

**Arsenic Concentrations in Groundwater in the
Vicinity of Koppers and Murphree Wellfield**

Prepared for Jones Edmunds & Associates, Inc.

By Dr. Thomas Pichler

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EXECUTIVE SUMMARY

Groundwater beneath and immediately downgradient of the Cabot/Koppers Superfund Site contains elevated arsenic (As) concentrations up to 6040 µg/L in the Surficial aquifer, up to 2.7 µg/L in the Intermediate aquifer (Hawthorn Group) and up to 197 µg/L in the Upper Floridan aquifer. An array of up-gradient and down-gradient with respect to the Cabot/Koppers Superfund Site wells were sampled in order to identify the source of As. These wells did not show elevated As concentrations. Thus, considering the extremely high values in Surficial groundwater the As in the Upper Floridan aquifer beneath the Cabot/Koppers Superfund Site must be the result of vertical As movement through the Hawthorn Group.

Elevated As concentrations seen in a down-gradient monitoring well (MWTP-MW-1) could indicate the migration of As from the Cabot/Koppers Superfund Site towards the Murphree well field. However, the constant decline of As in MWTP-MW-1 from approximately 20 µg/L to 7 µg/L from April to November does not allow for this conclusion at this time. There are five possible scenarios that may explain the observed trend:

- 1) The migration of As in the Floridan aquifer could be periodic or pulse-like and thus we may have sampled the tail end of a passing plume;
- 2) The As plume varies in position due to pumping patterns at the Murphree well field and thus we may have sampled its left or right boundary;
- 3) The installation of the monitoring wells itself caused the introduction of oxygen into the Floridan aquifer and caused the oxidation of pyrite and subsequent release of As to groundwater in the vicinity of MWTP-MW-1.
- 4) Microbial activity (influenced by the well installation) may cause the oxidation of pyrite and thus the release of As.
- 5) Dilution of Floridan groundwater in the vicinity of well MWTP-MW-1 due to enhanced recharge through the confining Hawthorn Group, i.e., activation of fractures after rainfall, etc.

1. INTRODUCTION

This report describes the sampling and chemical analyses that were conducted to investigate the elevated arsenic concentrations detected in Gainesville Regional Utilities groundwater monitoring wells MWTP-MW-1 and MWTP-MW-2.

1.1 Background

The Gainesville Regional Utilities (GRU) operates the Murphree Wellfield and the Murphree Water Treatment Plant in order to supply water to residents of the City of Gainesville and adjacent communities. Wells at the Murphree Wellfield extract water from the Floridan aquifer. The Cabot/Koppers Superfund Site is located approximately 2-miles southeast of the Murphree Wellfield and is within the capture zone of the wellfield.

Site-related contaminants were previously detected in groundwater in the Surficial Aquifer, Intermediate (Hawthorn) Aquifer, and the Floridan aquifer beneath the Koppers Industries facility. GRU installed two monitor wells (MWTP-MW-1 and MWTP-MW-2) into the Floridan aquifer at locations downgradient from the Koppers facility. Those two wells were free of detectable organic contamination; however, arsenic was detected at concentrations above what is generally considered natural background concentrations in the Floridan aquifer and above the new 10 µg/L MCL. However, arsenic was analyzed by a method (ICP-OES) that may not be suited for concentrations around 10 µg/L.

1.2. Objectives

This study was intended to confirm the levels of arsenic that were detected in previous studies and to determine if the arsenic in groundwater monitoring wells MWTP-MW-1 and MWTP-MW-2 is of natural or man-made origin, using a defined set of geochemical parameters (Table 1). In addition, this study increases the level of information on arsenic in the Floridan Aquifer in Alachua County specifically near the Murphree Water Treatment Plant.

2. SAMPLING AND ANALYTICAL PROCEDURES

Sampling and field measurements were conducted by field crews from Jones Edmunds & Associates (Jones Edmunds). The first round of samples was taken in April 2004 and consisted of those wells listed in Table 2a. In July 2004 MWTP-MW-1 and MWTP-MW-2 were re-sampled and the Floridan Background Wells 0501 and 3201 were sampled for the first time. Once the first round of samples was analyzed several new wells were added for better regional coverage and sampled in November 2004 (Table 2b). In January 2005 the wells ADAMS, AAF6934, and AAF6919 were added and F-6F was sampled once more. A complete listing of those wells is given in Table 4. The locations of all wells that were sampled during this study are indicated in Figures 1a, b and c. The sample collection/preservation/shipping methods, and analytical methods are described below:

2.1. Groundwater Sampling (performed by Jones Edmunds)

Groundwater samples were collected from the GRU monitor wells and from other wells outside the Koppers property by Jones Edmunds' Field Services group. In addition to regular sampling, wells MWTP-MW-1 and MWTP-MW-2 were "over-purged" with the intent to remove the potential influences of water that may have been introduced during drilling (due to lost circulation in the limestone). Wells were purged at a rate of approximately 2 gal/min to a target volume of 200 gal. Samples were collected at the beginning, mid, and end point of purging.

Sampling of wells at the Koppers facility was coordinated with Beazer to assure that samples were split during Beazer's sampling effort.

2.2. Sample Collections and Analyses

Analyses included a combination of field and laboratory measurements. Sampling protocols, sample containers and holding times followed US EPA recommendations, i.e., the Code of Federal Regulations, July 1, 2000, title 40, Part 136.3.

April 2004: The GRU-sample splits collected at the Koppers facility were analyzed for the parameters listed in Table 1 in order to further the understanding of arsenic fate and transport in the area of the Koppers facility. Samples from monitor wells MWTP-MW-1 and MWTP-MW-2 and selected wells that are currently monitored by FDEP and local agencies were also analyzed for all parameters listed in Table 1.

July 2004: Only total arsenic was determined for the wells, SEC3601, 3201, 0501, MWTP-MW-1 and MWTP-MW-2 during this round of sampling.

November 2004: All the wells listed in Table 4 were sampled and analyzed for the parameters in Table 1. Ion chromatography and ICP analyses were performed by the USF Center for Water Analyses instead of Actlabs.

Total arsenic analysis and arsenic speciation of filtered and unfiltered groundwater samples from each well were conducted by the University of South Florida Center for Water and Environmental Analyses. Total arsenic concentration was determined by converting soluble arsenic into arsine gas via hydride generation. The arsine gas was then analyzed using atomic fluorescence spectrometry (AFS) (arsine gas was excited by a hydrogen flame and resulting fluorescence was measured). The detection limit for this method is approximately 0.02 µg/L (ppb). Arsenic speciation was performed by a combination of AFS and ion chromatography. The arsenic species arsenite (AsIII), DMA, MMA and arsenate (AsV) were separated in a Hamilton X-100 column.

Activation Laboratories (Actlabs) conducted the analyses of metals by ICP/MS. This analysis is identified by Actlabs as “Code 6”. Fluoride, chloride, bromide, nitrite, nitrate, phosphate, and sulfate were determined by Activation Labs using ion chromatography (Code 6B) for the April 2004 samples. The same parameters for the November 2004 samples were measured by the USF Center for Water Analyses, using comparable analytical instrumentation and methodology.

Oxygen and hydrogen isotopes were determined by Dr. John Humphrey, Colorado School of Mines using isotope ratio mass spectrometry (IRMS).

Sulfate and sulfide were measured in the field by the Jones Edmunds sampling crew colorimetrically using a Hach DR/800 Series Colorimeter and following the recommended Hach method. Field determination of sulfate and sulfide was preferred because the oxidation of sulfide

to sulfate will invariably occur after sample collection. This affects both, the sulfide and sulfate concentrations.

The other parameters that are typically determined in the field (Table 2) were carried out by the sampling crew during well purging using the methods listed in Table 1.

