

Weeki Wachee Spring and River Basin Management Action Plan

Meeting Summary

Wednesday, July 9, 2014

3:30 PM – 5:30 PM

Weeki Wachee Springs State Park – Enchanted Ballroom
6131 Commercial Way, Spring Hill, Florida 34606

Attendees

Clay Black, Hernando County	Christine Lynch, Pasco County
Alys Brockway, Hernando County	Sine Murray, FDEP
John Burnett, Hernando County	Marcy Policastro, Wildwood Consulting
Tiffany Busby, Wildwood Consulting	Jeff Priddle, ERC Florida
Michael Czerwinski, MGC Environmental	Erin Rasnake, FDEP
Dave DeWitt, SWFWMD	Dale Ravencraft, GPI
Holly Edmond, FDACS	Mary Szafraniec, AMEC
Terry Hansen, FDEP	Nico van Dyk, Citizen
Janet Hearn, ATM	Dawn Velsor, Hernando County

Presentations

Meeting presentations are located at: http://publicfiles.dep.state.fl.us/DEAR/BMAP/SpringsCoast/BMAPs/WW_BMAP/ in the appropriate month folder.

Introduction

Terry Hansen welcomed everyone to the Weeki Wachee Spring and River Basin Management Action Plan (BMAP) meeting. The participants introduced themselves and the entity they represent.

Terry presented a map of the Springs Coast, and noted that total maximum daily loads (TMDLs) have been adopted for Weeki Wachee and Kings Bay. TMDLs will be adopted by the end of the year for two more springs, and those BMAPs will likely start early next year. The rest of the major springs in the area also have TMDLs under development. Terry noted that it is important for the local governments to keep the bigger picture in mind because there are more impairments in the area than just Weeki Wachee. The regional perspective should be considered when planning projects.

The Weeki Wachee TMDL includes a curve of the population in Hernando County and the nitrate concentration in the system over time. The increase in nitrate mirrors the increase in population, which indicates that human sources are causing the nitrate impairment. The BMAP boundary is the springshed. The TMDL for the spring requires a 71% reduction to achieve nitrate targets, and the TMDL for the river requires a 76% reduction. These targets are where the Florida Department of Environmental Protection believes the waterbodies will meet their designated uses. The river and spring were listed as impaired because there is too much algae in the system. Therefore, there may need to be another way to measure improvement because the algal mats might not go away even when the nitrate target concentrations have been achieved. Mary Szafraniec will discuss options for other ways to measure improvements later in the meeting.

Terry stated that the goal of the BMAP is to come up with projects to reduce the nutrient footprint within the area that impacts the spring and river. The Department is aware that the required reduction is large; however, a large percent of the load to the river and spring is a residual load from past practices,

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such as citrus lands that are no longer in production. Terry noted that it will take a while to meet the TMDL target, but the BMAP will document the reductions that will be seen in the spring and river in the future. The BMAP components include a description of how to address future growth in the basin, what projects will be implemented to make reductions, how to assess progress towards the TMDL, and how to modify the plan, if needed.

The land use in the springshed is 27% residential, 23% forest, 23% agriculture, and 15% wetlands. There are different types of projects to address the nutrient footprints from different sources. Terry stated that during the next meeting, he hopes to review the draft nutrient source inventory for the basin, which will help to determine the sources of load to the spring and river.

Terry stated that during the last meeting, a participant asked how the Weeki Wachee TMDL would be integrated in the numeric nutrient criteria (NNC) process. The NNC give a set number for nutrients in a waterbody, instead of the current descriptive nutrient criteria. The NNC developed by the Department need to be approved by the U.S. Environmental Protection Agency (EPA). A suit was recently filed with EPA on this process, so EPA approval is still pending.

The question from the last meeting was about the nitrate TMDL for the river, which did not include limits for total nitrogen (TN), total phosphorus (TP), and chlorophyll-*a*, which are required for the streams NNC. The NNC process uses a hierarchical approach to determine the criteria for a waterbody. TMDLs are at the top of the hierarchy because they provide site-specific information for the waterbody instead of the regional criteria. EPA has to approve a TMDL as the NNC for a waterbody, and the TMDL will supersede the NNC only for the parameters in the TMDL. The regional NNC parameters will continue to be monitored but are not the priority since they are not the cause of the impairment. The TMDLs for springs will supersede the NNC of 0.35 milligrams per liter (mg/L), and the Weeki Wachee Spring TMDL is more stringent than the NNC. For the Weeki Wachee River, the BMAP will focus on addressing nitrate since that is the TMDL target. However, if monitoring shows that the TN, TP, and/or chlorophyll-*a* stream NNC are not met, there may be a need for another TMDL. Terry noted that he will post this presentation on the BMAP website so that the participants can review the details of the NNC process.

