

Mr. Matthew Preston, P.E.
Project Management Office
Southwest Florida Water Management District
7601 Highway 301 North, Building 1
Tampa, FL 33637

**Re: Review of 4th Quarter Water Quality Sampling Results and
Summary of Four Quarters of Sampling,
March 2016 Sampling Event, Sawgrass Lake Site Restoration Project
Southwest Florida Water Management District
3200 Gandy Boulevard, St. Petersburg, FL 33702
FDEP Facility ID # COM_301769**

Dear Mr. Preston:

At the request of the Southwest Florida Water Management District (the District), Atkins is presenting this review of the results of the fourth quarterly sampling event (March 2016) for the facility referenced above. This document is designed to comply with the requirements of Sections 8.8 and 8.9 of the Remedial Action Plan (RAP), dated April 2007, and the letter from FDEP (Gary Millington, P.E.) to the District (Jennette Seachrist, P.E.), dated July 8, 2014, regarding water quality monitoring at the above-referenced site.

BACKGROUND

A full description of the site location, physical description of the site, and a more detailed discussion of the site history are provided in Section 2.0 of the RAP, dated April 2007. A full description of the lead shot remediation activities performed at this site is provided in the Remediation Completion Report, dated May 2014. What follows is a brief summary.

The Sawgrass Lake Site Restoration Project occupies a portion of the Sawgrass Lake Water Management Area (WMA), which is a largely wetland area owned by the District and located in Pinellas County, FL. From the 1930s until 2004, the Skyway Trap and Skeet Club (Skyway Gun Club), formerly the Lealman Rod and Gun Club, operated a trap and skeet shooting range, which included the use of lead shot. During that time, the western portion of the Sawgrass Lake WMA received lead shot because it was used as the shot drop zone.

Beginning in 1999, multiple studies of the soil, sediment, surface water, and groundwater of the Sawgrass Lake WMA were performed. These studies included sampling and laboratory analytical

testing, which confirmed that the soil, sediment, surface water, and groundwater in the western portion of the Sawgrass Lake site (down-range of the gun club) had been adversely impacted by the lead shot deposited in that area. By 2004, the contamination assessment investigations of the Sawgrass Lake site were largely completed. Elevated concentrations of lead (and some other metals, such as arsenic and antimony) were noted in the soil, sediments, and groundwater of the shot drop zone and areas immediately adjacent to the shot drop zone. In 2004, the Skyway Gun Club entered into an agreement with the District and FDEP, which prohibited the continued trespassing of lead-containing shot onto the District's property.

From 2005 to 2007, the District completed a RAP, which was submitted to FDEP in April 2007. The RAP recommended the excavation and treatment of the lead-impacted soils and sediments from the upland and wetland areas down-range of the Skyway Gun Club. The RAP was approved by the FDEP in December 2007. From 2007 through 2010, the District developed the plans for restoration of the site, including excavation and treatment of lead-impacted media. From 2011 through 2014, the remediation activities recommended in the RAP, as well as additional site restoration activities, were completed by Woodruff & Sons, Inc., the District's construction contractor. The District submitted a Remediation Completion Report to the FDEP in May 2014, which was approved by the FDEP on July 8, 2014. The Remediation Completion Report recommended water quality monitoring at the site, in accordance with Sections 8.8 and 8.9 of the RAP. In the July 8, 2014 letter, the FDEP agreed that remediation of the site was complete, but that water quality monitoring was required in accordance with the RAP.

Section 8.8 of the RAP indicated that four monitoring wells would be installed in the western portion of the District property and would be sampled quarterly (for one year) for certain metals and Total Dissolved Solids (TDS) parameters. The four monitoring wells were installed at the site in 2015. Similarly, Section 8.9 of the RAP indicated that samples of surface water would be collected on a quarterly basis. The surface water samples would be collected from three locations in the lake and one location in Channel 3 upstream of the project area. The surface water samples would be collected quarterly for one year and would be analyzed for lead, hardness, phosphorus, and nitrogen. After one year, the data from the groundwater and surface water sampling programs would be evaluated, and a decision would be made regarding continued monitoring.