3. RESULTS

3.1. Field Measurements

The results for field-based measurements are given in Tables 2a and 2b. Most parameters show a discrepancy between the July and November data that is larger than what could be explained by seasonal variation. The deviation between the two sampling events is given in Table 2c. In particular the sulfide measurements show a very large deviation, which is likely the cause of a combination of low concentrations and calibration problems. Nevertheless sulfide was detected in most samples, which is as expected for Floridan groundwater. The high pH measurements of the November sampling are enigmatic, but could be due to grout problems or may be related to a calibration error.

During the over-purging test of MWTP-MW-1 and MWTP-MW-2 pH and T stayed more or less constant. Dissolved oxygen (DO) on the other hand showed the expected decrease from 0.21 mg/L to 0.03 mg/L in MWTP-MW-1 (Fig. 2). MWTP-MW-2 started with a much lower value of 0.06 mg/L, which dropped to 0.02 mg/L (Fig. 2).

3.2 Major Anions and Cations

The values for major anions and cations are as expected for the three water types that were sampled, i.e., surficial, intermediate (Hawthorn) and upper Floridan (Ocala). Deviations between the different sampling events were minimal despite the different analytical instrumentation/laboratories that were used. Results are listed in Tables 3a and b. The only anomalous values analyzed were for potassium (K), sodium (Na) and calcium (Ca) in the samples 3-H1 and 3H-2 and to a lesser extent in LS108-H1 and LS108-H3. The cation values

for the two wells A-0702 and A-0693 at the fairgrounds are most likely incorrect as given in Table 3b. It seems that the values for Na, Mg, K, Ca, Si, Fe, Ba and Sr in A-0702 belong to A-0693 and vice versa. Whether this mix up happened in the field or in laboratory is unclear. Corrected values are presented in Table 3c. These values are also in much better agreement with the field measurements for these two samples, i.e., conductivity and alkalinity now correspond to the observed Ca concentrations. Whether the bottles that were used for the collection of sample material for the arsenic analysis is unclear, but possible.

These wells also show very high pH values, which could point towards a grout problem and thus explain the K, Na and Ca values.

3.3 Trace Elements

The April samples were analyzed by ICP-MS at Actlabs for a set of more than 40 trace elements with the hope to identify an additional tracer to help unravel the As values seen in MWTP-MW-1 and MWTP-MW-2 (Table 4). Only 3 elements, Cr, Sb and V showed any promise to be used as a potential tracer. However the concentrations of these elements are extremely low and thus near the detection limit of the method/instrument, which severely affect analytical precision. Thus for the second round of sampling only Ba, Sr and Fe were analyzed per special request from GRU (Table 3b) for an independent study unrelated to the arsenic problem. These 3 elements showed nearly perfect correlation between the April and November samples.

The element antimony (Sb) is significantly enriched in sample MWTP-MW-1 compared to other Floridan wells and thus may shed some light into the decreasing As values seen in MWTP-MW-1 (see below). Similar to As, Sb is also elevated in pyrite and thus Sb can be used as a proxy for As.

3.4 Arsenic Totals and Speciation

Values for total arsenic (As^T) varied from as low as 0.01 to 6040 $\mu\text{g/L}$. The concentrations for most wells did not change significantly between samplings, except for the monitoring well MWTP-MW-1 (Tables 5 a and b). This well showed a constant decline in As from 19 $\mu\text{g/L}$ in April to 11.9 $\mu\text{g/L}$ in July and to 7.3 $\mu\text{g/L}$ in November. In MWTP-MW-2, As decreased from

0.8 µg/L to 0.5 µg/L, however these are very low values and thus prone to higher sampling and analytical uncertainty. The highest As values were encountered in the Surficial and Floridan aquifers at the Koppers facility. Most samples that exceeded 2µg/L, the expected background for groundwater and surface water in central Florida, were on or near the Koppers facility. Only 3 samples that were collected from wells further away (F6-F, A-0693 and A-0391) showed higher As values. All wells that were sampled up gradient from the Koppers facility had significantly lower As values than those on site (Table 5b). The only enigmatic As value was encountered in F-6F, which is a Floridan well located to the west of the GRU well field at a significant distance from the Koppers site. During the November sampling this well showed 19.2 µg/L As. Because of the unexpectedly high concentration, this well was re-sampled in January, which confirmed the high As (Table 5b).

The over-purging tests that were performed on wells MWTP-MW-1 and MWTP-MW-2 showed different results for the two wells. MWTP-MW-2 showed the lowest As concentration at the beginning (1 µg/L), the highest at the midpoint (1.3 µg/L) and the middle value (1.2 µg/L) at the end of the purge test. MWTP-MW-1 on the other hand showed a constant decline of As during over-purging. MWTP-MW-1 was sampled in duplicate and showed the following values: 19.7 and 19.8 µg/L at the beginning, 19.5 and 18.9 µg/L at the midpoint and 17.9 and 18.2 µg/L at the end of the purge test. These values are very close together and thus prone to sampling and analytical error, nevertheless they show a consistent trend.

The As speciation revealed arsenite (As^{3+}) as the predominant species. Only the samples taken from MWTP-MW-1 during the April sampling show minor arsenate (As^{5+}) (Table 5a). Neither of the two organic/methylated species, DMA and MMA, were detected.

In April filtered and unfiltered samples were collected for As determination. Concentrations are more or less identical (considering sampling and analytical uncertainty) and thus the collection of unfiltered samples was omitted in July, November and January.

3.5 Oxygen and Deuterium Isotopes

Oxygen and deuterium isotopes values that were analyzed to identify “unusual” groundwaters showed values as expected for central Florida (Table 6, Fig. 3). The samples collected from those

wells in the Surficial sediments and Hawthorn Group show different values than those collected from Ocala wells.

4. DATA EVALUATION

The field-based measurements show significant discrepancies between the sampling events, which limits any substantial interpretations. However, sulfide (although in varying amounts) as detected in almost every sample, which is as expected for groundwater. The high pH values encountered during the November sampling could be grout related (dissolution of grout in the well); most of the high-pH samples show elevated major element concentrations, such as elevated K, Na and Ca in combination with very high alkalinity. Alternatively some of the high pH values could be due to calibration errors; in particular the variation in FW-3 and FDOT-H132, which were sampled in April and November is larger than expected.

Major anions and cations compared well to published data for similar water types (Sacks, 1996) with one exception. The cation values for the two wells A-0702 and A-0693 at the fairgrounds are most likely incorrect as given in Table 3b. It seems that the values for Na, Mg, K, Ca, Si, Fe, Ba and Sr in A-0702 belong to A-0693 and vice versa. Whether this mix up happened in the field or in laboratory is unclear. Corrected values are presented in Table 3c. These values are also in much better agreement with the field measurements for these two samples, i.e., conductivity and alkalinity now correspond to the observed Ca concentrations. Whether the bottles that were used for the collection of sample material for the arsenic analysis is unclear, but possible.

The purpose of the trace element analyses (Table 4) was to identify potential tracers that could serve as a proxy for As and thus help to explain the elevated values seen the two monitoring wells MWTP-MW-1 and MWTP-MW-2. The elements Cr, V and Sb could be potential tracers, however, this would require lower analytical detection limits and thus, more sophisticated instrumentation than the one used by Actlabs.

Several samples show elevated As concentrations when compared to the expected concentration in Florida surface and ground water of $< 1\text{-}2 \mu\text{g/L}$ (groundwater is generally $< 1 \mu\text{g/L}$). While the origin of As in the three wells F6-F, A-0693 and A-0391 remains unclear, the elevated values seen in the Floridan wells below the Koppers facility and in Well FW-7, located

immediately north (downgradient) of the facility, are most likely due to vertical water movement through the Hawthorn into the Upper Floridan aquifer. Here surficial groundwater shows concentrations of up to 6040 µg/L and Upper Floridan groundwater shows concentrations of up to 197 µg/L. Since water movement in the Hawthorn is more or less vertical (very little lateral flow) and because of the limited amount of monitoring wells at the Koppers site it is impossible to detect (a) elevated As concentrations in Hawthorn groundwater and (b) areas of enhanced vertical water movement. Substantial amounts of As may enter the Upper Floridan aquifer at only a few locations. A similar scenario was observed at another site in west-central Florida where As and sulfate concentrations were higher in the Upper Floridan aquifer than in the Surficial aquifer, although the contaminant source was located in the Surficial aquifer (Pichler, 2004). In particular the absence of elevated As in wells to the south and southwest of the Koppers site (Fig. 1) makes an up-gradient source for the high As less likely.

