

Memorandum

Florida Department of Environmental Protection

TO: Jennifer Gihring, Watershed Planning and Coordination Section

FROM: Rick Hicks, Ground Water Protection Section

DATE: September 3, 2009

SUBJECT: Findings of Reclaimed Water Sampling Event, Wekiva BMAP Area

In early August 2009, representatives of the Ground Water Protection Section visited three sites to collect reclaimed water samples and a container nursery site to collect ground water samples from an area not influenced by reclaimed water discharge. The purpose of this sampling was to attempt to identify distinct chemical characteristics of reclaimed water that could be used as tracers and to determine nutrient concentrations of reclaimed water at different locations.

Analytes

Analytes included chloride, nitrogen species, potassium, boron, and trihalomethanes (THMs) which would be residual from chlorination. In addition, samples were collected for future analysis by the University of Northern Arizona Stable Isotope Laboratory for $\delta^{15}\text{N}$ and $\delta^{18}\text{O}$ in NO_3 , which are isotope tracers used to help differentiate between inorganic and organic sources of nitrogen. All the results except the stable isotopes are reported herein. Isotope samples have not yet been analyzed.

Sampling Summary

The sampling sites are shown in **Figure 1**.

At the Wekiva Hunt Club wastewater treatment facility, we collected ground water samples from two surficial-aquifer monitoring wells, one located adjacent to and downgradient from a rapid infiltration basin (RIB) and one near the water treatment plant. These two wells were the ones in the monitoring network at the facility with the highest nitrate concentrations from quarterly monitoring records. In addition, we collected a sample of reclaimed water effluent, which is the water that is discharged to the three RIBs at the facility and delivered as golf course and residential irrigation water.

At the Wekiva Country Club, we collected a sample of water used for irrigation at the golf club. This was taken at the pump station that receives reclaimed