The first quarterly sampling event at the Sawgrass Lake Site Restoration Project was conducted in June 2015, the second quarterly sampling event was performed in September 2015, the third quarterly sampling event was performed in December 2015, and the fourth (most recent) quarterly sampling event was performed in March 2016. This report presents the results of the fourth quarter of groundwater and surface water sampling at the Sawgrass Lake Site Restoration Project. The groundwater and surface water sampling locations are illustrated in **Figure 1**.

FOURTH QUARTERLY SAMPLING EVENT (MARCH 2016)

The fourth quarterly sampling event was conducted on March 10, 2016 for the groundwater samples and March 15, 2016 for the surface water samples. The groundwater and surface water samples were collected in general accordance with the Florida Department of Environmental Protection (FDEP) Standard Operating Procedure for Field Activities (SOP 001/01). Sample collection was performed by Atkins personnel, and analysis was performed by Pace Analytical Services, Inc. (Pace). Pace is a NELAC-certified laboratory.

At the time the RAP was prepared, there were five monitoring wells on the project site property (MW-1, MW-2, MW-3, MW-4, and MW-10). All were properly abandoned in 2011, at the beginning of the restoration project, since they would be destroyed by the remediation/restoration activities. After the remediation and restoration activities were completed in 2015, four of the wells were replaced with MW-1R, MW-2R, MW-3R, and MW-4R. Due to the location of the berm, the realignment of the site access road, and the creation of a wetland that encompassed a portion of the former site road, the new (replacement) wells are not located in the exact same locations as the corresponding original wells. The replacement wells are located north, west, or east of the original wells, based on changes to the alignment of the new site access road. MW-10 was not replaced, as that area is now an inaccessible wetland. Groundwater samples were collected from MW-1R, MW-2R, MW-3R, and MW-4R on March 10, 2016.

Groundwater Sample Collection Methodology

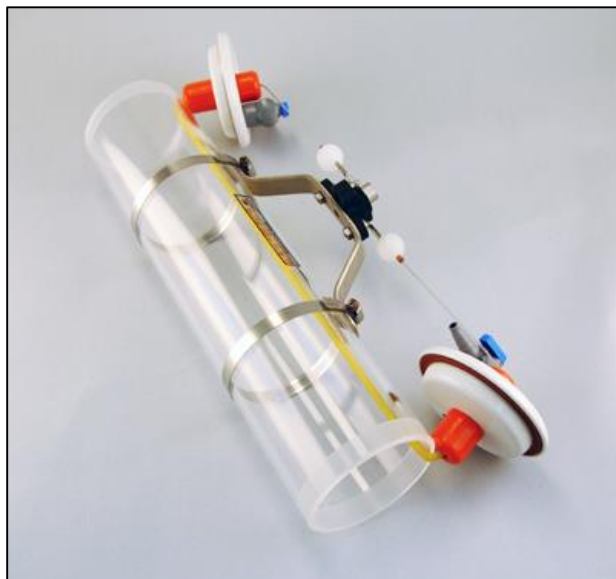
Prior to sampling the monitoring wells, each well was purged with a peristaltic pump using the “low-flow” method. A minimum equivalent of one to three well volumes was purged from each well prior to sample collection. Temperature, pH, conductivity, dissolved oxygen (DO), and turbidity measurements were monitored and recorded throughout the purging process to ensure that representative water samples were collected. The groundwater samples were given identifiers which corresponded to the well of origin. The samples were named using a naming convention that consisted of Sawgrass Lake (SL), the well identification number (for example, MW-1R), and the sampling month (0316, in this case). For example, the sample from MW-1R was labeled “SLMW-1R-0316”. Depth-to-groundwater measurements were made from the top-of-casing (TOC) at each monitoring well prior to initiating the purging process. The groundwater sampling logs and field equipment calibration logs are provided in **Attachment A**.

