matrix		Water						
SAL Sample Number		1401927-10						
Date/Time Collected Collected by		02/18/14 07:06	llivet					
Date/Time Received		Josephine Edeback	-11151					
Date/Time Received		02/19/14 15:30						
Inorganics								
Bromide	mg/L	750	EPA 300.0	20	2.2		02/25/14 07:40	0 100
Sample Description		Tank						
Matrix		Water						
SAL Sample Number		1401927-11						
Date/Time Collected		02/18/14 15:05						
Collected by		Josephine Edeback	-Hirst					
Date/Time Received		02/19/14 15:30						
Inorganics								
Bromide	mg/L	760	EPA 300.0	20	2.2		02/24/14 17:50) 100
Sample Description		Tank						
Matrix		Water						
SAL Sample Number		1401927-12						
Date/Time Collected		02/17/14 14:45						
Collected by		Josephine Edeback	-Hirst					
Date/Time Received		02/19/14 15:30						
Inorganics								
Bromide	mg/L	770	EPA 300.0	20	2.2		02/24/14 18:00	0 100

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February 25, 2014

Work Order: 1401927

Hazen and Sawyer 10002 Princess Palm Ave, Suite 200

Tampa, FL 33619

Project Name		Was	tewater					
Parameters	Units	Results *	Method	PQL	MDL	Prepared	Analyzed D	ilution
Sample Description		Tank						
Matrix		Water						
SAL Sample Number		1401927-13						
Date/Time Collected		02/17/14 15:05						
Collected by		Josephine Edeback	-Hirst					
Date/Time Received		02/19/14 15:30						
Inorganics								
Bromide	mg/L	730	EPA 300.0	20	2.2		02/24/14 18:09	9 100
Sample Description		EF2						
Matrix		Water						
SAL Sample Number		1401927-14						
Date/Time Collected		02/17/14 09:32						
Collected by		Josephine Edeback	-Hirst					
Date/Time Received		02/19/14 15:30						
Inorganics								
Bromide	mg/L	0.022 U	EPA 300.0	0.20	0.022		02/24/14 18:18	3 1
Sample Description		C4-12-S						
Matrix		Water						
SAL Sample Number		1401927-15						
Date/Time Collected		02/18/14 12:05						
Collected by		Josephine Edeback	-Hirst					
Date/Time Received		02/19/14 15:30						
Inorganics								
Bromide	mg/L	0.022 U	EPA 300.0	0.20	0.022		02/24/14 18:28	3 1

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February 25, 2014

Work Order: 1401927

Hazen and Sawyer

10002 Princess Palm Ave, Suite 200

Tampa, FL 33619

Inorganics - Quality Control

					Spike	Source		%REC		RPD
Analyte	Result	PQL	MDL	Units	Level	Result	%REC	Limits	RPD	Limit
Batch BB42401 - Ion Chromat	tography 300.0	Prep								
Blank (BB42401-BLK1)					Prepared 8	Analyzed:	02/24/14			
Bromide	0.022 U	0.20	0.022	mg/L						
Surrogate: Dichloroacetate	1.02			mg/L	1.0		102	90-115		
LCS (BB42401-BS1)					Prepared 8	Analyzed:	02/24/14			
Bromide	7.25	0.20	0.022	mg/L	7.5		97	85-115		
Surrogate: Dichloroacetate	1.03			mg/L	1.0		103	90-115		
LCS Dup (BB42401-BSD1)					Prepared 8	Analyzed:	02/24/14			
Bromide	7.29	0.20	0.022	mg/L	7.5		97	85-115	0.6	200
Surrogate: Dichloroacetate	1.04			mg/L	1.0		104	90-115		
Matrix Spike (BB42401-MS1)		Source: 1	401927-10		Prepared 8	Analyzed:	02/24/14			
Bromide	1,420	20	2.2	mg/L	750	749	90	85-115		
Surrogate: Dichloroacetate	0.953			mg/L	1.0		95	90-115		
Matrix Spike (BB42401-MS2)		Source: 1	401882-05		Prepared 8	Analyzed:	02/24/14			
Bromide	72.3	2.0	0.22	mg/L	75	2.04	94	85-115		
Surrogate: Dichloroacetate	0.987			mg/L	1.0		99	90-115		

AND ACCORDANCE

February 25, 2014

Work Order: 1401927

Hazen and Sawyer 10002 Princess Palm Ave, Suite 200 Tampa, FL 33619

* Qualifiers, Notes and Definitions

Results followed by a "U" indicate that the sample was analyzed but the compound was not detected. Results followed by "I" indicate that the reported value is between the laboratory method detection limts and the laboratory practical quantitation limit.

A statement of estimated uncertainty of test results is available upon request.

For methods marked with **, all QC criteria have been met for this method which is equivalent to a SAL certified method.

Test results in this report meet all the requirements of the NELAC standards. Any applicable qualifiers are shown below.

Questions regarding this report should be directed to :

Christy Whitehurst Telephone (813) 855-1844 FAX (813) 855-2218 Christy@southernanalyticallabs.com

Findard



Client Name

927
140
SAL Project No

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	Hazer	Hazen and Sawyer													
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SAL Project No. 1401927

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110 BAYVIEW BOULEVARD, OLDSMAR, FL 34677 813-855-1844 FAX 813-855-2218



Work Order: 1402044

March 5, 2014

Hazen and Sawyer 10002 Princess Palm Ave, Suite 200

Tampa, FL 33619

Project Name		Was	tewater					
Parameters	Units	Results *	Method	PQL	MDL	Prepared	Analyzed	Dilution
Sample Description		TA5-Outlet						
Matrix		Wastewater						
SAL Sample Number		1402044-01						
Date/Time Collected		02/24/14 10:34						
Collected by		Josefin Hirst						
Date/Time Received		02/25/14 10:30						
Inorganics								
Bromide	mg/L	98	EPA 300.0	2.0	0.22		03/03/14 19:1	2 10
Sample Description		Tank-WW						
Matrix		Wastewater						
SAL Sample Number		1402044-02						
Date/Time Collected		02/23/14 08:20						
Collected by		Josefin Hirst						
Date/Time Received								
		02/25/14 10:30						
Inorganics								
Bromide	mg/L	34	EPA 300.0	2.0	0.22		03/03/14 19:2	3 10
Sample Description		Tank-1000						
Matrix		Wastewater						
SAL Sample Number		1402044-03						
Date/Time Collected		02/20/14 12:23						
Collected by		Josefin Hirst						
Date/Time Received		02/25/14 10:30						
Inorganics								
Bromide	mg/L	750	EPA 300.0	20	2.2		03/04/14 09:4	9 100
Sample Description		TA3-LY-12S						
Matrix		Wastewater						
SAL Sample Number		1402044-04						
Date/Time Collected		02/20/14 18:15						
Collected by		Josefin Hirst						
Date/Time Received		02/25/14 10:30						
Inorganics								

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Work Order: 1402044

March 5, 2014

Hazen and Sawyer 10002 Princess Palm Ave, Suite 200

Tampa, FL 33619

Project Name		Was	tewater					
Parameters	Units	Results *	Method	PQL	MDL	Prepared	Analyzed	Dilution
Sample Description		Tank WW						
Matrix		Wastewater						
SAL Sample Number		1402044-05						
Date/Time Collected		02/24/14 09:45						
Collected by		Josefin Hirst						
Date/Time Received		02/25/14 10:30						
Inorganics								
Bromide	mg/L	26	EPA 300.0	2.0	0.22		03/04/14 16:2	24 10
		Taula 4000						
Sample Description		Tank-1000						
Matrix		Wastewater						
SAL Sample Number		1402044-06						
Date/Time Collected Collected by		02/20/14 17:15						
Date/Time Received		Josefin Hirst						
Date/Time Received		02/25/14 10:30						
Inorganics								
Bromide	mg/L	750	EPA 300.0	20	2.2		03/04/14 16:3	35 100
Sample Description		TA5-Outlet						
Matrix		Wastewater						
SAL Sample Number		1402044-07						
Date/Time Collected		02/24/14 13:47						
Collected by		Josefin Hirst						
Date/Time Received		02/25/14 10:30						
Inorganics		100	EPA 300.0	2.0	0.00		00/04/44 40:4	10 10
Bromide	mg/L	100	EPA 300.0	2.0	0.22		03/04/14 16:4	6 10
Sample Description		Tank-WW						
Matrix		Wastewater						
SAL Sample Number		1402044-08						
Date/Time Collected		02/24/14 13:45						
Collected by		Josefin Hirst						
Date/Time Received		02/25/14 10:30						
Inorganics								