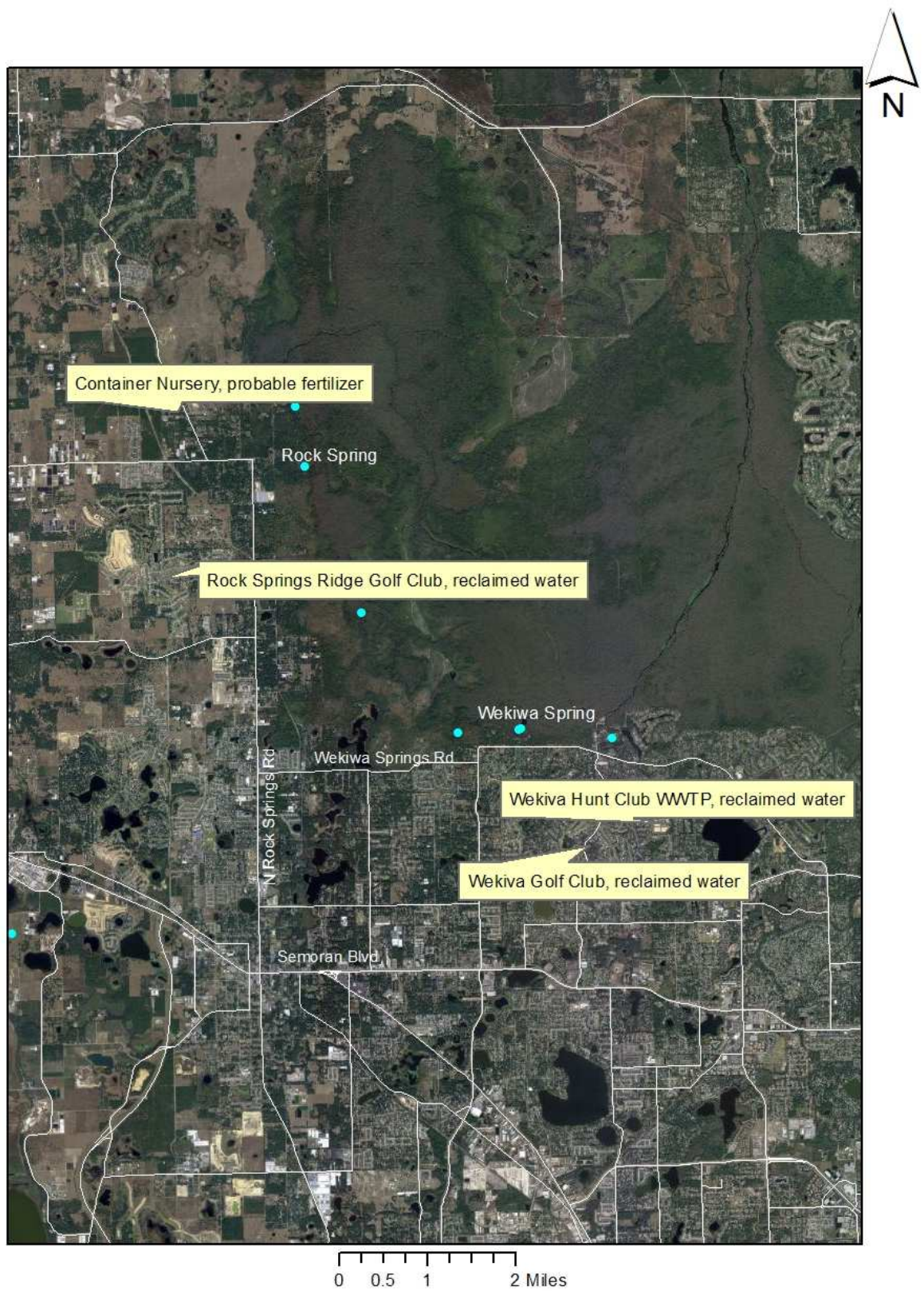


Figure 1- Sites included in study

water from the Wekiva Hunt Club plant. Additionally, we collected a water sample from a sprinkler head on the golf course for THMs.

At Rock Springs Ridge Golf Course, we collected samples from the two reclaimed water ponds on the site (2A and 8A) from which all of the golf course irrigation water is pumped. The source of the reclaimed water at this golf course is the City of Apopka. In addition, we collected one aerated sample of water at the pond 8A pump station, which was used to simulate water pumped from a sprinkler head.

As a control, we collected ground water samples from an area of potential fertilizer impact which was intended to be sampled in a previous episode. These included two Floridan aquifer supply wells a short distance west of Rock Springs. One sample was collected from an irrigation well at a container nursery and the second sample was collected from a residential well located to the east. This home also has two in-service septic tanks, one for gray water and one for domestic waste.

Results

The chemical results are shown in **Table 1**.

The Wekiva Hunt Club WWTP is the source of reclaimed water discharged to the onsite RIBs and used as irrigation water by the nearby Wekiva Golf Club. The data show that there is very little difference between the water quality of the plant effluent and the water received at the Wekiva Golf Club (Hunt Club Effluent and Wekiva Golf Club, respectively, in **Table 1**). NO₂NO₃-N concentrations in both are about 7 mg/L and chloride, boron, and potassium concentrations are also very similar. Total Kjeldahl nitrogen (TKN) concentrations in both samples were low but similar. The Wekiva Golf Club effluent sample had a higher total THM concentration than the plant effluent, probably because of the difference between sampling ports. The high level of flow from the plant effluent pipe made sampling for volatile organics very difficult whereas the golf club station had a valve that was more easily controlled. The sample from the Wekiva Golf Club sprinkler (Wekiva Golf Club Sprinkler, in **Table 1**) showed that aeration at the sprinkler head partially volatilized the THMs, but a significant concentration still remained.

Upon comparison, the Wekiva Hunt Club monitoring wells had very different NO₂NO₃-N concentrations, whereas the other indicator parameter concentrations were similar. The well adjacent to the RIB (MWB-2, in **Table 1**) had a much lower NO₂NO₃-N concentration, most likely due to denitrification. However, the NO₂NO₃ concentration in the well adjacent to the plant (MWC-3, in **Table 1**) was very similar to the effluent sample concentration, showing little

to no nitrate reduction. It appeared that the THMs in the effluent were significantly volatilized as they migrated through the soil profile to the surficial aquifer. None were detected in the RIB monitoring well, however a low-level detection was found in the well sample from near the plant. Boron, chloride, and potassium concentrations in the effluent and the monitoring wells were elevated and all nearly the same in both well samples. TKN concentration was similar in both samples, but low.

Reclaimed water samples were collected at the Rock Springs Ridge Golf Club from the two ponds used to store reclaimed water used for irrigation (SR-2A and RSR-8A, respectively, in **Table 1**). When they were sampled, both ponds were hypereutrophic, laden with algae, and had a strong organic odor. NO₂NO₃-N concentrations in both ponds were very low and THMs were not detected. However, boron and chloride concentrations were significant in both pond samples. TKN in both pond samples was higher than the effluent samples from the other sites, which was probably due to organic material in the ponds and not from the effluent. The sample from the pond 8A transfer pump (RSR-8A-P, in **Table 1**) contained no detectable THM concentrations.