The As in the Upper Floridan is likely migrating towards the northeast in the direction of the GRU well field due to pumping/drawdown. Whether the elevated As in MWTP-MW-1 is from the Koppers site, however, cannot be determined at this time.

The declining As concentrations in MWTP-MW-1 are enigmatic. There are five possible scenarios that may explain the observed trend:

- 1) The migration of As in the Floridan aquifer could be periodic or pulse-like and thus we may have sampled the tail end of a passing plume;
- 2) The As plume varies in position due to pumping patterns at the Murphree well field and thus we may have sampled its left or right boundary;
- 3) The installation of the monitoring wells itself caused the introduction of oxygen into the Floridan aquifer and caused the oxidation of pyrite and subsequent release of As to groundwater in the vicinity of MWTP-MW-1.
- 4) Microbial activity (influenced by the well installation) may cause the oxidation of pyrite and thus the release of As.
- 5) Dilution of Floridan groundwater in the vicinity of well MWTP-MW-1 due to enhanced recharge through the confining Hawthorn Group, i.e., activation of fractures after rainfall, etc.

At this time, it is not possible to favor any one of the possible scenarios over the other four, however, the As values seen in MWTP-MW-2 are much lower than those observed in well MWTP-MW-1. This raises the question about possible differences between MWTP-MW-1 and

MWTP-MW-2 at the time of well installation that caused As to be high in one but not the other. However, the two wells are relatively close together, drilled and installed using the same methods, and both completed in the Ocala Limestone.

It is noteworthy that at the time of installation As was higher in MWTP-MW-2 (49 $\mu\text{g/L}$) than MWTP-MW-1 (19 $\mu\text{g/L}$). However, at that time As was analyzed by a different laboratory using ICP-ES, an analytical technique not suitable for the low-level detection of this element.

The over-purging test that was conducted in April shows a decline in As and DO concentration. While DO drops significantly in MWTP-MW-1, the drop in As is much more subtle and hardly beyond the analytical uncertainty (Fig. 2). Nevertheless, values drop constantly. It is also noteworthy that the sample from MWTP-MW-1 was the only sample that contained a minor amount of arsenate (As^{5+}), which could indicate enhanced recharge as well as microbial activity or atmospheric oxygen. The well MWTP-MW-2 did not show any variation of DO and As beyond the analytical uncertainty (Fig. 3).

Oxygen and deuterium isotopes were measured in order to identify unusual isotope signatures, which in turn could identify unusual recharge areas and flow paths. The observed values, however, were as expected for the region and compared well to those reported by Sacks (1996). Sacks (1996) observed a separation into two populations, i.e., aerobic low-sulfate groundwater and anaerobic low-sulfate groundwater, which compares well to the separation seen between the Surficial and Hawthorn samples and the Floridan samples (Fig. 4).

The newly installed well F-6F currently shows As in the range of 20 $\mu\text{g/L}$ (similar to those values first observed in MWTP-MW-1). This well is more or less removed from any known source of anthropogenic contamination and thus the detailed study of this well may provide an answer about the high As values in MWTP-MW-1.

TABLES

Table 1 Analytical Requirements

Parameter	Analytical Method	Laboratory
As species (As ³ , As ⁵)	Atomic Fluorescence Spectrometry	USF Center for Water Analyses
As total **	Atomic Fluorescence Spectrometry	USF Center for Water Analyses
Oxygen and hydrogen isotopes	Mass Spectrometry	Colorado School of Mines
Oxidation/reduction potential	Field (electrode)	sample crew
Hydrogeochemistry parameters (Code 6)	ICP/MS	Activation Labs
Hydrogeochemistry parameters (Code 6B)	Ion Chromatography	Activation Labs
pH , temp., conductivity	Field (electrode)	sample crew
Alkalinity	Field (H ₂ SO ₄ titration)	sample crew
Sulfate/sulfide	Field (colorometric)	sample crew

* Filtered and Unfiltered fractions were taken during April 2004.

Table 2a Field measurements for July 2004. Data provided by Jones Edmunds & Associates.

Well	Location	pH	T (°C)	DO (mg/L)	Conductivity (µmhos/cm)	Sulfide (mg/L)	Sulfate (mg/L)	Alkalinity (mg/L CaCO ₃)
F-2	Floridan	7.1	22.6	0.05	469	0.03	0	220
F3-F	Floridan	7.0	22.8	0.06	533	0.67	10	245
F-4	Floridan	7.2	24.1	0.03	537	0.17	67	165
FDOT-FL28	Floridan	7.3	32.1	0.05	383	0.7	6	161
FDOT-FL32	Floridan	7.2	23.1	0.03	373	0.9	4	125
FDOT-H128	Hawthorn	8.0	23.2	0.03	366	0.01	0	170
FDOT-H132	Hawthorn	7.6	22.4	0.03	354	0.17	2	191
FW-3	Floridan	8.5	22.8	0.11	435	0.80	3	154
FW-5	Floridan	8.6	23.9	0.24	512	0.56	13	147
HG-4D	Hawthorn	6.9	23.0	0.38	475	0.02	0	160
HG-5D	Hawthorn	8.6	25.4	1.83	261	0.03	0	96
M-23BR	Surfical	4.9	23.0	0.02	199	0.03	23	17
M-9BR	Surfical	4.8	22.6	0.13	79	1.60	1	26
MWPT-MW-1	Floridan	7.6	24.8	0.08	546	0.27	1	245
MWTP-MW-2	Floridan	7.7	24.9	0.10	434	1.30	0	206

Table 2b Field measurements for November 2005. Data provided by Jones Edmunds & Assoc.

Well	Location	pH	T (°C)	DO (mg/L)	Conductivity (µmhos/cm)	Sulfide (mg/L)	Sulfate (mg/L)	Alkalinity (CaCO ₃)
2-H3 (A-0399)	Hawthorn	9.0	25.9	1.5	334	0	0.03	133
2-S (A-0398)	Surficial	5.8	22.1	1.21	138	0	0	59
3-H1 (A-0396)	Hawthorn	10.6	19.1	0.32	723	1	0.01	368
3-H2 (A-0397)	Hawthorn	12.2	21.2	0.3	2850	0	0.03	760
4-H1 (A-0408)	Hawthorn	6.9	21.5	0.17	475	1	0	246
4-H2 (A-0409)	Hawthorn	7.8	23.6	5.7	299	7	0.02	107
4-S (A-0411)	Surficial	6.9	21.2	0.8	456	1	0.01	220
6-H1 (A-0402)	Hawthorn	7.6	20.4	0.58	341	4	0.01	168
6-S (A-0401)	Surficial	4.6	19.2	0.51	53	2	0.16	0
F-2	Floridan	7.4	24.2	0.08	403	1	0.04	178
F-3	Floridan	7.3	22.0	0.15	498	20	0.09	210
F-4 (11-12-04)	Floridan	7.2	24.5	0.16	509	75	0.13	145
F-4 (12-6-04)	Floridan	7.3	24.7	0.22	560	78	0.35	159
F-6F (A-0404)	Floridan	7.3	22.5	0.08	462	17	0.09	210
Fairgrounds Well (A-0702)	Surficial	4.6	23.7	0.61	37	3	0	0
Fairgrounds Well (A-0366)	L. Floridan	7.8	25.8	1.94	423	11	0.3	143
Fairgrounds Well (A-0693)	U. Floridan	7.3	22.3	--	639	4	0.24	159
FDOT-FL28	Floridan	7.0	23.6	0.69	380	5	0.1	150
FDOT-FL32	Floridan	7.5	22.9	0.08	346	7	0.2	159
FDOT-H128	Hawthorn	7.2	22.8	0.5	364	0	0.02	179
FDOT-H132	Hawthorn	10.7	22.8	0.98	181	4	0.05	71
FL Background (0501)	Floridan	7.4	23.5	0.23	381	15	0.22	176
FL Background (3201)	Floridan	7.4	22.8	1.42	359	7	0	165
FW-3	Floridan	10.6	21.7	0.37	210	0	0.44	139
FW-5	Floridan	9.1	23.8	0.69	311	7	0.19	145
FW-6	Floridan	10.9	22.2	0.61	335	0	0.33	172
FW-7	Floridan	8.9	21.3	0.69	360	33	0.04	214
FW-8	Floridan	8.0	22.5	0.55	340	11	0.02	150
FW-9	Floridan	7.5	22.9	0.87	377	30	0.07	158
HG-4D	Hawthorn	6.8	24.7	0.31	346	0	0.01	150
HG-5D	Hawthorn	7.4	25.9	0.29	264	1	0.07	118
LS108-H1 (A-0392)	Hawthorn	11.1	21.0	3.28	649	8	0.02	232
LS108-H3 (A-0393)	Hawthorn	9.8	21.9	0.57	561	3	0.01	287
LS108S (A-0391)	Surficial	5.2	19.8	0.12	171	1	0.2	18
M-23BR	Surficial	4.6	24.1	211	157	7	0.19	0
M-9BR	Surficial	4.8	25.1	0.67	57	1	0.12	5
MWTP-MW-1	Floridan	7.7	23.2	1.07	450	0	0.06	294
MWTP-MW-2	Floridan	7.6	24.9	0.28	443	0	0.18	199
WTP Well #11	Floridan	7.5	26.0	1.01	693	14	0.31	169
WTP Well #3	Floridan	7.5	25.5	1.84	576	8	0.38	177
WTP Well #4	Floridan	7.5	24.9	2.15	528	56	0.3	158
WTP Well #5	Floridan	7.5	25.2	1.1	686	12	0.13	152
WTP Well #9	Floridan	7.5	23.9	1.62	451	25	0.25	161

