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14 pages

Review Comments on the November 2010 Draft Report on the Wakulla Spring Minimum Flow Determination

Synopsis of Review Comments

The Northwest Florida Water Management district recently released the draft report on the Sally Ward and Wakulla Spring Minimum Flow. This follows the same “formula” approach used to set the minimum flow for St, Marks Rise. In both cases, “Significant harm” is determined using measures that do not assess the impairment of the composite habitat values and ecosystem functions of the spring area and downstream river reaches. Even more problematic, the minimum flow determination did not consider hydrologic and water quality impacts that are currently impacting Wakulla Spring and which represents a significant level of increasing harm to the spring.

Since 2007, Wakulla Spring has experienced approximately 10 salinity spikes represented by the Specific Conductance (SpCond) of the spring discharge. The last occurrence was in 2019 which had both a high SpCond and a relatively long duration. While the spring discharge has remained fresh, the salinity incursions are the result of subsurface intrusion of saltwater in the Floridan Aquifer from coastal areas where the Floridan Aquifer is saline. The influx of saline water from the coast should be viewed as the initial occurrences of higher salinity water in the spring discharge. This was not examined as part of the minimum flow determination even though this poses an increasing threat to the water quality of Wakulla Spring, Wakulla River and to the biota and freshwater habitats.

The salinity impacts are occurring in Spring Creek Basin in addition to the Wakulla Spring. These have resulted from the combined impacts of droughts and the recent increase in the rate of seal level rise in the Gulf of Mexico due to global warming. The impact of ground water withdrawals in Florida and Georgia may also be a contributing factor. The WMD, however, has refused to examine the impacts of the withdrawals as part of the minimum flow determination of the Wakulla Spring. Instead, the WMD has indicated that the impact of the ground water withdrawals will be determined after the minimum flow is adopted. No timeframe has been established for this impact analysis nor is there any assurance that this will actually be conducted. In addition, the WMD has spent approximately $800,000 to develop a ground water model for the basin which will be used for the purpose of determining the impacts of the ground water withdrawals. The impacts, therefore, should be determined now rather than after minimum flow is adopted.

The period of hydrologic record used by the WMD for the MFL analysis was from November 2004 through December 2019. Severe multi-year droughts occurred from early 2005 through 2007 and from late 2010 through mid-2012. Another less severe drought occurred from mid-2019 through mid-2020. Lesser, short duration events also occurred from 2013-2018. Each of the SpCond (salinity) spikes in Wakulla Spring occurred during the more severe droughts and during some of the shorter duration droughts. As a result there is good correspondence between droughts and spikes in SpCond of Spring Creek. Unfortunately, no drought analysis was conducted by the WMD in the setting of the Wakulla

Spring minimum flow. More specifically, the WMD did not examine the impacts during the critical drought period when the greatest flow impacts would likely occur. This is of particular importance when the “harm” (and especially significant harm) is the focus. For the Wakulla Spring MFL, the critical period is the multi-year drought of 2005 through 2007.

Sea level rise due to global warming is occurring in the Gulf of Mexico as it is worldwide. National Oceanic & Atmospheric Administration (NOAA) sea level monitoring stations on the northern Gulf Coast include Panama City, Apalachicola and Cedar Key with records covering the last 47-105 years. In each case, the rate of rise of sea levels sharply increases in approximately 2005 and the total rise over the period 2005-2019 was significantly higher than over any other similar length of time at any of the stations. What’s more, the period record rise in gulf levels is precisely the same period used by the WMD to determine the minimum flow for Wakulla Spring. This is also the same period that the salinity related spikes have occurred. For example, the nearest station to Wakulla County is at Apalachicola where the rise in the level of the Gulf of Mexico was 5.9 inches from 2005-2019 or 0.42 inch per year. Instead, the WMD used the long term average rate of rise of 0.1 inch per year computed over the 52 year period of record at the Apalachicola station. Since there was little or no increase in sea level for much of the past 52 years it’s not surprising that rate of rise is small. Therefore, the WMD did not consider the very rapid rise in sea level in the Gulf that occurred from 2005 through 2019 in the determination of the minimum level of the Wakulla Spring for the exact same period. For reference, the rate sea level rise at Panama City and Cedar Key were similar to the record at Apalachicola
The current sea level rise in the Gulf is 300% to 400% greater than assumed by the WMD. As a result, the WMD projected a rise in the level of the Gulf of Mexico of just 1.9 inches by 2040. At the current rate, however, the actual rise will be 8.4 inches by 2040. Therefore, the WMD’s assumed minimal impacts over the next 20+ years (through 2040) ignores the importance of the current rate of rise and uses averages computed in one instance over 105 years. The WMD also ignored the role of sea level rise on the salinity of Wakulla Spring over the next 20+ years.

The ground water withdrawals assumed by the WMD in the basin is yet another deficiency in the MFL determination. Most obvious is the refusal by the WMD staff to utilize the costly ground water model to determine the impact the ground water withdrawals. Instead the WMD staff will examine the impact of demands only after the minimum flow is adopted. However, the ground water withdrawals listed by the WMD are considerably less than the demands listed in the draft report on the ground water model. Figure 44 of the MFL report for Wakulla Spring indicates a total of 15 Mgal/d as the ground water withdrawals in the Georgia portion of the basin with total ground water withdrawals of 70 Mgal/d in both states in 2015. In contrast, Table 3 of the draft ground water model report lists Georgia ground water withdrawals of 260, 217 and 298 Mgal/d in 2009, 2011 and 2014, respectively. No explanation is provided for the reduction in the Georgia withdrawals. More importantly, the MFL report also conflicts with the 2015 U.S. Geological Survey report entitled “Estimated Use of Water in Georgia for 2015 and Water Use Trends, 1985-2015.” This lists approximately 173+ Mgal/d in ground water withdrawals in the Georgia part of the basin (excluding counties that were partially outside the basin). Approximately 129 Mgal/d of this total was for crop irrigation.

Depending on the year, the various reported ground water withdrawals in the Georgia portion of the basin range from 173+ to 298 Mgal/d or 267+ to 467 cfs. Therefore, the MFL report understates the report ground water withdrawals in the Georgia portion the basin by 158+ to 283 Mgal/d (=244 to 437 cfs). In addition, the WMD has not adjusted the crop irrigation usage from an annual average to a growing season average. Assuming a six month growing season (May-October) and that 75% of the withdrawals are for irrigation (per the U.S.G.S 2015 Georgia water use report) then the total ground water withdrawals during the growing season will range from 303 to 521 Mgal/d or 475 to 817 cfs. In addition, since the growing season overlaps the annual dry season, the WMD does not account for the higher irrigation that occurs during drought years. These omissions are discussed in greater detail below. At a minimum, however, the WMD has understated ground water withdrawals in Georgia by approximately 450 Mgal/d or 700 cfs during the growing season of drought years. This compares to the 15 Mgal/d or 23 cfs listed by the WMD in the MFL report as the ground water use in the Georgia part of the basin.