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Sample Description TA5-LY-18-C Matrix Wastewater SAL Sample Number 1002044-10 Date/Time Collected 02/23/14 09:10 Collected by Josefin Hirst Date/Time Collected 02/23/14 10:30 Inorganics Bromide mg/L 410 EPA 300.0 2.0 0.22 03/04/14 17:20 Sample Description TA3-LY-42S Matrix Groundwater SAL Sample Number 1402044-11 Date/Time Collected 02/25/14 10:30 Inorganics Bromide mg/L 410 EPA 300.0 2.0 0.22 03/04/14 17:20 Sample Description TA3-LY-42S Matrix Groundwater SAL Sample Number 1402044-11 Date/Time Received 02/25/14 10:30 Inorganics Bromide mg/L 0.022 U EPA 300.0 0.20 0.022 Oliceted 02/24/14 09:12 Collected 02/24/14 09:09 Collected 02/24/14 09:09 Collected 02/24/14 09:09 Collected 02/24/14 09:09 Collected by 02/26/14 10:30 </th <th>Project Name</th> <th></th> <th>Was</th> <th>tewater</th> <th></th> <th></th> <th></th> <th></th> <th></th>	Project Name		Was	tewater					
Matrix Wastewater SAL Sample Number 1402044-09 Date/Time Collected 02/24/14 09:16 Collected by Josefin Hirst Date/Time Received 02/25/14 10:30 Bromide mg/L 580 EPA 300.0 20 2.2 03/04/14 17:09 1 Sample Description TA5-LY-18-C Wastewater SAL Sample Number 1402044-10 Date/Time Collected 02/23/14 09:10 Collected 02/23/14 09:10 Collected by Josefin Hirst 02/23/14 09:10 2.0 0.22 03/04/14 17:20 Sample Description TA3-LY-42S Sample Description TA3-LY-42S Sample Collected 02/23/14 09:10 Collected by Josefin Hirst Groundwater SAL Sample Number 1402044-11 Date/Time Collected 02/25/14 10:30 Long Long Matrix Groundwater SAL Sample Number 1402044-12 Date/Time Received 02/25/14 10:30 Long Long Inorganics mg/L 0.022 U EPA 300.0 0.20 0.022 03/04/14 17:43 Sample Description TA3-LY-42S Sample Number 1402044-12 Sample Number 1402044-12 Date/Time Received 02/25/14 10:30 Long	Parameters	Units	Results *	Method	PQL	MDL	Prepared	Analyzed Di	lution
Collected by Date/Time Received 02/25/14 10:30 Increanics Bromide mg/L 580 EPA 300.0 20 2.2 03/04/14 17:09 1 Sample Description TA5-LY-18-C Matrix Wastewater SAL Sample Number 1402044-10 Date/Time Received 02/23/14 09:10 Collected by Josefin Hirst Date/Time Collected 02/25/14 10:30 Increanics Bromide mg/L 410 EPA 300.0 2.0 0.22 03/04/14 17:20 Sample Description TA3-LY-42S Groundwater SAL Sample Number 1402044-11 Date/Time Collected 02/25/14 10:30 Increanics Bromide mg/L 0.022 U EPA 300.0 0.20 0.022 03/04/14 17:43 Sample Description TA3-LY-42S Collected by Josefin Hirst Date/Time Received 02/25/14 10:30 Increanics Bromide mg/L 0.022 U EPA 300.0 0.20 0.022 03/04/14 17:43 Sample Description TA3-LY-24-S Groundwater SAL Sample Number 1402044-12 Date/Time Collected 02/24/14 09:12 Collected by Josefin Hirst Date/Time Received 02/25/14 10:30 Increanics Bromide mg/L 0.022 U EPA 300.0 0.20 0.022 03/04/14 17:43 Sample Description TA3-LY-24-S Matrix Groundwater SAL Sample Number 1402044-12 Date/Time Collected 02/24/14 09:09 Collected by Josefin Hirst Date/Time Collected 02/24/14 09:09 Collected by Josefin Hirst Date/Time Received 02/24/14 10:30 Increanics Bromide Mg/L 0.022 U EPA 300.0 0.20 0.022 03/04/14 17:43 Sample Number 1402044-11 Date/Time Collected 02/24/14 09:12 Collected by Josefin Hirst Date/Time Collected 02/24/14 09:12 Collected by Josefin Hirst Date/Time Received 02/25/14 10:30 Increanics Date/Time Received 02/25/14 10:30 Increanics Date/Time Received 02/24/14 09:19 Collected Dy Josefin Hirst Date/Time Collected 02/24/14 09:09 Collected Dy Josefin Hirst Date/Time Received 02/24/14 09:09 Coll	Matrix		Wastewater						
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Bromide mg/L 580 EPA 300.0 20 2.2 03/04/14 17:09 1 Sample Description TA5-LY-18-C Wastewater 1402044-10 02/23/14 09:10 0	Date/Time Received		02/25/14 10:30						
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Matrix Wastewater SAL Sample Number 1402044-10 Date/Time Collected 02/23/14 09:10 Collected by Josefin Hirst Date/Time Received 02/25/14 10:30 Inorganics Bromide mg/L 410 EPA 300.0 2.0 0.22 03/04/14 17:20 Sample Description TA3-LY-42S Matrix Groundwater SAL Sample Number 1402044-11 Date/Time Collected 02/24/14 09:12 Collected by Josefin Hirst Date/Time Received 02/25/14 10:30 Inorganics Bromide mg/L 0.022 U EPA 300.0 0.20 0.022 03/04/14 17:43 Sample Description TA3-LY-24-S Matrix Groundwater SAL Sample Number 1402044-12 Date/Time Collected 02/24/14 09:09 Collected by Josefin Hirst Date/Time Collected 02/24/14 09:09 Collected by Josefin Hirst Date/Time Collected 02/24/14 09:09 Collected by Josefin Hirst Date/Time Received 02/25/14 10:30	Bromide	mg/L	580	EPA 300.0	20	2.2		03/04/14 17:09	100
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Matrix Groundwater SAL Sample Number 1402044-11 Date/Time Collected 02/24/14 09:12 Collected by Josefin Hirst Date/Time Received 02/25/14 10:30 Inorganics Bromide mg/L 0.022 U EPA 300.0 0.20 0.022 03/04/14 17:43 Sample Description TA3-LY-24-S Matrix Groundwater SAL Sample Number 1402044-12 Date/Time Collected 02/24/14 09:09 Collected by Josefin Hirst Date/Time Received 02/25/14 10:30									
SAL Sample Number 1402044-11 Date/Time Collected 02/24/14 09:12 Collected by Josefin Hirst Date/Time Received 02/25/14 10:30 Inorganics Bromide Bromide mg/L 0.022 U EPA 300.0 0.20 0.022 03/04/14 17:43 Sample Description TA3-LY-24-S Matrix Groundwater SAL Sample Number 1402044-12 Date/Time Collected 02/24/14 09:09 Collected by Josefin Hirst Date/Time Received 02/25/14 10:30									
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Collected by Josefin Hirst Date/Time Received 02/25/14 10:30 Inorganics Bromide mg/L 0.022 U EPA 300.0 0.20 0.022 03/04/14 17:43 Sample Description TA3-LY-24-S Matrix Groundwater SAL Sample Number 1402044-12 Date/Time Collected 02/24/14 09:09 Collected by Josefin Hirst Date/Time Received 02/25/14 10:30	•								
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Sample DescriptionTA3-LY-24-SMatrixGroundwaterSAL Sample Number1402044-12Date/Time Collected02/24/14 09:09Collected byJosefin HirstDate/Time Received02/25/14 10:30	Inorganics								
MatrixGroundwaterSAL Sample Number1402044-12Date/Time Collected02/24/14 09:09Collected byJosefin HirstDate/Time Received02/25/14 10:30	Bromide	mg/L	0.022 U	EPA 300.0	0.20	0.022		03/04/14 17:43	1
MatrixGroundwaterSAL Sample Number1402044-12Date/Time Collected02/24/14 09:09Collected byJosefin HirstDate/Time Received02/25/14 10:30	Sample Description		TA3-LY-24-S						
SAL Sample Number1402044-12Date/Time Collected02/24/14 09:09Collected byJosefin HirstDate/Time Received02/25/14 10:30									
Date/Time Collected02/24/14 09:09Collected byJosefin HirstDate/Time Received02/25/14 10:30									
Collected by Josefin Hirst Date/Time Received 02/25/14 10:30									
Date/Time Received 02/25/14 10:30									
Inorganics	Date/Time Received		02/25/14 10:30						
	Inorganics								
		ma/l	590	EPA 300 0	20	0 22		03/04/14 18.17	10

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Project Name		Was	tewater					
Parameters	Units	Results *	Method	PQL	MDL	Prepared	Analyzed Di	lution
Sample Description Matrix SAL Sample Number Date/Time Collected Collected by Date/Time Received		TA3-LY-24S Groundwater 1402044-13 02/23/14 09:08 Josefin Hirst 02/25/14 10:30						
Inorganics								
Bromide	mg/L	470	EPA 300.0	2.0	0.22		03/04/14 18:29	10
Sample Description Matrix SAL Sample Number Date/Time Collected Collected by Date/Time Received		TA3-LY-12S Groundwater 1402044-14 02/24/14 09:07 Josefin Hirst 02/25/14 10:30						
Inorganics								
Bromide	mg/L	400	EPA 300.0	2.0	0.22		03/04/14 18:40	10
Sample Description Matrix SAL Sample Number Date/Time Collected Collected by Date/Time Received		TA3-LY-12S Groundwater 1402044-15 02/23/14 09:05 Josefin Hirst 02/25/14 10:30						
Inorganics								
Bromide	mg/L	580	EPA 300.0	20	2.2		03/04/14 18:52	100
Sample Description Matrix SAL Sample Number Date/Time Collected Collected by Date/Time Received		TA3-LY-12S Groundwater 1402044-16 02/22/14 08:11 Josefin Hirst 02/25/14 10:30						
Inorganics								
Bromide	mg/L	330	EPA 300.0	2.0	0.22		03/05/14 10:24	10

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Project Name		Was	tewater					
Parameters	Units	Results *	Method	PQL	MDL	Prepared	Analyzed D	ilution
Sample Description		TA3-LY-42S						
Matrix		Groundwater						
SAL Sample Number		1402044-17						
Date/Time Collected		02/23/14 09:22						
Collected by Date/Time Received		Josefin Hirst						
		02/25/14 10:30						
Inorganics								
Bromide	mg/L	0.022 U	EPA 300.0	0.20	0.022		03/04/14 19:14	4 1
Sample Description		TA3-LY-24S						
Matrix		Groundwater						
SAL Sample Number		1402044-18						
Date/Time Collected		02/22/14 08:12						
Collected by		Josephine Edeback	-Hirst					
Date/Time Received		02/25/14 10:30						
Inorganics								
Bromide	mg/L	73	EPA 300.0	2.0	0.22		03/04/14 19:26	6 10
Sample Description		TA5-LY-18C						
Matrix		Groundwater						
SAL Sample Number		1402044-19						
Date/Time Collected		02/22/14 08:15						
Collected by		Josefin Hirst						
Date/Time Received		02/25/14 10:30						
Inorganics								
Bromide	mg/L	180	EPA 300.0	2.0	0.22		03/04/14 19:37	7 10

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Inorganics - Quality Control