Table 2c Deviation between April and November field measurements in %

Well	pH	T	DO	Conductivity	Sulfide	Sulfate	Alkalinity
F-2	5	7	38	-16	25	100	-24
F-3	3	-4	60	-7	-644	50	-17
F-4 (11-12-04)	0	2	81	-6	-31	11	-14
FDOT-FL28	-5	-36	93	-1	-600	-20	-7
FDOT-FL32	4	-1	63	-8	-350	43	21
FDOT-H128	- 11	-2	94	-1	50	0	5
FDOT-H132	29	2	97	-96	-240	50	-390
FW-3	19	-5	70	-107	-82	0	-6
FW-5	6	-1	65	-65	-195	-86	15
HG-4D	-2	7	-23	-37	-100	0	-7
HG-5D	- 16	2	-531	1	57	100	19
M-23BR	-8	5	100	-27	84	-229	0
M-9BR	0	10	81	-39	-1233	0	-420
MWTP-MW-1	2	-7	93	-21	-350	0	17
MWTP-MW-2	-1	0	64	2	-622	0	-4

Table 3a Major anions and cations for April 2004 (reported in mg/L). Data provided by Actlabs.

Element	Location	F	Cl	NO₂	Br	NO₃	PO₄	SO₄	HCO₃*	Na	Mg	K	Ca	Si
F-2	Floridan	0.73	9.9	<0.02	0.23	0.02	<0.04	0.2	268	10.7	>20	1.2	>20	15.2
F3-F	Floridan	0.51	12.1	<0.02	0.05	<0.02	<0.04	21	299	10.0	>20	1.0	>20	14.4
F-4	Floridan	0.42	12.4	<0.01	0.06	<0.01	<0.02	82	201	9.8	>20	1.0	>20	13.4
FDOT-FL28	Floridan	0.97	9.6	<0.01	0.03	<0.01	<0.02	15	196	7.7	17.0	0.8	>20	14.2
FDOT-FL32	Floridan	0.36	9.7	<0.01	0.05	<0.01	<0.02	15	153	7.8	15.0	0.7	>20	13.4
FDOT-HI28	Hawthorn	0.50	7.4	<0.01	0.04	<0.01	<0.02	1.7	207	11.7	19.3	1.16	>20	8.9
FDOT-HI32	Hawthorn	0.65	12.4	<0.01	0.03	<0.01	<0.02	3.5	233	13.5	18.1	1.1	>20	8.4
FW-3	Floridan	0.29	10.1	<0.01	0.07	<0.01	<0.02	16.2	188	10.1	18.4	11.9	>20	13.6
FW-5	Floridan	0.37	11.4	<0.01	0.50	<0.01	0.15	31.6	179	15.0	17.7	1.9	>20	12.9
HG-4D	Hawthorn	0.35	9.1	<0.01	0.05	<0.01	<0.02	<0.03	195	4.2	18.1	0.5	>20	8.0
HG-5D	Hawthorn	0.65	6.5	<0.01	<0.03	<0.01	<0.02	4.4	117	8.2	9.3	2.0	>20	19.5
M-23BR	Surficial	<0.01	25.3	<0.01	0.09	<0.01	<0.02	20	21	9.3	2.0	1.9	3.4	2.2
M-9BR	Surficial	0.01	6.4	<0.01	<0.03	<0.01	<0.02	4.0	32	4.0	0.6	2.6	1.3	1.1
MWPT-MW-1	Floridan	0.38	10.4	<0.02	<0.06	<0.02	<0.04	2.2	299	15.0	>20	1.3	>20	20.9
MWTP-MW-2	Floridan	0.53	10.7	<0.01	0.03	<0.01	<0.02	7.7	251	15.8	19.3	2.1	>20	16.1

Note: * was calculated from total alkalinity and pH

Table 3b Major anions* and cations for November 2004 (reported in mg/L). Data provided by USF Center for Water Analyses.