There are a considerable number of significant omissions and discrepancies in the WMD Wakulla Spring MFL. Given the importance of Wakulla Spring as a major natural resource of the state coupled with the WMD expenditure of $8 Million in public funds over 6+ years, the district should recall the MFL report and conduct a much more thorough analysis of significant harm to the spring. In addition, the WMD should also remove the allowed flow reduction of 59 cfs in the average spring flow from any future MFL for Wakulla Spring.

Review Comments

Defining Harm to Wakulla Spring

The most significant potential harm to Wakulla Spring is from intrusion of saline water into the spring discharge. This has already begun and is marked by sharp increases in specific conductance (SpCond) of the spring. The first of these occurred in 2007 with many more observed through mid-2020. In each case, these coincided with flow reversals previously described by D. Barr in white papers provided to the Northwest Florida Water Management District and the Wakulla Spring Alliance.

The spikes in SpCond result from the intrusion of saltwater from the Gulf of Mexico into the Florida Aquifer and moving in the direction of Wakulla Spring. The spikes in SpCond (salinity) occur during droughts when the outflow of Spring Creek to the Gulf of Mexico stops and the flow reverses. As shown below, these coincide with the rising levels of the Gulf of Mexico due to global warming. Presumably these are also linked to the impact of present and future withdrawals in the basin during droughts which the District will not determine these impacts until after the MFL is adopted (if then).

The WMD has also failed to consider the SpCond spikes in the Wakulla Spring discharge or the additional impacts that will occur as the Gulf of Mexico continues to rise resulting in progressively greater impacts on the Floridan Aquifer and Wakulla Spring. At present, Wakulla Spring remains fresh during the SpCond spikes; however, this along with the more severe impacts along the coast is the most serious source of harm to Wakulla Spring. This has been ignored by the WMD in the setting the MFL. The prevention of significant harm to the spring is, of course, the entire purpose of the District MFL. As a result the MFL fails in fulfilling its most basic purpose. Instead, the WMD has focused on a relatively few actual resource metrics of harm along with others such as recreation which are trivial in comparison to the SpCond and salinity impacts which have already started.

Impacts of Drought on Flows of Spring Creek and Wakulla Spring

By statutory definition, the MFL for Wakulla Spring is the flow below which there is significant harm. For surface streams or aquifers receiving direct rainfall recharge or other rainfall dependent sources of recharge, the most severe harm occurs during droughts. Droughts are usually defined using one or more accepted drought severity indices. For purposes of the Apalachicola-Chattahoochee-Flint River

Interstate Compact, the U.S. Corps of Engineers and the states of Alabama, Florida and Georgia used the weekly Drought Severity and Coverage Index (DSCI) for each county in the basin. The DSCI ranges between 0-500 for a county for any given week. At zero, there are no drought conditions in the county. At a value of 500 the entire county is experiencing Exceptional Drought (the highest categorization). Therefore, the higher (more severe) the DSCI, the lower the rainfall, surface flows and recharge will be over a given county.

In relation to the Wakulla Spring Basin, the Spring Creek Basin is of special importance during droughts. First, as drought conditions persist over time and become more severe, the Wakulla Basin expands to the south and captures an increasing proportion of the Spring Creek Basin ground water flow and diverts this towards Wakulla Spring. Secondly, during droughts the flow of Spring Creek reverses and flows to the north and becomes saline due to inflow of water from the Gulf of Mexico. Saltwater also intrudes further north in the Floridan Aquifer as it moves in the directions of Wakulla Spring.

Figure 1 illustrates the combined Drought Severity and Coverage Index (DSCI) for Wakulla and Leon counties for the period May 2001 through December 2019. As shown, the droughts with the most severe impacts in terms magnitude and duration occurred from September 2005 – January 2008 and February 2011 – June 2012. Figure 2 shows the Wakulla County DSCI vs. the flow of Spring Creek since 2013 (the start of monitoring of Spring Creek flow). As shown, Spring Creek flow reversals (negative flows) closely coincide with DSCI for Wakulla County. For the more severe and longer duration droughts in 2005 – 2008 and 2011 – 2012 the impacts on the flows of Spring Creek would have been correspondingly greater.