Each well was sampled for total arsenic, dissolved arsenic, total lead, dissolved lead, calcium hardness, magnesium hardness, total hardness, and TDS. A duplicate sample was collected from MW-1R. All of the samples were placed in laboratory-prepared containers, placed on ice, and carried to Pace for analysis of the analytes listed above.

Surface Water Sample Collection Methodology

Four sampling locations were selected based on compliance with the RAP and water depths within the lake. The first sample location was in the upland cut canal to the south and the remaining three samples were taken from the southwest area of the lake. The samples were named using a naming convention that consisted of Sawgrass Lake (SL) and the surface water location identification number (for example, SW-1) and the depth (in feet) at which the sample was collected (for example, -2). The process consisted of collecting four water samples at the canal sampling location and four samples at the other three locations within the lake. Samples were collected based on water depth, including a surface, one-foot, mid-depth and bottom sample. Samples were collected using a Kemmerer water sampler (see photo below). The device is lowered into the water column to the desired depth, then a weight is dropped down the main line activating two latches which close the outside doors and seal the sample inside the tube without being contaminated by other water.

Each sample was tested for Arsenic, Calcium, Lead, Magnesium, Nitrogen (Kjeldahl, Total), Nitrogen (NO₂ plus NO₃), Phosphorous (Total as P), Total Hardness as CaCO₃, and Total Nitrogen. Arsenic was only tested for during the Q2 and Q3 sampling events to expand testing parameters. All of the samples were placed in laboratory-prepared containers, placed on ice, and delivered to Pace for analysis of the analytes listed previously. The surface water field sampling sheets and YSI calibration logs are provided in **Attachment B**.



Typical Kemmerer water sampling device.

FOURTH QUARTERLY SAMPLING EVENT RESULTS (MARCH 2016)

Groundwater Flow Pattern

Depth to groundwater measurements were collected at the four monitoring wells. The depth to groundwater ranged from 2.83 feet below the TOC at MW-2R to 3.54 feet below the TOC at MW-3R. The water table was up to 0.29 feet higher than during the previous sampling event. As the wells are flush-mounted, the TOC elevation is similar to the ground surface elevation. The layout of the monitoring wells parallel to the shoreline of the open-water wetland area did not lend itself to preparation of a credible groundwater contour map (based solely on the four monitoring wells). It is assumed that the groundwater flow direction is toward the open-water wetland area immediately east across the access road, and ultimately towards Sawgrass Lake. The groundwater flow direction can be assumed to be eastward, towards Sawgrass Lake, which is consistent with previous studies.

Sampling Results

A description of the detections in the groundwater and surface water is presented below.

Groundwater Analytical Results

A summary of the groundwater analytical results is presented in **Table 1**, and the laboratory analytical reports are provided in **Attachment C**. **Figure 2** illustrates the March 2016 concentrations of arsenic, dissolved arsenic, lead, dissolved lead, and TDS on a map of the project site. **Table 1** also provides the corresponding groundwater analytical results from the original monitoring wells for the period from 2000 to 2006, as well as the results from the three prior quarterly sampling events.

The concentrations of all of the parameters analyzed in the groundwater were compared to their respective Maximum Contaminant Level (MCL) or Secondary Drinking Water Standard (SDWS) in accordance with the Florida statutes. The MCLs and SDWSs for Drinking Water Standards, Monitoring, and Reporting are promulgated by Chapters 62-550 and 62-777 of the Florida Administrative Code (FAC). Not every parameter has an MCL or SDWS. There were three analytes detected at concentrations that did not comply with their standards – arsenic, pH, and TDS. Note that lead was not detected in the groundwater during this sampling event or during the prior two sampling events. TDS and pH have SDWS criteria, while arsenic has an MCL, as provided in Chapter 62-550 FAC. A description of the detection patterns with these three analytes is described below.