Sample	F	Cl	Br	PO ₄	SO ₄	Na	Mg	K	Ca	Si	Ba	Sr	Fe
2-H3 (A-0399)	1.64	11.6	<0.01	<0.01	3.3	24.7	16.9	8.5	27.7	9.9	0.091	0.229	<0.005
2-S (A-0398)	0.03	3.2	<0.01	<0.01	8.6	2.9	0.8	1.2	28.7	2.3	<0.001	<0.010	0.549
3-H1 (A-0396)	0.67	9.8	<0.01	<0.01	4.4	146.0	6.5	133.0	6.3	2.5	<0.001	0.157	<0.005
3-H2 (A-0397)	1.28	5.0	<0.01	<0.01	2.8	112.0	<0.1	100.0	174.0	11.4	0.613	4.190	<0.005
4-H1 (A-0408)	0.18	11.3	<0.01	<0.01	<0.1	7.9	29.1	2.2	62.4	8.8	0.010	0.063	2.915
4-H2 (A-0409)	0.50	9.1	<0.01	0.04	15.5	8.0	5.7	11.0	45.4	11.3	<0.001	0.087	<0.005
4-S (A-0411)	0.27	12.4	<0.01	<0.01	<0.1	8.4	29.2	2.2	57.1	7.5	0.006	0.053	1.854
6-H1 (A-0402)	0.27	11.9	<0.01	<0.01	8.0	24.1	17.2	3.6	38.4	14.1	<0.001	0.050	1.920
6-S (A-0401)	0.04	7.4	<0.01	<0.01	4.3	3.9	0.5	1.1	0.8	3.5	<0.001	<0.010	1.122
F-2	1.00	9.4	<0.01	<0.01	3.0	20.8	20.4	4.1	39.7	13.7	0.068	0.130	0.264
F-3	0.45	12.3	<0.01	<0.01	37.7	14.1	25.5	2.7	65.4	16.0	0.002	0.633	0.038
F-4 (11-12-04)	0.50	12.7	<0.01	<0.01	7.7	11.5	22.0	3.2	66.2	13.1	0.004	0.958	<0.005
F-4 (12-6-04)	0.38	13.5	<0.01	<0.01	85.8	12.7	22.5	3.8	67.0	13.1	0.004	0.983	<0.005
F-6F (A-0404)	0.43	10.8	<0.01	<0.01	22.3	9.5	24.1	2.5	60.0	18.0	0.014	2.000	<0.005
Fairgrounds Well (A-0702)	<0.01	3.0	<0.01	<0.01	4.8	11.2	19.3	3.1	51.9	13.9	<0.001	0.782	0.082
Fairgrounds Well (A-0366)	0.37	12.4	<0.01	<0.01	23.8	9.7	17.5	2.4	44.4	14.8	<0.001	0.303	<0.005
Fairgrounds Well (A-0693)	0.38	9.6	<0.01	<0.01	8.9	1.4	0.1	3.5	1.5	1.3	0.004	<0.010	0.070
FDOT-FL28	0.40	10.5	<0.01	<0.01	15.0	9.8	15.5	2.7	41.6	13.0	<0.001	0.338	<0.005
FDOT-FL32	0.38	9.3	<0.01	<0.01	14.5	5.8	16.6	1.8	45.2	13.4	<0.001	0.361	<0.005
FDOT-H128	0.50	7.8	<0.01	<0.01	1.6	13.6	18.0	2.5	40.0	8.7	0.006	0.102	0.089
FDOT-H132	0.65	14.5	<0.01	<0.01	7.9	9.8	3.0	2.3	21.1	3.1	<0.001	0.070	<0.005
FL Background (0501)	0.35	10.5	<0.01	<0.01	17.2	6.4	17.7	1.8	50.7	11.4	<0.001	0.277	0.047
FL Background (3201)	0.31	8.9	<0.01	<0.01	10.1	7.0	16.4	1.9	49.7	11.4	<0.001	0.223	<0.005
FW-3	0.38	9.3	<0.01	<0.01	0.5	12.6	13.2	17.4	23.5	10.9	0.168	1.340	<0.005
FW-5	<0.01	24.4	<0.01	<0.01	22.4	21.6	20.2	3.2	36.9	13.3	<0.001	0.741	<0.005
FW-6	0.31	10.1	<0.01	<0.01	0.4	21.0	20.5	11.4	43.0	16.1	0.001	0.459	<0.005
FW-7	0.37	9.4	<0.01	<0.01	2.5	23.2	18.2	3.3	44.4	10.9	<0.001	0.191	0.106
FW-8	0.52	13.6	<0.01	<0.01	2.1	9.7	19.3	2.5	51.1	9.0	<0.001	0.231	0.022
FW-9	0.51	13.9	<0.01	<0.01	5.2	10.6	20.7	3.2	59.1	9.3	<0.001	0.770	0.099
HG-4D	0.37	9.4	<0.01	<0.01	<0.1	4.1	19.2	1.7	39.2	8.3	<0.001	0.022	1.448
HG-5D	0.66	5.6	<0.01	<0.01	0.2	6.4	12.6	2.3	30.6	19.9	<0.001	0.024	0.062
LS108-H1 (A-0392)	0.16	10.3	<0.01	<0.01	14.4	86.0	1.5	34.4	1.9	0.8	0.020	0.491	<0.005
LS108-H3 (A-0393)	0.57	8.9	<0.01	<0.01	7.3	75.5	12.3	32.4	13.5	7.3	<0.001	0.200	<0.005
LS108S (A-0391)	0.14	25.7	<0.01	<0.01	9.7	31.8	2.4	2.6	9.4	11.1	0.002	<0.010	2.797
M-23BR	<0.01	24.5	<0.01	<0.01	22.3	11.8	1.8	3.5	2.7	2.5	<0.001	<0.010	0.573
M-9BR	0.01	3.4	<0.01	<0.01	4.3	4.4	0.6	5.2	1.1	1.0	<0.001	<0.010	0.689
MWTP-MW-1	0.31	10.3	<0.01	<0.01	0.1	17.6	30.0	8.7	61.2	21.1	0.028	0.194	0.032
MWTP-MW-2	0.86	10.7	<0.01	<0.01	0.3	20.3	20.0	7.8	45.5	15.9	0.004	0.188	<0.005
WTP Well #11	0.40	15.8	<0.01	<0.01	155.2	13.7	26.5	3.8	87.9	12.5	0.001	2.500	<0.005
WTP Well #3	0.37	15.2	<0.01	<0.01	112.6	11.8	24.3	3.5	74.5	13.2	0.003	1.360	<0.005
WTP Well #4	0.39	14.0	<0.01	<0.01	79.4	13.7	23.2	3.1	67.4	13.9	0.001	0.856	<0.005
WTP Well #5	0.38	17.5	<0.01	<0.01	166.4	15.1	28.1	3.3	85.2	13.0	0.005	1.570	<0.005
WTP Well #9	0.40	12.5	<0.01	<0.01	39.2	7.6	19.8	2.2	54.3	13.9	<0.001	0.635	<0.005

* Nitrite and nitrate, although analyzed were omitted because both were consistently below their detection limit of <0.01 mg/L.

** The cation values for the two wells A-0702 and A-0693 at the fairgrounds are most likely incorrect as given in Table 3b. It seems that the values for Na, Mg, K, Ca, Si, Fe, Ba and Sr in A-0702 belong to A-0693 and vice versa. Whether this mix up happened in the field or in laboratory is unclear. Corrected values are presented in Table 3c. These values are also in much better agreement with the field measurements for these two samples, i.e., conductivity and alkalinity now correspond to the observed Ca concentrations. Whether the bottles that were used for the collection of sample material for the arsenic analysis is unclear, but possible.

Table 3c Corrected Fairgrounds Wells - Major anions* and cations for November 2004 (reported in mg/L). Data provided by USF Center for Water Anayses.

Sample	F	Cl	Br	PO₄	SO₄	Na	Mg	K	Ca	Si	Ba	Sr	Fe
Fairgrounds Well (A-0702)	<0.01	3.0	<0.01	<0.01	4.8	1.4	0.1	3.5	1.5	1.3	0.004	<0.010	0.070
Fairgrounds Well (A-0366)	0.37	12.4	<0.01	<0.01	23.8	9.7	17.5	2.4	44.4	14.8	<0.001	0.303	<0.005
Fairgrounds Well (A-0693)	0.38	9.6	<0.01	<0.01	8.9	11.2	19.3	3.1	51.9	13.9	<0.001	0.782	0.082

* Nitrite and nitrate, although analyzed were omitted because both were consistently below their detection limit of <0.01 mg/L.

Table 4 Selected Trace Elements Including Arsenic (Reported in µg/L). Data provided by Actlabs.