Dave DeWitt asked if there could there be a case where a nitrate TMDL target would be greater than the 0.35 mg/L NNC target for springs. Terry responded that none of the springs TMDLs will be above the 0.35 mg/L value. However, there could be rivers above the NNC, such as in the Bone Valley area where the waterbodies cut through natural sources of phosphorus. The Department would have to show that the TMDL target is adequate to protect the waterbody.

Hydrogeology of Weeki Wachee

Dave stated that the Southwest Florida Water Management District's (SWFWMD) Northern Ground Water Basin extends from Pasco County northward, and is about 4,600 square miles. The Weeki Wachee springshed is small part of this basin, and is about 250 square miles. The ground water in this area is from the Upper Floridan aquifer, and there are springs all along the coastal area. The Brooksville Ridge runs north to south near the coast. This area has a limestone bedrock forming the aquifer, with overlying sediments. These sediments are important because water has to infiltrate those sediments before recharging the aquifer. There are a lot of areas of deep sand in the Spring Hill region before the water reaches the limestone; therefore, this is a high recharge area that is important for springs flows.

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This area does not have a surficial aquifer because of the permeable sands. This area is mostly Ocala Limestone with the underlying Avon Formation. There are some places where the limestone is close to the surface so there are sinkholes and swallets, which is important for direct localized recharge. To the west of the ridge, there are a lot of closed topographic depressions, including in the Weeki Wachee springshed. Terry noted these closed depressions are low spots where water collects. If there was clay in this region, these depressions would be lakes but the sand in this area creates almost a direct discharge to the ground water. Dave added that some of the closed depressions are ephemeral lakes.

Dave stated that Weeki Wachee Spring and Twin Dees Spring are both located on park property. There are other springs that are located downstream, many of which are brackish and tidally influenced. Weeki Wachee Spring is a freshwater and 1st magnitude spring. Eagles Nest, which is located north of Weeki Wachee, is a karst feature with a cave system. The major conduits are about 200-250 feet below water level at Eagles Nest, so this is a main conduit to the spring. There are also cave conduits beneath Weeki Wachee Spring, which continued to be dived and explored to learn about the system. Twin Dees is a 3rd magnitude spring, and when water levels are low, it has little or no flow. Mary asked if Twin Dees Spring always flows clear or if it sometimes has color. Dave responded that it is usually clear but it could have a little color during low flows. Twin Dees Spring has very similar chemistry to Weeki Wachee Spring.

Dave showed a composite map of cave diagrams from diving surveys between 1995 and 2013. Divers cannot get into Weeki Wachee during high flows, so it can only be mapped during low flow conditions. The cave systems between Weeki Wachee Spring and Twin Dees Spring are similar and at similar depths. It looks like the two cave systems may be connected but there is no information to show that yet. While there is good information about the caves near the springs, only a small area has been mapped compared to the overall springshed.

Ground water flow is driving the system, and the flow is based on potentiometric surface. Ground water moves by gravity and hydraulic pressure from southeast to northwest, and the water eventually discharges at the spring. The U.S. Geological Survey (USGS) has been measuring discharge at the spring for many years. Dave presented data from last 20 years as the medians of monthly averages. There are high flows during the end of the summer months. Then, in the winter months, there is a steady recession of ground water flows, which flattens out right before the rainy season begins (June/July). Flows then increase to about October before they start to decrease again. The lowest flow during the last 20 years was in 1994, which was a drought year, and there was a peak in the flow in 2012 from Tropical Storm Debby. Under normal conditions, the flows are about 150-200 cubic feet per second (cfs). The discharge records for the spring date back to 1931, and the average since then is 171 cfs. The low point was 103 cfs in 1994, with a peak of 252 cfs in 2003.