- pH - The SDWS for pH is any value within the range of 6.5 to 8.5. The pH values at MW-2R and MW-4R (with readings of 6.13 and 6.42, respectively) were less than the standard range of 6.5 (see **Attachment A**). The pH readings at the other two wells were within the standard range. The pH values appear to vary seasonally and from well to well.
- Arsenic –The standard (MCL) for arsenic is 0.01 milligrams per liter (mg/L). The total arsenic concentrations in MW-1R and MW-3R (0.0157 mg/L and 0.0182 mg/L, respectively) exceeded the standard. The dissolved arsenic concentrations at these monitoring wells were generally consistent with the total arsenic concentrations, which suggested that groundwater turbidity was not affecting the arsenic concentrations at these wells. As shown on **Table 1**, elevated arsenic concentrations had historically been detected at MW-1 and MW-3, which were located in the vicinity of existing wells MW-1R and MW-3R, respectively. Arsenic had also been detected at those existing wells during the June 2015 and/or September 2015 sampling events.
- TDS - The SDWS for TDS is 500 mg/L. The TDS concentrations in the samples collected at all four monitoring wells exceeded the standard. The TDS concentrations ranged from 713 mg/L at MW-4R to 2,510 mg/L at MW-1R. As shown in **Table 1**, the TDS concentrations in the existing monitoring wells are considerably higher than in the corresponding former wells (sampled in 2006). From December 2015 to March 2016, there were increases in the TDS concentrations at all of the wells.

With the exception of the specific results discussed above, the groundwater quality results from the March 2016 sampling event were in the same general range as the results from the June and September 2015 sampling events, and the arsenic and TDS values were slightly elevated in comparison to the December 2015 sampling event. During March 2016, it was noted that conductivity readings ranged from two to five times higher in the groundwater (at MW-1R, for example) than in the surface water. The total hardness values in the groundwater ranged from two to nearly ten times higher than the surface water.

Surface Water Analytical Results

A summary of the surface water analytical results is presented in **Table 2**, and the Pace analytical report is provided in **Attachment D**. **Table 3** presents a summary of the field measurements collected by Atkins staff with the YSI sonde, including: temperature, specific conductivity, salinity, pH, dissolved oxygen (total and %), and turbidity. The data was collected on March 15, 2016, and 0.0 inches of rain was observed the previous day at the St. Pete – Clearwater Airport. The non-native plant, Hydrilla (*Hydrilla verticillata*) was also observed in the lake during the sampling, but not as wide-spread as during the December 2015 sampling event. **Figure 3** illustrates the March 2016 mean concentrations of lead, hardness, total phosphorus, and total

nitrogen on a map of the project site. **Table 2** also provides the corresponding analytical results compared to the original surface water sampling on April 12, 2007.

There were several analytes tested for in the surface water samples. The concentration of every analyte that was detected in the surface water sample was compared to the FDEP surface water quality standards (if a standard existed for that analyte) found in Chapter 62-302, FAC and mean values recorded from pre-construction bench scale sampling.

- Arsenic – testing of this heavy metal was added for the second and third quarterly sampling events. Arsenic was undetected at every location during the previous sampling; therefore, it was removed from fourth quarterly sampling event to reduce lab costs.
- Lead – the surface water criteria for lead was identified as being ≤ 8.68 $\mu\text{g/L}$. All of the surface water samples resulted in readings less than the Laboratory Method Detection Limit (MDL), resulting in no lead detection. The mean value was measured at 10 $\mu\text{g/L}$ prior to construction.
- Total Phosphorus – all four samples collected at station SLSW-1 reported a readings below the mean value bench scale of 102 $\mu\text{g/L}$ recorded during the April 2007 sampling.
- Total Nitrogen – sample values ranged from a low of 610 $\mu\text{g/L}$ the canal portion of the Lake to a high of 810 $\mu\text{g/L}$ in open portion of the Lake, which were all below the mean value bench scale reading of 8,188 $\mu\text{g/L}$ from April 2007.
- Nitrogen, NO_2 plus NO_3 – the mean value bench scale was measured at an average of 32.1 $\mu\text{g/L}$ in 2007. Two samples exceeded the bench scale average at station SLSW-1 measuring 35 $\mu\text{g/L}$ near the top of the water column (SLSW-1-0 and SLSW-1-1). The three remaining stations had readings below the bench scale value at all of the sampled water depths.
- Nitrogen, Kjeldahl, Total – all of the samples collected during March 2016 were below the pre-construction mean of 7,863 $\mu\text{g/L}$. The collected samples during the fourth quarterly sampling event ranged from 580 $\mu\text{g/L}$ to 800 $\mu\text{g/L}$.
- Hardness as CaCO_3 – collected values ranged from 142,000 $\mu\text{g/L}$ to 194,000 $\mu\text{g/L}$, which were all below the April 2007 mean bench scale value of 220,000 $\mu\text{g/L}$ from April 2007.
- Calcium - collected values ranged from 48,300 $\mu\text{g/L}$ to 66,100 $\mu\text{g/L}$, which were all below the mean bench scale value of 75,500 $\mu\text{g/L}$ from April 2007.