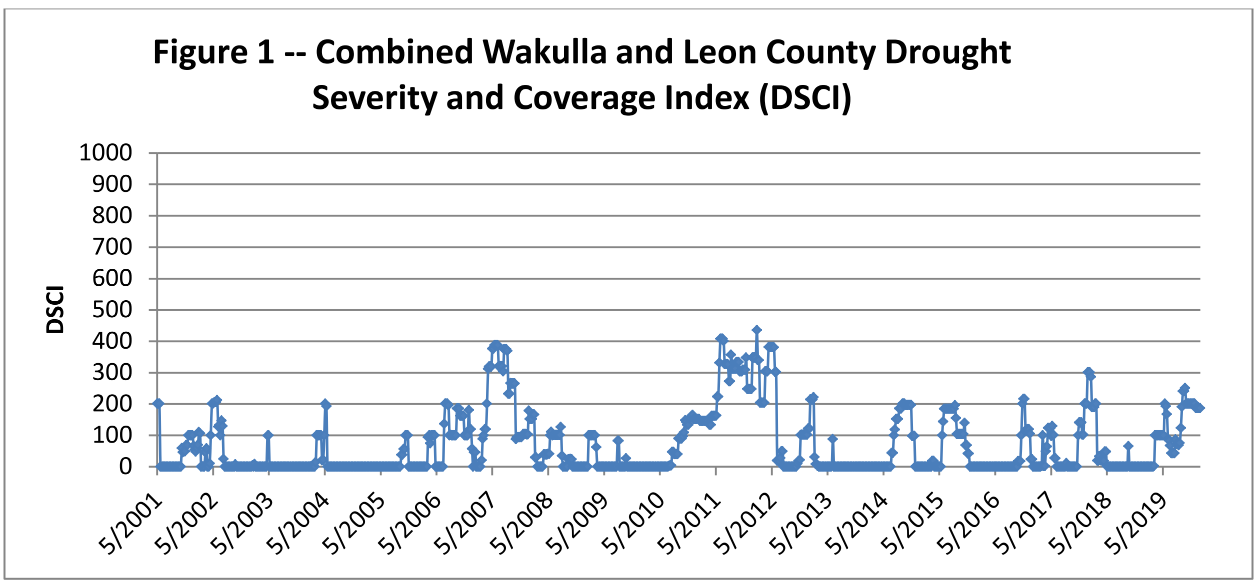
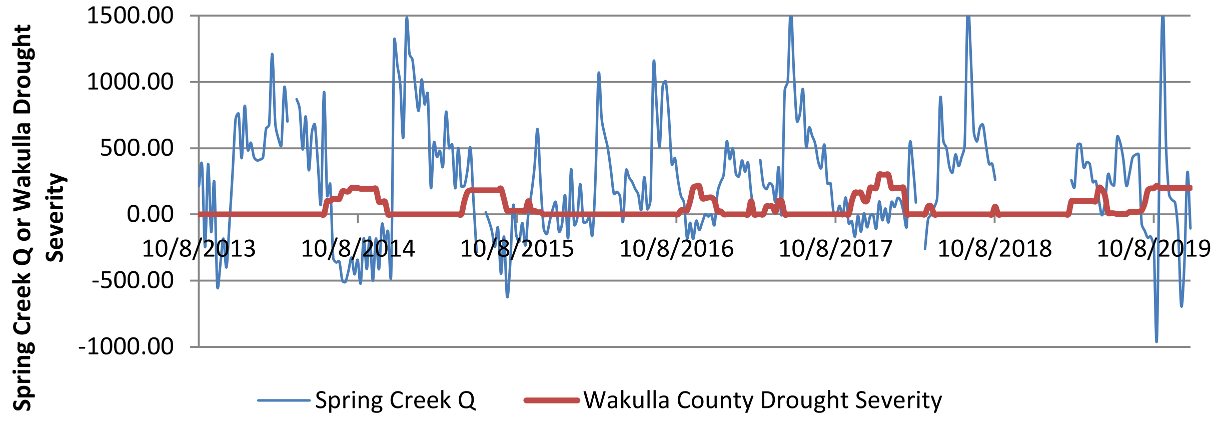
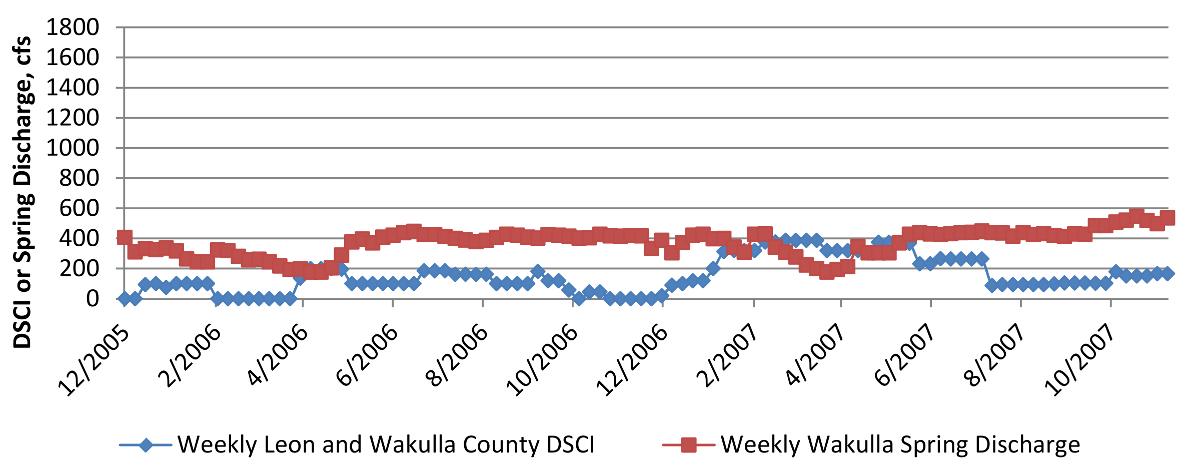


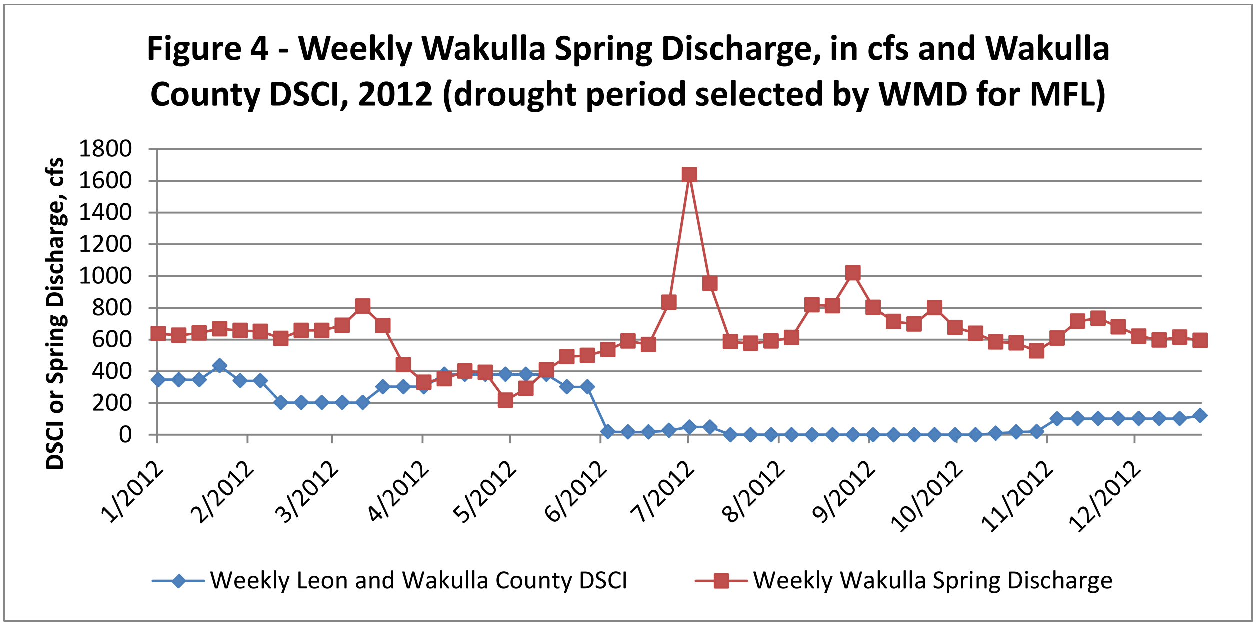
Figure 2 -- Weekly Spring Creek Discharge vs. Weekly Wakulla County Drought Severity Index



For Wakulla Spring, Figures 3 and 4 illustrate the DSCI vs. spring flow for the 2005 – 2008 and 2011 – 2012 droughts, respectively. In comparison to the 2011-2012 the 2005-2008 drought had a longer duration and resulted in considerably lower flows. Therefore, the critical period for Wakulla Spring is the drought of 2005-2007. This drought lasted for over two years with an average weekly Wakulla Spring flow of 370 cfs with a minimum of 177 cfs and a maximum 546 cfs. In contrast, the WMD selected 2012 as the dry year for any future simulation of the impacts of ground water withdrawals in the basin. This is less than half the duration of the 2005-2008 drought. In addition, in 2012 the average weekly flow of Wakulla Spring was 637 cfs with a minimum of 217 cfs and a maximum of 1,638 cfs. Clearly, 2012 is not the most severe drought in terms of magnitude or duration. The determination of "significant harm" should be based on simulations of the impacts of current and future withdrawals in Florida and Georgia in addition to the "allowable MFL reduction of flow should be based on the drought of 2005-2007. Absent this, the District is ignoring the critical period during which the most sever harm will occur.