Well	F-2	F3-F	F-4	FDOT-FL28	FDOT-FL32	FDOT-HI28	FDOT-HI32	FW-3*	FW-5	HG-4D	HG-5D	M-23BR	M-9BR	MWPT-MW-1	MWTP-MW-2
Ag	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Al	<2	<2	<2	<2	<2	4	3	2	4	3	6	36	32	3	4
As	0.1	0.03	0.06	0.01	0.1	0.2	0.1	61	2.5	0.5	0.9	4869	7.7	19	0.8
Au	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Ba	52.6	20.3	19.0	14.4	12.1	23.8	21.2	123	10.9	10.9	19.7	15.5	8.4	40.7	28.3
Be	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Bi	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Br	38	45	51	40	39	32	38	81	526	79	26	112	38	41	42
Cd	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	0.02	<0.01	0.03	<0.01	<0.01	0.01	0.05
Co	<0.005	<0.005	0.111	0.073	0.090	0.053	0.017	<0.005	<0.005	<0.005	<0.005	0.235	0.077	0.034	0.026
Cr	<0.5	0.6	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	2.6	0.5	<0.5	<0.5
Cs	0.016	0.009	0.016	0.022	0.012	0.091	0.026	1.25	0.013	0.014	0.045	0.455	0.113	0.147	0.422
Cu	<0.2	0.3	<0.2	<0.2	0.4	<0.2	0.5	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.5	<0.2
Fe	223	162	<10	16	<10	77	<10	44	51	1,370	34	495	478	44	36
Ga	<0.01	<0.01	<0.01	<0.01	<0.01	0.06	0.01	<0.01	0.03	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Ge	0.04	0.05	0.04	0.03	0.03	0.06	0.04	0.13	0.36	0.05	0.07	<0.01	0.04	0.07	0.09
I	5	14	17	13	14	10	9	47	207	20	8	12	5	9	14
In	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.006	<0.001	<0.001	<0.001
Li	4	3	3	2	2	5	4	10	<1	<1	3	<1	<1	5	11
Mn	9.4	10.8	5.1	5.4	2.9	9.3	2.1	3.5	8.4	45.5	15.5	8.3	9.3	21.2	4.2
Mo	2.5	7.2	0.1	0.7	2.0	1.7	5.5	1.4	6.1	1.1	7.8	<0.1	<0.1	5.8	16.4
Nb	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Ni	<0.3	0.4	<0.3	<0.3	<0.3	<0.3	<0.3	1.3	<0.3	0.4	<0.3	1.1	<0.3	0.4	<0.3
Os	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Pb	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	0.01	0.01	<0.01	0.02	0.02	0.02	0.01	<0.01
Pd	0.03	0.04	0.02	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01
Pt	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Rb	2.14	1.95	2.49	2.14	2.04	3.27	3.00	50.5	2.38	1.43	2.54	4.22	2.24	5.80	12.1
Re	<0.001	<0.001	<0.001	<0.001	0.003	0.002	<0.001	0.017	0.024	<0.001	0.025	0.002	0.007	0.007	0.011
Ru	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Sb	<0.01	<0.01	<0.01	<0.01	0.01	0.03	0.03	<0.01	0.04	<0.01	0.02	0.14	0.65	0.18	0.04
Sc	5	4	4	4	4	3	3	4	4	3	6	<1	<1	7	5
Se	<0.2	<0.2	0.2	<0.2	<0.2	<0.2	<0.2	0.3	0.5	0.3	0.4	0.6	0.3	<0.2	<0.2
Sn	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Sr	156	>200	>200	>200	>200	144	163	>200	>200	67.9	77.8	19.7	6.33	>200	>200
Ta	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	0.002
Te	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	<0.1	<0.1
Th	0.002	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.004	0.007	<0.001	<0.001
Ti	2.7	2.6	1.9	2.2	2.2	1.5	1.3	2.5	4.2	1.8	3.5	0.5	0.5	3.9	2.6
Tl	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.003	<0.001
U	0.114	0.012	0.004	0.015	0.009	0.024	0.023	0.021	0.096	0.070	0.016	0.012	0.047	27.5	3.29
V	<0.1	<0.1	<0.1	0.2	<0.1	<0.1	0.3	0.2	0.2	0.2	0.3	2.1	1.3	0.5	0.4
W	<0.02	<0.02	<0.02	<0.02	<0.02	0.08	0.30	0.06	0.61	<0.02	0.03	<0.02	<0.02	0.83	1.61
Y	<0.003	0.007	0.005	<0.003	<0.003	<0.003	<0.003	0.007	0.003	0.004	<0.003	0.104	0.531	0.006	0.005
Zn	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Zr	0.18	0.07	0.05	0.03	0.02	0.04	0.03	<0.01	0.03	<0.01	0.35	0.01	0.04	0.03	0.03

Table 5a Arsenic concentration for filtered and unfiltered samples (Reported in µg/L or ppb) and arsenic species for filtered and acidified samples collected in April and July 2004. DMA and MMA are the two organic arsenic species, dimethylarsinic acid and monomethyl arsonic acid, respectively. Data provided by the USF Center for Water Analyses.

SampleID	As (µg/L) filtered and acidified	As (µg/L) unfiltered and acidified	As (µg/L) filtered only	As ³⁺ (µg/L) As species	DMA (µg/L) As species	MMA (µg/L) As species	As ⁵⁺ (µg/L) As species
4S	-*	-	0.5	-	-	-	-
F-2	0.1		-	<0.5	<0.5	<0.5	<0.5
F3-F	0.03	0.03	-	<0.5	<0.5	<0.5	<0.5
F-4	0.1 (0.1)**	0.1	-	<0.5	<0.5	<0.5	<0.5
FDOT-FL28	0.01	0.03	-	<0.5	<0.5	<0.5	<0.5
FDOT-FL32	0.1	0.1	-	<0.5	<0.5	<0.5	<0.5
FDOT-HI28	0.2	0.2	-	<0.5	<0.5	<0.5	<0.5
FDOT-HI32	0.1	0.1	0.1	<0.5	<0.5	<0.5	<0.5
FW-3	61	55	-	61	<0.5	<0.5	<0.5
FW-5	2.5	2.7	-	2.5	<0.5	<0.5	<0.5
HG-4D	0.5	0.5	-	0.5	<0.5	<0.5	<0.5
HG-5D	0.9	1.3	-	0.9	<0.5	<0.5	<0.5
M-23BR	4870	5260	-	4870	<0.5	<0.5	<0.5
M-9BR	7.7	10	-	7.7	<0.5	<0.5	<0.5
Murphree Well Field	0.4	0.38 (0.37)	0.4	<0.5	<0.5	<0.5	<0.5
MWPT-MW-1	19	18	18	18	<0.5	<0.5	1
MWTP-MW-1 (July)	11.9	-	-	-	-	-	-
MWTP-MW-2	0.8 (0.8)	0.9	1.1	<0.5	<0.5	<0.5	<0.5
MWTP-MW-2 (July)	0.8	-	-	-	-	-	-
SEC 3601 (July)	0.4	-	-	-	-	-	-
SEC 3201 (July)	2.0	-	-	-	-	-	-
SEC 0501 (July)	1.1	-	-	-	-	-	-
EQB (4-13-04)	0.3	-	-	<0.5	<0.5	<0.5	<0.5
EQBI (4-27-04)	0.01	0.01	0.02	<0.5	<0.5	<0.5	<0.5

Notes: *- indicates “not analyzed”

** were analyzed in duplicate

Table 5b Arsenic concentration for filtered and acidified samples (reported in µg/L or ppb) and arsenic species for filtered and acidified samples collected in November 2004 and January 2005.

SampleID	As (µg/L)	As ³⁺ (µg/L)	DMA (µg/L)	MMA (µg/L)	As ⁵⁺ (µg/L)
	filtered and acidified	As species	As species	As species	As species
2-H3 (A-0399)	0.3	<0.5	<0.5	<0.5	<0.5
2-S (A-0398)	0.5	<0.5	<0.5	<0.5	<0.5
3-H1 (A-0396)	2.3	2.3	<0.5	<0.5	<0.5
3-H2 (A-0397)	0.7	<0.5	<0.5	<0.5	<0.5
4-H1 (A-0408)	0.7	<0.5	<0.5	<0.5	<0.5
4-H2 (A-0409)	0.8	<0.5	<0.5	<0.5	<0.5
4-S (A-0411)	0.5	<0.5	<0.5	<0.5	<0.5
6-H1 (A-0402)	1.7	1.7	<0.5	<0.5	<0.5
6-S (A-0401)	0.1	<0.5	<0.5	<0.5	<0.5
F-2	0.2	<0.5	<0.5	<0.5	<0.5
F-3	0.1	<0.5	<0.5	<0.5	<0.5
F-4 (11-12-04)	0.5	<0.5	<0.5	<0.5	<0.5
F-4 (12-6-04)	0.1	<0.5	<0.5	<0.5	<0.5
F-6F (A-0404)	19.2	19.2	<0.5	<0.5	<0.5
F-6F (January)	23.3	-	-	-	-
ADAMS (January)	4.5	-	-	-	-
AAF6934 (January)	8.8	-	-	-	-
AAF6919 (January)	4.7	-	-	-	-
Fairgr. Well (A-0702)	0.1	<0.5	<0.5	<0.5	<0.5
Fairgr. Well (A-0366)	0.1	<0.5	<0.5	<0.5	<0.5
Fairgr. Well (A-0693)	7.1	7.1	<0.5	<0.5	<0.5
FDOT-FL28	2.0	2.0	<0.5	<0.5	<0.5
FDOT-FL32	0.1	<0.5	<0.5	<0.5	<0.5
FDOT-H128	1.4	1.4	<0.5	<0.5	<0.5
FDOT-H132	0.1	<0.5	<0.5	<0.5	<0.5
FL Background (0501)	0.7	<0.5	<0.5	<0.5	<0.5
FL Background (3201)	1.1	1.1	<0.5	<0.5	<0.5
FW-3	50.0	50.0	<0.5	<0.5	<0.5
FW-5	2.0	2.0	<0.5	<0.5	<0.5
FW-6	1.3	1.3	<0.5	<0.5	<0.5
FW-7	197	197.2	<0.5	<0.5	<0.5
FW-8	5.9	5.9	<0.5	<0.5	<0.5
FW-9	12.0	12.0	<0.5	<0.5	<0.5
HG-4D	0.2	<0.5	<0.5	<0.5	<0.5
HG-5D	2.7	2.7	<0.5	<0.5	<0.5
LS108-H1 (A-0392)	0.1	<0.5	<0.5	<0.5	<0.5
LS108-H3 (A-0393)	0.1	<0.5	<0.5	<0.5	<0.5
LS108S (A-0391)	6.8	6.8	<0.5	<0.5	<0.5