- Magnesium - collected values ranged from 4,700 µg/L to 6,960 µg/L, which were all below the previous mean bench scale value of 7,813 µg/L from April 2007.
- pH – The SDWS for pH is any value within the range of 6.5 to 8.5. At station SLSW-1, the four samples collected had pH values that ranged from 6.30 to 6.37, which is slightly below the SDWS. At SLSW-4-9, the pH value was 5.78, which is also below the SDWS. All of the pH readings at each measured depth at the other sampling locations were within the accepted SDWS standard range.
- Dissolved Oxygen - concentrations ranged from 1.80 mg/L to 84.5 mg/L. Two readings of 3.87 mg/L at SLSW-1-4 and 1.80 mg/L at SLSW-4-9 did not meet the surface water criteria for dissolved oxygen which is ≥ 5 mg/L. The low dissolved oxygen levels in these samples were recorded at the bottom of the water column at their respective sampling station. All of the other samples collected were above the ≥ 5 mg/L requirement.
- Salinity – values ranges from 0.19 ppt to 0.25 ppt, with little variation between depth and location.
- Specific Conductivity – the field measurements collected with the YSI sonde ranged from a low of 405 µS/cm to high of 512 µS/cm at sample station SLSW-1-4 in the canal portion of the lake.
- Turbidity – values at each site were very consistent between sample locations, with a small range from 1.8 NTU to 7.2 NTU.
- Temperature (water) – readings were between 22.62 °C at depth and 26.10 °C at the surface of the lake.

SUMMARY AND CONCLUSIONS

The results of the fourth quarterly sampling event at the Sawgrass Lake Site Restoration Project were generally consistent with the results of the prior three quarterly sampling events (June 2015, September 2015, and December 2015) and with previous (2000 to 2007) sampling events, with some exceptions, as discussed below.

There were three analytes detected in the groundwater that did not comply with their regulatory standards: arsenic, pH, and TDS were detected in the groundwater at concentrations in that did not comply with their regulatory criteria. Lead was (again) not detected in the groundwater samples. Findings of low pH (ranging from 6.13 to 6.42) were identified at two of the four monitoring wells. The arsenic concentrations at MW-1R and MW-3R were consistent with

previous sampling events (prior to December 2015), where elevated arsenic concentrations had been detected. TDS concentrations were higher than the pre-2011 data collected from the corresponding wells. The significantly elevated TDS concentrations detected in all four monitoring wells may be the result of the recent site remediation/restoration activities implemented beginning in 2011, as they have no historical precedent. The TDS concentrations in all of the monitoring wells increased between the December 2015 and the March 2016 sampling events.

There was one analyte measured in the surface water that exceeded the mean bench scale readings from April 12, 2007 during the fourth quarter (March 15, 2016) sampling event. The Nitrogen, NO₂ plus NO₃, was elevated at two sample locations (SLSW-1-0 and SLSW-1-1) and these samples were also elevated during the December 2015 sampling event, as shown in **Table 2**. All of the pH values at station SLSW-1 and one value at SLSW-4-9 had readings during the fourth quarter sampling outside of the acceptable SDWS pH range of 6.5 to 8.5. Dissolved oxygen readings at SLSW-1-4 and SLSW-4-9 were below 5 mg/L which do not meet the surface water criteria for dissolved oxygen, which is ≥ 5 mg/L. During the March 2016 sampling event, there was vegetation covering the water column in the canal portion of the lake, where some of these elevated values occurred. All of the surface water samples that were tested for arsenic and lead during the previous year returned results that were less than the laboratory MDLs. As observed during the previous three sampling events, the total hardness and conductivity data collected in March 2016 revealed significantly lower readings in the surface water compared to the values determined from the groundwater sampling.