Figure 3 - Weekly Wakulla Spring Discharge and Wakulla County DSCI, 2005-2007 Drought (Critical Period)





Impacts of Drought and Global Warming Related Sea Level Rise on Salinity Spikes in Wakulla Spring Discharge.

Starting in 2007, spikes in SpCond began to occur in discharge from Wakulla Spring and have continued to occur periodically since that time (Figure 5). This is attributed to increased subsurface movement of saltwater into the Florida Aquifer resulting in intrusion of saltwater into areas as far north as Wakulla Spring. This is illustrated by Figure 6 which shows the relationship between the occurrences of SpCond spikes in Spring Creek and the related spikes in Wakulla Spring. The offset between the Spring Creek peak and the Wakulla Spring peak results from the near instantaneous increase in salinity at Spring Creek versus the delayed increase in Wakulla Spring due to much longer distance and travel time for the higher salinity water to reach Wakulla Spring.

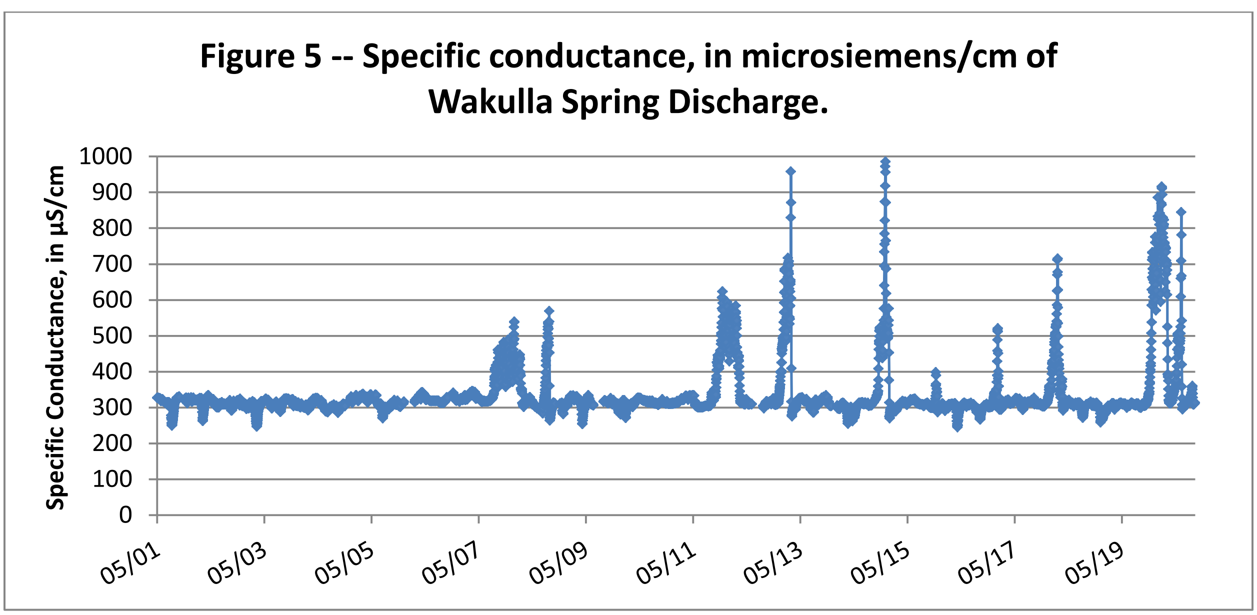
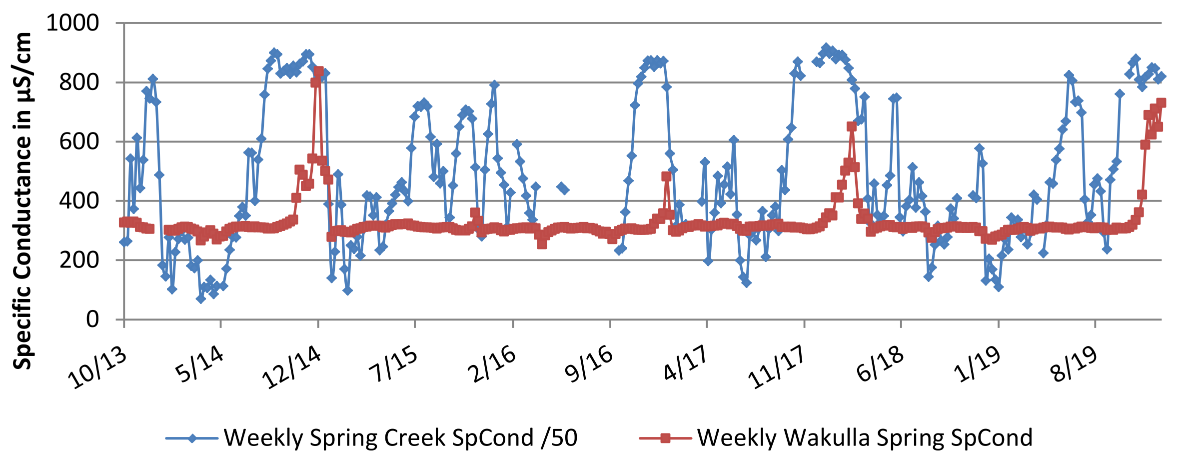


Figure 6 -- Wakulla Spring SpCond vs Spring Creek SpCond/50, microsiemens/cm.



[NOTE Figure 6: For purposes of this plot the SpCond of Spring Creek has been reduced by a factor of 50 to better show the temporal changes in SpCond at the two sites since the SpCond is much higher at Spring Creek.

The cause of the salinity related spikes in the SpCond of Wakulla Spring are not solely attributable to droughts but rather a combination of drought and a rapid rise in sea level along the coast of North Florida. Figures 7, 8 and 9 illustrate the actual sea level rise that has occurred at Panama City, Apalachicola and Cedar Key. These three stations bracket Spring Creek and have all experienced an increased rate or sea level rise since approximately 2005 (red box on each figure). In addition, the three stations have also followed a similar general pattern in the variation of the measured levels of the Gulf of Mexico.

Figure 7 – Monthly Mean Sea Level at Apalachicola, Florida, National Oceanic and Atmospheric Administration.