David stated that about 6% of the all the recharge in the springshed is pumped annually for water usages. This number does not include any water that recharges the aquifer after it has been pumped out and used for irrigation or in septic tanks. For Citrus and Hernando counties, the ground water use has leveled off. There has also been a decrease in the per capita ground water use for public supply across the state. The West Hernando public water supply withdrawals peaked in 2006 and have since decreased. The Cross Bar Ranch well field is located in the basin, and its pumping peaked in the mid-1990s, and has since decreased. The pumping decreased because of ecological damage that was occurring. The reduction in pumping also helped to prevent a reduction in flow to Weeki Wachee

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Spring. Tiffany Busby asked why the pumping at the Cross Bar Ranch well field was so low in 2003. Dave responded that 2003 was a really wet year but he was unsure if that was the reason for the low pumping that year or if it was due to modifications being made at the well field.

The 2011 land use coverage shows that urban and built up lands are located in the closest one-third of the basin to the spring. However, the density of the development varies greatly. The Spring Hill area is relatively high density with a lot of septic tanks, but the development is lower density in Pasco County. There is also some agriculture in the area.

The most recent curve of nitrate concentrations at the spring from 1964 to 2014 shows that concentrations have been increasing with some “stair steps” where it looks like the concentration is leveling off. These steps could be cycles of drought followed by nutrients in the sediment getting pushed into the aquifer during rainfall. The last value collected at the spring was 0.86 mg/L. Mary noted that the slope of increase is not as great as it was before the late 1990s, so the rate of increase has gone down. Dave stated that SWFWMD and the Department have been collecting nitrogen isotope information to determine sources of nutrients to the ground water. Results with low isotope value indicates inorganic nitrogen, and results over three are generally a mix of inorganic and organic nitrogen. In this basin, the results fall into the mixed category because it is a complex system with various land uses and sources that become mixed. The last sample collected had a result of 5.65, which is still a mixed signal.

Dave stated that the SWFWMD website, www.wattermatters.org/springs, has dashboards with current information for the springs, such as rainfall and stream flow. The nitrate loading pie charts on the website will be updated using the information the Department is developing as part of the nutrient source inventory.

Jeff Priddle asked how legacy load is accounted for in this process. Dave responded that part of the reason for the leveling off of the nitrate concentration curve could be that the legacy load is getting out of the system. Historically, there was more agriculture in the basin that is not in production anymore. Ground water movement can be slow so the legacy load becomes a continuum of contribution to the aquifer. Terry added that it is difficult to account for the legacy load because the conduits that feed this system are 250-300 feet below the ground water surface, and they are pulling out at least 100 cfs. This area does not have a massive conduit system, such as Wakulla Springs in the Tallahassee area, which makes it difficult to determine where the water is coming from in the basin. This is why the composite age of the water becomes important. Dave noted that the nitrate ground water study that SWFWMD did in the 1990s included isotope work that showed the water is several years to several decades old. The legacy load is blending and mixing with other available shallow ground water. Terry stated that portions of the basin had citrus in the 1970s/1980s and the practices at the time were to intensively fertilize. There were also historical wastewater treatment plants that were not held to today’s discharge effluent standard of 10 mg/L. These loads will have to work through the system, but the goal of the BMAP is to make sure the current sources are not continuing to add to the problem.

John Burnett asked if the BMAP will be a multi-generational project because of this legacy load. Terry responded that the BMAP could potentially be multi-generational. The BMAP will document the reductions that will occur with projects. Once these reductions start being seen at the spring and river, monitoring in the basin can occur to evaluate the nitrate concentrations in the ground water. Dave added

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that there are some monitoring wells in the basin that can be used to track changes in ground water concentration.

Mike Czerwinski asked for a clarification on how the nitrogen isotopes are being used. Dave responded that the numbers are a ratio of the N^{14} to N^{15} molecules. If the ratio is less than three, the nitrogen source is inorganic, such as fertilizer. Mike asked if the ratio was determined from the water discharging from the spring. Dave responded that ratio does use spring vent samples, and SWFWMD contracts with an outside laboratory for the analysis. The isotope ratio is a useful diagnostic tool to determine types of sources. A ratio of eight or higher would indicate organic sources. Terry noted that the ratio here is mixed because there are inorganic fertilizer sources, as well as organic septic tank sources. John asked if something changed, such as the technique, which resulted in such a big change in the isotope ratio from 2011 to 2013. Dave responded that he is not sure what caused the change in the ratio but it could be due to a change in hydrology. In 2011, the area was coming out of a drought so it could have been a pulsing of nutrients out of the soil from an increase in rainfall.