A 1.4	D "	DOI	MDI		Spike	Source	0/ DE0	%REC		RPD
Analyte	Result	PQL	MDL	Units	Level	Result	%REC	Limits	RPD	Limit
Batch BC40306 - Ion Chroma	tography 300.0	Prep								
Blank (BC40306-BLK1)					Prepared &	& Analyzed:	03/03/14			
Bromide	0.022 U	0.20	0.022	mg/L						
Surrogate: Dichloroacetate	1.01			mg/L	1.0		101	90-115		
LCS (BC40306-BS1)					Prepared 8	& Analyzed:	03/03/14			
Bromide	7.05	0.20	0.022	mg/L	7.5		94	85-115		
Surrogate: Dichloroacetate	0.961			mg/L	1.0		96	90-115		
LCS Dup (BC40306-BSD1)					Prepared 8	& Analyzed:	03/03/14			
Bromide	7.22	0.20	0.022	mg/L	7.5		96	85-115	2	200
Surrogate: Dichloroacetate	0.972			mg/L	1.0		97	90-115		
Matrix Spike (BC40306-MS1)		Source: 1	401951-02		Prepared &	& Analyzed:	03/03/14			
Bromide	75.2	2.0	0.22	mg/L	75	ND	100	85-115		
Surrogate: Dichloroacetate	0.981			mg/L	1.0		98	90-115		
Matrix Spike (BC40306-MS2)		Source: 1	402044-03		Prepared &	& Analyzed:	03/03/14			
Bromide	1,560	20	2.2	mg/L	750	754	107	85-115		
Surrogate: Dichloroacetate	0.967			mg/L	1.0		97	90-115		
Batch BC40410 - Ion Chroma	tography 300.0	Prep								
Blank (BC40410-BLK1)					Prepared 8	& Analyzed:	03/04/14			
Bromide	0.022 U	0.20	0.022	mg/L						
Surrogate: Dichloroacetate	0.976			mg/L	1.0		98	90-115		

Surrogate: Dichloroacetate	0.976			mg/L	1.0	98	90-115	
LCS (BC40410-BS1)					Prepared & An	alyzed: 03/04/14		
Bromide	7.20	0.20	0.022	mg/L	7.5	96	85-115	
Surrogate: Dichloroacetate	0.950			mg/L	1.0	95	90-115	

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Inorganics - Quality Control

Analyte	Result	PQL	MDL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch BC40410 - Ion Chroma	tography 300.	0 Prep								
LCS Dup (BC40410-BSD1)					Prepared &	& Analyzed:	03/04/14			
Bromide	7.32	0.20	0.022	mg/L	7.5		98	85-115	2	200
Surrogate: Dichloroacetate	0.971			mg/L	1.0		97	90-115		
Matrix Spike (BC40410-MS1)		Source: 1	402044-10)	Prepared &	& Analyzed:	03/04/14			
Bromide	489	2.0	0.22	mg/L	75	415	100	85-115		
Surrogate: Dichloroacetate	0.927			mg/L	1.0		93	90-115		
Matrix Spike (BC40410-MS2)		Source: 1	401942-01	l	Prepared &	& Analyzed:	03/04/14			
Bromide	77.2	2.0	0.22	mg/L	75	ND	103	85-115		
Surrogate: Dichloroacetate	0.955			mg/L	1.0		96	90-115		

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* Qualifiers, Notes and Definitions

Results followed by a "U" indicate that the sample was analyzed but the compound was not detected. Results followed by "I" indicate that the reported value is between the laboratory method detection limts and the laboratory practical quantitation limit.

A statement of estimated uncertainty of test results is available upon request.

For methods marked with **, all QC criteria have been met for this method which is equivalent to a SAL certified method.

Test results in this report meet all the requirements of the NELAC standards. Any applicable qualifiers are shown below.

Questions regarding this report should be directed to :

Christy Whitehurst Telephone (813) 855-1844 FAX (813) 855-2218 Christy@southernanalyticallabs.com

Finbail

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JRIES,
ORATO
L LAB
YTICA
ANAL
SOUTHERN

SAL Project No. 1402044

0	Client Name								Contact	Contact / Phone:	\	120-149D	۵	
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.	roject Name / Location	Area 3	Trac	cer Tes	105				1 UTT ATO 24 Hour*	una lime K	i um Around i ime Requested (Surcharges may apply) 24 Hourt 🔲 48 Hourt 🔲 5 Bus. Dayst 📋 10 Bus. Days	cnarges may a		
	Samplers: (Signature)	a de	A					PARA	PARAMETER / CONTAINER DESCRIPTION	JER DESCR	IPTION			
	Matrix Codes: DW-Drinking Water WW-Wastewater SW-SurfaceWater SL-Sludge SO-Soil GW-Groundwater SA-Saline Water O-Other R-Reagent Water	astewater ge SO-Soil ater O-Other					مر	W					[<u>-</u>]	
//	SAL Use Only Sampla Doscription Sampla Doscription)ate	əmi	Xitis N	Somposite	Brown	n Br Pp						lo. of Contair er each loca
	TAS-0	linn	Mrrk	10:34	۶ ۲		>	102						
<u></u>	22 Tane-ww		2/23/14	8	33		>	26						
SAL F	03 Tank - 1000		2 Juo In	12:23	MM		7	1000						
_	04 TA3- LY-125		2 2 20 14	18.15	3 M		7	42						
t Pao	15 Tank-ww		rirth	09:45	M		Ż	gy						
	ch Tame 1000		2/20/14	マット	Jum		7	0001				•		
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-	09 TAS-UY-18-C		アリントレ	11:60	(n/n))	fat						
1	10 THS- LY-18-C		3/23/14	940	Ww		2	294						
	1 TA3-LY-425		Aluc/E	09:12	(ساع		7	1.6			13×125M	25MLP.	co l	
	2 TA3-17-24.5		p/rc/e	09:09	وللم)	しいや			TXBEAN	1,1	(a)	
Ů Ř	Containers Prepared/ Relinquished	2	Received: Switt	Mccul	lough	Date/Time: J/J5	т _{те:} 25/14	Seal intact? Samples int	Seal intact? Samples intact upon arrival?	an z Ø	Instru			
ά.	Relinquished: Scotthe Cullorg	Date/Time: 2/25/1432	1030 Received:	Jeff		Date/Time	": 10,30 - 1 U	Received (Received on ice? Temp 3.1	Ø n na	_			
¢۲		Date/Time:	Received:			Date/Time		Proper pre Rec'd w ith	Proper preservatives indicated? Rec'd within holding time?	× N (C) N N N				
ď	Relinquished:	Date/Time:	Received:			Date/Time:	ë	Volatiles re	Volatiles rec'd w /out headspace	z Z				
<u> </u> æ	Relinquished:	Date/Time:	Received:			Date/Time:		Proper con	Proper containers used?	AN NO				
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			813-800-1844 fax 813-800-2218	344 fax B13	800-5518			Contact	Contact / Dhone:		-	
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Sam	Samplers: (Signature)	A A	~				PA	PARAMETER / CONTAINER DESCRIPTION	VER DESCRI	PTION		
	Matrix Codes: DW-Drinking Water VW-Wastewater SW-SurfaceWater SL-Sludge SO-Soil GW-Groundwater SA-Saline Water O-Other R-Reagent Water	astewater e SO-Soil ater O-Other					יר נמר			-		
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2 2 10	TA3-W-		2/22/11	8:12	لالم	7	95					
of	TAS-U-BC		זו / בערב	8:15	3	J	040					
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Contail Relinqu	Containers Prepared/ Relinquished:	Date/Time: 2_/25/14	5	H McCullough	llouah	Date/Time:	14 Seal intact?	Seal intact? Samples intact upon arrival?	ν z Σ Σ	Ø N NA Instructions / Remarks 例 N NA	emarks	
Reling		Date/Time: 10.20 2/25/[4	Received:	ll a	þ	Date/Time: 10 2-25-14	IV SO Receiv	Received on ice? Temp.3.1	C n na			
Relinquished		Date/Time:	Received:			Date/Time:	Proper Rec'd	Proper preservatives indicated? Rec'd w thin holding time?	z Z Z Z Z Z Z Z Z Z			
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Chain of 6 Rev.Date	Chain of Custody.446 Rev.Data 11/1901								Ğ	Chain of Custody	Pageof	

110 BAYVIEW BOULEVARD, OLDSMAR, FL 34677 813-855-1844 FAX 813-855-2218



Work Order: 1402168

March 5, 2014

Hazen and Sawyer 10002 Princess Palm Ave, Suite 200

Tampa, FL 33619

Project Name		Was	tewater					
Parameters	Units	Results *	Method	PQL	MDL	Prepared	Analyzed [Dilution
Sample Description		BR-100-E-1						
Matrix		Water						
SAL Sample Number Date/Time Collected		1402168-01 02/27/14 12:50						
Collected by		Josefin Hirst						
Date/Time Received		02/27/14 14:50						
		02/2//14 14.50						
Inorganics								
Bromide	mg/L	63	EPA 300.0	2.0	0.22		02/28/14 06:1	1 10
Comple Description								
Sample Description		BR-100-E-2						
Matrix SAL Sample Number		Water 1402168-02						
Date/Time Collected		02/27/14 12:50						
Collected by		Josefin Hirst						
Date/Time Received		02/27/14 14:50						
		02/2//14 14:30						
Inorganics								
Bromide	mg/L	82	EPA 300.0	2.0	0.22		02/28/14 06:2	3 10
Sample Description		BR-1000-E-1						
Matrix		Water						
SAL Sample Number		1402168-03						
Date/Time Collected		02/27/14 12:45						
Collected by		Josefin Hirst						
Date/Time Received		02/27/14 14:50						
1								
Inorganics Bromide	mg/L	700	EPA 300.0	20	2.2		02/28/14 06:3	4 100
Diomide	ilig/L	700	2177000.0	20	2.2		02/28/14 00.3	4 100
Sample Description		BR-1000-E-2						
Matrix		Water						
SAL Sample Number		1402168-04						
Date/Time Collected		02/27/14 12:45						
Collected by		Josefin Hirst						
Date/Time Received		02/27/14 14:50						
Inorganics								