RECOMMENDATIONS FOR SITE CLOSURE BASED ON REVIEW OF FOUR QUARTERS OF WATER QUALITY DATA

This section summarizes the significant results of four quarters (June 2015 through March 2016) of water quality sampling at the Sawgrass Lake Site Restoration Project and provides recommendations for site closure. The primary purpose of the restoration project was to remove the lead from the soils and sediments of the site down-range of the shooting range. Lead was not detected once in the surface water samples collected, and lead was detected only once (at MW-3R in June 2015) in the groundwater at a concentration (0.018 mg/L), which exceeded its MCL of 0.015 mg/L. Lead was not detected in the groundwater during the subsequent three quarters.

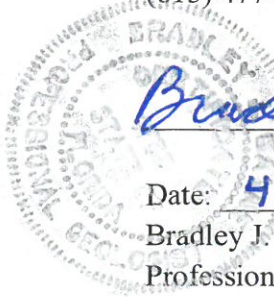
The pH values in the groundwater were less than the SDWS range of 6.5 – 8.5 at one or more of the monitoring wells during each sampling event. The pH values were typically in the 6.1 – 6.7 range, but they frequently were in compliance with the SDWS range. It should be noted that the pH values from the corresponding wells sampled in 2006, prior to the site's restoration, were in the 4.9 – 6.3 range. The quarterly sampling activities appear to indicate that pH conditions vary seasonally and from well to well. The pH conditions appear to be slightly better than prior to the site's restoration.

Arsenic was detected in at least one monitoring well at concentrations greater than its MCL (of 0.010 mg/L) during three of the four quarterly sampling events. The December 2015 sampling event was the only sampling event during which arsenic was not detected in the groundwater. The arsenic concentrations were highest at MW-3R (0.0313 mg/L – 0.0324 mg/L) during June and September 2015. Based on only four quarters of data, Atkins cannot predict whether the arsenic concentrations will decrease to the point that they will consistently be less than their MCL.

TDS concentrations were consistently much higher than their SDWS (of 500 mg/L) at all of the monitoring wells during each sampling event. The elevated TDS concentrations may be related to the remediation activities, and there was no indication from the four quarters of groundwater sampling to suggest that the TDS concentrations would eventually decrease to less than their SDWS.

The only laboratory constituents in the surface water that were consistently detected at elevated concentrations were nitrogen (NO₂ plus NO₃) and phosphorus, and these detections were generally limited to the upstream sample location (SLSW-1). Conductivity values and hardness concentrations in the groundwater were typically two to five times the corresponding values in the surface water. Based on the significant differences between the conductivity values and the hardness concentrations in the groundwater versus the surface water, the groundwater conditions are not impacting the surface waters. Arsenic and lead were not detected in the surface waters.

It appears that impacts to the site from lead have been successfully remediated. However, concentrations of arsenic and TDS in the groundwater remain at levels that exceed their regulatory criteria. Atkins has reviewed the analytical results from all four quarterly sampling events and, based on the collected data, Atkins recommends that the site owner should pursue a Site Rehabilitation Completion Order (SRCO) *with Conditions*. It is unlikely that additional sampling will consistently provide results for arsenic groundwater concentrations that are less than the MCL at all monitoring wells. It is also very unlikely that TDS concentrations will subsequently be reduced to less than 500 mg/L at all of the monitoring wells. Therefore, continued groundwater monitoring will not likely show results that could achieve a SRCO *without Conditions*. If you have any questions regarding the information presented in this report, please contact Atkins at (813) 477-7275 or bradley.bayne@atkinsglobal.com.



Bradley J. Bayne

Date: 4-15-16
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