SampleID	As ($\mu\text{g/L}$) filtered and acidified	As³⁺ ($\mu\text{g/L}$) As species	DMA ($\mu\text{g/L}$) As species	MMA ($\mu\text{g/L}$) As species	As⁵⁺ ($\mu\text{g/L}$) As species
M-23BR	6040.4	6040.4	<0.5	<0.5	<0.5
M-9BR	17.8	17.8	<0.5	<0.5	<0.5
MWTP-MW-1	7.3	7.3	<0.5	<0.5	<0.5
MWTP-MW-2	0.5	<0.5	<0.5	<0.5	<0.5
WTP Well #11	0.1	<0.5	<0.5	<0.5	<0.5
WTP Well #3	0.3	<0.5	<0.5	<0.5	<0.5
WTP Well #4	0.6	<0.5	<0.5	<0.5	<0.5
WTP Well #5	0.3	<0.5	<0.5	<0.5	<0.5
WTP Well #9	0.1	<0.5	<0.5	<0.5	<0.5

Note: - indicates "not analyzed"

DMA and MMA are the two organic arsenic species, dimethylarsinic acid and monomethyl arsonic acid, respectively. Detection limit for total arsenic is 0.02 $\mu\text{g/L}$ and for individual species 0.5 $\mu\text{g/L}$. Data provided by USF Center for Water Analyses.

Table 6 Isotope composition of selected samples in per mil (‰) relative to the VSMOW (Vienna Standard Mean Ocean Water Standard).

Sample	$\delta^{18}\text{O}$ (‰ VSMOW)	δD (‰ VSMOW)
2-H3	-2.1	-8.7
2-S	-2.6	-11.7
3-H1	-2.4	-12.6
3-H2	-2.3	-12.4
4-S	-2.3	-12.3
6-H1	-2.5	-13.1
6-S	-2.4	-11.9
F-3	-2.0	-10.2
F-4	-1.3	-7.4
F-4	-2.1	-10.8
F-6F	-2.2	-12.6
FDOT-FL28	-1.8	-11.2
FDOT-FL32 (April)	-1.3	-8.9
FDOT-FL32	-2.3	-13.7
FDOT-H128	-2.3	-13.9
FDOT-H132	-2.0	-10.7
FL Background (0501)	-2.7	-14.1
FL Background (3201)	-2.5	-14.2
FW-2	-1.9	-8.5
FW-3 (April)	-1.6	-10.7
FW-3	-2.2	-11.2
FW-5 (April)	-1.3	-8.1
FW-5	-1.7	-8.6
FW-6	-1.9	-11.2
FW-7	-1.6	-10.7
FW-8	-1.9	-11.5
FW-9	-1.5	-9.0
HG-4D (April)	-2.3	-14.4
HG-4D	-2.4	-15.4
HG-5D (April)	-2.6	-16.8
HG-5D	-2.8	-16.9
LS108-H1	-2.2	-12.4
LS108-H3	-2.1	-11.1
LS108S	-2.4	-15.7
M-23BR	-2.1	-13.9
M-23BR	-2.4	-14.0
M-9BR	-3.0	-19.6
M-9BR	-2.7	-15.1
MWTP-MW1 (April)	-1.6	-10.0
MWTP-MW1	-1.7	-11.6
MWTP-MW2 (April)	-1.5	-9.6
MWTP-MW2	-2.1	-9.7
WTP-WELL3	-1.7	-8.2
WTP-WELL4	-1.8	-9.2

Note: Those samples collected in April are indicated. Data provided by Dr. John Humphrey, Colorado School of Mines

FIGURES

Purge Test MWTP-MW-1

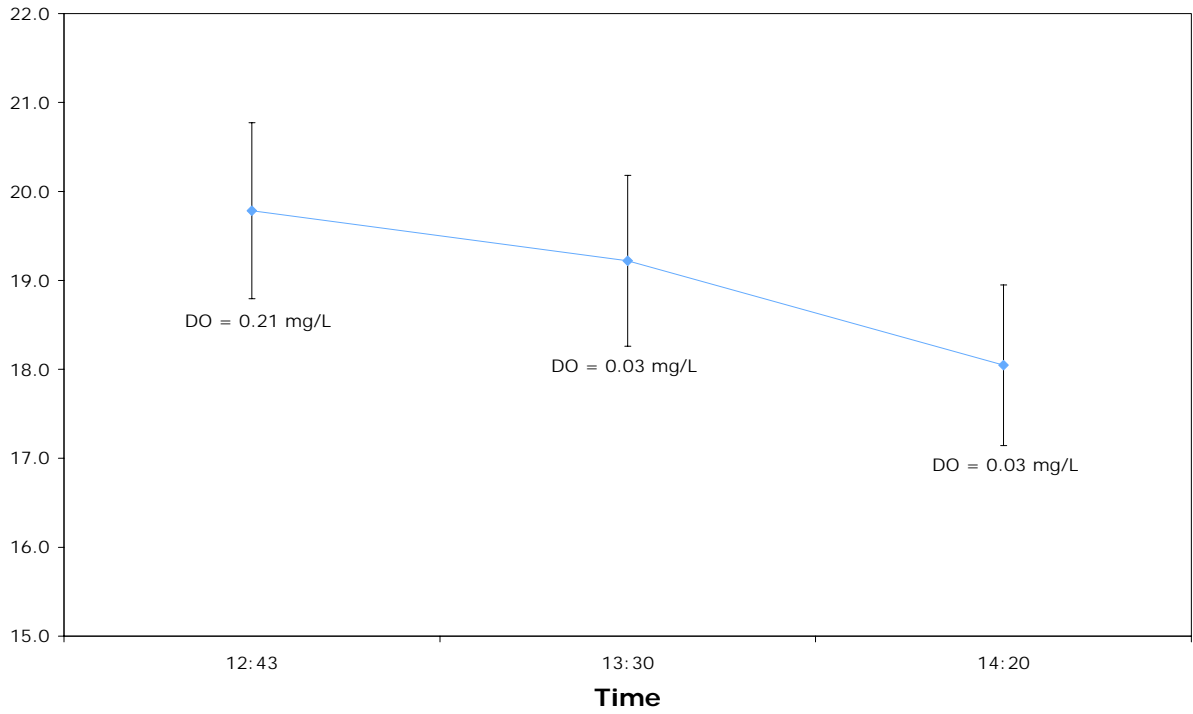


Figure 2 Arsenic (As) Concentration and Dissolved Oxygen (DO) vs. Time for the Purge Test for MWTP-MW-2.