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Work Order: 1402168

March 5, 2014

Hazen and Sawyer 10002 Princess Palm Ave, Suite 200

Tampa, FL 33619

Project Name		Was	tewater					
Parameters	Units	Results *	Method	PQL	MDL	Prepared	Analyzed [Dilution
Sample Description Matrix		BR-10-E Water						
SAL Sample Number Date/Time Collected		1402168-05 02/27/14 13:15						
Collected by		Josefin Hirst						
Date/Time Received		02/27/14 14:50						
Inorganics								
Bromide	mg/L	6.6	EPA 300.0	0.20	0.022		03/01/14 00:2	7 1
Sample Description		BR-100-E-3						
Matrix		Water						
SAL Sample Number		1402168-06						
Date/Time Collected		02/27/14 13:40						
Collected by		Josefin Hirst						
Date/Time Received		02/27/14 14:50						
Inorganics								
Bromide	mg/L	74	EPA 300.0	2.0	0.22		03/01/14 00:3	8 10
Sample Description		BR-500-E						
Matrix		Water						
SAL Sample Number		1402168-07						
Date/Time Collected		02/27/14 13:20						
Collected by		Josefin Hirst						
Date/Time Received		02/27/14 14:50						
Inorganics								
Bromide	mg/L	370	EPA 300.0	20	2.2		03/01/14 00:4	9 100
Sample Description		BR-1000-E-3						
Matrix		Water						
SAL Sample Number		1402168-08						
Date/Time Collected		02/27/14 13:35						
Collected by		Josefin Hirst						
Date/Time Received		02/27/14 14:50						
Inorganics								
Bromide	mg/L	800	EPA 300.0	20	2.2		03/01/14 01:0	1 100

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Work Order: 1402168

March 5, 2014

Hazen and Sawyer 10002 Princess Palm Ave, Suite 200

Tampa, FL 33619

Project Name		Was	tewater					
Parameters	Units	Results *	Method	PQL	MDL	Prepared	Analyzed	Dilution
Sample Description		BR-2000						
Matrix		Water						
SAL Sample Number		1402168-09						
Date/Time Collected		02/27/14 13:25						
Collected by		Josefin Hirst						
Date/Time Received		02/27/14 14:50						
Inorganics								
Bromide	mg/L	1,500	EPA 300.0	20	2.2		03/01/14 01	:12 10

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Work Order: 1402168

March 5, 2014

Hazen and Sawyer

10002 Princess Palm Ave, Suite 200

Tampa, FL 33619

Inorganics - Quality Control

Analyte	Result	PQL	MDL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch BB42730 - Ion Chroma	tography 300.0	Prep								
Blank (BB42730-BLK1)					Prepared &	Analyzed:	02/28/14			
Bromide	0.022 U	0.20	0.022	mg/L						
Surrogate: Dichloroacetate	0.994			mg/L	1.0		99	90-115		
LCS (BB42730-BS1)					Prepared &	Analyzed:	02/28/14			
Bromide	7.47	0.20	0.022	mg/L	7.5		100	85-115		
Surrogate: Dichloroacetate	0.996			mg/L	1.0		100	90-115		
LCS Dup (BB42730-BSD1)					Prepared &	Analyzed:	02/28/14			
Bromide	7.56	0.20	0.022	mg/L	7.5		101	85-115	1	200
Surrogate: Dichloroacetate	1.02			mg/L	1.0		102	90-115		
Matrix Spike (BB42730-MS1)		Source: 1	402168-04		Prepared &	Analyzed:	02/28/14			
Bromide	1,640	20	2.2	mg/L	750	816	110	85-115		
Surrogate: Dichloroacetate	1.04			mg/L	1.0		104	90-115		
Batch BB42832 - Ion Chroma	tography 300.0	Prep								
Blank (BB42832-BLK1)					Prepared 8	Analyzed:	02/28/14			
Bromide	0.022 U	0.20	0.022	mg/L						
Surrogate: Dichloroacetate	1.07			mg/L	1.0		107	90-115		
LCS (BB42832-BS1)					Prepared &	Analyzed:	02/28/14			
Bromide	7.21	0.20	0.022	mg/L	7.5		96	85-115		
Surrogate: Dichloroacetate	0.948			mg/L	1.0		95	90-115		
LCS Dup (BB42832-BSD1)					Prepared &	Analyzed:	02/28/14			
Bromide	7.29	0.20	0.022	mg/L	7.5		97	85-115	1	200
Surrogate: Dichloroacetate	1.03			mg/L	1.0		103	90-115		

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March 5, 2014 Work Order: 1402168

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Inorganics - Quality Control

Analyte	Result	PQL	MDL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch BB42832 - Ion Chroma	tography 300.0	Prep								
Matrix Spike (BB42832-MS1)		Source: 1	401964-03		Prepared &	Analyzed:	03/01/14			
Bromide	7.23	0.20	0.022	mg/L	7.5	0.197	94	85-115		
Surrogate: Dichloroacetate	1.05			mg/L	1.0		105	90-115		

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Work Order: 1402168

March 5, 2014

Hazen and Sawyer 10002 Princess Palm Ave, Suite 200 Tampa, FL 33619

* Qualifiers, Notes and Definitions

Results followed by a "U" indicate that the sample was analyzed but the compound was not detected. Results followed by "I" indicate that the reported value is between the laboratory method detection limts and the laboratory practical quantitation limit.

A statement of estimated uncertainty of test results is available upon request.

For methods marked with **, all QC criteria have been met for this method which is equivalent to a SAL certified method.

Test results in this report meet all the requirements of the NELAC standards. Any applicable qualifiers are shown below.

Questions regarding this report should be directed to :

Christy Whitehurst Telephone (813) 855-1844 FAX (813) 855-2218 Christy@southernanalyticallabs.com

Finbail

SAL Project No. 1402168

	tient	Client Name Hare and Surge.					121	554	0	Contact / F	hone:	0-51	813-630-4498	५७४	
	roje	Test Area 3	hale		Stoch		•	51/8-		Fum Arour 24 Hour*	nd Time R 48 Hour*	equested ((*Surcharge . Days*	ss may apply 10 Bus. Days	
Chrining With Codes: Maint Codes: Code Code <thcode< th=""> Code Code <</thcode<>	amp	Openess H					-14	C PARA	METER / C	ONTAINE	ER DESCF	RIPTION			
Sample Description Sample Description Sample Description 100-E-1 2):11/1 10:12 0 100 米 AMP / MAP / M		Matrix Codes: DW-Drinking Water WW-Wastewater SW-SurfaceWater SL-Sludge SO-Soil GW-Groundwater SA-Saline Water O-Other R-Reagent Water					<u>ل</u>	diffy 20		phil s	0				ners (Total
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10-E J.P.41(1 U; 1) 10 V M. Mucule M10 500-E 13: 20 500 V J.000 V J.000 500-E 13: 35 1900 V J.000 V J.000 500-E 13: 35 1900 V J.000 V J.000 10000-E3 13: 35 1900 V J.000 V J.000 1000 V 13: 35 2.000 V J.000 V J.000 1000 V 13: 35 2.000 V J.000 V J.000 1000 Data/Time Salitact V N N N 1000 Data/Time Data/Time Data/Time Do											e				
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500-E 13: 32 10.00 V 40.00 10U0 - E - 3 13: 35 10.00 V 40.00 10U0 - E - 3 13: 75 10.00 V 40.00 10U0 - E - 3 13: 75 10.00 V 40.00 10U0 - E - 3 13: 75 10.00 V 40.00 10U0 - E - 3 13: 75 10.00 V V 40.00 aret Date/Ime: Date/Ime: Benefice E N N Inc. Date/Ime: Date/Ime: Benefice E N N Date/Ime: Date/Ime: Date/Ime: Benefice E N N Date/Ime: Date/Ime: Date/Ime: Poper preservatives indications / Remain M Date/Ime: Date/Ime: Received: Date/Ime: Poper preservatives indications / Remain Date/Ime: Date/Ime: Proper preservatives indications / V M Date/Ime: Date/Ime: Proper containers used1 N Date/Ime: Date/Ime: Poper containers used1 N	٩	BV-100-E-3	_	13:40			001			2	3 >	Nevere	\mathbf{x}	to set	
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110 BAYVIEW BOULEVARD, OLDSMAR, FL 34677 813-855-1844 FAX 813-855-2218



March 17, 2014

Work Order: 1402575

Hazen and Sawyer 10002 Princess Palm Ave, Suite 200

Tampa, FL 33619

Project Name		Was	tewater					
Parameters	Units	Results *	Method	PQL	MDL	Prepared	Analyzed [Dilution
Sample Description		TA3 I2						
Matrix	,	Wastewater						
SAL Sample Number		1402575-01						
Date/Time Collected		03/10/14 09:24						
Collected by		Sean Schmidt						
Date/Time Received		03/11/14 13:00						
Inorganics								
Bromide	mg/L	45	EPA 300.0	0.20	0.022		03/14/14 22:2	2 1
Sample Description		TA3 G3.5						
Matrix		Wastewater						
SAL Sample Number		1402575-02						
Date/Time Collected		03/10/14 09:09						
Collected by		Sean Schmidt						
Date/Time Received		03/11/14 13:00						
		03/11/14 13:00						
Inorganics								
Bromide	mg/L	150	EPA 300.0	2.0	0.22		03/14/14 22:3	3 10
Sample Description		TA3 EF2						
Matrix	,	Wastewater						
SAL Sample Number		1402575-03						
Date/Time Collected		03/10/14 09:12						
Collected by		Sean Schmidt						
Date/Time Received		03/11/14 13:00						
Inorganics								
Bromide	mg/L	37	EPA 300.0	0.20	0.022		03/14/14 22:4	5 1
				0.20	0.011			
Sample Description		TA3 G3.5						
Matrix	,	Wastewater						
SAL Sample Number		1402575-04						
Date/Time Collected		03/11/14 08:42						
Collected by	:	Sean Schmidt						
Date/Time Received		03/11/14 13:00						
Inorganics								

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March 17, 2014

Work Order: 1402575

Hazen and Sawyer 10002 Princess Palm Ave, Suite 200

Tampa, FL 33619

Project Name		Was	tewater					
Parameters	Units	Results *	Method	PQL	MDL	Prepared	Analyzed D	ilution
Sample Description		TA3 I2						
Matrix		Wastewater						
SAL Sample Number		1402575-05						
Date/Time Collected		03/11/14 08:48						
Collected by		Sean Schmidt						
Date/Time Received		03/11/14 13:00						
Inorganics								
Bromide	mg/L	51	EPA 300.0	0.20	0.022		03/14/14 23:08	3 1
Sample Description		BR-10G						
Matrix		Wastewater						
SAL Sample Number		1402575-06						
Date/Time Collected		03/10/14 12:30						
Collected by		Sean Schmidt						
Date/Time Received		03/11/14 13:00						
Inorganics								
Bromide	mg/L	9.1	EPA 300.0	0.20	0.022		03/14/14 23:19	€ 1
		0.1		0.20	0.022		00,11,1120.11	· ·
Sample Description		BR-100F						
Matrix		Wastewater						
SAL Sample Number		1402575-07						
Date/Time Collected		03/10/14 15:00						
Collected by		Sean Schmidt						
Date/Time Received		03/11/14 13:00						
Inorganics								
Bromide	mg/L	92	EPA 300.0	2.0	0.22		03/14/14 23:30) 10
Sample Description		BR-100G						
Matrix		Wastewater						
SAL Sample Number		1402575-08						
Date/Time Collected		03/10/14 12:45						
Collected by		Sean Schmidt						
Date/Time Received		03/11/14 13:00						
Inorganics								