Control samples were collected from an area to the north of Rock Springs Ridge Golf Course where there is no reclaimed water use. This area is, however affected by fertilizer and, to a lesser extent, septic tank influences. In this area, two private wells that withdraw water from the Floridan aquifer were sampled; an irrigation well at a container nursery and a well at a private residence (JG-1 and Longhorn-1, respectively, in **Table 1**). Both of these wells appear to be in an eastward-trending plume of nitrate contamination based on Florida Department of Health private well sampling data and the SJRWMD potentiometric surface data (**Figure 2**). The most significant result from this area is the elevated NO₂NO₃-N concentration in the irrigation well sample (18 mg/L). Concentrations of boron, chloride, and potassium are much lower in these two well samples than the reclaimed water, pond, and monitoring well samples from the other sites. The chloride and potassium levels are consistent with ambient ground water concentrations for the Floridan aquifer in this area (per FDEP OGWIS database). The OGWIS database does not have ambient Floridan-aquifer water quality for boron. Low-level concentrations of THMs were detected in the residential well sample but not in the irrigation well sample. The homes in this area are on well water and the chlorine source is not known.

Observations

- The reclaimed water effluent NO₂NO₃-N concentration from the Wekiva Hunt Club plant and Wekiva Golf Club was about 7 mg/L. We would expect that the water routinely applied to these sites would be similar.

- The irrigation ponds at Rock Springs Ridge Golf Club appear to provide treatment of the reclaimed water, reducing the $\text{NO}_2\text{NO}_3\text{-N}$ concentrations to very low levels. Reclaimed water used for irrigation water at this golf course is therefore very low in nitrogen.
- The data from the Wekiva Hunt Club effluent and monitoring wells and the Rock Springs Ridge Golf Club effluent show that boron and chloride (and to a lesser extent potassium) may be good tracers of reclaimed water influence. Monitoring wells at the Wekiva Hunt Club plant showed boron and chloride to be highly conservative. Boron and chloride concentrations were also significant in the Rock Springs Ridge Golf Course irrigation ponds, suggesting that despite the “treatment” provided by the ponds, these tracers may remain as artifacts of the reclaimed water.
- Total THMs do not work very well as tracers of reclaimed water because of their high volatility. The two monitoring wells at the Wekiva Hunt Club plant, where reclaimed water is discharged, had very low to non-detect concentrations, much lower than the THM concentration in the effluent.
- Our previous work with septic systems has shown that septic tank drainfield effluent has boron and chloride at concentrations very similar to the reclaimed water concentrations. However, in areas where homes are on city sewer, boron and chloride would still serve as good tracers of reclaimed water influence if a source of reclaimed water is present.
- Boron was included in the analytical suite from the previous sampling episode (March 2009) and was at high concentrations in one of the MACTEC monitoring wells adjacent to the Wekiva Golf Club (MW-16). In addition, the three episodes of sampling by MACTEC, which did not include boron, also showed elevated chloride in several monitoring wells near this golf club. Homes in this area are on sewer, so these findings suggest reclaimed water influence. Lawns at these homes are fertilized so it would be difficult to attribute the moderate to low nitrogen concentrations in these wells to any specific source.
- The March 2009 sampling also found boron at somewhat elevated concentrations in several of the residential well samples, some of which could be in areas influenced by reclaimed water, septic tanks or wastewater from package plants. In addition, the boron concentration in Wekiwa Spring in the March 2009 sampling was also elevated in comparison to the concentration in Rock Spring and the control samples collected during the August 2009 sampling episode.
- The irrigation well data from the container nursery suggests that this site and similar ones could be significant sources of $\text{NO}_2\text{NO}_3\text{-N}$ to ground water and thus the springs. However, this is would be a separate discussion.

Table 1- Sampling Results

Station	Source	Chloride (mg/L)	Ammonia- N (mg/L)	Kjeldahl N (mg/L)	NO ₂ NO ₃ - N (mg/L)	Boron (Ug/L)	Potassium (mg/L)	Total THM
Wekiva Hunt Club Wastewater Treatment Plant								
Hunt Club Effluent	Reclaimed Water Effluent	61	0.024	0.97j	7.5	207	9.0	34
MWB-2	Monitoring well near RIB (surficial aquifer)	44	ND	0.22	0.60	224	5.1	ND
MWC-3	Monitoring well at plant (surficial aquifer)	53	ND	0.28	5.9	222	7.8	1.1
Wekiva Golf Club								
Wekiva Golf Club	Reclaimed water pump station	58	0.065	0.81	6.3	215	9.3	65.1
Wekiva Golf Club Sprinkler	Fairway sprinkler delivering reclaimed water	NS	NS	NS	NS	NS	NS	38.7
Rock Springs Ridge Golf Club								
RSR-2A	Reclaimed water irrigation pond 2A	24	0.064	1.1	0.015	76	3.4	ND
RSR-8A	Reclaimed water irrigation pond 8A	39	0.22	2.5	0.025	132	6.0	ND
RSR-8A-PS	Aerated sample from pump station delivering water from pond 8A	NS	NS	NS	NS	NS	NS	ND
Container nursery and downgradient residential well								
JG-1	Irrigation well at container nursery (Floridan aquifer)	9.0	ND	ND	18	26i	2.4	ND
Longhorn-1	Residential well downgradient from nursery (Floridan aquifer)	15	ND	ND	2.4	29i	1.4a	0.21i