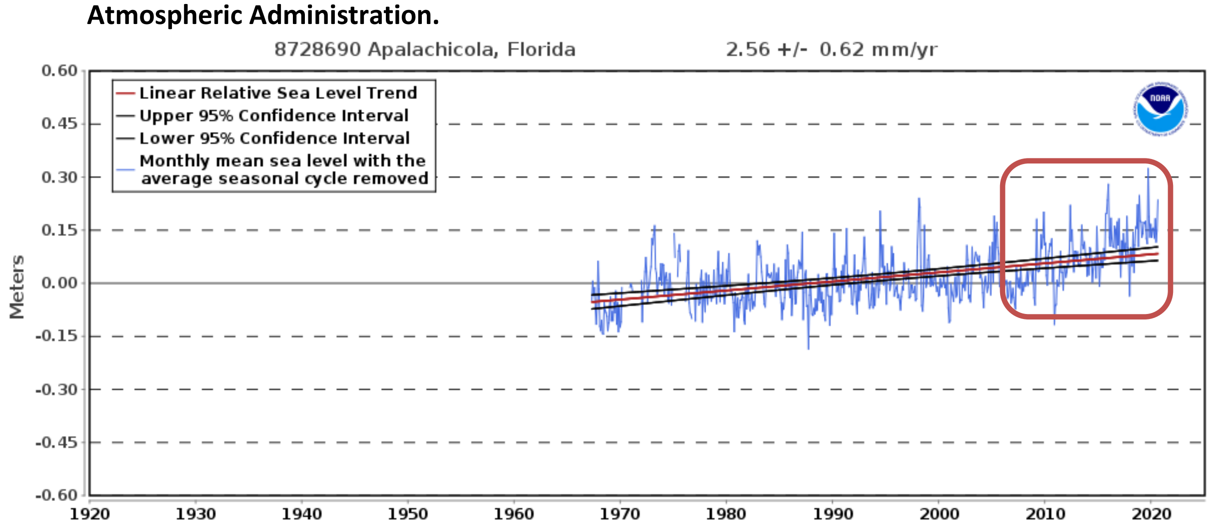


Figure 8 – Monthly Mean Sea Level at Panama City, Florida, National Oceanic and Atmospheric Administration.

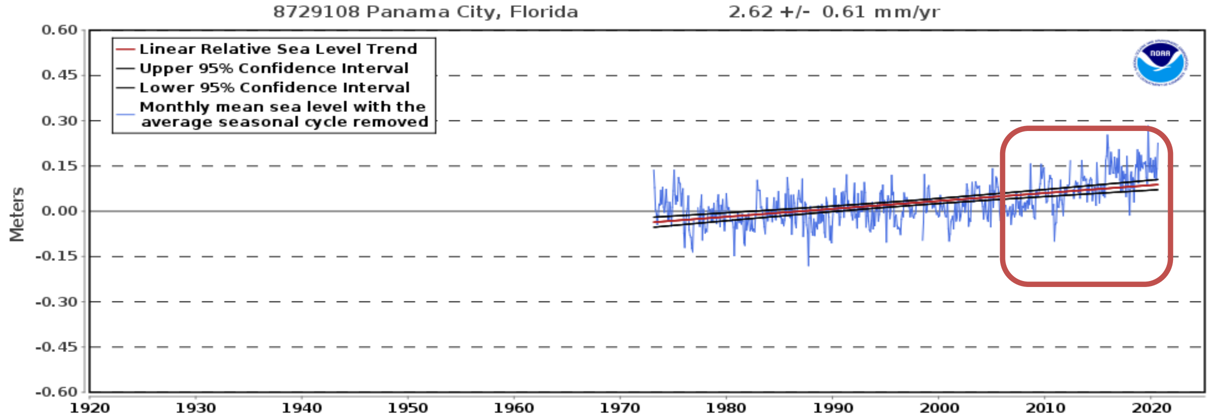
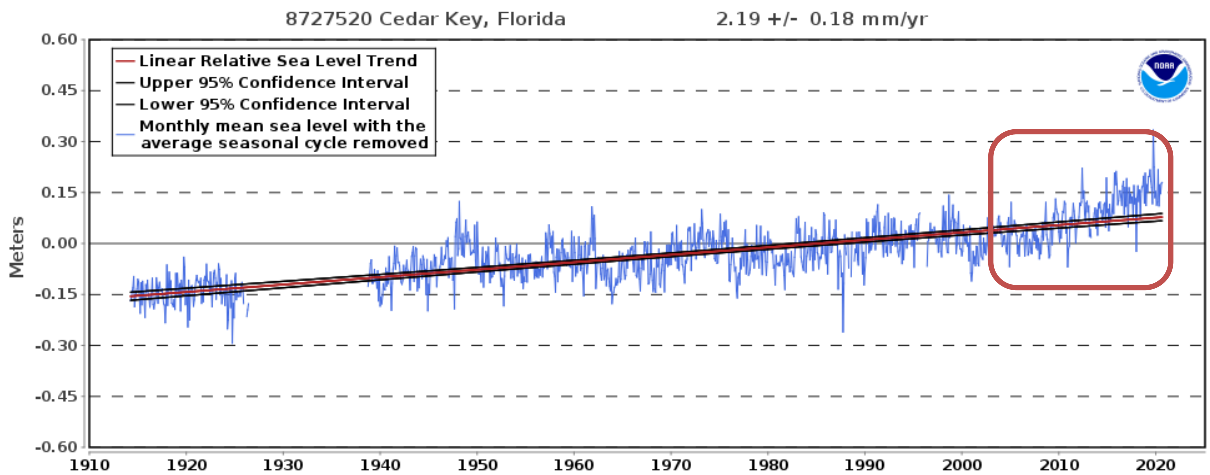


Figure 9 – Monthly Mean Sea Level at Cedar Key, Florida, National Oceanic and Atmospheric Administration.



To better illustrate this, the monthly sea levels at the Apalachicola NOAA station are shown on Figure 10 for the period 1970 to 2019. As show, there are two trends to the data. The early record from 1970 through the early 00's is relatively flat with no increasing or decreasing trend. Following this, the level in the Gulf of Mexico rises rapidly from approximately 0.0 meter sea level to +0.15 meter by 2019 (150 mm or 5.9 inches in just 15 years). A 2nd order polynomial is fitted to the data to show the trend as illustrated by the red line. This shows that the entire data set is comprise of two distinctly different rates of sea level rise. The two trends are segregated in figures 11 and 12 which show that the data for 1970 to 2004 has a nearly zero slope indicating that the data are uncorrelated over the 34 year period. In contrast, rates increased sharply since 2005 and especially since 2010. Total rise was 5.0 inches in just this 9 year period. Data from the Panama City and Cedar Key Stations yielded very similar trends in sea level rise.