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March 17, 2014

Work Order: 1402575

Hazen and Sawyer 10002 Princess Palm Ave, Suite 200

Tampa, FL 33619

Project Name		Was	tewater					
Parameters	Units	Results *	Method	PQL	MDL	Prepared	Analyzed D	ilution
Sample Description		BR-500G						
Matrix		Wastewater						
SAL Sample Number		1402575-09						
Date/Time Collected		03/10/14 12:55						
Collected by		Sean Schmidt						
Date/Time Received		03/11/14 13:00						
Inorganics								
Bromide	mg/L	460	EPA 300.0	2.0	0.22		03/14/14 23:53	3 10
Comula Description		BR-1000G						
Sample Description								
Matrix SAL Sample Number		Wastewater						
Date/Time Collected		1402575-10 03/10/14 13:00						
Collected by		Sean Schmidt						
Date/Time Received								
		03/11/14 13:00						
Inorganics								
Bromide	mg/L	900	EPA 300.0	20	2.2		03/15/14 00:05	5 100
Sample Description		BR-1000F						
Matrix		Wastewater						
SAL Sample Number		1402575-11						
Date/Time Collected		03/10/14 15:00						
Collected by		Sean Schmidt						
Date/Time Received		03/11/14 13:00						
Inorganics								
Bromide	mg/L	810	EPA 300.0	20	2.2		03/15/14 00:50) 100
	5							
Sample Description		BR-2000G						
Matrix		Wastewater						
SAL Sample Number		1402575-12						
Date/Time Collected		03/10/14 13:15						
Collected by		Sean Schmidt						
Date/Time Received		03/11/14 13:00						
Inorganics								
Bromide	mg/L	1,800	EPA 300.0	20	2.2		03/15/14 01:02	2 100

110 BAYVIEW BOULEVARD, OLDSMAR, FL 34677 813-855-1844 FAX 813-855-2218



March 17, 2014

Work Order: 1402575

Hazen and Sawyer

10002 Princess Palm Ave, Suite 200

Tampa, FL 33619

Inorganics - Quality Control

					Spike	Source		%REC		RPD
Analyte	Result	PQL	MDL	Units	Level	Result	%REC	Limits	RPD	Limit
Batch BC41402 - Ion Chromat	tography 300.0	Prep								
Blank (BC41402-BLK1)					Prepared &	Analyzed:	03/14/14			
Bromide	0.022 U	0.20	0.022	mg/L						
Surrogate: Dichloroacetate	1.15			mg/L	1.0		115	90-115		
LCS (BC41402-BS1)					Prepared &	Analyzed:	03/14/14			
Bromide	7.42	0.20	0.022	mg/L	7.5		99	85-115		
Surrogate: Dichloroacetate	1.14			mg/L	1.0		114	90-115		
LCS Dup (BC41402-BSD1)					Prepared &	Analyzed:	03/14/14			
Bromide	7.42	0.20	0.022	mg/L	7.5		99	85-115	0.05	200
Surrogate: Dichloroacetate	1.13			mg/L	1.0		113	90-115		
Matrix Spike (BC41402-MS1)		Source: 1	402575-10		Prepared &	Analyzed:	03/15/14			
Bromide	1,620	20	2.2	mg/L	750	899	96	85-115		
Surrogate: Dichloroacetate	1.14			mg/L	1.0		114	90-115		
Matrix Spike (BC41402-MS2)		Source: 1	402575-12		Prepared &	Analyzed:	03/15/14			
Bromide	2,490	20	2.2	mg/L	750	1810	91	85-115		
Surrogate: Dichloroacetate	1.13			mg/L	1.0		113	90-115		

110 BAYVIEW BOULEVARD, OLDSMAR, FL 34677 813-855-1844 FAX 813-855-2218



March 17, 2014

Work Order: 1402575

Hazen and Sawyer 10002 Princess Palm Ave, Suite 200 Tampa, FL 33619

* Qualifiers, Notes and Definitions

Results followed by a "U" indicate that the sample was analyzed but the compound was not detected. Results followed by "I" indicate that the reported value is between the laboratory method detection limts and the laboratory practical quantitation limit.

A statement of estimated uncertainty of test results is available upon request.

For methods marked with **, all QC criteria have been met for this method which is equivalent to a SAL certified method.

Test results in this report meet all the requirements of the NELAC standards. Any applicable qualifiers are shown below.

Questions regarding this report should be directed to :

Christy Whitehurst Telephone (813) 855-1844 FAX (813) 855-2218 Christy@southernanalyticallabs.com

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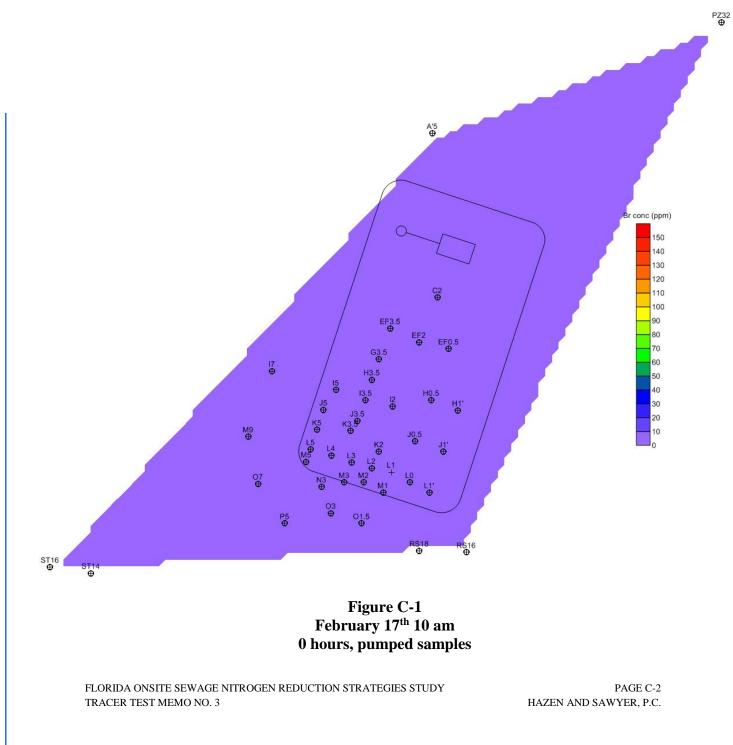
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Appendix C: Pumped Sample Graphs

FLORIDA ONSITE SEWAGE NITROGEN REDUCTION STRATEGIES STUDY TRACER TEST MEMO NO. 3

PAGE C-1 HAZEN AND SAWYER, P.C.



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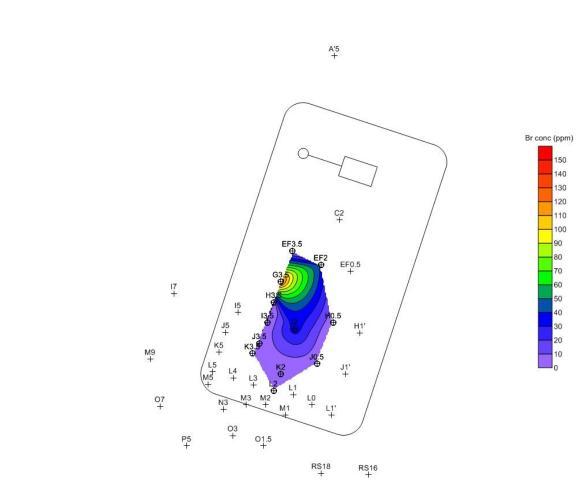


Figure C-2 March 10th 9am 498 hours, pumped samples

FLORIDA DEPARTMENT OF HEALTH TRACER TEST MEMO NO. 3 PAGE C-3 HAZEN AND SAWYER, P.C.

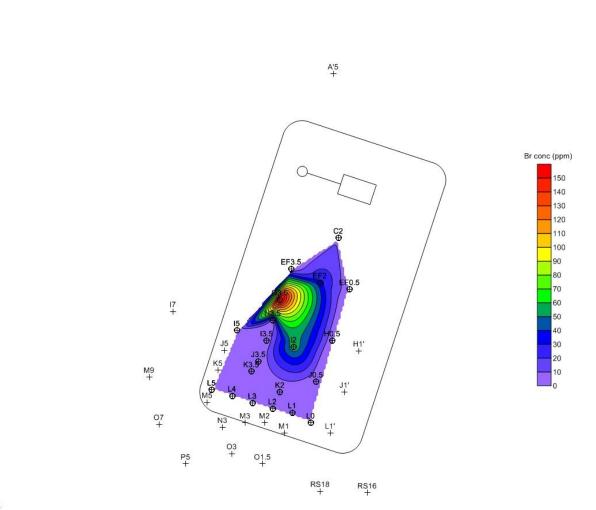


Figure C-3 March 11th 8am 521 hours, pumped samples

FLORIDA DEPARTMENT OF HEALTH TRACER TEST MEMO NO. 3 PAGE C-4 HAZEN AND SAWYER, P.C.

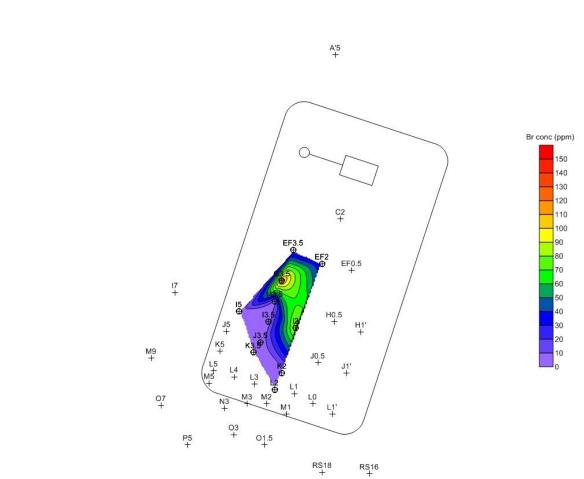


Figure C-4 March 13th 8am 569 hours, pumped samples

FLORIDA DEPARTMENT OF HEALTH TRACER TEST MEMO NO. 3 PAGE C-5 HAZEN AND SAWYER, P.C.