Mike stated that in the Homosassa area, there is a lot of organic debris after a rainfall because of the mosquito control canals and wetlands, which would affect the nitrogen isotope ratio. However, Weeki Wachee is different because there are not a lot of canals. Terry stated that the Department recently added analyses for human indicators to look for human sources of wastewater when they sample. This would help determine if there is organic nitrogen from human sources. Mike noted that there may be springs legislation next year that would require removing septic tanks in a springshed, so information will be needed to ensure that removing septic tanks will help. Dave responded that the Weeki Wachee basin is considered to be mixed source of septic tanks and fertilizer. Mike asked if any dye tracing has been done to track sources. Dave responded that SWFWMD tried dye tracing at Diepolder Sinks but the dye did not come out. Sucralose is a good tracer for human wastewater.

Monitoring Options for Weeki Wachee River

Mary stated that her presentation will discuss monitoring options with ecological perspective, instead of only focusing on nitrate. There may be changes occurring in the river and spring that are not due to organic sources alone. The Weeki Wachee TMDL states that nitrate was determined to contribute to the imbalance of flora and fauna due to the shift from submerged aquatic vegetation (SAV) to filamentous macroalgae. The BMAP could include ecological indicators other than algae. This presentation will focus on aquatic floral communities including SAV, epiphytic (attached) algae, or filamentous benthic macroalgae. SAV provide good habitat for fish and wildlife, act as a substrate for epiphytic complex, and stabilize sediments. A SAV/epiphyte complex can enhance water quality, water clarity, and primary productivity, as well as provide a good quality carbon source that provides fuel for nutrient uptake.

There are a lot of stressors on aquatic flora including water column nutrients, light attenuation, sediment quality, and nutrients. Mary noted that the TMDL did not include the nutrients entrained in sediments that algae can use, and did not look at the influence of hydrology and residence times on the ecology. There can be an increase in SAV after a rainfall that washes the sediment nutrients downstream. Grazing also has an impact because manatee grazing can affect the SAV distribution. There are also snails that scrape down algae. Disturbance and recreation are other factors that stress aquatic flora.

SWFWMD collects a lot of data in the system, which include biological and water quality parameters. The nutrients are collected on a quarterly basis, and this is important to build relationships with the

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ecological parameters. Dave noted that the sampling listed in the presentation is for surface water samples, which have a much greater parameter list than the ground water sampling. Mary noted that the parameters include a few trace metals, minerals, biological/detrital, and ecological. The ecological information is collected on an annual basis for SAV and algae using the Braun Blanquet method, which characterizes coverage in different general categories. Clay Black asked if the monitoring results are available online. Mary responded that all but the ecological data are available online. Mike asked if the Department also collects biological data. Erin Rasnake responded that the Department collects stream condition index (SCI) information on a five-year rotation. Mary added that the SCI monitoring occurs at one location in the Weeki Wachee River, and the data are available from the Department's SBIO database.

Mary stated that there are two options for ecological monitoring. The first is the rapid surveys that the Department developed including the rapid periphyton survey (RPS), linear vegetation survey (LVS), and SCI. The second option is a more detailed benthic zone approach. The Department developed the rapid surveys during the NNC process to assess flora and fauna using a weight of evidence approach. The RPS and LVS are qualitative, and look at the relative presence and dominance of periphyton and vegetation over a 100-meter area. The SCI for macroinvertebrates includes ten tolerance/fidelity metrics, some of which do not fit spring systems and the Department has acknowledged this. If SCI were used for Weeki Wachee River, it would have to be modified for the spring system. Erin noted that the Department also conducts a habitat assessment with the SCI. The RPS collects 99 points over a 100-meter stretch of the river. Algae is randomly collected and ranked based on thickness. Any algae that ranks higher than three is taken back to the laboratory to be identified.

Mary presented the Rainbow River mapping that was done in 2011. This mapping occurs about every five years, and it takes a lot of field time to collect the data and post process the data to create a Geographic Information System (GIS) layer. This mapping will not be able to track BMAP progress quickly but could be used to provide information for redevelopment of the BMAP in the future. This mapping collected epiphytic and benthic algae in 100-meter zones across the entire Rainbow River. This information was used in the development of the Rainbow River and Spring TMDL. The data from this process were aggregated into native and exotic vegetation categories, as well as filamentous and epiphytic algae to come up with a river condition index. Mary noted that this is something the Department could adapt for the BMAP.