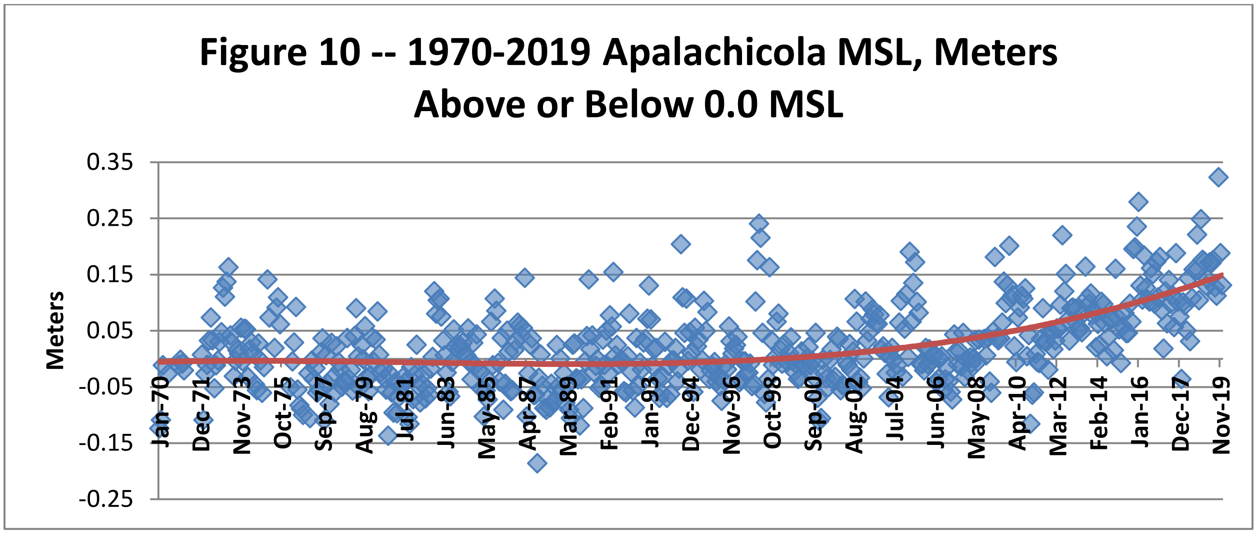


Figure 10 -- 1970-2019 Apalachicola MSL, Meters Above or Below 0.0 MSL

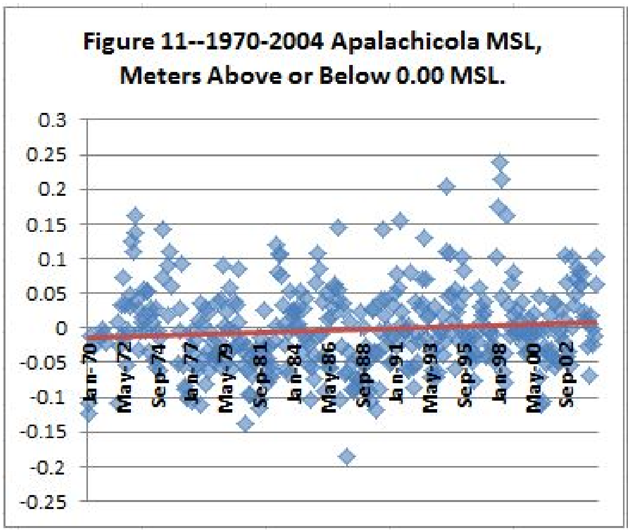


Figure 11--1970-2004 Apalachicola MSL, Meters Above or Below 0.00 MSL.

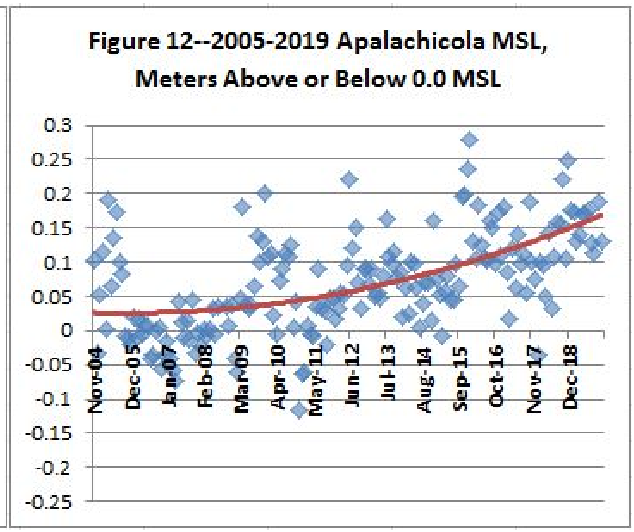


Figure 12--2005-2019 Apalachicola MSL, Meters Above or Below 0.0 MSL

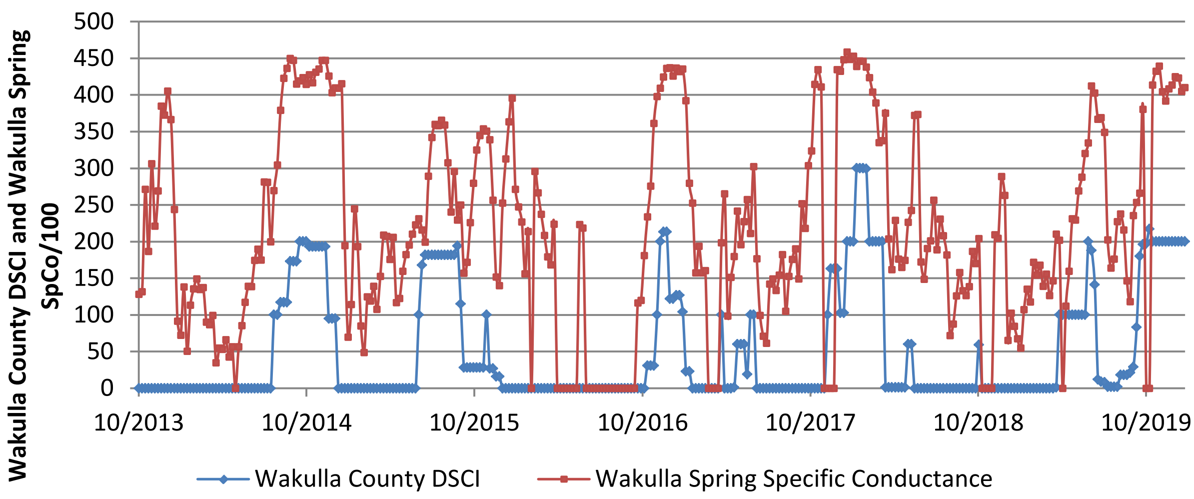
In Section 5.4 of the MFL report entitled "Effects of Sea Level Rise", the WMD staff state that potential current and future changes to the ecology of Wakulla River are resulting from rising sea levels, best estimates of current rates of sea level rise in the Gulf of Mexico. In fact, the WMD staff simply used the long term averages computed by NOAA for the entire period of record for the Apalachicola and Cedar Key stations (upper right of the NOAA graphs illustrated by figures 7-9, above). For their purposes, NOAA computed the linear regression of each station over the entire period of record and the yearly rate of sea level rise from the linear regression. The period of record for the Apalachicola, Panama City and Cedar Key stations through 2019 are approximately 52, 32, and 105 years, respectively.