Purge Test MWTP-MW-2

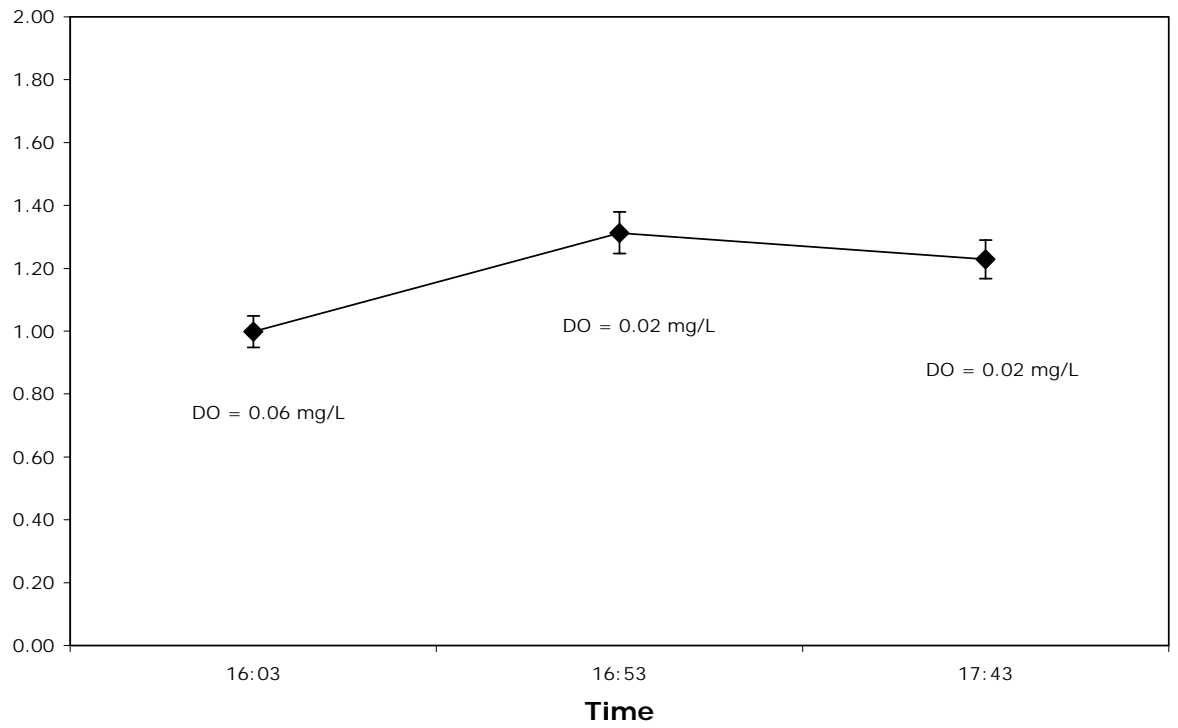


Figure 3 Arsenic (As) Concentration and Dissolved Oxygen (DO) vs. Time for the Purge Test for MWTP-MW-2.

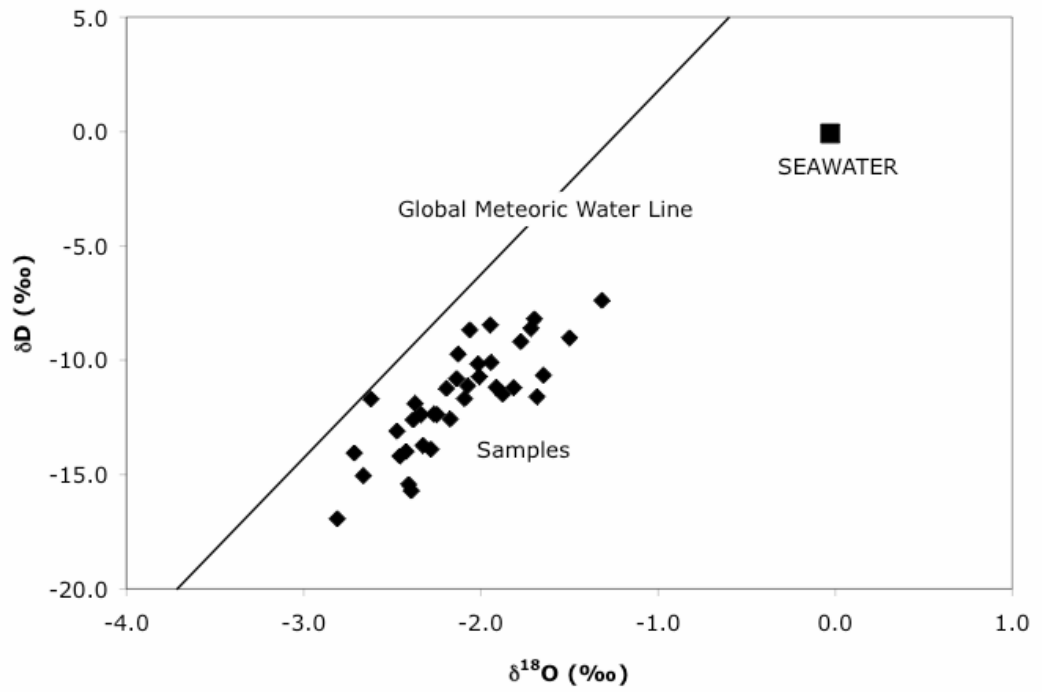


Figure 4 Oxygen and deuterium isotopes in groundwater from the study area compared to the global meteoric water line (GMWL) and seawater. The data set includes all samples that were taken throughout the study.

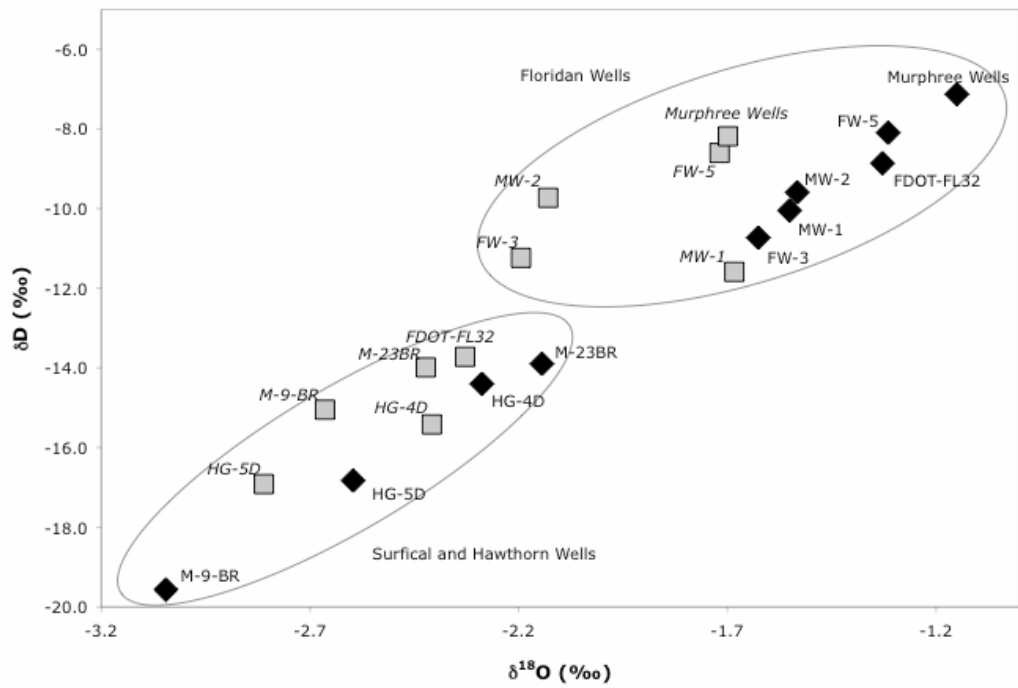


Figure 5 Oxygen and deuterium isotopes in groundwater for those wells that were collected twice throughout the study period. Diamonds (◆) represent the April samples and rectangles (■) represent the November samples.