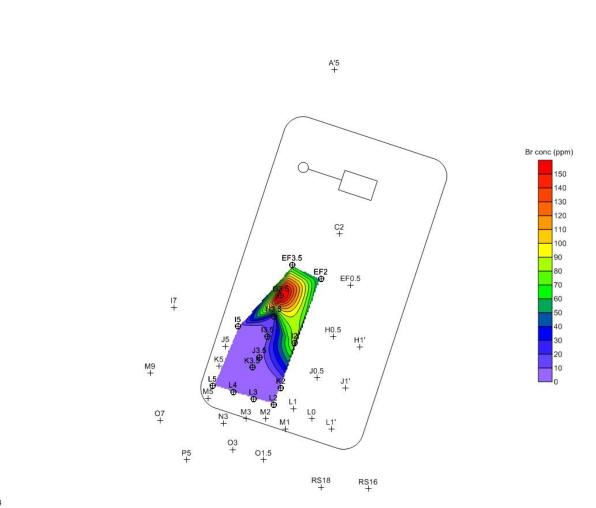


Figure C-5 March 14th 8am 593 hours, pumped samples

FLORIDA DEPARTMENT OF HEALTH TRACER TEST MEMO NO. 3 PAGE C-6 HAZEN AND SAWYER, P.C.

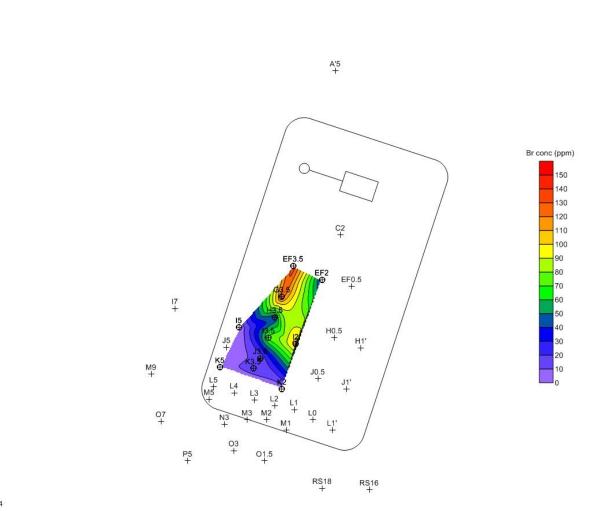


Figure C-6 March 17th 8am 665 hours, pumped samples

FLORIDA DEPARTMENT OF HEALTH TRACER TEST MEMO NO. 3 PAGE C-7 HAZEN AND SAWYER, P.C.

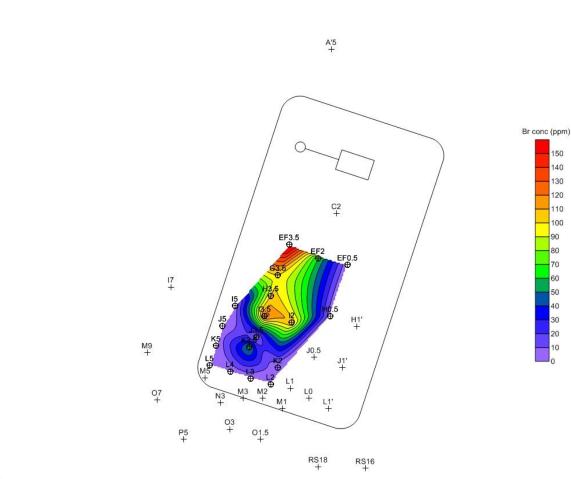


Figure C-7 March 18th 8am 689 hours, pumped samples

FLORIDA DEPARTMENT OF HEALTH TRACER TEST MEMO NO. 3 PAGE C-8 HAZEN AND SAWYER, P.C.

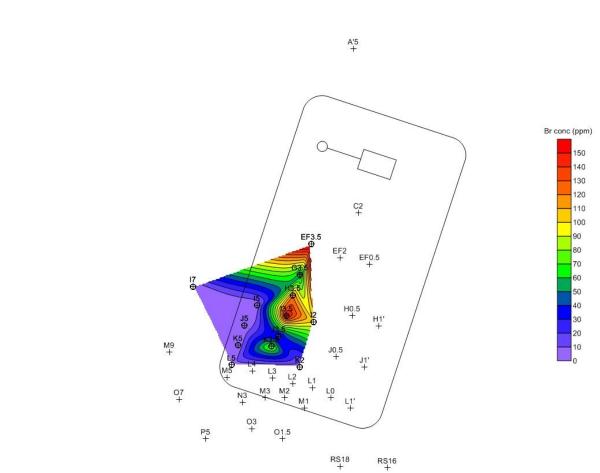


Figure C-8 March 19th 8am 713 hours, pumped samples

FLORIDA DEPARTMENT OF HEALTH TRACER TEST MEMO NO. 3 PAGE C-9 HAZEN AND SAWYER, P.C.

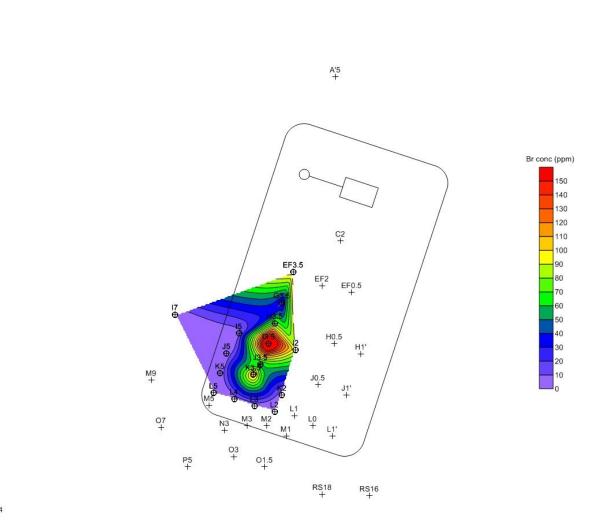


Figure C-9 March 21st 8am 761 hours, pumped samples

FLORIDA DEPARTMENT OF HEALTH TRACER TEST MEMO NO. 3 PAGE C-10 HAZEN AND SAWYER, P.C.

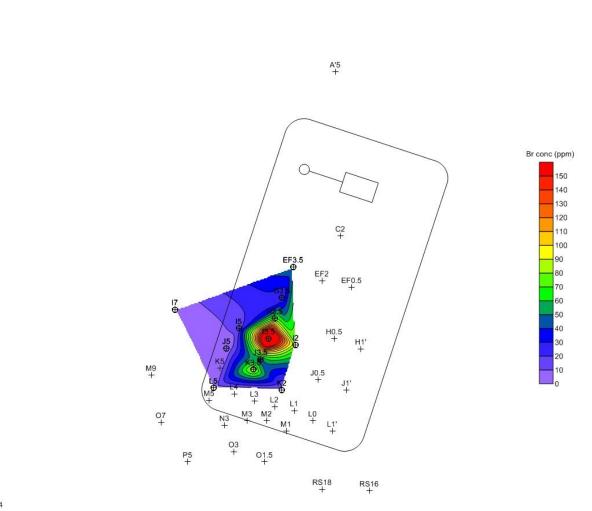


Figure C-10 March 24th 8am 833 hours, pumped samples

FLORIDA DEPARTMENT OF HEALTH TRACER TEST MEMO NO. 3 PAGE C-11 HAZEN AND SAWYER, P.C.

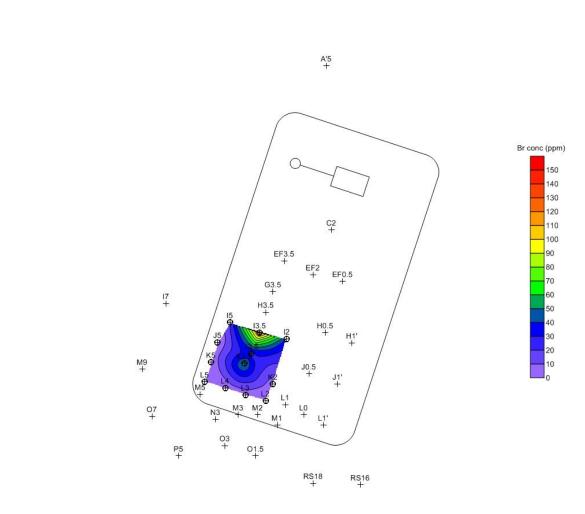


Figure C-11 March 26th 1pm 886 hours, pumped samples

FLORIDA DEPARTMENT OF HEALTH TRACER TEST MEMO NO. 3 PAGE C-12 HAZEN AND SAWYER, P.C.

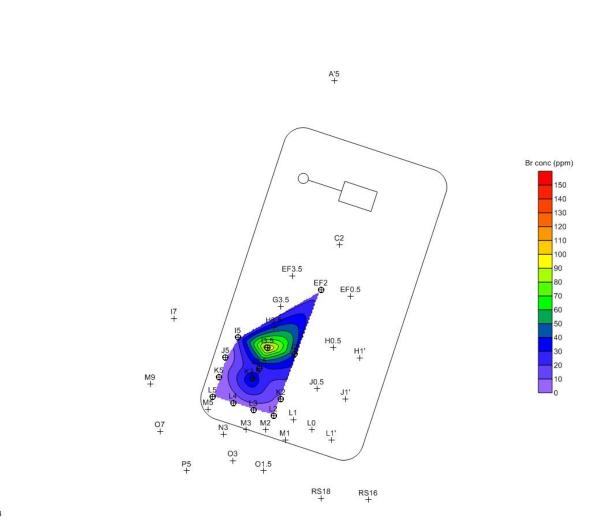


Figure C-12 March 27th 10am 907 hours, pumped samples

FLORIDA DEPARTMENT OF HEALTH TRACER TEST MEMO NO. 3 PAGE C-13 HAZEN AND SAWYER, P.C.