NOAA performed a simple regression analysis of the data for each station which yielded a long term average rate of sea level rise. NOAA is not responsible, however, for determining whether the long term average is the most relevant and technically appropriate for a specific application. For the Wakulla Spring MFL, the responsibility for this determination was solely the responsibility of the WMD.

The WMD used the NOAA results for the Apalachicola and Cedar Key stations. At both stations, the rate of sea level rise in the Gulf of Mexico beginning in approximately 2005 far exceeded the rate of rise that occurred in prior years.

The SpCond of Spring Creek has been measured at the U.S.G.S. station since late 2013. Since then the spikes in SpCond observed in Wakulla Spring have coincided with the occurrence of droughts during this period See Figure 13).

Figure 13 -- Wakulla County DSCI and Wakulla Spring Specific Conductance/100



During droughts the water levels in the Spring Creek Basin decline due to reduced rainfall. Similarly, water levels and seaward flow in the Florida Aquifer also decline as a result of reduced recharge to the aquifer. As the seaward flow of freshwater in the Floridan Aquifer declines, it is replaced by seawater originating from the Gulf of Mexico. The influx of saltwater into the Floridan Aquifer is a function of the head difference between the freshwater in the aquifer and the saltwater intruding from the south. The rising sea level in the Gulf of Mexico increases the level (head) forcing the saltwater to move further north than in the past (i.e., prior to sea level rise). As shown by the National Oceanic and Atmospheric Administration graphs shown in Figures 7-9, the rate of sea level rise increased beginning in approximately 2005 and has continued to the present. Therefore, the spikes in salinity related SpCond in Wakulla Spring discharge coincide with the magnitude and duration of droughts and the onset of the measured increase in the rate of sea level rise in coastal Wakulla County as indicated by long term sea level monitoring stations from Panama City and Apalachicola to the west and Cedar Key to the southeast. At each of these station the rise in sea level has been similar (approximately 150mm) since about 2005. Therefore, the first SpCond spike observed in Wakulla Spring occurred during the first drought after the rate of sea level rise increased at about 2005.

The National Oceanic and Atmospheric Administration data shows that sea level rise is occurring in the Gulf of Mexico and as shown above is already impacting Wakulla Spring. Since sea levels are projected to continue increasing, it follows that during droughts similar to those in the past progressively higher salinity levels will occur in Wakulla Spring. Over the last 15 years, therefore, the level of the Gulf of Mexico has been increasing at approximately 10mm/year. There is no way of knowing with certainty what the actual level of rise will be over the next 30 years or even the next 10 years. There is little doubt, however, that the levels will continue to rise resulting in further increases in SpCond and salinity in Wakulla Spring during droughts. The amount will be a function of the future rise in sea level and the severity of future droughts. These will be further compounded by ground water withdrawals in the Wakulla Spring recharge area along with the "allowable" reduction of 59.21 cfs provided by the MFL.

It's necessary to mention that the WMD ignored the impact of sea level rise in developing the MFL for Wakulla Spring. This was based on long trends of sea levels at Apalachicola and Cedar Key. The long term trends used by the WMD are identical to averages listed immediately above and to the right of the NOAA graphs in Figures 7 (2.56 +/- 0.62 mm/year) and Figure 9 (2.19 +/- 0.18 mm/yr). In the case of Apalachicola station this is a 50+ year average of the linear regression of the data shown on the graph. For the Cedar Key station the long term average is a 100+ year average of the linear regression.

The WMD use of the long term averages taken over 50+ and 100+ years ignores the significant increase in the rate of rise since about 2005. Consistently at the Panama City, Apalachicola and Cedar Key stations, the recent rate of increase is by far the highest that has occurred at each station. For example, the rate of sea level rise at Cedar Key for the past 15 years (0.15 meter) was the same as the rise over the prior previous 90 years from 1905-2005. NOAA, of course, was simply computing a long term linear trend for the entire period of record. It is the responsibility of the WMD (not NOAA) to determine the applicability of the long term average to determine an MFL for the comparatively short period before the MFL will be reevaluated (usually 20 years). For such a near term, relatively short period of time the WMD should have known that 1) the 50+ to 100+ year linear trends were out of line with the most recent data which represents the increasing impact of human activity on global warming in recent times and 2) the actual observed rate of sea level rise which is clearly much greater than periods dating back many decades in the last century.

In addition, the 2000-early 2002 drought had a much greater magnitude than the drought of 2005-2007 and was much more severe than the 2011-2012 and the comparatively mild drought of 2019-2020 (Figure 14). There was not, however, any increase in the SpCond of Wakulla Spring in available data for this period. This includes the SpCond spike in 2019-2020 which was the most significant in terms of magnitude and duration even though this drought was far less severe than the 2001-early 2002 drought.

Finally, as shown above the magnitude of the SpCond spikes have been increasing since the drought of 2005-2007. The 2019-2020 SpCond spike was the most significant to date in terms of the combined magnitude and duration of the drought. During the SpCond spike in 2019-2020, however, the Wakulla Spring flow was twice the observed spring flow that occurred during the critical period drought of 2005-2007.

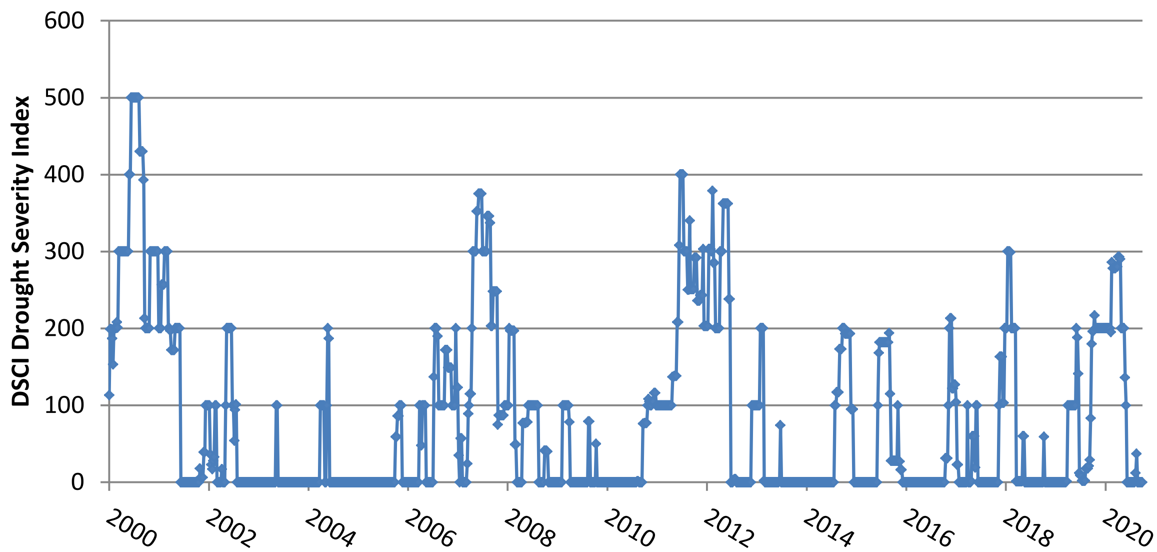


Figure 14 -- Comparison of Drought Severity in Wakulla County for the Period 2000 to 2020.