Notes:

j-estimated value

ND-not detected

NS-not sampled

a-value reported is the mean of two or more determinations

i-value reported is between the laboratory method detection limit and the laboratory practical quantitation limit

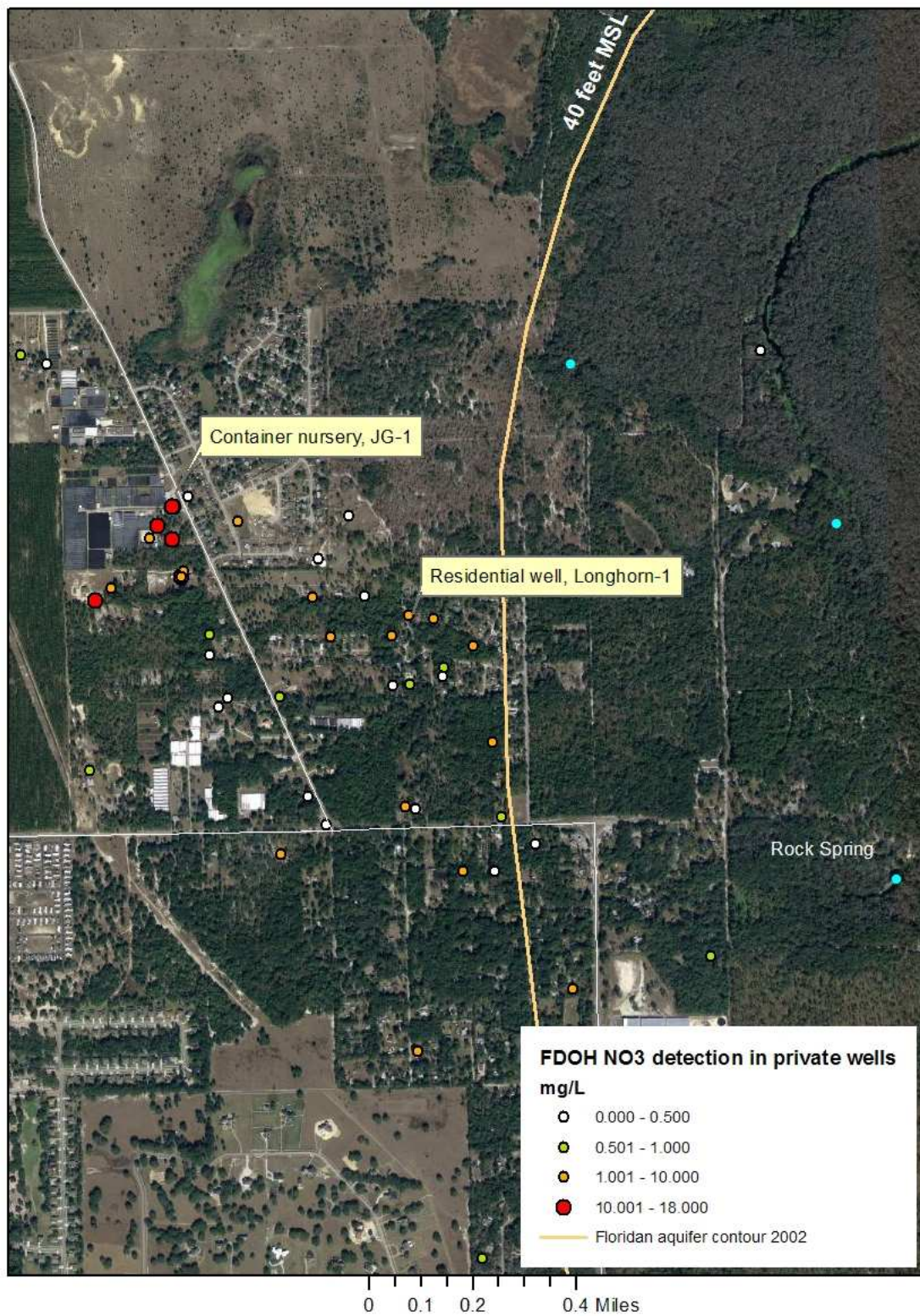


Figure 2-Control area sampling locations