Mary stated that her research in Weeki Wachee River looked at the ecology at the sites where SWFWMD collects data. She collected information on SAV, benthic algae, and epiphytes, which included coverage, biomass, and percent cover. Dave asked when the data period for this study ended. Mary responded that she conducted quarterly sampling in 2011 only. Dave noted that it would be good to update this study because more SAV is growing in the river now.

Mary stated that she also conducted a paired epiphyte/plankton study, which was not part of the published data. Data from the RPS could be used in this study. A spring system typically does not form algal blooms because of the high velocity and low residence time. In Weeki Wachee River, algal blooms are not an issue until far downstream of the spring, where there are canals and the water stagnates. Mary found that the epiphytes were dominated by blue-green algae and there were no diatoms present in the system. The lack of diatoms is a problem for the trophic structure of the system.

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Mary noted that in her evaluation of macroinvertebrates, she found that it may be better adjust the SCI to evaluate the system on a more focused scale.

The TMDL is based on nitrate influencing the growth of algae. Mary noted that she was not able to find a direct relationship with nitrate in the water column and algae, although there seems to be a threshold concentration. Velocity is an important factor, and Mary did a study on velocity and algae and so did Sean King (SWFWMD). More work will need to be done to evaluate this relationship. The sediment nutrient content is also important, and there was some dredging in the river that helped to reduce the sediment nutrients. A volunteer group also removed a large algal mat from the bottom of the river.

Mary noted that her study focused on light quantity and quality. While there is a lot of light in the Weeki Wachee system, the quality is not always great. The quality is determined by the wavelength. There are three bands: 400-500 nanometers (nm) is blue light, 500-600 nm is green light, and 600-700 nm is red light. In looking at the wavelengths, SAV prefers blue and red light. Algae also prefer blue and red light but have a greater absorption of green light than SAV. The particulates in the water take up light in the blue and red zones, which leaves green light. This information is important for vegetation management, and is especially helpful for planting.

Mary noted that the BMAP monitoring plan should use multiple parameters, including SAV, as well as algae communities associated with SAV. The monitoring options to track change should include a wide variety of spatial and temporal scales. Terry stated that this information will be revisited when discussions start on developing the BMAP monitoring plan. These options can be used to help determine if the waterbodies are really improving.

Mike noted that it does not seem like the right approach would be to focus solely on nitrate in the water column. Mary responded that there are other parameters that affect the ecology, so it would help to look at these parameters in future revisions of the TMDL. Terry stated that the BMAPs are for a set period of time, usually five years. Projects will be identified and implemented to reduce the nutrient footprint, and then some of these parameters could be monitored to determine if the system is improving.

Mike noted that in Rainbow River there is no thermocline, but there is a big thermocline in Kings Bay, especially in the canals. There is also a lot of light attenuation, and there are no grass beds in the canals. Mary responded that this light information is critical for Kings Bay. If a planting project were to be done in the bay, the plants would need to be a type that could live off green light. Shading and canopy in an area is also important to evaluate because it removes a lot of the light. Mike asked if Mary also looked at the sediment when evaluating SAV coverage. Mary responded that she did not collect sediment data in Weeki Wachee River, but it would be helpful to do this. Sediment data could be collected annually along with biomass during the biological monitoring. Erin asked if only a qualitative grab to determine the sediment composition would be needed. Mary responded information on the sediment nutrients would be helpful.

Adjourn

Terry stated that the next BMAP meeting will be held on Friday, August 15th at 10:30 AM at Weeki Wachee Springs State Park. Dave offered the SWFWMD office in Brooksville as an option. Terry responded that he would follow up with Dave to see if the room was available for the August meeting and then he would send a notice to the distribution list with the location.

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The meeting was adjourned at 5:37 PM.

Action Items

- The Weeki Wachee nutrient source inventory will be presented at a future BMAP meeting.
- Terry Hansen will post the meeting presentations to the BMAP website.
- The ecological indicators will be discussed again at a future BMAP meeting, during development of the BMAP monitoring plan.
- Terry will follow up with Dave DeWitt about using the SWFWMD office in Brooksville as the next meeting location.