The WMD analysis of Sea Level Rise ignores the rapid rise in sea level in the northern Gulf of Mexico which is evident data from NOAA and which coincides with the spikes in SpCond (salinity) in the discharge of Wakulla Spring. Instead, the WMD utilizes long term rates of rise computed over periods of 50 to 100 years. These significantly understate the current rate of rise and do not follow from the data for Wakulla Spring as discussed above. As also demonstrated above, SpCond spikes also closely follow the pattern of droughts particularly in regard to flow reversals of Spring Creek near the coast. In turn the SpCond spikes in Wakulla Spring closely follow the occurrence of droughts in Wakulla County. Similarly, the Spikes in SpCond in Wakulla Spring coincide with SpCond spikes at Spring Creek. Even the expected lag between the spike in Wakulla Spring and the spike at the coastal station on Spring Creek is observed in the data.

The MFL for Wakulla Spring as prepared by the WMD fails to consider the ongoing impact of sea level rise and droughts on the salinity spikes in the discharge of Wakulla Spring and in Spring Creek near the Gulf of Mexico. The MFL also fails to consider the impact of ground water withdrawals in the Florida and Georgia parts of the Basin. These withdrawals can also act to compound the impacts from sea level rise and drought on the migration of saltwater from the coastal fringe north towards Wakulla Spring. The observed increases in SpCond (salinity) of Spring Creek and Wakulla Spring are by far the most significant source of harm to Wakulla Spring and the entire freshwater ecosystem of Wakulla Spring and River. Unfortunately, none of these were considered by the WMD in developing the MFL. These should have been evident long before the MFL was completed in November 2020. Currently, the WMD has sent the MFL report to reviewers and intends to adopt the MFL shortly after this is completed.

Undetermined impacts of Consumptive Withdrawals on the Wakulla Spring MFL

In section 2.9 of the MFL report entitled "Ground Water Withdrawals" the District does not specifically describe the ground water withdrawals in the Georgia portion of the basin. This was an odd omission since the Georgia withdrawals are considerably greater than the withdrawals in Florida. Figure 44 of the

MFL report provides the ground water withdrawals at 5-year intervals for the Georgia portion of the Wakulla Spring Ground Water Contribution area. This shows the 2015 ground water withdrawals in Georgia to be approximately 15 Mgal/d with total GW withdrawals in both states of 70 Mgal/d. This conflicts with the U.S.G.S. report entitled "Estimated Use of Water in Georgia for 2015 and Water Use Trends, 1985-2015". This lists approximately 173+ Mgal/d (268 cfs) in ground water withdrawals in Georgia (excluding counties that were partially outside the basin). Approximately 129 Mgal/d of this total was for crop irrigation. In addition, Table 3 in the WMD draft ground water model report lists total Georgia ground water withdrawals of 260 Mgal/d, 217 Mgal/d and 298 Mgal/d in 2009, 2011, and 2014, respectively. Without explanation, the District has reduced ground water withdrawals in the Wakulla Spring Basin by at least 150 Mgal/d. The WMD is thereby contradicting its own recently completed draft report on the GW model and the most recent U.S. Geological Survey Report on Georgia Water Use.

Much is made of the recent increase in spring flow with no fewer than 5 possible explanations put forth by the District. It follows, therefore, that the District neither knows the reason for the increase or whether or not it will continue. It's clear, however, that the drought of 2005-2007 is the critical period and should be used to examine the impacts of the 59.21 cfs reduction in the average combined flow of Wakulla and Sally Ward Creek plus at least 230 cfs in Georgia ground water withdrawals that were removed without explanation along with future withdrawals in Florida. Special care must be used in examining the impacts of the Georgia agricultural withdrawals. These only occur during the growing season or approximately 6-7 months each year. Assuming the agricultural withdrawals occur over the six month growing season than the actual withdrawal is 460 cfs for six months (rather than 230 for 12 months) of each non-drought year. During droughts, work done for the ACF Comprehensive Study (USCOE) indicated that irrigation increases by a factor of up to 1.5 or higher during drought years. This is necessary since the annual growing season coincides with the annual dry season the basin. Therefore, the agricultural withdrawal in Georgia during drought years is 690 cfs continuously during the growing season. Finally, the analysis should focus on the impact these and all other withdrawals have on the flows and the movement of saline water from the Spring Creek area north towards Wakulla Spring. The withdrawals should also include the WMD's allowed reduction of 59 cfs to the average flow of Wakulla Spring.

Conclusions

The District paints a rosy picture of Wakulla Spring by 1) understating the magnitude of demands in the Georgia portion of the basin, 2) failing to consider the compounding effects of withdrawals and the allowed flow reduction on the greatly reduced flows during severe multi-year droughts and in particular the critical period drought of 2005-2007, 3) failing to recognize and analyze the associated increases on the intrusion of saltwater resulting from documented impacts of rising levels of the Gulf of Mexico due to global sea level rise. The District will not even make use of the costly ground water model application costing over $800,000 to simulate the impacts of the demands in the basin. The district has argued that the flow record used for the MFL already includes the impact of current demand. The demands, however, may already be contributing to the SpCond spikes occurring in Wakulla Spring and the future migration of saltwater towards Wakulla Spring as a result of demands, drought and sea level rise.

The District has spent 6+ years and approximately $8 million on the Wakulla Spring MFL. However, as demonstrated above the MFL is seriously deficient in examining the most serious potential source of significant harm to Wakulla Spring. The importance of Wakulla Spring to the state and northwest Florida requires that the WMD exercise caution and ensure the MFL accurately accounts for the most significant sources of harm.

The WMD has indicated that it will likely modify the MFL in 10 years, although there can be no assurance this will actually occur. Also, this would simply allow 10 more years of impacts to Wakulla Spring with unknown consequences to the spring. Therefore, now is the appropriate time to correct the MFL deficiencies. To accomplish this, the WMD should withdraw the MFL and stop the adoption process. This will allow the WMD to correct the many deficiencies in the MFL and examine the greatest threats to Wakulla Spring.