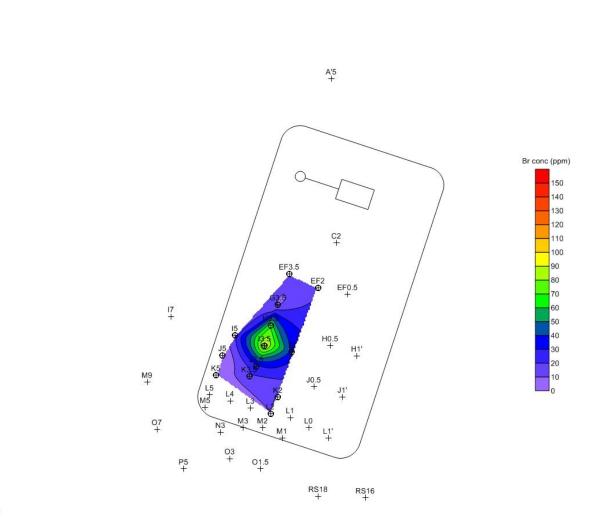
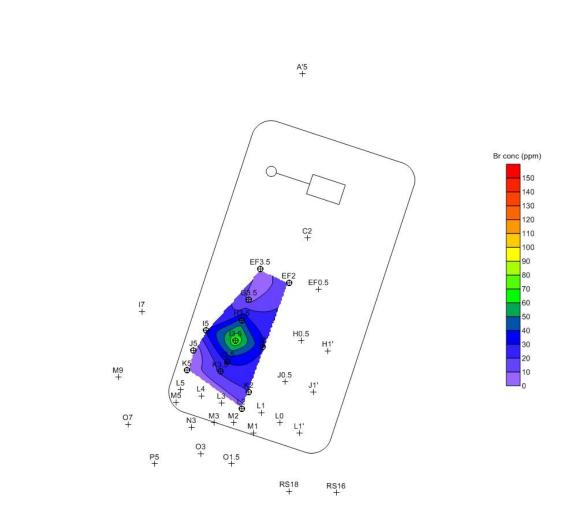
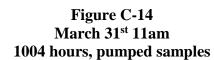


Figure C-13 March 28th 9am 930 hours, pumped samples

FLORIDA DEPARTMENT OF HEALTH TRACER TEST MEMO NO. 3 PAGE C-14 HAZEN AND SAWYER, P.C.





FLORIDA DEPARTMENT OF HEALTH TRACER TEST MEMO NO. 3 PAGE C-15 HAZEN AND SAWYER, P.C.

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ST14 +

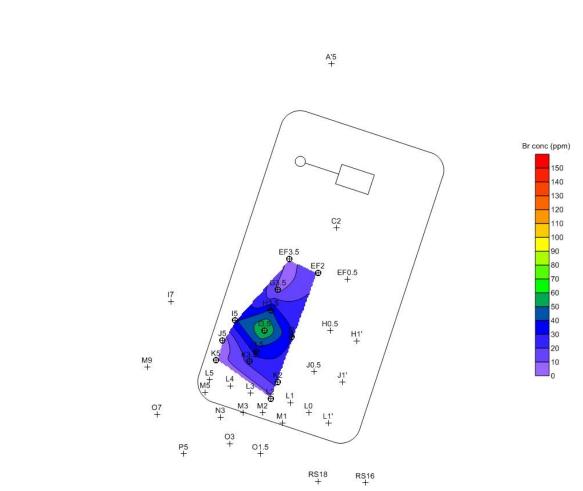




Figure C-15 April 1st 9am 1026 hours, pumped samples

FLORIDA DEPARTMENT OF HEALTH TRACER TEST MEMO NO. 3 PAGE C-16 HAZEN AND SAWYER, P.C.

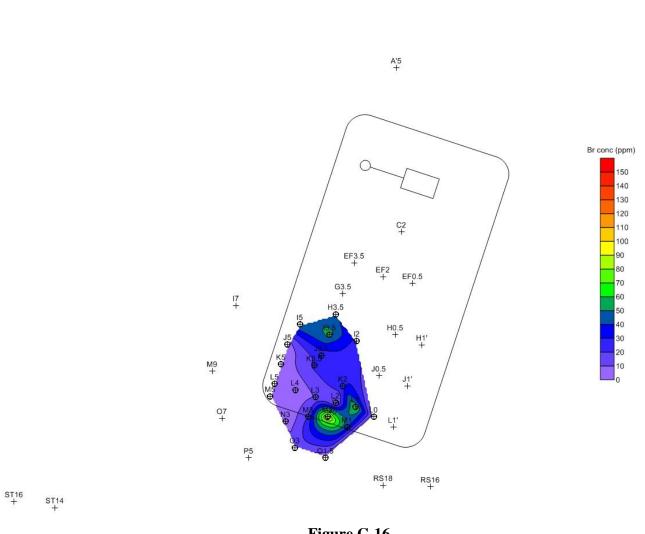


Figure C-16 April 2nd 9am 1050 hours, pumped samples

PAGE C-17 HAZEN AND SAWYER, P.C.

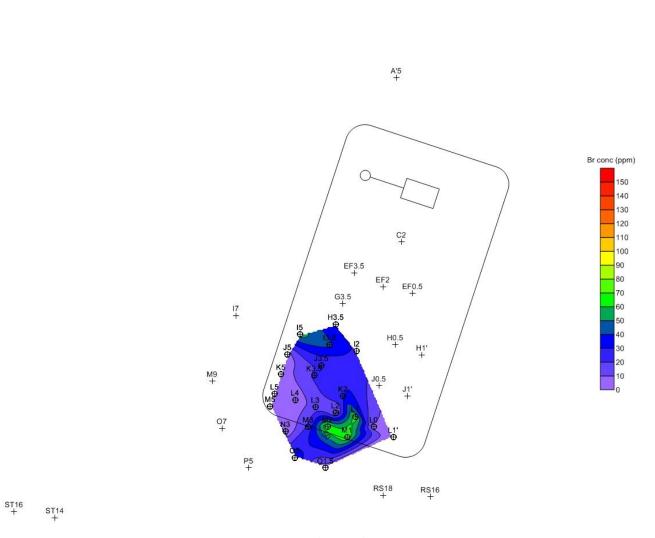
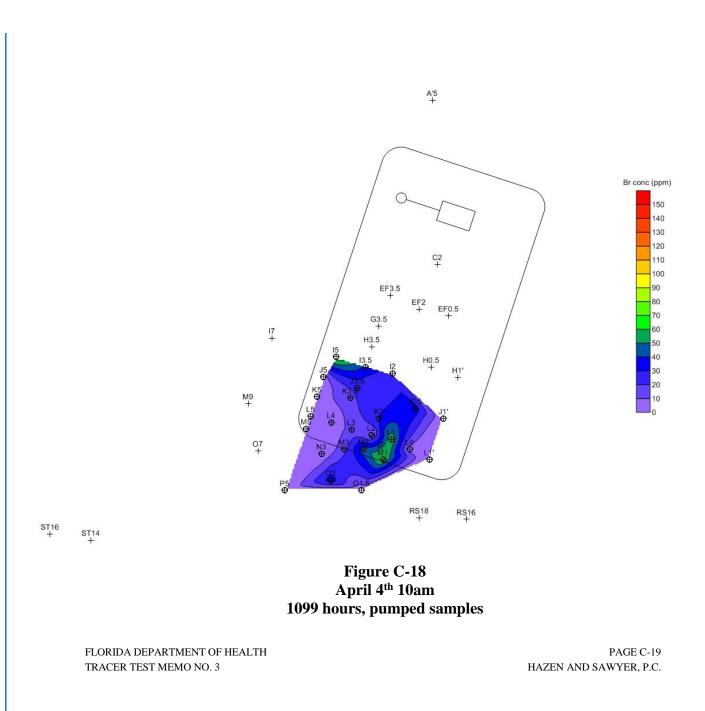


Figure C-17 April 3rd 3pm 1080 hours, pumped samples

PAGE C-18 HAZEN AND SAWYER, P.C.



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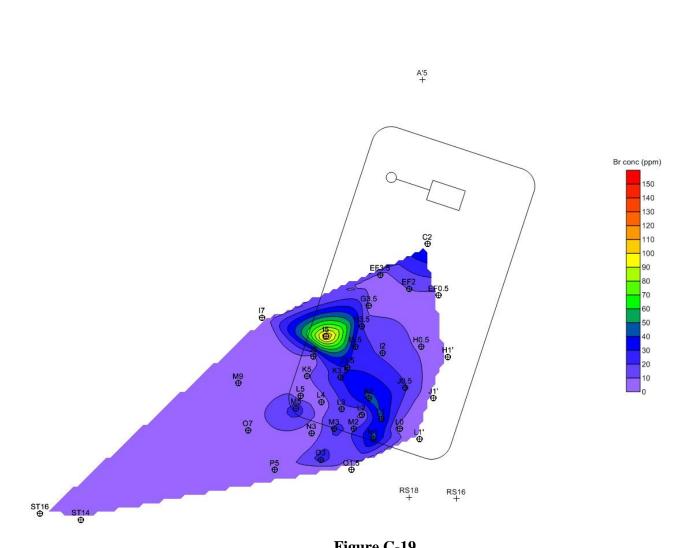


Figure C-19 April 7th 10am 1171 hours, pumped samples

PAGE C-20 HAZEN AND SAWYER, P.C.

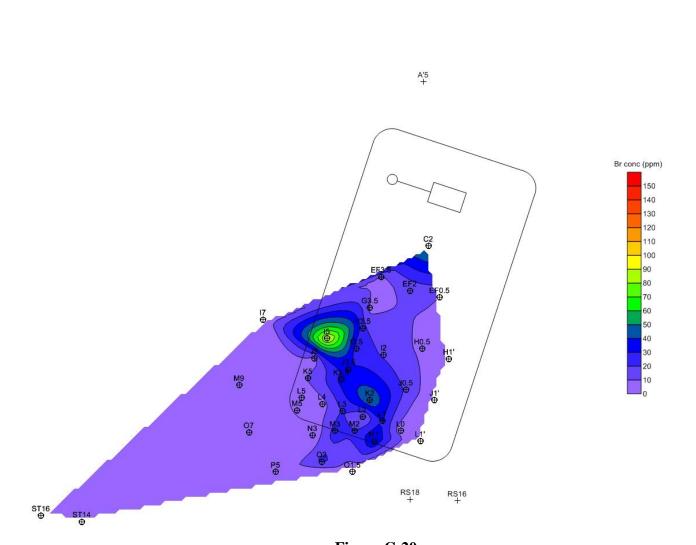


Figure C-20 April 8th 12pm 1197 hours, pumped samples

PAGE C-21 HAZEN AND SAWYER, P.C.

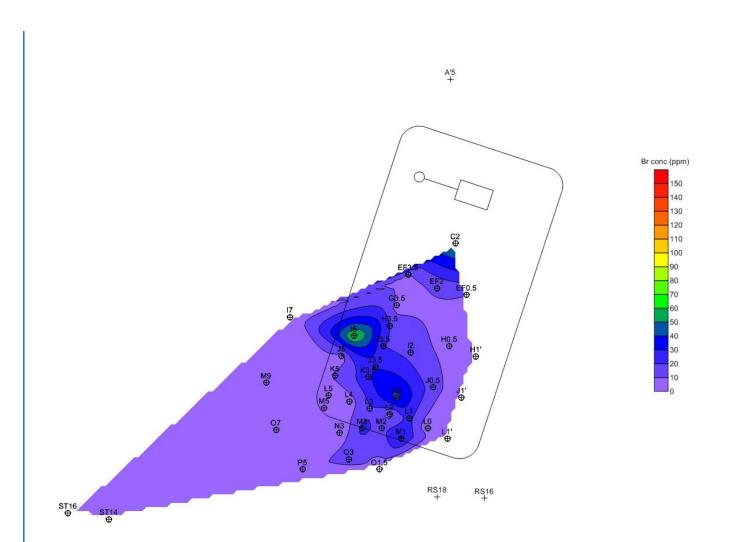


Figure C-21 April 9th 10am 1219 hours, pumped samples

FLORIDA DEPARTMENT OF HEALTH TRACER TEST MEMO NO. 3 PAGE C-22 HAZEN AND SAWYER, P.C.

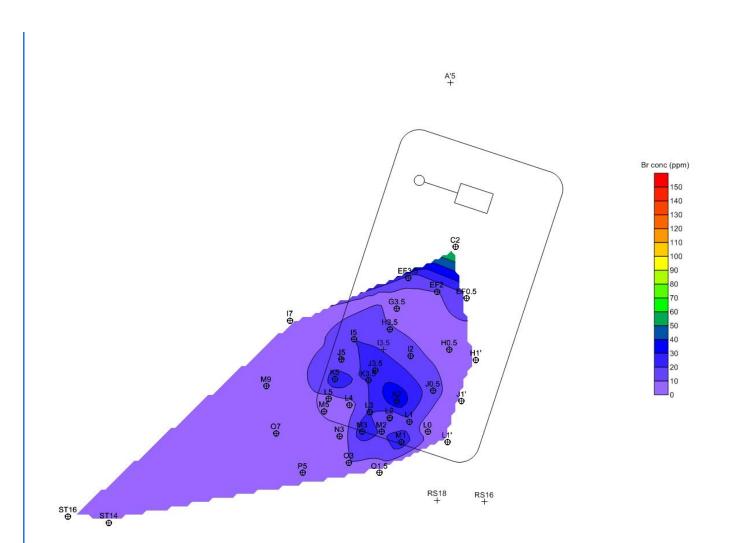


Figure C-22 April 15th 10am 1363 hours, pumped samples

PAGE C-23 HAZEN AND SAWYER, P.C.

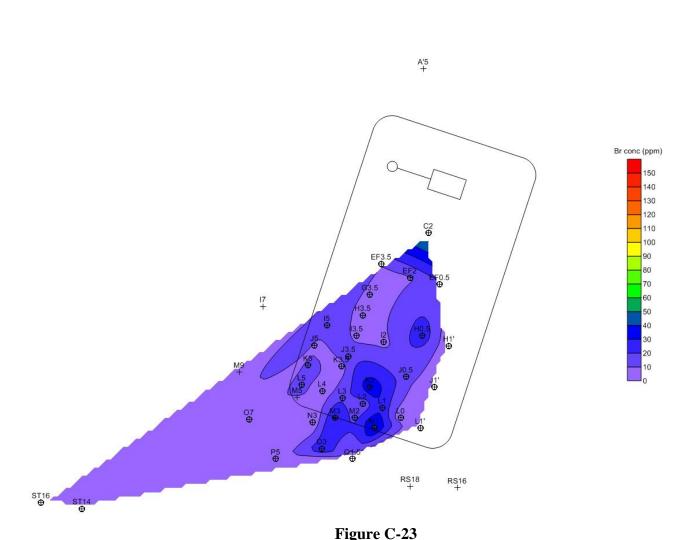


Figure C-23 May 6th 9am 1866 hours, pumped samples

PAGE C-24 HAZEN AND SAWYER, P.C.

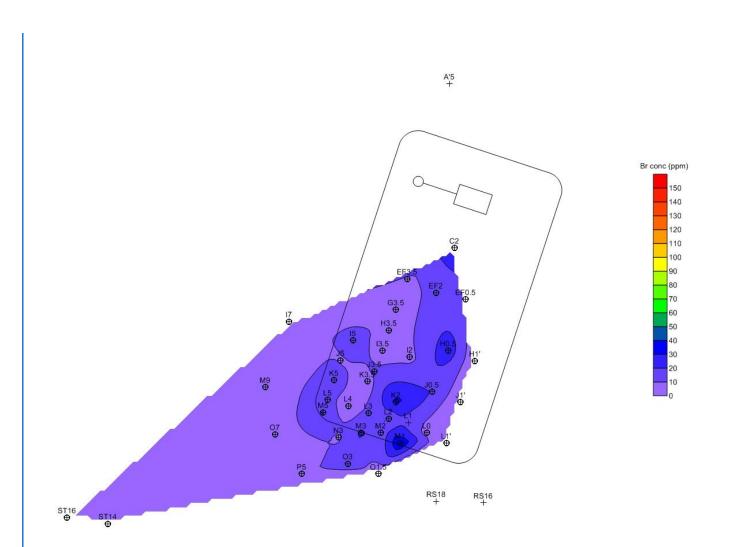


Figure C-24 May 16th 9am 2106 hours, pumped samples

PAGE C-25 HAZEN AND SAWYER, P.C.

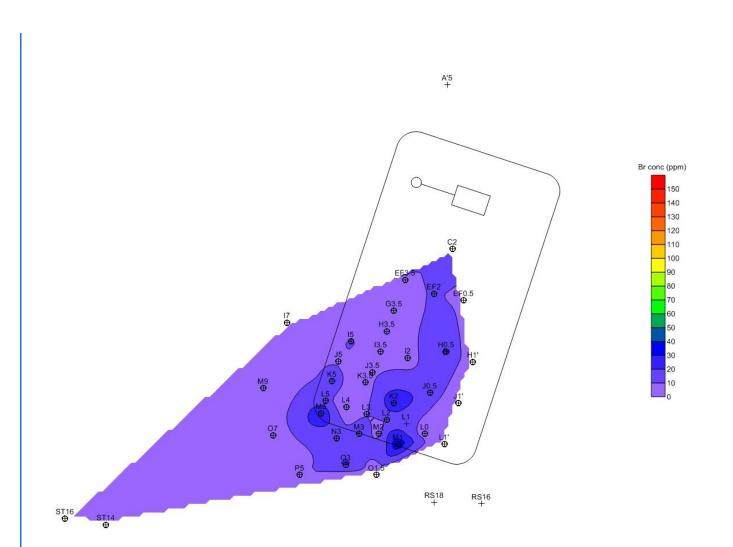


Figure C-25 May 22nd 9:30am 2250 hours, pumped samples

PAGE C-26 HAZEN AND SAWYER, P.C.

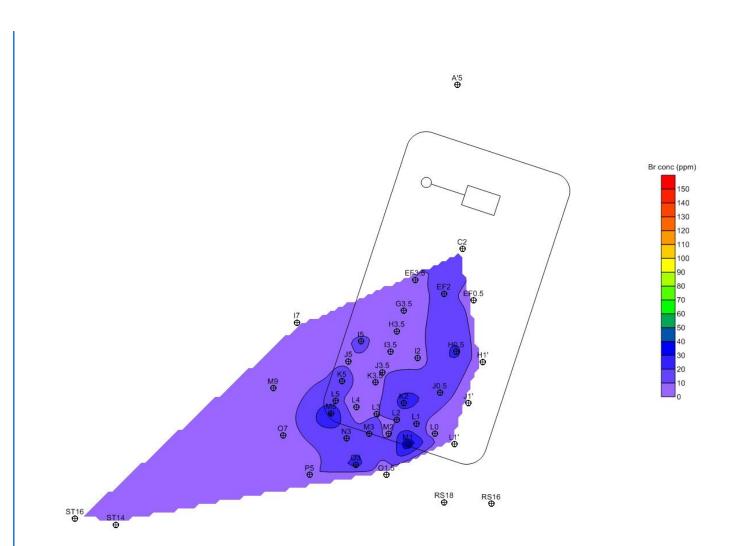
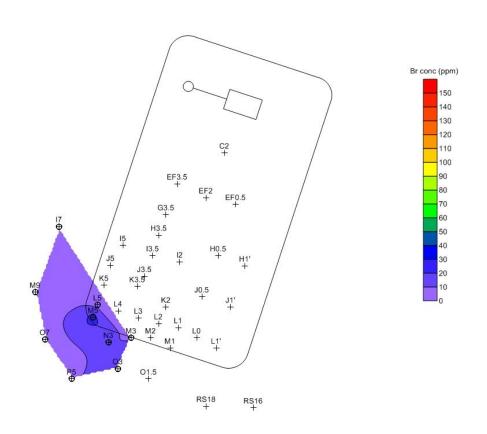


Figure C-26 May 23rd 9am 2274 hours, pumped samples

PAGE C-27 HAZEN AND SAWYER, P.C.



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Figure C-27 June 10th 1pm 2710 hours, pumped samples

FLORIDA DEPARTMENT OF HEALTH TRACER TEST MEMO NO. 3 PAGE C-28 HAZEN AND SAWYER, P.C.